



Building Awareness, Developing Policies, Inspiring Oklahomans to Move Ideas Into Action!

OKLAHOMA ENERGY: Optimizing Our Resources for the Future



The 2019 Oklahoma Academy Town Hall

October 20–23, WinStar World Casino, Resort & Convention Center, Thackerville



The Oklahoma Academy for State Goals is a statewide nonprofit, nonpartisan, membership organization founded by Governor Henry Bellmon to bring public attention to policy issues, provide objective, thorough research and act as a catalyst for positive change.

After his first term as governor, Bellmon knew there was a need for open, nonpartisan dialogue in the young state. He sought to create a public policy organization that was independent, nonpartisan and inclusive. The purpose of which was to provide citizens the opportunity to participate in a truly democratic process designed to shape the future of Oklahoma. To this day, The Oklahoma Academy upholds Bellmon's vision and the organization's long-standing reputation as the state's premier citizen-based organization for nonpartisan public policy development.

From its inception in 1967 to its revitalization in 1985 to its adoption of the Town Hall process in 2001, The Oklahoma Academy has maintained its relevance in raising awareness and shaping public policy in Oklahoma. Despite its small staff and limited resources, The Oklahoma Academy generates and manages an impressive amount of public policy information, engages the citizens of Oklahoma in discussing and developing policy recommendations and works ardently with the community leaders and policymakers to implement the resulting ideas through community and legislative action. To date more than 65 pieces of legislation passed since the adoption of the Town Hall process in 2001.

The Academy Process identifies areas of need and problems facing Oklahoma, conducts research on identified critical issues, and develops long range goals, consensus recommendations, and agendas for action.

Through the Town Hall conference process, citizens are given the opportunity to honestly and openly discuss the issues, determine the solutions, and collaborate to develop public policies that they believe will achieve the greatest good. Then, the attendees are empowered to lobby their legislators and other policy makers about the proposed policies.

The Academy has covered a wide range of topics, including education, small business development, government structure, crime, technology and the future, and the state's constitution.

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Academy President and CEO

Hello 2019 Town Hall Member Participant!

The 2019 Town Hall focus on Oklahoma Energy and our future could not be better timed. Oklahoma is an Energy state and the goal of the Town Hall is having a collaborative and thoughtful discussion seriously considers Oklahoma's future as an energy systems leader. We are looking to the future . . . we know major change is coming. As an energy state we need to be more than ready, and our energy systems need to be ready. What are the steps that must be considered and taken now and within the next five years that allow us to meet the changes 10, 20 and 30 years from now?

By accepting the invitation to participate, you have promised to be prepared and ready for open, honest discussion and deliberation. This resource book has been developed to help you do that. It is important that you read the document. Several of you work directly or indirectly in the energy field or closely related fields, and therefore may feel you know all there is to know on energy and our future. You may, but you still need to be willing to listen and learn. Others participating know that energy is important to our lives and appreciate the convenience we all experience with having energy at our beck and call, but don't necessarily know all of the specific aspects to be considered in making sure we have a sound, fair, balanced, forward-thinking energy future that utilizes our natural resources wisely and strategically while developing and providing the power we need. . . and others need. The Background Resource Document is developed to provide many different sides of the issue. If you do not read the document, you will not be prepared, and you will stifle your group's discussion.



JULIE KNUTSON
President and CEO

You have also accepted the responsibility to represent others in your geographic, demographic, and vocational areas as you discuss and deliberate the discussion questions at Town Hall. You'll be sharing what you learned and Information on the Findings and Recommendations you helped create. It is critical to be prepared. The success of any Town Hall is dependent upon the preparedness of its participants. As a Town Hall member your voice can be heard, should you choose it to be.

Throughout late Spring and Summer, we held community "listening sessions" on the topic of Oklahoma's Energy Future. By "listening session" we mean an opportunity to hear from citizens on their thoughts and concerns about energy -- all forms of energy. The Information we gathered will be provided to you prior to the Town Hall's start. Many thanks to Michael Gordon, Martie Oyler, Mark Schell, and Lana Reynolds for their help in organizing sessions in their parts of the state!

Your Assignment and Role...

Take advantage of your unique opportunity. Be prepared. Listen actively, share your thoughts and ideas, and importantly, be willing to learn. The work of the Town Hall is much easier, more satisfying, better done, and more fun to those who have prepared themselves appropriately for the discussions. While there are some plenary session speakers who share information with us during the Town Hall, the real speaker and developer of what comes out of a Town Hall is YOU. The better prepared you are, the richer the discussions and the better the consensus recommendations and solutions.

So, I say again, Be Prepared!

I'm looking forward to seeing you at Town Hall 2019!

Many thanks to our two Town Hall Co-Chairs, Mike Ming and Stuart Solomon. They have collaboratively participated in the work of the research committee in developing the details and specifics of this Town Hall. Huge thanks to the Town Hall Steering Committee members. And, many thanks to Craig Knutson, Research Committee Chair, along with Research Committee members Mark Snead and Stephen Greetham.

Recognition must be given to staff member, Lynn Thompson, Communications & Development Director, for the design and production of the Background Resource Document; and Recognition must be given to our new staff member April Maddry, Membership & Programs Manager, for her work in maintaining excellent contact with those interested in participating or observing this Town Hall as well as working with the Town Hall facility to ensure all is set up properly.



Oklahoma Secretary of Energy & Environment

The Governor and his team are excited that the Academy has chosen to tackle this exciting topic that touches the lives of all Oklahomans on a daily basis and is an important driver to our state's economy. As the Governor's Cabinet Secretary of Energy and Environment, I am his primary advisor relating to the matters being considered in this year's Town Hall. This is such a great opportunity for me to participate in, and more importantly, listen and hear all other diverse viewpoints about vision for our state's energy future.

As a proud fourth generation Oklahoman, our Governor, Kevin Stitt knows the importance of our legacy as an energy leader and the importance that we continue to be a leader in energy production of all sources. The Governor believes that innovation and technology advancements will continue to drive environmental improvements and that the free market will continue to guide energy development that plays to Oklahoma's strengths. He takes the principled stance that government should not be in the business of picking winners and losers.

Instead, under the Governor's leadership, we will promote policies that play to Oklahoma's strengths and that concentrate our efforts on the responsible development and production of energy in all forms. We know the only function of renewables is to produce electricity for distribution on the grid, while oil and natural gas continues to offer reliability in the grid while also providing the basis for many household items everyone in this room depends on today, from the plastic pen you are holding to take notes to the rubber on the tires that transported you to the event. Oklahoma's leadership in emerging renewable energy will continue, and we will also champion the fulfillment of market demands for affordable traditional forms of fossil fuels.

Governor Stitt also believes energy independence, and yes, dominance, is essential for the continued security and prosperity of our country and our state. Oklahoma is leading the way! We currently rank #3 in Wind Energy; #3 in Natural Gas production; #4 in Oil Production. Better yet, we have some of the nation's cleanest and most affordable energy.

We are also actively monitoring consumers' demands. When your purchasing interests or habits change, then markets change, and new forms of energy and transportation emerge. We must be leaders and embrace technology like carbon capture utilization and storage to make environmental progress. Oklahoma must have a market-based approach to our energy policy, ensuring a level playing field that neither over-incentivizes nor penalizes our citizenry for choosing or avoiding any particular form of energy. We can only achieve that goal through the type of meaningful debate and civil discourse that the Oklahoma Academy's Town Hall provides.

Thank you to the Oklahoma Academy for providing this wonderful forum for the exchange of ideas that will allow our state to move forward with policies that ensure affordable clean energy for all Oklahomans.

Kenneth Wagner,
Oklahoma Secretary of Energy & Environment





2019 Town Hall Leadership

Dear Town Hall Member Participant:

The energy market has undergone a rapid and transformative change in recent years, and while energy scarcity was once a concern, this change has given way to energy abundance in new models and economic resources. Electrification, digitalization, and new technologies and platforms all combine to present new and efficient options to you, the energy consumers.

Oklahoma is an energy producing state. We have been blessed with not only our great oil and natural gas supplies, but we are leading the pack when it comes to electricity generation from wind. These transformative changes can create new winners, but it also impacts the legacy players that have been the driving force of our great state for generations. And with these changes comes uncertainty.

New models can arise in short order in ways that are hard to imagine. Oklahoma in many ways is at the forefront of these changes. But there is a bigger role for us to take on as the leader both here in the U.S. and as an example for the globe, as our research universities, innovative companies, and tribal partners share a common objective — how to affordably power the world in an environmentally sustainable way.

Better understanding this new energy system, and how to optimize our resources, technologies and behaviors is now more important than ever to guide our path in to the future. That is why the Oklahoma Academy 2019 Town Hall will focus on our energy resources and determine how best to maximize our legacy as an energy leader to enhance our economy, consumer needs, and the environment. We hope you will take this important opportunity to create a robust future for Oklahoma and increase Oklahoma's energy leadership role in the world.

We must move the research focus and public dialogue away from polarized arguments and models that in many cases simply are no longer relevant or optimal, to a new and better conversation of a system approach where the focus is on how fuels and technologies work best together to produce a better outcome. We need this approach now, because the progress in addressing the critical issues of energy security, environmental sustainability, affordability, global energy poverty and decarbonization is inadequate.

The energy system of the future will require a fresh look at capital markets, customers, and public sentiment. Capital markets have new investment criteria, and consumers have more choices. Society in general is demanding improved performance with reduced environmental impact, and capital providers face pressure to meet demanding commercial, social, and environmental criteria.

The time is now for a new approach and a new conversation. Leadership, as always, will be the key to progress. Polarized and biased positions that impede or even prevent progress must give way to pragmatic and open-minded dialogue and fact-based analysis. There is a tremendous opportunity at hand — Oklahoma must seize it, and with your knowledge and help, this can be achieved!



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Town Hall Co-Chair

MIKE MING
Town Hall Co-Chair



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Thoughts from our Town Hall Research Chair...

The research associated with this year's Town Hall Topic has been both challenging and enlightening. Challenging in that energy production and distribution is so essential to our daily lives, from the cooling of our houses and buildings to the transporting of people and products, and yet it is cyclically volatile, impacting both the economy and the environment in positive and negative ways. How does the industry balance the twin challenges of rising energy demand while reducing emissions?

Enlightening in that oil and gas formations that had been abandoned and thought to be depleted have been transformed into "new" production due to technological innovation and investment. Old formations, from North Dakota to Texas, are producing record amounts of oil and natural gas, moving us closer to energy independence. And while, as a country we still import large amounts of oil (9.93 million barrels/day, 2018), our NET imports are significantly less (2.3 mb/d) due to record production and export levels.



As Gregory Zuckerman wrote in his book *The Frackers*, "everyone knew it was crazy to try to extract oil and natural gas buried in shale rock deep below the ground, everyone, that is, except a few reckless wildcaters." The author of course was talking about Texas and Oklahoma wildcaters like Mitchell, McClendon, Ward, Hamm and others, the true entrepreneurial risk-takers that pioneered the extraction technique called hydraulic fracturing. Ironically, according to the American Oil and Gas Historical Society, the first commercial hydraulic fracturing of an oil well took place in 1949, 12 miles east of Duncan, Oklahoma!!

So who will be the next set of risk-takers? Will they be small independents, investments from the majors, or primary research from universities? What will our energy source portfolio for electrical generation look like in the next 20 years? The table that opens Section 2 on Energy reveals that in 1990, Wind accounted for 0.0 megawatt hours of electricity; 27 years later Wind accounted for 23.6 million megawatt hours of electricity, right at 1/3 of all megawatt hours produced in 2017. Today, Oklahoma ranks 3rd in the country in installed wind power capacity.

How will artificial intelligence impact investments and operations of utilities, energy companies and grid operators in the near and foreseeable future? How will these investments impact the delivery and cost of electricity for consumers and businesses?

In this highly regulated environment, what must legislators and regulators know and have at their disposal to encourage private sector exploration, improve the quality and effectiveness of public utility regulation, while dealing with issues like cybersecurity environmental protection and remediation?

At a recent MIT Energy Conference, five energy topics were identified as being key to the WORLD'S future. Since the US population represents less than 5% of the world's population, these five topics should be most relevant to our country and state. The five topics, in no particular order, were: Solar, Energy Storage, the Electrical Grid (reliability, security, and adaptability), Nuclear Energy, and Carbon Capture and Sequestration. Expect any and/or all to be topics we might cover in this Town Hall.

Craig Knutson
Town Hall Research Chair
President/CEO of Potts Family Foundation



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Section 1

Introduction

What is Energy?

Roger Blais, Town Hall Research Committee, June 2019

In the media energy means the oil and gas economy, or renewables, or the stuff that powers our cars and light bulbs—even something you get in breakfast cereal or Red Bull. It is pep, or zip, or power. But what is energy exactly in physics? In short, **energy is the capacity to do work.**

What is work? Let's start with force—a push or a pull. It is measured in pounds (lb) in our everyday US Customary units. In physics, **work only occurs when a force acts on a mass while it moves through a distance.**

- You can push on a solid wall all day, but if it doesn't budge, your body may have expended metabolic energy, but you have done no work on the wall. **Force but no movement—no work!**
- Likewise, if a bowling ball is rolling on an alley of negligible friction, it does no work until it exerts a force that causes movement by striking the pins. **Movement but no force as it rolls—no work!**

So the unit for measuring work is the foot-pound. If you exert a force through a distance you accomplish work. Lift a 3 lb object 2 ft and you do 6 ft-lb of work.

To say energy is the **capacity** to do work seems confusing, because both are measured in the same units. An analogy is to think of energy being like the money in your checking account, and work being like the money you draw out to purchase a pair of shoes. Both your account balance and the purchase price are measured in dollars, but the balance in the bank is the capacity to buy something. The fundamental law that governs this is called the **work-energy theorem**. It states that **work accomplished equals the change in the balance of available energy**. The price paid equals the change in your bank account.

Energy comes in many forms—mechanical, heat, sound, light, electromagnetic, chemical, or nuclear to name a few. The history of technology can be written in how we have learned to convert one form of energy to another. Consider two simplified examples of changes of energy from one form to another.

- In the heat and pressure at the core of the sun, four hydrogen nuclei fuse into a helium nucleus, releasing energy that is emitted as electromagnetic waves (light) into space. The earth absorbs sunlight converting it to heat, evaporating water which later falls as rain or snow in the mountains. The water gathered in rivers falls to lower altitudes flowing through a dam turning a turbine, converting its flow energy to turbine rotation. That drives a generator converting motion to electricity, which reaches your light bulb converting electricity to light and heat.
- Solar energy falling on a green leaf powers conversion of water vapor and carbon dioxide into sucrose (a simple sugar) and oxygen in a process called photosynthesis. Sunlight converted to chemical energy is thus stored in chemical bonds of sucrose. The plant is buried and over geologic time is converted into peat, coal, or petroleum depending on the conditions. It is extracted from the ground, and the chemical energy stored millions of years before is converted to heat by burning the fossil fuel. The heat from the burning coal heats water in a boiler to produce steam that runs a turbine, a generator, and ... onto the lightbulb.

In fact, almost all of the energy we have on earth comes originally from sunlight, with the exceptions of some radioactive ores that we mine and concentrate to run nuclear reactors, or geothermal heat from the solid earth itself. Even wind energy comes from the sun by differential heating of the air.

Two rules for energy.

- **The Law of Conservation of Energy comes in two forms. One for everyday mechanical of chemical processes and a more general second one for nuclear power processes.**

- **Classical Law of Conservation of Energy states that energy can neither be created nor destroyed.** Energy changes from form to form, but the amount after is the same as before. But it may change into more than one form; electricity in the light bulb changes into the light you want, and heat you don't seek. This conversion to other forms makes all energy conversion devices inefficient, because the energy that you want out is less than what you have to put in. And the lost energy always ends up as heat.
- **Modern Law of Conservation of Mass-Energy.** Einstein showed that mass can be converted to energy and vice versa using a famous conversion equation $E=mc^2$. The modern law states that the total of mass and energy can neither be created nor destroyed but some can change from one form to another. This is only important in nuclear fission (reactors or the A-Bomb) or thermonuclear fusion (solar interior or the H-Bomb). Conservation of Energy is also called the **First Law of Thermodynamics**.
- **The Second Law of Thermodynamics.** If the first law teaches that you cannot get something for nothing, the second law is even more pessimistic. It says that every time energy changes from one form to another the efficiency is never 100% with the result that the energy becomes more disorganized and less useful. A cup of hot coffee has organized heat energy in a small volume of coffee, but let it sit on a desk for an hour, and the energy has fled the cup flowing out into the room. It is still there, but now spread out around the room at a lower temperature. It is therefore less organized and no longer useful to do further work. An equivalent statement is that heat always flows spontaneously from high to lower temperature regions.

Units for energy. Reports on energy policy use a confusing array of units. You probably do not need to make mathematical conversions, but consider each paper by itself looking at the percentage information offered in their consistent system of units. You just need to know that all the units are for energy, and thus can be converted. For the masochist who wants to compare one paper to another, here is some reference material. Most American papers use English units, but electrical measurements are always metric units. The Quad is the largest commonly used with total 2017 annual energy production for the world about 548 Quads, and for the US 87.5. The million metric tons of oil equivalent (Mtoe) and the Terawatt-hour (TWh) are also commonly used. The **Watt is not a unit of energy, but of power meaning energy per unit time**, so it occurs in energy units as a product with time like the TWh.

$$1 \text{ Quad} = 10,000,000,000 \text{ Therms} = 25.2 \text{ Mtoe} = 293 \text{ TWh} = 1.055 \times 10^{18} \text{ Joules}$$

Primary energy sources are listed below. Electricity is a secondary source produced from these.

Production	Oil	Coal	Natural Gas	Biomass	Nuclear	Hydro	Mtoe	Quad
Global	31.5%	27.1%	22.3%	9.7%	5.0%	2.6%	13,821.8	548
USA	37%	14%	29%	4.9%	9%	2.8%	2,206.4	87.5

US energy consumption in 2017 was about 3.6% more than domestic production. The difference being net energy imports. Since 2011 the US is a net exporter of petroleum, and since 2017 of natural gas. But we remain a net importer of total energy, though at a historically low rate for recent decades. Consumption in the USA from primary sources is as follows. uses: Electricity 38.1%, Transportation 28.8%, Industry 22.4%, Residential 6.2%, Commercial 4.5%.

Roger Blais retired in 2018 as Provost and professor emeritus of physics after forty-one years on the faculty of The University of Tulsa. His physics degrees include a BA from the University of Minnesota, and a PhD from the University of Oklahoma. His research on fluid dynamics led to cofounding in 1983 an industrially funded research consortium in artificial lift technology at TU which is still in operation.

The Global Energy Transformation

Mark Stansberry, Fall 2018

Over the past few months, I have spoken at several events, including: The Pipeline & Energy Expo in Tulsa, Oklahoma, the 25th Annual Meeting of the Louisiana Oil and Gas Association in Lake Charles, Louisiana, the Digital Transformation in the Oil and Gas Industry Conference in Houston, Texas, the Pre-Conference of the National Council on Undergraduate Research at the University of Central Oklahoma in Edmond, Oklahoma, and the OK-National Association of Royalty Owners Annual Convention in Oklahoma City.



Mark Stansberry

National Energy Talk

The theme of my presentations has been “National Energy Talk: America’s Energy Dreams and Global Economic Realities.” The sub-theme has been “Achieving Operational Excellence Through Digital Transformation.”

On July 31st, 2017, National Energy Talk (nationalenergy-talk.com) was launched in Elk City, Oklahoma. With the launch of National Energy Talk (NET), what once was an annual conference has expanded into a media-driven platform with year-round engagement. Today, NET is helping lead a national dialogue on energy issues, views, and solutions through events, publications, videos, audio and online content. NET believes in the power of people - “Nothing Moves Without Energy!”

Analytics and Data

As I state in my presentations, “to maximize potential and attract a new, younger workforce, companies of all sizes are going to have to focus on content, analytics, and digital transformation. Large amounts of data from many sources can be collected and analyzed quickly, which leads to being more informed and making better decisions.”

The U.S. will need the oil and gas industry for many years ahead. Analytics will play an important role in monitoring and analyzing the anticipated demand for energy and decisionmaking regarding cost effectiveness.

Energy Resources

“In the U.S., the elements of our strengths are many. They include our democratic government, our economic system, our natural resources,” stated Ambassador Jeane Kirkpatrick back in the 1980s.

Earlier this year, the U.S. Energy Information (EIA) reported that the U.S crude oil production exceeded 10

million barrels a day for the first time since 1970. During the 1970s, U.S. consumption began to outstrip production and America started importing more oil than it produced. The needed U.S. entrepreneurship came along through the efforts of research and development, along with technological advances. As of the fall of 2017, the number of barrels a day was at 2.5 million.

Energy Education

Energy education is more important than ever as we envision America’s energy transformation. National Energy Talk is a platform engaging a national dialogue on energy issues, views and solutions. We address the needs, plans and issues that all types of energy face today. Through discussion, we can create a national energy vision.

Energy Industry’s Impact

In 2001, I teamed up with Academy Award-winning producer Gray Frederickson (Godfather II) to begin a film production company, GrayMark Productions. Since that time, I have heard from several in the movie industry who believe that the oil and gas industry should not be respected. Several in Hollywood believe that the oil and gas industry is only for the greedy and that it is not interested in the welfare of others and of the environment.

Having been in the oil and gas industry for more than 40 years, I have advocated that the message is clear. I continue to point out that the movie industry is a major user of energy and, therefore, needs the oil and gas industry. Energy is needed from the beginning to the end of production as well as into the marketing and distribution of films.

The movie industry needs transportation and the use of power generation. A film project often needs transportation to and from the sets, the use of autos, trucks and other vehicles including planes and helicopters, fuel for traveling and living for the crew, transportation of animals, air transportation, taxi/limos, phones, rail transportation, and products made from petroleum including wardrobes, film, air conditioners, carpet... and the list goes on.

Electricity is needed for lighting, equipment, and music. The sound for the movie needs a mixer, boom operator and microphones, to mention only a few of the items needed.

Global Impact

In the fall of 2013, only five years ago, then-U.S. Congressman Mike Pompeo addressed a crowd gathered at the International Energy Policy Conference (National Energy Talk/The Energy Advocates) held in Tulsa, Oklahoma. I founded the conference and have chaired it since 1992. Now, U.S. Secretary of State Pompeo is highly involved in ongoing negotiations with Korea.

There was a point in my life that I thought there would never be peace between East and West Germany. I could not imagine the Berlin Wall coming down. Now, we are facing a similar point in history where North and South Korea, at least in appearance, seem to be closing in on peace.

In 2012, there was an article published in The Korea Times entitled “PTPI (People to People International) seeks to open chapter in North Korea.” At that time, I was serving as chairman of the board of directors for worldwide operations of People to People International (PTPI) based in Kansas City, Missouri, founded by President Eisenhower in 1956.

Kim Seung-nam, chairman of PTPI Korea at the time, proposed the concept of a North Korean chapter during the worldwide conference. Most of us were asking ourselves, “is this really achievable?” At the conference, we supported the proposal but we, of course, did not know that there would be such a possibility six years later.

Peace between North and South Korea would bring economic development opportunities for the U.S. and other countries, especially for the energy industry. North Korea’s infrastructure is in poor condition while North and South Korea combined have around 75 million people. South Korea is already a large importer of LNG.

We are faced with America’s energy dreams and global economic realities. America needs America’s energy and the world needs the U.S. energy industry!

Mark Stansberry is Chairman of the GTD Group, award-winning film producer, columnist, radio talk show host, author and energy advocate. He is a corporate leader with extensive experience in the energy industry. He can be reached at markastansberry@gmail.com.

Notes

**This is a resource document for you to use.
Take notes, highlight, use as a text book.**

BOOK SUMMARY: America Needs America's Energy

Craig Knutson, Town Hall Research Chair, July 1, 2019

As research chair for the Oklahoma Academy's Town Hall process, I get to "explore" a number of critical aspects of each of our topics. This year's topic – Energy – provided me the opportunity to read a book I had picked up years ago, but then got busy on a different topic and set it aside. The book – ***America Needs America's Energy***, by Mark Stansberry – is quite prophetic for a book published just seven short years ago. The author has allowed me to provide MY summary of his book, which could be a scary proposition for both of us!

The first two parts of the book entitled Energy Perspectives: Then and Now and Energy Sources: Here and Now follow a similar format to what this background document has done. The perspectives, both national and international, provide the reader with a solid foundation of what the author says is "the background information you need to understand the variables of the energy equation." Written seven years ago, obviously some of the players have changed positions and the data tables need updating, but if the consumer is going to develop The People's Energy Plan, we must be armed with the realities and data upon which a market-driven plan, total energy independence, and energy security are to be realized.

Part III, entitled Creating Together the People's Energy Plan, introduces the reader to a public-private partnership organization called The International Society of Energy Advocates, an energy education organization started in 1974. Its mission is "to inform the general public about our vital energy industry and energy policy issues," while their goal is "to raise awareness and change the public's perception of the industry." The Energy Advocates (EA) maintain that "nothing moves without energy" and that "energy is a basic requirement of life." Finally, their motto, one that this Town

Hall could almost adopt, is "Striving for Energy Efficiency and Environmental Preservation."

One of their approaches to educating clear that the energy industry's infrastructure needs updating and there has been an historical over-reliance on external energy resources; both these conditions should be driving this country to develop a "national energy policy." Using the roundtables process to help reverse those trends, I found former Senator Lugar's quote most compelling: "Good policy emerges from serious debate, informed by the facts. Today we need bold new approaches for forging bipartisan coalitions." That statement applies to virtually any topic we address.

Finally, Mark announces that "America's energy future is in our hands." His charge to the reader is to start keeping a Personal Energy Journal. The forms he shares in the book represent a compilation of questions/actions he has compiled over the years. He asks the reader to track their energy consumption covering a number of different topics (e.g. water consumption, electric usage, travel, etc.) and set annual goals (e.g., adding solar panels to your house). In essence, we should each take the grassroots challenge to be more aware of our consumption habits . . . and encourage neighbors, employees, and others to do the same. This personal responsibility pledge reminds me of P.J. O'Rourke's statement about personal responsibility: "One of the annoying things about believing in free will and individual responsibility is the difficulty of finding someone to blame your problems on. And when you do find someone, its remarkable how often his picture turns up on your driver's license!" Thanks, Mark, for the challenge. All Town Hall attendees should consider Mark's suggestion of striving for **energy efficiency and environmental preservation**.

Oklahoma First Energy Plan (OFEP)

C. Michael Ming- Secretary of Energy 2011-2013, State of Oklahoma, 2011

Introduction

The nation is undergoing an energy revolution. Unprecedented new supplies of natural gas, a renaissance in oil production, and a newfound ability to economically capture energy from the wind are here today. Promising new supply technologies in CO2 enhanced oil recovery (EOR) and bio-fuels are close to commercial demonstration. New power generation, electricity distribution, and smart grid technologies are rapidly developing and penetrating the market. In each of these areas, Oklahoma is leading the way. Despite four decades of federal efforts to reduce America's dependence on foreign oil, imports have continued to rise—until now. The ideological ambitions of those seeking to eliminate traditional energy struggle to provide economically meaningful results at scale. In the meantime, pragmatic efforts to improve rather than replace traditional energy are yielding extraordinary results without massive federal subsidies or mandates. The twin national objectives to reduce oil imports and improve the environment are actually happening, but in ways many never expected.

American Innovation Produces Results

A suite of new supplies and new technologies, rather than the proverbial silver bullet, is creating new options for power generation, radically improving overall system efficiency, and enabling scalable alternatives for traditional transportation fuels. While energy has historically been viewed as discrete fuels, in reality, energy is a system where the components must be optimized. New supplies and technologies provide the tools to optimize the system to produce clean, affordable, abundant, reliable, and sustainable energy. Improving, instead of replacing, the system enhances national security, grows the economy, and creates jobs, all while protecting the environment. Oklahoma is an energy state and an energy leader. With virtually all of the pieces in place, the state's opportunity to seize the moment and lead the nation is here. In a globally competitive economy, especially with the growing economies in Asia, keeping Oklahoma competitive and business friendly is critical. Leveraging our unique human and natural resources to create wealth at home instead of exporting our commodities for final manufacture elsewhere should be a primary objective. In other words, think globally but act locally with Oklahoma resources.

The Oklahoma Contribution

Oklahoma's rich heritage has been built on traditional energy. For more than a century, natural gas and oil have advanced and sustained the state through good times and bad. Oklahoma's indigenous natural resource endowment, unmatched human resources, and cutting-edge companies have led the nation in practical and affordable energy inno-

vation. America's energy history has evolved from wood to coal to oil, with nuclear and hydropower subsequently joining the mix. Along the way, natural gas, much of which came from Oklahoma, began assuming an increasingly important role due to its diversity, cleanliness, flexibility, and efficiency. But with supply and decline concerns in the late 1970s and again in the late 1990s, natural gas as a fuel of the future suffered from a confidence crisis. Fortunately, beginning in the early 1980s, a few innovative and persistent visionaries knew that, with the right combination, much more natural gas could be unlocked. Finding the combination, however, took almost 20 years.

In the meantime, the nation sought to diversify by developing other transformational sources of energy, especially renewable resources such as wind, biofuels, and solar power. Oklahoma's tremendous renewable resource potential made it a natural location for those looking to develop these new and emerging industries. It was the start of a national push to rely more fully on renewable resources, and Oklahoma was quickly becoming a national leader in realizing the potential of this resource development. But almost simultaneous to this aggressive pursuit of renewables, the oil and gas industry, with extraordinary technological innovation, discovered the combination to unlock unprecedented new supplies of natural gas. The presumed death of traditional energy was premature.

Creating a New and Better Future

This time the story is different. Emerging technology provides economical options to use this newly enabled natural gas endowment in innovative and more efficient ways than before. Natural gas can do more than just heat homes and power industry. The opportunity to use natural gas to efficiently generate electricity and fuel vehicles is becoming a foreseeable reality. Natural gas and oil production are significantly increasing for the first time in decades. Production from unconventional reservoirs is surging, and the technologies unlocking this tremendous natural gas resource base are proving equally effective at increasing oil production. Oklahoma companies are once again leading this renaissance. The innovation making so much of this new resource base technically recoverable is now reshaping the understanding of future reserves as an economic concept replacing the past physical certainty that existed regarding availability of resources.

With such a large resource base, natural gas will be the nucleus of the optimized energy system of the future. Its unique attributes allow it to work in conjunction with improved energy efficiencies, renewable wind power, smart grids, and increasing oil production to provide the opportunity to achieve the long-pursued objective of energy inde-

pendence. Natural gas vehicles and new natural gas combined cycle power generation technologies that effectively and efficiently integrate Oklahoma's renewable resources into traditional energy grids can redefine domestic energy usage. Natural gas today accounts for more than 80% of the state's energy production, making it the centerpiece, although not the only piece, of our energy future, all while growing the economy and creating jobs right here at home.

The Government's Role

The role of government is to provide a fair and equitable environment for the free market to work while protecting the public interest. Government does not create wealth or jobs; companies and the free market do. Allowing the free market to create wealth, and meet the needs of the public good through good policy, is the objective. For example, inefficient energy use based on poor building construction or a poor choice of fuel options disproportionately hurt the elderly and low-income groups that do not have the resources or capabilities to rectify the situation. Those two groups not only end up paying an unacceptable percentage of their income on energy, but they are also oftentimes, without any choice on their part, stuck with the most expensive life-cycle energy cost option. Only those who have greater resources and knowledge can afford higher up-front costs to ultimately save more energy over a product's useful life. But the life-cycle benefits can and should be more available. Energy affordability and efficiency should not be a zero-sum game; everyone should be able to win.

Maintaining and growing competitive advantage requires continued technology development and innovation. This necessitates robust educational preparation from an early age and uncompromising commitment to research and development (R&D). Similar assurances are what enabled production from natural gas and oil resources once thought to be unproduceable, and they will be the same commitments that continually improve environmental performance to meet strict public demands. Educational excellence, technical workforce development, and world-class research initiatives are critical to keeping Oklahoma competitive and mandatory for the state to reach its full potential. Such a commitment would enhance Oklahoma's position as the natural gas capital of the world.

Health and the Environment

The recommendations in this energy plan also address human health and the full cost accounting of externalities, which historically have not been factored into energy cost analyses. Again, many times these burdens fall on those least able to help themselves. The combination of natural gas, renewable energy, and efficiency can dramatically improve the air we breathe and the water we drink, improving Oklahomans' health and the health of the economy at the same time. In the process, this can provide an affordable and practical method to use to comply with a host of existing federal environmental regulations regarding air and water. Energy efficiency itself may be the cheapest and quickest method to reduce energy costs and emissions.

Energy efficiency leverages all energy resources, and as a resource state, Oklahoma is well-positioned to benefit greatly from this leverage.

Oklahoma First

We are at the beginning of an energy revolution that will fundamentally change the way we produce and use energy. New markets will develop as capital flows to the most efficient uses, and consumers, opting for maximum utility and value, will vote with their purchases. Oklahoma, and its demonstrated track record in energy innovation, is leading the way as a model for other states and the nation in practical and affordable energy policy for a new energy future—an Oklahoma First energy future. Leveraging and improving the traditional while also embracing the transformational is the key.

Executive Summary

Fostering economic development, transitioning transportation fuels, optimizing the existing energy system, and positioning Oklahoma for the future by pragmatically leveraging Oklahoma resources are the key components of the Oklahoma First Energy Plan. Natural gas, renewable energy, and energy efficiency form the cornerstone of a new energy economy to address these objectives, and Oklahoma's natural resource base of natural gas, oil, and wind, along with technology and policy to make them work better and more efficiently together, position Oklahoma well as a national model for pragmatic energy policy.

Oklahoma First Energy Plan

Creating the Oklahoma First Energy Plan to make such a future possible began with the development of set criteria. A wide spectrum of groups representing Oklahoma's energy economy, including both producers and consumers of energy, was asked to provide input as to what an ideal energy plan for Oklahoma would look like, keeping the following questions in mind:

- ◇ Does the plan grow Oklahoma's economy?
- ◇ Does it create Oklahoma jobs?
- ◇ Does it protect and improve Oklahoma's environment?
- ◇ Does it protect and improve the health of Oklahoma's citizens?
- ◇ Factoring in questions 3 and 4, does it provide reliable and affordable energy for Oklahomans?
- ◇ Does it focus on Oklahoma's unique human and natural resources?
- ◇ Where are the opportunities to create leverage and synergy from our resource base?

In considering the input from participants, which resulted from a multitude of meetings, key concepts began to emerge. For one, it became clear that the ideological goal in Washington, D.C., of replacing traditional energy with an undeveloped silver bullet, has not materialized. Further, it could be seen that the challenges of cost and scale have not been appropriately acknowledged while abundant domestic

resources of all types have been marginalized and suboptimized. Therefore, it became apparent that a more pragmatic approach was needed, one that embraces and leverages traditional energy by making it better and more efficient instead of trying to replace it at any cost. In the process, the value and extent of Oklahoma's resource base became obvious. Oklahomans have always relied upon themselves rather than others to solve their challenges, and this time proved no different.

A popular book asks, "Who moved my cheese?" In many ways that question addresses the issue of jobs and the economy. Technology and global economic competition have moved the cheese. Oklahoma's unemployment rate, although well below the national average, is still higher than normal and economic growth is inadequate. Educating a new generation of students to meet the challenges, training a new workforce of energy technologists, and using Oklahoma human and natural energy resources to maintain existing industry and develop new industry therefore emerged as top priorities because job creation, workforce development, and economic development are key to Oklahoma's prosperous future.

Oklahoma's energy policy goals—affordable, reliable, secure, domestic, and clean—mirror those of the nation as a whole. Transportation is clearly an area of great national security risk. With almost total reliance on oil to fuel our mobility and an unacceptably high level of oil imports in a world where the energy needs of developing countries are expanding, repowering vehicles and refocusing the fueling infrastructure also become top priorities. With almost one-fourth of total national energy requirements met by energy imports, subject to geopolitical forces beyond our control, it is clearly time to take destiny back into our hands. Therefore, new vehicles and transportation fuels are additional priorities. Oklahoma's resources squarely address this critical need.

It also became apparent that energy supply isn't always necessarily the constraint; rather, how energy is used and produced can be the restricting factors. For example, energy efficiency leverages all forms of supply by stretching the value a given unit of energy supplies. Using energy more wisely and more efficiently, and making the system smarter, is the first step in optimizing the energy system. Oklahoma has been a national leader in making the system smarter, and much potential exists to wring significant additional efficiency from the system. Most importantly, the potential to create synergy in the energy system, where the whole is greater than the sum of the parts, is especially high for Oklahoma's resource base in, for example, the combination of natural gas and wind for new base-load electric power generation. Identifying opportunities and potential policies for synergy are thus also top priorities.

In addition, finding ways to increase all forms of Oklahoma energy production and building new markets that utilize the increase are imperative. By using the new production better

than has been done in the past, the new production becomes more valuable than in the past. New and unprecedented supplies of natural gas are revolutionizing U.S. energy markets, and finding ways to efficiently utilize that energy is critical. Oklahoma also has extraordinary opportunities for increased oil production, some of which is occurring today through the application of technologies developed for unconventional natural gas. CO2 EOR, for example, offers the potential to recover more oil than has previously been recovered in the state's history.

Finally, while making traditional energy better, embracing transformative energy where practical should remain a priority. This requires continued improvement, innovation, and a robust R&D commitment. Such efforts not only enhance environmental performance in all sectors, but also lead to new breakthroughs that can further leverage traditional supplies and importantly attract capital investment, including critical venture capital, into the state.

Developing the Objectives, Strategies, and Recommendations

With these priorities in place, a set of overarching principles could be developed, as seen below:

- ◇ Enhance all Oklahoma energy production to create jobs and grow the economy
- ◇ Lead the transition in transportation fuels to reduce dependence on foreign oil
- ◇ Leverage Oklahoma's energy resources to make the energy system smarter and more efficient and to protect the environment and human health
- ◇ Build new markets for Oklahoma natural gas
- ◇ Support local industry and attract new industry
- ◇ Make Oklahoma an energy research leader through the creation of the Oklahoma Energy Initiative to leverage Oklahoma's traditional and renewable resources with its world-class knowledge base

With these principles as guidelines, a specific set of objectives could then be developed. Breaking these objectives down into more precise strategies and detailed recommendations led to what is presented here as the Oklahoma First Energy Plan. Serving as a quick reference guide, a summary of these objectives and strategies is presented on the following page.

To start, the plan sets the stage for the content to follow by offering a general overview of the energy landscape. It then delves into these detailed objectives, strategies, and recommendations, organizing them by the appropriate energy sector and presenting them in individual sections along with the relevant background information, available opportunities, and existing challenges. Taken as a whole, the information in this plan will enable an Oklahoma energy system that is abundant, affordable, reliable, secure, domestic, and environmentally protective, all while growing the economy and creating jobs. The recommendations are designed to be used by legislators in statutes, employed by regulators in rule making, or promoted through executive order or

bully-pulpit advocacy. Although the recommendations are specific and tangible by sector and fuel, most importantly they include opportunities to create synergy among the energy system components. Mandates and subsidies are not necessary in order to implement these recommendations, and with a continuing tight budgetary situation, leadership in many cases will be the key factor for implementing the recommendations of this Oklahoma First Energy Plan.

Natural Gas and Oil

◇ Objective: Encourage the continued responsible development of natural gas and oil and promote new and existing market opportunities that enhance reliance on Oklahoma resources for economic growth.

- Promote Oklahoma's flagship fuel, natural gas
- Maintain the ability to develop Oklahoma oil and gas resources with hydraulic fracturing
- Address the price differential between Oklahoma crude prices and global crude prices to correct marketplace distortions
- Ensure the Oklahoma Corporation Commission has the capacity to carry out its statutory purpose
- Increase the recovery of Oklahoma oil resources through CO2 enhanced oil recovery
- Ensure refining regulations in Oklahoma remain effective while not impairing business development in the state
- Ensure equitable assessment of ad valorem taxes across the state
- Attempt to reduce litigation between oil and gas operators, producers, mineral owners, and surface estate owners

Renewables

◇ Objective: Encourage the robust build out of Oklahoma's wind industry by strategically connecting Oklahoma wind resources to primary load centers across the state and to export markets, as well as encourage the naturally complementary partnership of wind and natural gas.

- Endeavor to realize the potential of Oklahoma's wind resources to the fullest extent
- Enhance the integration of renewables into the power generation system by leveraging the complementary partnership potential of wind and natural gas
- Encourage increased use of renewables for power generation through the use of flexible, next-generation natural gas combined cycle equipment
- Endeavor to make Oklahoma an attractive place to locate additional wind turbine tower, blade, and component manufacturing as well as maintenance facilities and other support businesses
- Promote the large-scale build out of residential and commercial geothermal systems to preclude the need for new power generation where practical
- Solidify Oklahoma's position as a national leader in the development of biofuels
- Explore opportunities to enhance Oklahoma hydroelectric power generation and create new opportunities for the state's solar and biomass resources

Coal

◇ Objective: Promote opportunities to enhance Oklahoma coal production and streamline state processes to create effective regulation.

- Ensure the continued vitality of Oklahoma's coal industry with a special emphasis on metallurgic coal
- Assist industry in overcoming federal obstacles that stymie new mining permit evaluation processes

Power Generation and Transmission

◇ Objective: Harness the potential of all Oklahoma resources to promote diverse, reliable, and affordable power generation that makes the system smarter, more efficient, and more environmentally sound.

- Promote energy efficiency to preclude the need for new power generation and manage consumers' energy bills
- Address the issue of electric power dispatch preferences as it relates to Oklahoma resources
- Emphasize the importance of system reliability and fuel diversity
- Preserve Oklahoma's relative low cost of energy advantage to maintain a healthy business environment
- Encourage the build out of electric transmission to optimize power generation assets in the grid

Residential, Commercial, and State Buildings

◇ Objective: Empower consumers with the tools and information necessary to make informed energy decisions, taking advantage of efficiency opportunities that are economically feasible, in order to minimize life-cycle energy costs, maintain comfort and services, and help minimize the need for new power generation.

- Benchmark all state buildings, conduct energy audits, and set target efficiency gains (what gets measured gets managed)
- Ensure the effectiveness of legislative and municipal efforts designed to promote energy efficiency planning and reporting
- Encourage public outreach efforts to communicate the benefits of efficiency for commercial and residential applications

Industrial

◇ Objective: Establish efficiency targets that work to preserve energy affordability while precluding the need for new generation capacity.

- Capture the benefits of energy efficiency and combined heat and power opportunities in industrial processes
- Provide training, expertise, and services to industrial consumers looking to implement energy efficiency opportunities

Transportation, Distribution, and Infrastructure

◇ Objective: Drive a coordinated effort between states to reach a tipping point for the production of functional and

affordable original equipment manufacturer alternative vehicles.

- Make new compressed natural gas vehicle purchases and conversions a viable and economic option for both the state and individual consumers
- Strategically expand compressed natural gas and electric vehicle fueling and charging infrastructure
- Clear transportation impediments in the marketing and distribution of new, increasing supplies of crude oil

Education and Workforce Development

◇ Objective: Provide the foundation for a competitive, trained world-class energy workforce.

- Equip educational institutions with the resources necessary to enable successful energy training
- Address the need and promote the promising opportunity for employment in Oklahoma's energy industry

Environment

◇ Objective: Leverage all Oklahoma resources to provide a clean environment and spur economic growth.

- Increase utilization of natural gas and renewable energy sources for electric power generation

- Utilize demand-side management and energy efficiency to control emissions levels and ensure air quality
- Promote increased awareness of air quality issues
- Endeavor to communicate better understanding of the safe and important use of water in energy processes
- Reduce ozone levels through a decrease in transportation-related emissions

Research and Development

◇ Objective: Establish Oklahoma as the nation's capital for unconventional and renewable biofuel resource development.

- Promote efforts to support existing Oklahoma R&D efforts
- Advance new R&D efforts through the creation of the Oklahoma Energy Initiative
- Brand Oklahoma as a traditional energy and renewable resource R&D state

Read the full 2011 Oklahoma First Energy Plan at <https://www.naseo.org/Data/Sites/1/documents/stateenergyplans/OK.pdf>

Notes

**This is a resource document for you to use.
Take notes, highlight, use as a text book.**

UPDATE: The 2011 Oklahoma First Energy Plan (OFEP)

C. Michael Ming- Secretary of Energy 2011-2013, State of Oklahoma, September 10, 2019

Oklahoma is an energy state, consistently ranked among the top five states for energy production from oil, natural gas, and wind, while enjoying some of the lowest electric utility rates in the nation. And the state has achieved admirable environmental objectives by utilizing Oklahoma's clean resource endowment of natural gas, wind, smart grids, and energy efficiency. Oklahoma also has been ranked by the Fraser Institute as a top three state for energy investment. This impressive performance has not been by happenstance but rather by making the conversation intentional and deliberate, well thought through and conceived, with collaboration between industry, regulators, and the legislature to create a business-friendly climate that encourages energy production and investment while simultaneously protecting the environment.

It is said that plans are worthless but planning is invaluable. Despite our deep energy heritage, Oklahoma had never produced a comprehensive energy plan. In 2003 the Oklahoma Academy recommended the state develop such a plan, but it was not until 2011 that the first plan was developed. While suffering for years from energy scarcity and dependence on foreign oil imports, the nation was just beginning to realize the long dreamed of goal of energy abundance but that transition was just in its infancy. Oklahoma needed to step up and lead, so in 2011 a comprehensive and inclusive effort of all energy stakeholders in Oklahoma began a process to develop an energy roadmap for the state, looking first to Oklahoma's resources.

Over the eight years since the OFEP was written, much has changed. The great energy revolution and the profound shift from scarcity to abundance, that in many ways began with the shale revolution that was conceived by great leaders right here in Oklahoma, has continued to advance in new and sometimes unforeseen ways. Energy abundance has turned out to be real, and now our job is to make the abundance sustainable and affordable by optimizing our resources for the future for Oklahoma energy.

The OFEP began with a series of questions that had to be addressed for any recommendation – will they grow the economy, will they create jobs, will they protect and improve the environment, will they improve health of our citizens, are they affordable, do they leverage our human and natural resources, and where can we generate leverage and synergy? These questions made the energy discussion deliberate and intentional. While not all the recommendations came to fruition, the process led to outcomes that produced many beneficial outcomes merely by the act of forcing critical thought for the process. Sometimes optionality was created that was never fully utilized, such as natural gas vehicles, but the optionality had serendipitous benefits for other alternative fuels, facilitated a statewide CNG fueling network, and has been a contributor to lower transportation fuel costs for Oklahomans. In fact, the ODEQ programs to utilize the VW emission settlement funds are based upon the optionality for alternative fuel vehicles built out through the CNG initiative of the OFEP. One of those programs, the ChargeOK electric vehicle charging program, provides grants for charging stations along transportation corridors identified through the lessons of the CNG initiative. Another program, the Alternative Fuel School Bus program provided over \$4 Million for propane/LPG or CNG new school buses. A condition of the school bus grants was access to fueling infrastructure, much of which came from the OFEP's CNG initiative.

In other instances, the deliberate conversation helped create a constructive environment that ended up with better regulatory and legislative policies that produced win-win solutions for industry, consumers, and

impacted citizens such as longer horizontal wellbores to increase O&G recovery factors while reducing costs and surface utilization, O&G holding pit rules that promoted more water reuse which reduced the demand for potable water in O&G operations, and a working group to address induced seismicity that dramatically reduced the number of earthquakes from water disposal in the state.

Oklahoma was also recognized in 2012 as the most improved state in the nation for energy efficiency by the American Council for an Energy Efficient Economy. The CNG effort ultimately led to an MOU that was signed by approximately half of the states in the U.S. at a time that U.S. oil production had yet to ramp up to its current levels so transportation fuel was still a significant national security issue dependent on foreign oil imports from many politically risky areas of the world.

Oklahoma also helped lead the effort that led to the building of the southern leg of the Keystone XL pipeline which has enhanced oil transportation from North Dakota to oil storage in Cushing and then to refining and export markets on the Gulf Coast.

The Oklahoma based Ground Water Protection Council developed a public transparency database mechanism for hydraulic fracturing which provides the public with free access to specific information about injected fluids, and which likely circumvented costly and tedious federal regulation of hydraulic fracturing by the U.S. EPA. Such federal regulation could have strangled the U.S. shale revolution.

The collaborative process also resulted in an historic settlement with the U.S. EPA on regional haze and mercury and other air toxics which transferred air jurisdiction back to the state from the federal government, and dramatically lowered criteria pollutants and CO2 emissions in the state.

And the OFEP spurred a lively conversation each year at the Governor's Energy Conference where national leaders and experts came to Oklahoma to advance the energy dialogue, with Oklahoma as a proving and demonstration ground for new technologies, resources, and commercial models.

The great energy revolution is still well in progress. Oklahoma's impressive contribution to it has never been more important. O&G technology and advancements continue to increase U.S. production and reserves to historic levels, wind energy has exceeded all expectations and its costs continue to decrease benefiting local consumers, solar energy is beginning to emerge with larger scale project announcements in the state, and natural gas combined cycle power plants have helped decrease CO2 emissions in the U.S. by more than the rest of the world countries combined. This is largely due to a shift in the electric power generation mix from 2015 to 2018 to a more Oklahoma first portfolio, with natural gas increasing from 45% to 48%, coal (mostly from out of state) decreasing from 33% to 17%, and wind increasing from 18% to 32%.

But continuous improvement in any industry is mandatory. With new advances, new technologies, and new challenges, it is time to re-visit the OFEP and update it to optimize Oklahoma's energy resources for the future. The new plan won't play out in every way that it recommends, but the process of planning will make the path much better than a happenstance approach, utilizing collaboration and a conducive environment to make things happen. The planning will be invaluable, and will allow Oklahoma to continue to lead the nation and set the example for pragmatic progress for our energy future.

Section 2
Oklahoma's Energy Sector

Electrical Production Sources: Oklahoma 1990 vs. 2017 (EIA)

Craig Knutson, Town Hall Research Chair, August 26, 2019

Sources	1990		2017	
	Megawatt Hours	Percent Total	Megawatt Hours	Percent Total
Total Electric	47,079,131		73,731,764	
Coal	25,655,347	54.8	17,367,854	23.6
Hydroelectric	2,730,594	5.8	2,036,200	2.8
Natural Gas	18,236,766	38.7	30,450,679	41.3
Other Biomass	1,780	0.0	67,927	0.1
Other Gases	88,970	0.2	48,417	0.0
Petroleum	76,947	0.2	16,054	0.0
Pumped Storage	19,764	0.0	-117,610	
Wood/Wood Derived	268,963	0.6	230,818	0.2
Solar Thermal/ PhotoVoltaic	0.0	0.0	32,582	0.0
Wind	0.0	0.0	23,598,843	32.0

Summary: Over the past 27 years, there was a 57% increase in the amount of electricity generated in Oklahoma. The most notable changes from the individual sources used to generate that electricity are: the DRAMATIC increase in the contribution Wind provided to the total (now 32%); a 67% increase in the use of natural gas; and the 32% decline in coal usage to generate electricity.

The Town Hall attendees ought to consider what the next 27 years might look like in terms of not only the amount of electricity needed BUT the sources. Is Solar likely to mirror the growth of Wind from the past 27 years? If so what needs to occur to encourage this cheaply manufactured technology onto the grid?

Everything you know about energy in the U.S. might be wrong

Elizabeth Weise, USA TODAY, June 4, 2019

The energy landscape changes so fast, even experts have trouble keeping up. Prices for renewable power are plummeting, technologies for storage are becoming more cost-effective and what's competitive today isn't what was competitive five years ago – shifts that will only increase in the coming years.

“Air pollution” is the theme as we observe the 45th World Environment Day on Wednesday. Carbon pollution caused by burning fossil fuels is a major contributor to the greenhouse gases causing global warming. To stop the process, we need to stop burning fossil fuels.

The debate over how to do so has gone on for decades. As it has, the energy field has changed dramatically, shifting the outlines of the discussion. Here's a quick overview of where things stand:

Coal is over

Coal is more expensive than other major electricity generation systems. U.S. utilities no longer build coal-fired power plants because newer, more efficient natural gas and renewable power plants produce cheaper electricity.

That's partly because of clean air requirements, partly because the coal infrastructure is getting older, but mostly because “the price of producing power at natural gas plants and with wind and solar has declined so dramatically,” said David Schlissel, director of resource planning analysis at the Institute for Energy Economics and Financial Analysis, an energy research firm based in Cleveland.

Coal's share of the U.S. electricity mix fell from 48% in 2008 to 27% in 2018 and is projected to be 22% in 2020, according to the U.S. Energy Information Administration, the statistical agency of the U.S. Department of Energy.

“We're retiring a coal plant every month. Coal will all be gone by 2030,” said Bruce Nilles, a managing director at the Rocky Mountain Institute, a think tank in Colorado that focuses on energy and resource efficiency.

Prices per megawatt hour from electricity for coal-fired power plants range from a low of \$60 to a high of \$143, according to Lazard, a financial advisory firm that publishes annual estimates of the total cost of producing electricity. This is the levelized cost, which includes the cost to build, operate, fuel and maintain a power plant.

Wind is significantly cheaper: Unsubsidized, levelized prices per megawatt hour of electricity from wind range from \$29 to \$56, according to Lazard's most recent figures. In contrast, a decade ago, wind costs topped out at \$70 per megawatt hour, according to the U.S. Department of Energy's most recent report on the wind technologies market.

For solar electricity, unsubsidized, levelized prices range from \$40 to \$46, according to Lazard figures. In 2010, the average was closer to \$120 per megawatt hour, said Mark Bolinger, a research scientist with the electric markets and policy group at Lawrence Berkeley National Laboratory in Berkeley, California. Berkeley Lab conducts scientific research on behalf of the U.S. Department of Energy.

For reference, the average U.S. home uses about 10 megawatt hours of electricity each year.

Renewables are getting ever cheaper

The rise of fracking has produced a natural gas boom in the USA. Though less polluting than coal, it's still a fossil fuel, and burning it pumps carbon dioxide into the atmosphere. Natural gas is cheaper than coal, which it has rapidly replaced, and produces 35% of U.S. electricity, according to the Energy Information Administration.

Wind and solar power are becoming competitive with natural gas in many cases and are likely to grow even more competitive. The cost to produce a megawatt hour of electricity from natural gas ranges from \$41 to \$74, according to Lazard.

“It's fair to say that taken as a whole, there are parts of the country where wind or solar are competitive with natural gas generation,” under current market conditions, said Chris Namovicz, who leads the renewable electricity analysis team for administration.

Even with federal subsidies for wind and solar power generation being phased out, they are increasingly one of, if not the most, cost-efficient options for utilities.

“They've definitely come down quite a bit over the past decade, to the point where they're comparable just with the cost of burning natural gas in an existing gas plant,” Bolinger said. “You're seeing some utilities recognizing that, and they're buying wind and solar power, and they'll back down their gas plants to save fuel.”

Regulators are beginning to agree. In April, the Indiana Utility Regulatory Commission rejected a proposal by Vectren, an energy company, to build a natural gas-fuel power plant to replace an aging coal-burning generating station. In denying approval for the plant, the commission cited the potential financial risk to Vectren customers, who would take on a 30-year debt when the energy industry is rapidly evolving.

The commission said it didn't appear the company made "a serious effort to determine the price and availability of renewables."

Batteries are becoming a thing

The prevailing wisdom has long been that wind and solar power were all well and good, but they weren't that useful because there was no way to store the energy when the sun sets or the wind is not blowing.

That's less true than it used to be for two reasons. The first is that energy grids are getting better at moving power from renewable sources around.

The other is an increase in utility-scale energy storage systems. "Most solar projects that are being bid these days include a battery. It's almost become the default," Bolinger said.

These battery installations typically hold about four hours worth of electricity, enough to power the grid as people come home from work and cook dinner after sunset, he said.

These utility-scale battery installations typically hold about one-third the capacity of the solar power plant, so if you have a 100-megawatt plant, the battery is 30 megawatts.

"It pushes prices higher by maybe \$4 to \$7 per megawatt hour, so it's not a deal-killer," Bolinger said.

Some are even bigger. Last week, Utah announced an initiative to launch what will be the world's largest energy storage project, a facility that will be able to store 1,000 megawatts of power. It would be enough storage to completely serve the needs of 150,000 households for a year, said Mitsubishi Hitachi Power Systems, which is developing the project with Magnum Development.

To be sure, energy production is a highly regulated industry with many entrenched and overlapping interests, not all of which are focused on what's most cost-effective for the customer.

But in areas where markets set the agenda, they increasingly lean toward more cost-efficient carbon-neutral solutions, said Mike O'Boyle, director of electricity policy for Energy Innovation, a research nonprofit group focused on reducing greenhouse gas emissions.

"We should be open to a multitude of solutions, knowing that innovators are going to find ways to keep the system running at a low cost," he said. "That's what America thrives at – setting clear signals and allowing the market to innovate to capture that value."

Short-Term Energy Outlook

U.S. Energy Information Administration, September 10, 2019

FORECAST HIGHLIGHTS

Global liquid fuels

- Brent crude oil spot prices averaged \$59 per barrel (b) in August, down \$5/b from July and \$13/b lower than the average from August of last year. EIA forecasts Brent spot prices will average \$60/b in the fourth quarter of 2019 and \$62/b in 2020. EIA forecasts that West Texas Intermediate (WTI) prices will average \$5.50/b less than Brent prices in 2020.
- EIA forecasts that global liquid fuels consumption will increase by 0.9 million barrels per day (b/d) in 2019, down from year-over-year growth of 1.3 million b/d in 2018. The slowing liquid fuels demand growth reflects EIA's assumption (based on forecasts from Oxford Economics) of decelerating growth in global oil-weighted gross domestic product (GDP). EIA expects that global liquid fuels demand will increase by 1.4 million b/d in 2020 as a result of an expected increase in global GDP growth.
- EIA forecasts U.S. crude oil production will average 12.2 million b/d in 2019, up by 1.2 million from the 2018 level. Forecast crude oil production then rises by 1.0 million b/d in 2020 to an annual average of 13.2 million b/d. The slowing rate of crude oil production growth reflects relatively flat crude oil price levels and slowing growth in well-level productivity.

Natural gas

- The Henry Hub natural gas spot price averaged \$2.22 per million British thermal units (MMBtu) in August, down 15 cents/MMBtu from July. This summer, prices have declined amid rising natural gas production, despite high levels of both natural gas exports and consumption in the electricity generation sector. Based on recent price movements and EIA's assessment that natural gas production will be sufficient to meet expected demand and export levels at a lower price than previously forecasted, EIA lowered its Henry Hub spot price forecast for 2020 to an average of \$2.55/MMBtu, 20 cents/MMBtu lower than the August forecast.
- EIA forecasts that U.S. dry natural gas production will average 91.4 billion cubic feet per day (Bcf/d) in 2019, up 8.0 Bcf/d from 2018. EIA expects monthly average natural gas production to grow in late 2019 and then decline slightly during the first quarter of 2020 as the lagged effect of low prices in the second half of 2019 reduces natural gas-directed drilling. However, EIA forecasts that growth will resume in the second quarter of 2020, and natural gas production in 2020 will average 93.2 Bcf/d.
- Natural gas storage injections have outpaced the five-year (2014–18) average so far during the 2019 injection season as a result of rising natural gas production. At the beginning of April, the natural gas inventory injection season started with working inventories 28% lower than the five-year average for the same period. By the week ending August 30, working gas inventories were 82 billion cubic feet (Bcf), or 3%, lower than the five-year average of 3,023 Bcf. EIA forecasts that natural gas storage levels will be 3,769 Bcf by the end of October, which is slightly higher than the five-year average and 16% higher than October 2018 levels.

Electricity, coal, renewables, and emissions

- EIA expects the share of U.S. total utility-scale electricity generation from natural gas-fired power plants will rise from 34% in 2018 to 37% in 2019 and 38% in 2020. EIA forecasts that the share of U.S. generation from coal will average 25% in 2019 and 22% in 2020, down from 28% in 2018. EIA's forecast nuclear share of U.S. generation remains at about 20% in 2019 and in 2020. Hydropower averages a 7% share of total U.S. generation in the forecast for 2019 and 2020, similar to 2018. Wind, solar, and other nonhydropower renewables together provided 10% of U.S. total utility-scale generation in 2018. EIA expects they will provide 10% in 2019 and 12% in 2020.
- EIA forecasts generally lower wholesale electricity prices in 2019 compared with 2018. The lower forecast prices reflect lower natural gas fuel costs. The first half of 2019, the average U.S. cost of natural gas delivered to power generators was 9% lower than the same period in 2018. EIA expects the delivered cost of natural gas during the second half of 2019 to be 31% lower than last year. Forecast electricity prices in the southeast are less than 1% lower than 2018, while prices in New England are 28% lower.
- EIA forecasts that U.S. coal production in the second half of 2019 will be 328 million short tons (MMst), or 59 MMst (15%) less than in the second half of 2018. EIA expects that coal exports will continue to fall during the projection period as international demand for U.S. coal is dampened by high Atlantic freight costs in the near term and increased uncertainty in the metallurgical coal market in the longer term. EIA forecasts that U.S. coal consumption will total 593 MMst in 2019 and 548 MMst in 2020, a decline of 14% in 2019 and 8% in 2020.
- EIA forecasts that utility-scale renewable fuels, including wind, solar, and hydropower, will collectively produce 18% of U.S. electricity in 2019 and 19% in 2020. EIA expects that annual generation from wind will surpass hydropower generation for the first time in 2019 to become the leading source of renewable electricity generation and that it will maintain that position in 2020.
- EIA expects electric power sector generation from renewables other than hydropower—principally wind and solar—to grow from 409 billion kilowatthours (kWh) in 2019 to 467 billion kWh in 2020. In EIA's forecast, Texas accounts for 19% of the U.S. nonhydro renewables generation in 2019 and 21% in 2020. California has a share of 15% in 2019 and 14% in 2020. Regionally, the Midwest and Central power regions each have shares in the 16% to 17% range of the U.S. generation total from renewables other than hydropower.
- EIA forecasts that, after rising by 2.7% in 2018, U.S. energy-related carbon dioxide (CO₂) emissions will decline by 2.5% in 2019 and by 1.0% in 2020. In 2019, EIA forecasts that space cooling demand (as measured in cooling degree days) will be lower than in 2018, when it was 13% higher than the previous 10-year (2008–17) average. In addition, EIA expects U.S. CO₂ emissions in 2019 to decline because the forecast share of electricity generated from natural gas and renewables is increasing while the forecast share generated from coal, which is a more carbon-intensive energy source, is decreasing.

Oklahoma State Profile and Energy Estimates

U.S. Energy Information Administration, February 21, 2019

QUICK FACTS

- Oklahoma was the nation's sixth-largest crude oil producing state in 2017.
- As of January 2018, Oklahoma had five operable petroleum refineries with a combined daily processing capacity of almost 522,000 barrels per day, almost 3% of the total U.S. capacity.
- Oklahoma was the fourth-largest natural gas-producing state in the nation in 2017, accounting for 8.6% of marketed production.
- The benchmark price in the domestic spot market for the U.S. crude oil known as West Texas Intermediate (WTI) is set at Cushing, Oklahoma, home to almost one-sixth of the nation's commercial crude oil storage capacity.
- In 2017, Oklahoma ranked second in the nation, after Texas, in net electricity generation from wind, and Oklahoma's electricity generation from wind surpassed coal's share for the first time in 2016.

Last Updated: February 21, 2019

Overview

Oklahoma is in the heart of the U.S. Mid-Continent oil region, a vast oil and natural gas-producing area that extends northward from Texas and is flanked by the Mississippi River to the east and the Rocky Mountain states to the west. Crude oil and natural gas wells can be seen across much of Oklahoma, and some of the largest natural gas and oil fields in the country are found in the state. Eastern Oklahoma is also a coal-mining region. However, fossil fuels are not the state's only energy resources. Winds that blow across the open plains and low hills of the prairie that covers most of Oklahoma give the state significant wind energy potential, and wind provides a substantial and increasing share of Oklahoma's electricity generation. With several rivers and large reservoirs, the state also has ample hydropower resources. Oklahoma's climate is humid and subtropical in the east and semi-arid in the west. Solar potential in the state is widespread and the available solar energy resource increases across Oklahoma from east to west as sunny, arid conditions increase and precipitation decreases.

Oklahoma is the 28th most populated state, but it ranks 11th in the nation in energy use per capita. Although Oklahoma's economy is diverse, the state is best known for its energy-intensive petroleum and natural gas industries, and Oklahoma's industrial sector accounts for almost two-fifths of the state's end-use energy consumption. The transportation sector uses less energy than the industrial sector and

accounts for three-tenths of Oklahoma's end-use sector energy consumption. Despite the long hot summers and the widespread use of air conditioning, the state's residential sector accounts for only about one-sixth of the state's end-use energy consumption. Because Oklahoma is a major crude oil and natural gas producing state, almost two and a half times as much energy is produced in the state as is consumed there. Oklahoma sends the energy it doesn't use out of state, primarily as natural gas, petroleum, and electricity.

Natural gas

More than 8% of the nation's proved natural gas reserves are in Oklahoma. All or part of 14 of the 100 largest U.S. natural gas fields, as measured by proved reserves, are located in the state. Oklahoma's proved natural gas reserves rose to an all-time high of more than 38 trillion cubic feet in 2017, and in that same year annual natural gas production was at an all-time high of more than 2.5 trillion cubic feet, about 7.5% of U.S. total production. Because almost four times as much natural gas is produced in Oklahoma as is consumed in the state, surplus natural gas is added to the volumes transported by the interstate pipelines that cross through the state. In 2017 almost three times as much natural gas flowed out of Oklahoma as flowed into the state. Oklahoma natural gas was sent to northern and eastern markets through Kansas, Arkansas, Texas, and Missouri.

The Hugoton-to-Chicago pipeline enabled the first U.S.

marketing of natural gas far from its source.

The Hugoton Gas Area is the largest natural gas field in Oklahoma and one of the largest natural gas fields in the United States, covering much of the western Oklahoma panhandle, as well as parts of the Texas panhandle and Kansas. The initial development of the Hugoton natural gas area was limited by lack of accessible markets. Construction of a 24-inch high-pressure pipeline from the Hugoton Gas Area in Oklahoma to the Chicago area in 1931 enabled the first long-distance pipeline transportation and marketing of natural gas far from its source. The ability to market natural gas far from where it was produced was a critical development in the creation of the modern natural gas industry. Today a web of interstate and intrastate natural gas pipelines covers the state. The natural gas produced from the Hugoton field also contains unusually high concentrations of helium. The helium is separated out of the natural gas and is piped to the National Helium Reserve in Amarillo, Texas, where it is accessible for use as a coolant and for other scientific and industrial applications. Although production has declined in recent years, for much of the 20th century the Hugoton field was the source of most of the world's helium.

Oklahoma has substantial shale gas and coalbed methane resources. In 2017, Oklahoma was the seventh-largest shale gas-producing state and accounted for more than 7% of the nation's proved shale gas reserves. Oklahoma produced almost 7 trillion cubic feet of natural gas from shale between 2007 and 2017, and production has steadily increased as a result of advanced horizontal drilling and hydraulic fracturing technologies. Oklahoma is also one of a dozen states with natural gas production from coal seams. That natural gas resource, called coalbed methane, is found in eastern Oklahoma. Coalbed methane production in the state has declined from a peak of 82 billion cubic feet in 2007 to 36 billion cubic feet in 2017. By the end of 2017, Oklahoma's remaining proved coalbed methane reserves were less than 3% of the nation's total.

More than two-fifths of the natural gas consumed in Oklahoma is used for electric power generation. The industrial sector consumes slightly less than two-fifths of end-use deliveries. Although half of Oklahoma households are heated with natural gas, the residential sector accounts for only about one-tenth of the natural gas delivered to consumers in the state. Because of the many natural gas fields in Oklahoma, more natural gas is consumed for lease and plant use, which includes the gathering and processing of natural gas, than is used by the combined residential and commercial end-use sectors.

Petroleum

Cushing, Oklahoma, is the designated delivery and pricing point for the U.S. benchmark crude oil, West Texas Intermediate.

Oklahoma has about 5% of the nation's proved crude oil

reserves and is the sixth-largest oil-producing state, accounting for nearly 5% of the nation's total annual crude oil production. Although oil fields predominate in the eastern half of the state and natural gas fields in the west, oil wells are found throughout Oklahoma. One of the 100 largest oil fields in the United States, the Sho-Vel-Tum field, is in Oklahoma. That field has produced crude oil since its discovery in 1905. The state's oil industry experienced a decline in production from the mid-1980s until 2005, when crude oil production in Oklahoma hit its lowest point since 1913. Production has rebounded since 2005, and in 2017, it was almost three times greater than in 2005. Between 2007 and 2017, Oklahoma's proved crude oil reserves experienced an almost four-fold increase.

Oklahoma's crude oil provides feedstock for the state's refineries, which have a combined distillation capacity of almost 522,000 barrels per calendar day—nearly 3% of the total U.S. refining capacity. There are currently five operating refineries in the state. Several petroleum product pipelines connect the state's refineries to markets in Oklahoma and in other states. Pipelines also bring crude oil into Oklahoma from other states and Canada, and send it on to refineries in Oklahoma and in other states. The city of Cushing, in central Oklahoma, is known internationally as the designated delivery and pricing point for the U.S. benchmark crude oil, West Texas Intermediate (WTI), a domestically produced light (low density), sweet (low sulfur content) crude oil traded in both the physical and futures markets. Cushing is the terminus for many crude oil pipelines. It is also a major storage terminal, with almost one-sixth of the nation's crude oil storage capacity, excluding the U.S. Strategic Petroleum Reserve. End-of-year stocks of crude oil at Cushing increased from about 29 million barrels in 2011 to almost 68 million barrels in 2016, but decreased to less than 49 million barrels in 2017.

Many important oil and gas conservation practices and organizations trace their origins to Oklahoma.

Per capita petroleum consumption in Oklahoma is greater than in three-fourths of the states. The transportation sector uses nearly four-fifths of petroleum consumed in Oklahoma, and the industrial sector uses most of the rest. The residential sector accounts for less than 2% of state consumption as fewer than 1 in 100 households use fuel oil or kerosene for home heating and only about 6 in 100 use hydrocarbon gas liquids, mostly propane.

The discovery of oil transformed Oklahoma's economy. By the time Oklahoma became a state in 1907, it was the largest oil producer in the nation. Because the early history of petroleum development in Oklahoma was one of booms and busts, including unregulated overproduction and waste, many important oil and gas conservation practices and organizations trace their origins to the state. In 1935, the Interstate Oil and Gas Compact Commission (IOGCC), headquartered in Oklahoma City, was created to ensure responsible development of petroleum resources through the

coordinated efforts of oil-producing states. The voluntary IOGCC has grown from an association of 6 oil-producing member-states in 1935 to 31 member-states and 7 associate member-states in 2019.

Electricity

Oklahoma ranked second in the nation in electricity generation from wind in 2018.

Although Oklahoma's largest power plant is coal-fired, the state's coal-fueled power generation decreased from more than half to less than one-fourth of in-state net generation between 2005 and 2017, and coal's share has continued to decline. As coal's contribution has decreased, the share of state generation from natural gas has remained relatively stable, and wind-powered generation in the state has increased. In 2018, natural gas and wind energy each accounted for more of Oklahoma's net electricity generation than coal. Natural gas-fired power plants produced more than two-fifths of the electricity generated in the state in 2017 and contributed half of state electricity generation in 2018. Wind energy supplied almost one-third of in-state generation in both 2017 and 2018. Oklahoma ranks second in the nation, behind Texas, in electricity generation from wind. Almost all the rest of Oklahoma's electricity generation, about 4% of the total, comes from other renewable resources, primarily from hydroelectric power. Oklahoma does not have any nuclear power plants.

Electricity consumption per capita in Oklahoma is greater than it is in about three-fourths of the states. Retail sales of electricity are highest in the residential sector, where two in five Oklahoma households rely on electricity as their primary energy source for home heating. However, more electricity is generated in Oklahoma than is consumed in the state, and the surplus is sent to the regional grid.

Renewable energy

Oklahoma generates more than one-third of its electricity from renewable resources, an increase from less than one-tenth a decade ago. Although most of that power is from wind energy, other renewable energy resources contribute to state generation, particularly hydropower and to a much more limited extent biomass and solar energy. In 2017, wind provided a larger share of state electricity generation in Oklahoma than it did in all but two other states, and wind's contribution to Oklahoma's net generation is increasing. In 2018, wind energy alone provided almost one-third of the state's net electricity generation.⁷⁷ Oklahoma had almost 7,700 megawatts of wind capacity installed by November 2018, which equaled about nine-tenths of Oklahoma's total installed capacity from all renewable resources.

Many of the rivers that flow across Oklahoma have been dammed to form lakes, and the state has more man-made lakes than any other state in the nation. Those dams, and the rivers they restrict—including the Neosho River, the Grand River, and the Arkansas River—are the sites of 10

hydroelectric power generation facilities. Hydroelectric power contributes varying amounts to the state's electric grid depending on river levels, precipitation, and drought. On average, hydroelectric power provides about 3% of the state's annual net generation.

There is one hydroelectric pumped storage power plant in the state. It has about 250 megawatts of generating capacity. Pumped storage allows system operators to purchase inexpensive power during periods of low demand and use it to pump water from a lower reservoir to an upper reservoir. During periods of high demand, water is released from the upper reservoir and flows through turbines to the lower reservoir. Electricity is generated as the water flows through the turbines. A pumped storage facility uses more power than it generates, but it supplies power in periods of peak demand when electricity prices are highest.

Biomass resources provide a small amount of power generation in Oklahoma. Those facilities use wood and wood waste, municipal solid waste, and landfill gas to generate power. Oklahoma is a major agricultural state. It ranks among the top states in livestock production, and animal fats are used as a feedstock at the state's one bio-diesel plant. Oklahoma does not have any ethanol plants or wood pellet manufacturing facilities. Solar energy provides a small but increasing amount of electricity generation in Oklahoma. Solar photovoltaic (PV) power generation experienced an almost five-fold increase between 2016 and 2017, primarily from utility-scale facilities. However, solar power generation from utility-scale and distributed (customer-sited, small-scale) generators combined was less than 0.1% of state generation in 2017. Despite increases in 2018, solar PV's contribution remains below 0.1% of total generation.

Oklahoma's legislature established a renewable energy goal for the state's electric utilities in 2010. The goal required that 15% of a utility's total installed generation capacity within the state of Oklahoma use renewable sources by 2015. A variety of renewable energy resources were allowed, including wind, solar, biomass, hydropower, geothermal, and hydrogen. Energy efficiency and demand-side management could be used to meet up to 25% of the overall goal. By 2015, the goal had been exceeded statewide, and 25.9% of Oklahoma's installed capacity came from eligible renewable energy resources and demand side management. In 2018, almost one-third of the state's installed generating capacity used renewable resources.

Coal

Oklahoma's coal reserves are modest. The state's coal mining region is in the northeastern part of Oklahoma and extends south from the Kansas border and eastward to the Arkansas border.⁹⁶ Currently there are five active mines in the state, and another mine is temporarily closed.⁹⁷ Commercial coal mining in Oklahoma began in 1873. Numerous early mines supplied fuel for the railroads and production peaked at 4 million tons per year during World War

I. However, production decreased in the 1920s,⁹⁸ and by 2017, the state's mines produced only 561,000 tons of bituminous coal. Oklahoma's coal meets only a small fraction of the state's needs. Most of the coal consumed in the state is brought into Oklahoma from Wyoming by rail for use by the electric power sector. Some of Oklahoma's production is shipped to industrial users in neighboring states.

Energy on tribal lands

Oklahoma has the second-largest Native American population in the nation, after California. Federal legislation enacted at the end of the 19th century stripped reservation status from almost all tribal lands in Oklahoma before it became a state. Oklahoma tribes now govern and provide services within tribal jurisdictional areas. Oklahoma's tribal areas are spread across about three-fourths of the state, and only one of the state's 38 federally recognized Native American tribes has a reservation. The nearly 1.5 million acres of the Osage Nation Reservation occupies all of Osage County, Oklahoma. The tribe purchased its land, including the mineral rights, from the Cherokee in the 19th century. After oil was discovered on their land in 1894, the Osage tribe became very wealthy. The crude oil and natural gas resources on the reservation are now administered by the Osage Minerals Council. The tribe continues to receive income from the significant amounts of crude oil and natural gas produced in the county. In addition to fossil energy resources, Oklahoma's tribal areas share in many of the state's renewable resources. Six of the nation's tribes with the greatest potential for wind electricity generation and six of those with the highest potential for solar PV electricity generation are in Oklahoma. Five of the state's tribes are among the 15 in the nation with the greatest concentrating solar power potential, and 4 are among those with the highest potential for electricity generation using woody bio-

mass. Seven Oklahoma tribes are leaders in biogas potential from wastewater and organic landfill waste, and 3 tribes are among the nation's 15 tribes with the most hydropower potential.

Energy infrastructure development on Oklahoma tribal lands includes both conventional and renewable distributed generation projects. In 2004, the Citizen Potawatomi Nation was awarded a grant to develop a ground-source heat pump system, and in 2018, the U.S. Department of Energy funded a Citizen Potawatomi Nation distributed generation energy infrastructure project. Four megawatts of natural gas-fired distributed generation capacity will provide power to nine community facilities and the Nation's senior housing complex while reducing the tribe's energy costs and dependence on coal-fired power. Some tribes use solar energy for distributed generation. The Delaware Nation installed a 37.5-kilowatt solar array on the roof of their headquarters complex north of Anadarko, Oklahoma. Several tribal areas in Oklahoma have wind potential. Five tribes have partnered with a company that develops and constructs wind power projects to build a wind farm around the Chilocco Indian School at Chilocco. The 200-megawatt project will be the largest wind farm in the nation that is entirely on Native American lands. It is being built on land owned by and leased from five Oklahoma tribes—the Cherokee Nation, the Kaw Nation, the Otoe-Missouri Tribe, the Pawnee Nation, and the Ponca Nation. Work on the wind farm began in 2013 and construction began in 2018. Oklahoma tribes also have pursued energy efficiency projects. The Chickasaw Nation upgraded lighting at several businesses to reduce energy costs and improve efficiency in 2013. The result is a 30% reduction in the amount of energy used for lighting in those structures.

Notes

This is a resource document for you to use.

Take notes, highlight, use as a text book.

Fossil Fuels and American Energy Dominance

U.S. Department of Energy



U.S. DEPARTMENT OF
ENERGY

Fossil
Energy

When it comes to energy resources, the U.S. is leading the world in the production of both oil and natural gas. We also have the largest reserves of coal in the world. By developing and using these abundant resources, America is becoming energy dominant in the global market place. Energy dominance not only supports U.S. energy security and economic growth, it also benefits our partners and allies around the world. Here's a look at where the U.S. stands when it comes to fossil fuels:

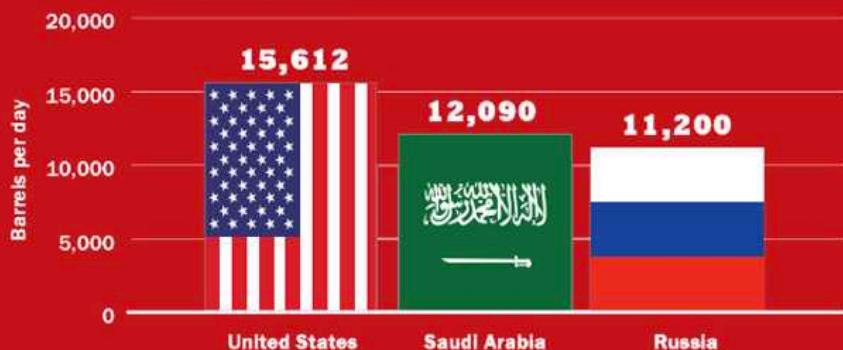


PETROLEUM

In addition to our robust oil production, the U.S. also has the largest government-owned stockpile of emergency crude oil in the Strategic Petroleum Reserve (SPR). And, at 660 million barrels, the SPR is by far the largest oil stockpile in the world. The SPR was created after the oil embargo of 1973-74, when the Organization of Petroleum Exporting Countries cut off their supply of oil to the United States.

The shale revolution in the U.S. boosted American oil production, and we recently became *the world's top producer of crude oil*. Reducing our dependence on foreign oil leads to greater *energy security, economic security, and job creation*.

2017 Petroleum Production

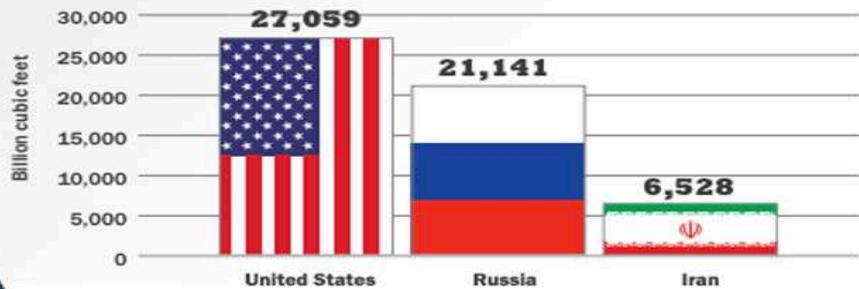




NATURAL GAS

The shale revolution also led to a dramatic shift in the U.S.—and global—energy landscape. The United States is now the top natural gas-producing country, and we have transitioned from a natural gas importer to a natural gas exporter. In fact, our liquefied natural gas (LNG) exports are positively impacting global markets. To date, U.S. LNG exports have landed in 30 different countries on 5 continents. In July 2018, the U.S. Department of Energy issued a rule that will allow faster approval of small-scale natural gas exports, and the Administration is focused on finding more ways to unleash American energy.

2015 Natural Gas Production

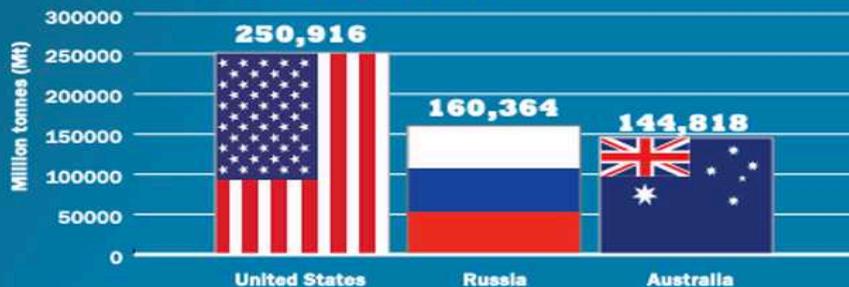


COAL

The U.S. has **more coal reserves than any other country**. Additionally, we remain one of the world's top producers of coal—third only behind China and India. And, coal accounted for 30.1% of U.S. electricity generation in 2017.

After a decline in 2016, coal production, exports, and prices rose again in 2017. In fact, U.S. coal production increased to 773 million short tons (MMst) in 2017. The 45MMst increase over 2016 is the largest year-over-year tonnage increase in coal production since 2001. The U.S. exported 97MMst of coal in 2017, a 61% increase from 2016 exports. And U.S. coal exports have landed in 63 different countries so far in 2018.

Proven Coal Reserves at End of 2017



OU Energy Symposium: Natural gas vital to reliable and affordable energy

Daisy Creager, The Journal Record, April 25, 2019



The nation's need to have natural gas supplement renewable energy sources and to reduce carbon emissions will depend on how fast technological advancements can be made.

That was one of the messages delivered at Thursday's University of Oklahoma's Price College of Business Energy Symposium, held at the BHGE Energy Innovation Center.

Speakers throughout the day focused on a goal set by California to reduce greenhouse gas emissions from 1990 levels by 40% and making state electricity 60% renewable by 2030.

California has joined other states in a goal of reducing carbon emissions by 80% by 2050.

Melanie Kenderdine, former director of the office of energy policy and system analysis for the U.S. Department of Energy, said breakthrough technologies currently in research stages, including efforts to capture carbon emissions, will not advance quickly enough to make those 2030 goals.

Meanwhile, policymakers like those in California need to rely on natural gas for electricity generation to back up renewable resources, she said.

"If you are relying to some degree on wind and wind stops blowing, gas is the flexible (energy) generation that comes in and helps manage that intermittency," Kenderdine said.

Brian Modellmog, vice president of Houston-based Calpine Corporation, said the need for batteries and storage to hold renewable energy sources for days with less wind

and sunlight hinders the production of renewables.

The state cannot afford to "go dark" so they will need to be more open to the idea of the use of natural gas, in addition to renewable energy, while working toward decarbonization goals.

"At some point, whether they will admit it publicly ... they're going to have to make the right decision, and the right decision, until you have a (technology) breakthrough, is that you've got to have the backup of natural gas," Modellmog said.

Stanford Geophysics Professor Mark Zoback said the switch from coal to natural gas in electricity generation in the U.S. has already decreased carbon emissions and it will play a critical role in the decarbonization of electric power around the world.

Zoback said studies have shown more carbon emissions come from transportation than electrical power, contrary to public perception that complete transfer of electrical generation to renewable forms would make the largest difference in decarbonization.

"What has been now transmitted to the governor and the policymakers in (California) is that if we're going to have a chance of meeting these goals, it's going to require a lot of natural gas," Zoback said. "It's going to require us to maintain...the highly efficient (auto) standards that are now in place (and) to make them even more stringent. And we're going to get even more serious about storing carbon in the subsurface."

Increased U.S. oil production lessens impact of geopolitical events on market volatility

Mike Averill, The Tulsa World, July 7, 2019



The last year is proof that oil prices are going to do what oil prices do: Seesaw back and forth like a flickering flame of volatility.

The price of West Texas Intermediate Crude was \$70.98 per barrel in July 2018. The forecast for the benchmark crude for July of this year is \$55, according to data from the U.S. Energy Information Administration.

During that time, the price per barrel of WTI dipped as low as \$44.48 in December and bounced back as high as \$76.40 in October.

One difference, based on recent market reactions, is that the country's efforts to increase production and become a major exporter have served to insulate the effects of geopolitical events that in the past might have wreaked havoc on prices.

"Geopolitical events still have the biggest impact on the industry," said Tom Seng, applied assistant professor of energy business and assistant director of the School of Energy at The University of Tulsa.

"Just last week we had U.S. versus Iran and U.S. versus China. Those are things that spook the market."

Mounting tensions with Iran had a bullish effect on markets while trade talks with China seem to have bullish results

one day and bearish the next.

Since the U.S. lifted its ban on crude oil exports in December 2015, it has increased production to more than 12 million barrels per day, putting the country on par with Saudi Arabia and Russia — the three countries combine for about 30% of oil production.

One of the byproducts of the U.S.'s increase in oil production and exports is that it shields most of the country from price spikes from events that in the past might have really hit consumers.

"Yes the prices are being impacted, but the populace of the country isn't being seesawed as we could if we weren't producing the amount of oil we are producing," Seng said.

Explosions on two oil tankers in the Gulf of Oman last month could have ultimately resulted in spikes at the gas pump. But because of increased reserves and domestic production, the U.S. is less vulnerable to such events, Seng said.

"We have more energy security than we ever have in the past," he said. "As we can produce more, we will produce more than the demand will increase, and that will make us more secure and increase our share of the markets on a global standpoint."

Planning for volatility

Oklahoma has lived and died with oil prices over the years. After decades of being hamstrung by boom and bust cycles, state government has begun diversifying away from its heavy reliance on oil. In the 1980s, gross production tax accounted for as much as 30% of the state's general revenue. That's now down to about 5%.

Sen. Roger Thompson, R-Okemah, chairman of the Senate Appropriations Committee, said the state budgeted for oil to be at \$54.23 per barrel for this fiscal year.

That amount is determined by the Tax Commission, which uses economists from area state universities who base their predictions off the global market.

Late last year when prices dipped to \$50 and below, the state was able to offset that with increased sales tax revenue.

"In times past, we've been able to see prices dip and (energy companies) start laying people off and your car sales go down and purchases go down and that hits the sales tax," he said. "The dips in November and December were not long enough to have much of an impact on the budget."

Local production companies also have to plan for volatility in oil prices.

Rick Muncrief, CEO of WPX, said the Tulsa-based exploration and production company believes crude will trade between \$50 and \$65 per barrel for the rest of the year and has planned on the lower end.

For 2019, the company has about two-thirds of its production hedged at \$53 per barrel and for 2020, one-third is hedged at \$59.

The company hedges a percentage of its production to insulate itself from market fluctuations. If the price comes in at the low end, the company still profits. If oil prices are higher, it will determine whether to reinvest, pay down additional debt or buy stock back.

"We are not at \$100 (per barrel) and thinking we will never have a poor day again, and we are also not at \$35 or \$40 and thinking about survival," Muncrief said. "We're in the mid part of a cycle, and I think it's a really good time to invest."

Continuing demand

Ever looming on the horizon is the eventual decline of fossil fuels and the continuing emergence of alternatives and renewable energy sources.

As the U.S. appetite for fossil fuels declines in the coming decades, global demand will not, Seng said.

Instead, growing foreign demand will offset the decline in

U.S. consumption.

The Energy Information Administration projects that by 2050, one-third of U.S. electricity will be produced by various alternatives and renewables. The vast majority of power will be generated from natural gas, which is a cheap, clean fuel that is a natural byproduct of oil production and is in abundance in Oklahoma.

"That was kind of staggering for me," Seng said. "It's a much better outlook for natural gas than I would have expected."

"Natural gas will sustain the way we live as wind and solar grow, and slowly and surely they will overtake natural gas the way natural gas took over coal, but that isn't going to happen overnight."

Room for growth

The U.S. is producing record amounts of oil currently, and there is still plenty of capacity left.

Look at the number of drilled, but uncompleted wells.

There are 8,283 wells, as of May 2019, that have been drilled but are not complete. That's up more than 51% from the 5,455 in September 2016.

In the past, drilled but uncompleted wells were mostly the result of low-price environments, meaning wells that didn't make financial sense to produce from were drilled anyway so a company could retain its lease.

The present increase has more to do with a lack of infrastructure. In the Permian Basin in west Texas and southeast New Mexico, for instance, more than 3,900 wells are drilled but uncompleted.

"Almost everything revolves around infrastructure," Seng said.

Several projects are underway to increase the output from hot spots like the Permian and connect those products to export hubs, be it the shipping of crude overseas or transporting natural gas to Mexico via pipeline.

Magellan, a Tulsa-based midstream company, has \$1.25 billion in expansion projects underway including projects to expand its transportation, storage and distribution services. The company is also considering a new pipeline from Cushing to Houston and an expansion of its Saddlehorn pipeline.

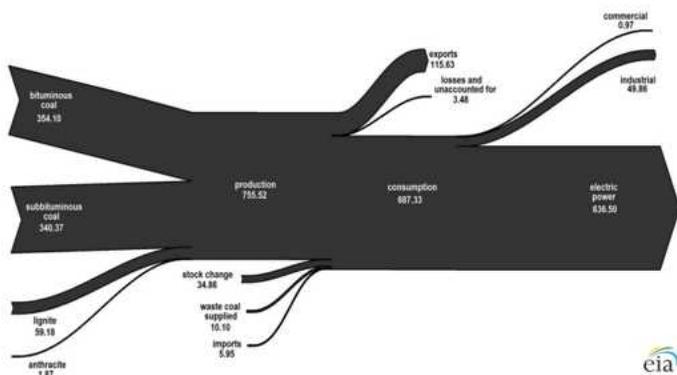
As projects like this come online, the amount of oil produced in the country could potentially increase to 13 million to 14 million barrels per day.

"If we are producing that much, you would expect to see a softening in prices, but if we could have the corresponding ability to increase our exports, then we won't see that affect the price," Seng said.

Almost all U.S. coal production is consumed for electric power

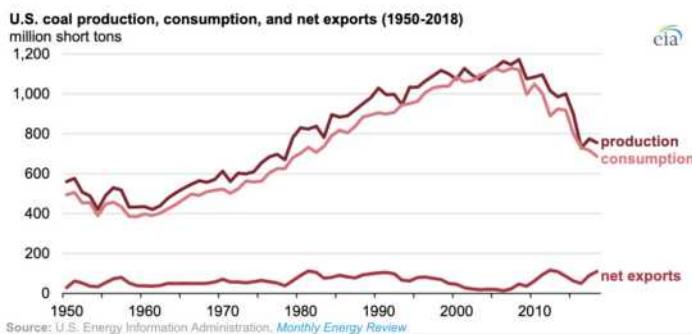
Mickey Francis and Andrew York-Thomson, U.S. Energy Information Administration, June 10, 2019

U.S. coal flow, 2018
million short tons



Coal is one of the main sources of energy in the United States, accounting for 16% of its primary energy production in 2018 according to EIA's Monthly Energy Review. Nearly all of the coal consumed in the United States is produced domestically, and most is consumed by the electric power sector to generate electricity, while some is exported. EIA's U.S. coal flow diagram helps to visualize the overall view of U.S. coal energy from supply (production, imports, and stock withdrawals) to disposition (consumption, exports, and losses).

In 2018, of the more than 755 million short tons (MMst) of coal produced in the United States, the electric power sector consumed 636 MMst. The industrial sector consumed nearly 50 MMst, and the United States exported another 115 MMst.



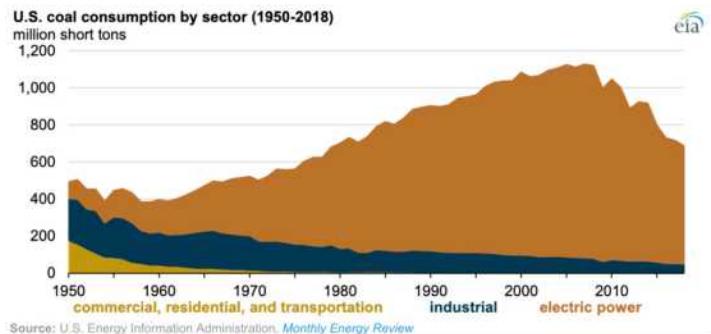
U.S. coal production and consumption have both declined since their peaks of 1,172 MMst in 2008 and 1,128 MMst in 2007, respectively. In 2018, coal production reached 756 MMst, the second-lowest level since 1978, and coal consumption fell to 687 MMst, the lowest since 1978.

Most of the coal produced in the United States is bituminous or subbituminous. Coal is classified into different types, or ranks, based on the amount of carbon it contains

and how much heat energy it produces when combusted. Bituminous coal, which accounted for an estimated 47% of total U.S. coal production in 2018, ranges from 45% to 86% carbon and is produced in states such as West Virginia, Illinois, Pennsylvania, Kentucky, and Indiana.

Subbituminous coal, which accounted for an estimated 45% of production in 2018, ranges from 35% to 45% carbon, has a lower heating value than bituminous coal, and is mostly produced in Wyoming. Smaller amounts of lower-energy lignite (25% to 35% carbon) and higher-energy anthracite (86% to 97% carbon) coal are also produced in the United States.

Not all coal produced in the United States is consumed domestically. Coal production typically exceeds consumption, and the United States has been a net exporter of coal since 1949, the earliest year of EIA's coal trade data series. In 2018, U.S. exports of coal totaled about 116 MMst, the highest level since 2013. Less than 1% of total U.S. coal consumption was imported from other countries in 2018.



Since 1961, the electric power sector has been the largest consumer of coal in the United States, surpassing the industrial sector. The electric power sector used about 93% of coal consumed in the United States in 2018 to generate electricity and useful thermal output (heat). Most of the remaining U.S. coal is used directly by the industrial sector, such as in the industries that produce coal coke, concrete, paper, and steel. Relatively little coal is consumed directly in the commercial, residential, and transportation sectors.

Coal data can be found in various EIA sources, including

- *Coal data browser*, an interactive data browser containing nearly all of EIA's coal-related data series
- *Quarterly and annual coal reports*, which compile information from EIA's coal-industry surveys
- *U.S. coal reserves*, based on EIA's annual survey of coal reserves
- *Monthly Energy Review*, EIA's comprehensive source for historical energy data

Hydrocarbon Gas Liquids Explained

U.S. Energy Information Administration, December 19, 2018

What are hydrocarbon gas liquids?

Natural gas and crude oil are mixtures of different hydrocarbons. Hydrocarbons are molecules of carbon and hydrogen in various combinations. Hydrocarbon gas liquids (HGL) are hydrocarbons that occur as gases at atmospheric pressure and as liquids under higher pressures. HGL can also be liquefied by cooling. The specific pressures and temperatures at which the gases liquefy vary by the type of HGL. HGL may be described as being light or heavy according to the number of carbon atoms and hydrogen atoms in an HGL molecule.

HGL are categorized chemically as:

- Alkanes, or paraffins
 - Ethane—C₂H₆
 - Propane—C₃H₈
 - Butanes: normal butane and isobutane—C₄H₁₀
 - Natural gasoline or pentanes plus—C₅H₁₂ and heavier
- Alkenes, or olefins
 - Ethylene—C₂H₄
 - Propylene—C₃H₆
 - Normal butylene and isobutylene—C₄H₈

Hydrocarbon gas liquids are from natural gas and crude oil

HGL are found in raw natural gas and crude oil. HGL are extracted from natural gas at natural gas processing plants and when crude oil is refined into petroleum products. Natural gas plant liquids (NGPL), which account for most of HGL production in the United States, fall solely into the alkanes category. Refinery production accounts for the remainder of U.S. alkanes production, and it accounts for all of the olefins production data that are published by the U.S. Energy Information Administration (EIA). Greater volumes of olefins are produced at petrochemical plants from HGL and heavier feedstock. EIA does not collect or report petrochemical production data.

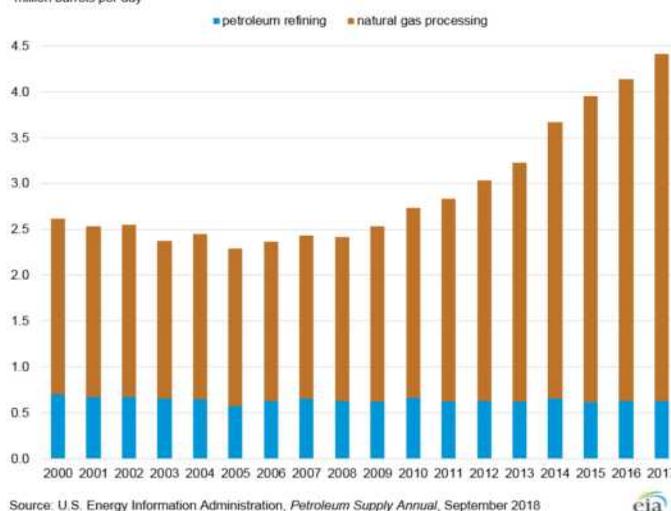
Hydrocarbon gas liquids have many uses

Because HGL straddle the gas/liquid boundary, their versatility and high energy density in liquid form make them useful for many purposes:

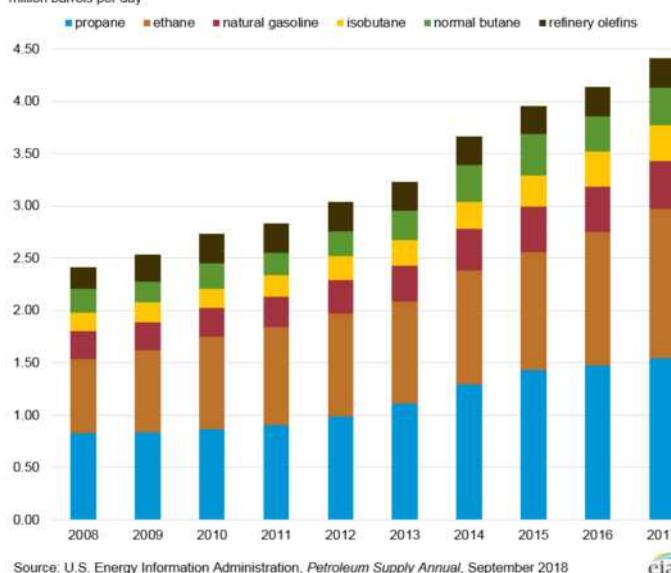
- Feedstock in petrochemical plants to make chemicals, plastics, and synthetic rubber
- Fuels for heating, cooking, and drying
- Fuels for transportation
- Additives for motor gasoline production
- Diluent (a diluting or thinning agent) for transportation of heavy crude oil

In 2017, total HGL use accounted for about 13% of total U.S. petroleum consumption.

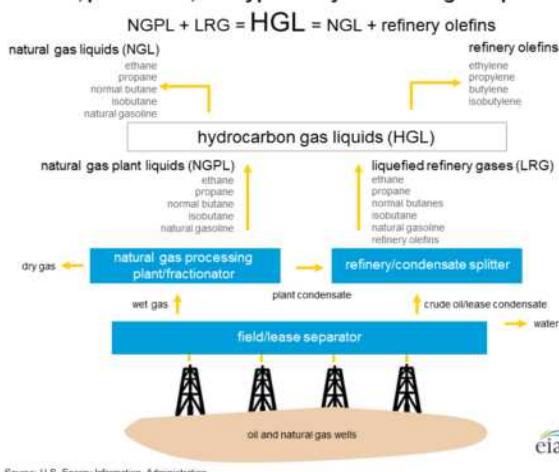
U.S. hydrocarbon gas liquids production by source, 2000–2017
million barrels per day



U.S. hydrocarbon gas liquids production by type, 2008–2017
million barrels per day

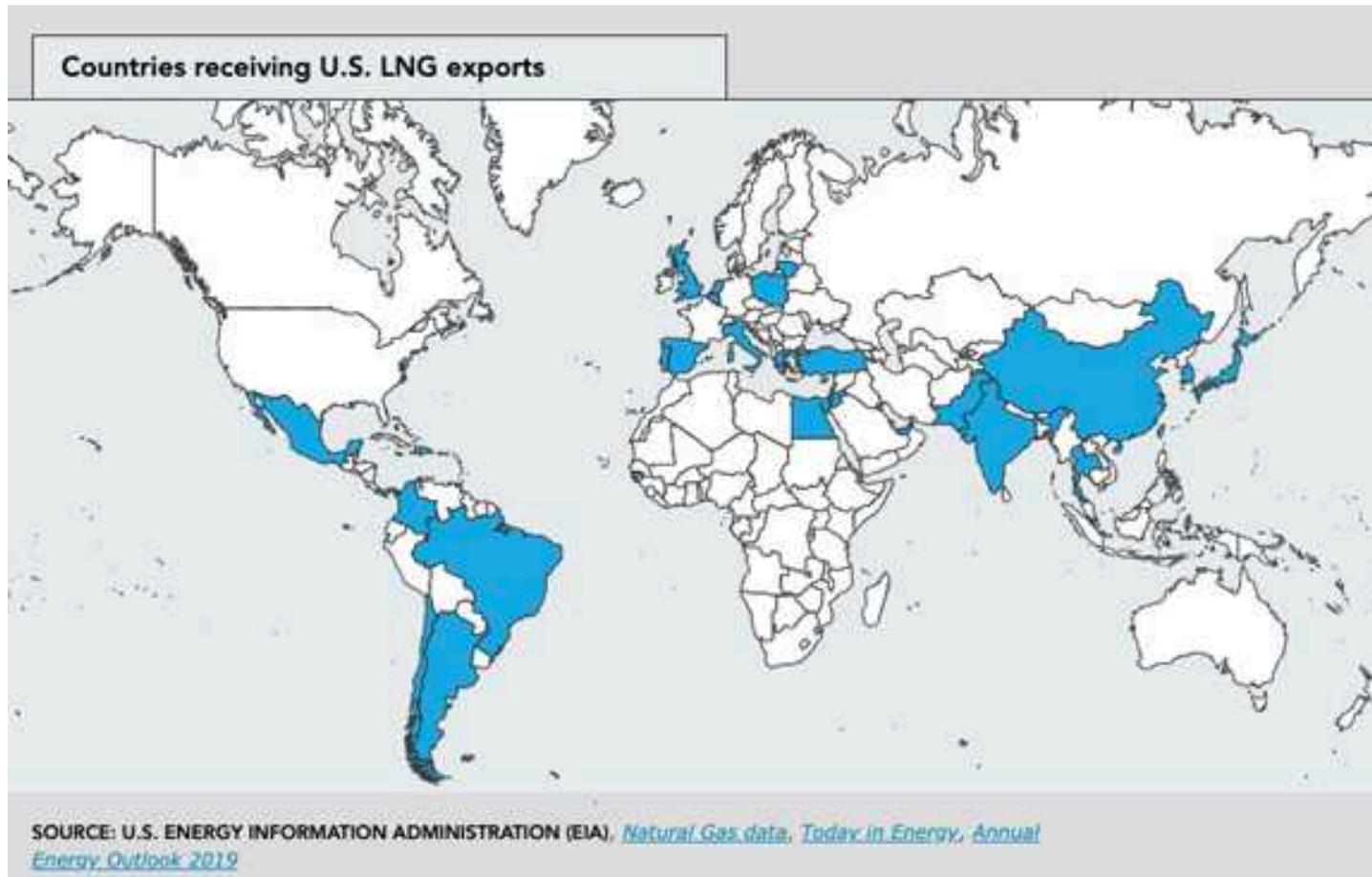


Sources, production, and types of hydrocarbon gas liquids



U.S. LNG Exports Continue Record Growth

Paul Lester, U.S. Department of Energy, May 15, 2019



The United States began exporting liquefied natural gas (LNG) from the Lower 48 states in February 2016, reflecting a decade of dramatic growth in natural gas production and the development of new LNG export facilities. LNG is natural gas that has been cooled to a liquid state so it can be easily shipped and stored. Increases in both natural gas production and liquefaction exports helped make the U.S. a net exporter of natural gas on an annual basis in 2017—for the first time in nearly six decades.

In 2018, total LNG exports grew by 53% compared to the previous year. The U.S. Energy Information Administration projects continued increases in American LNG export capacity will soon make the U.S. the world's third-largest LNG exporter, behind Australia and Qatar.

America's energy industry is booming. According to the U.S. Energy Information Administration, U.S. energy consumption, production and exports all reached record highs last year.

This is especially true for natural gas, with the U.S. leading the world in production. U.S. liquefied natural gas (LNG) exports have also surged in recent years, as indicated in the visualization above. The U.S. is now a net exporter of both natural gas and LNG, sending shipments to dozens of countries around the world.

But how do LNG exports work? It all starts at export facilities, where natural gas is cooled to minus 260° Fahrenheit, the temperature required to change it to a liquid state. This makes natural gas 600 times smaller in volume, so it can be easily shipped. Next, the LNG is transported overseas in specialized LNG carrier ships that have super-cooled cryogenic tanks to keep the LNG stable. After the LNG ships arrive at import terminals, the LNG is warmed and returned to a gaseous state and injected into natural gas pipelines, where it can then be distributed to power plants to generate electricity or directly to homes and businesses for space heating. LNG can also be used to fuel natural gas-powered vehicles and ships.

The Energy Department's Office of Fossil Energy plays a key role by authorizing which companies can export LNG from U.S. facilities. For instance, the Energy Department recently authorized exports from two future LNG facilities: Tellurian Inc.'s Driftwood project in Calcasieu Parish, Louisiana, and Sempra Energy's Port Arthur project in Texas. Learn more about the authorization process and read the Office of Fossil Energy's monthly and annual reports about U.S. LNG exports.

Check out EIA.gov for more data, analysis, and trends about every U.S. energy sector.

Opinion: LNG is key to reducing global warming

Mark J. Perry, The Oklahoman, April 28, 2019

The spectacular growth of U.S. exports of liquefied natural gas is going to do more than increase employment, trade and geopolitical benefits. It is also likely to reduce greenhouse-gas emissions, in ways we would not expect.

As oil companies struggle to stop the rise in methane emissions from the flaring of natural gas associated with oil production, they are investing in pipelines to transport the natural gas from shale fields in the Permian Basin to new LNG terminals on the Gulf Coast. This combination of advantages is drawing growing interest because of the role it could play in reducing global warming.

The era in which oil producers routinely flared natural gas to keep more profitable oil wells in production is ending. In 2017, Permian oil and gas producers burned enough gas to serve all the heating and cooking needs of Texas' seven largest cities. That's \$322 million of natural gas that went up in smoke. Today, producers have more options, and by selling the natural gas and reducing flaring, they can increase profits and environmental benefits.

And, in light of the current political debate, and contrary to conventional wisdom, oil and gas companies also know they need to manage the implications of a new world of climate action. Methane is an important bellwether because reducing methane emissions from oil and gas operations is easier and less costly than controlling carbon but no less important.

Methane is the primary component of natural gas. While methane doesn't stay in the atmosphere as long as carbon dioxide, it is initially far more of a problem, however. In



Mark J. Perry

the first two decades after its release, methane is 84 times more potent than carbon dioxide.

The oil and gas industry accounts for about a third of U.S. methane emissions. Several major oil companies, including Shell, BP and Exxon, have made reducing methane emissions one of their top environmental priorities.

What's helping is that LNG companies want to become an outlet for the record amount of methane being flared in the giant Permian Basin of West Texas and Eastern New Mexico, where much of it has been burned off due to a lack of pipelines needed to move it to the Gulf Coast. Now, Houston pipeline operator Kinder Morgan is building two pipelines, the first of which, the Gulf Coast Express Pipeline, is expected to begin moving 2 billion cubic feet of natural gas a day in October. The second pipeline, the Permian Highway Pipeline, will transport another 2 billion cubic feet a day to the Gulf Coast the following year.

An increase in pipeline capacity would bolster pipeline shipments of gas to Mexico but most of the gas would be set aside for LNG exports. By the end of this year, U.S. LNG capacity is expected to reach 9.6 billion cubic feet per day, making America the third-largest LNG exporter in the world, after Qatar and Australia.

The biggest customer for U.S. LNG is expected to be China, which wants to use clean-burning natural gas instead of coal for electricity generation. Thanks to LNG, possibly profound changes are taking place right now.

Perry is a scholar at the American Enterprise Institute and professor of economics at the Flint campus of the University of Michigan. He wrote this for InsideSources.com.

The Case for Propane

Richard L. Hess, Executive Director Oklahoma Propane Gas Association, August 2019

Dr. Walter Snelling, a Harvard graduate and Bureau of Mines chemist and explosives expert, made quite a name for himself when he created an underwater detonator that saved the U.S. over \$500,000 a year during the construction of the Panama Canal...the most expensive project in history at the time. Still, a century later, Dr. Snelling isn't known for his contribution to the Panama Canal. Instead, his career, both as a scientist and an entrepreneur, is defined by his accidental discovery a few years later. A friend of Dr. Snelling had complained about gas vapors that kept forming in this Model T Ford engine. He said when gas vapors accumulated in the engine, there invariably was less gasoline in the tank and his automobile's mileage was lower. Dr. Snelling was intrigued, and he did what any intrigued scientist would do. He drew samples, took them to his lab, and he ran tests. Dr. Snelling wasn't searching for a new source of energy, and he certainly wasn't looking for an alternative fuel. Gasoline powered automobiles were still a new phenomenon back then. Dr. Snelling was curious why the vapors kept forming, and he wanted to know what they were. He discovered that these vapors were made up of an energy-rich mixture of gases...a mixture that had several unique qualities which he thought might make them more marketable. Little did he know that this was the discovery that would define him and his career.

Dr. Snelling, the scientist, might have been satisfied with his initial findings. However, Dr. Snelling, the entrepreneur, wanted to know more. He knew that this liquefied petroleum gas was rich in energy, and he had discovered that he could change it from a gas to a liquid with relative ease. Plus, he knew that LP gas was much more compact as a liquid than as a gas... 270 times more. As he considered all of this, Dr. Snelling began to realize that LP gas should be easy to store and easy to transport. It wasn't long until Dr. Snelling was storing LP gas in bottles and selling it for lighting, for cutting metal and for heating. Dr. Snelling was granted the first LP gas patent, and he and three of his colleagues formed the first LP Gas company. It would be hard to find anyone who was a stronger advocate or more committed to LP gas than Dr. Walter Snelling. And yet, even Dr. Snelling didn't fully appreciate its full potential because a year or so later, Dr. Snelling sold his LP gas patent to Frank Phillips, the founder of Phillips Petroleum Company, for \$50,000.

Today, a little more than a century later, LP gas or propane, provides energy to more than 50 million Americans. Nearly 8 million American households use propane for their in-home heating, and another 4.6 million homes use propane to heat their water. Plus, more than 42 million homes have propane outdoor grills. This century old industry serves 900,000 commercial customers, 168,000 industrial customers, and 320,000 agricultural customers. Propane fuels more forklifts than any other fuel (500,000), and propane is the third most used fuel in school buses. Plus, more than 150,000 vehicles in the U.S. run on propane. Propane is used for everything from heating water to fueling hot air balloons. It's critical to rescue efforts on

Mt. Everest, and people throughout the world pause when the propane-fueled Olympic Torch passes by. Within a year of Dr. Snelling's discovery, propane fueled its first automobile. Today, propane fuels 16 to 18 million vehicles worldwide making it the most frequently used alternative fuel. Plus, propane is a clean fuel per the Clean Air Act of 1990 and the National Energy Policy Act of 1992.

Propane is popular as an alternative fuel, in part, because propane motorists in this country rely on the same infrastructure as the millions of other propane consumers...an infrastructure that moves more than 20 billion gallons of propane annually from the oil refineries and gas processing plants where it's produced to the millions of propane customers located throughout the country. Propane's infrastructure includes 70,000 miles of trunk line in the pipeline system, 22,000 railroad tank cars, 90 barges and tankers, 6,000 transport trucks, 35,500 bobtail trucks, 13,500 bulk/storage distribution points, more than 4,000 vehicle refueling stations, and more than 162,000 propane cylinder refilling locations.

Plus, propane has a significant effect on Oklahoma's economy. In 2015, Oklahomans consumed more than 116,698,000 gallons of propane. Of that, 71,204,000 gallons were for residential uses and 16,952,000 gallons were used commercially. Internal combustion uses accounted for 9,903,000 gallons, and agricultural uses accounted for 7,668,000 gallons. Industrial uses accounted for 5,185,000 gallons, and cylinder use totaled 4,786,000 gallons. Analysts say 95,737 Oklahoma households depend on propane, and the Oklahoma LP Gas Administration, the state's licensing and code enforcement agency, says approximately 400,000 Oklahomans use propane. Oklahoma is also a major propane producer supplying more than 10 percent of total U.S. production. Oklahoma refineries and gas processing plants produce approximately 808,435,000 gallons of propane annually, and propane contributes approximately \$1.356 billion to the state's gross domestic product (GDP).

While propane demand has increased steadily, the propane industry is not without issues. Propane is still the most commonly used alternative fuel. However, with assistance from state and federal incentive programs, other fuels have made inroads. Oklahoma's incentive program was revised and extended through 2027 during the 2019 legislative session, and the propane industry supported these efforts. While these incentives appear to apply to all fuels equally, they, in fact, benefit some fuels more than others. For example, the incentives that are currently in place provide for a one-time income tax credit of 45 percent of the cost of converting a motor vehicle to operate on an approved alternative fuel. The 45 percent tax credit applies to all approved fuels equally. However, the actual benefit received depends on the cost of the conversion, and propane conversions are often the least expensive. As a result, the benefit to the propane industry is less than that of other fuels.

Similarly, Oklahoma's incentive program provides a 75 percent income tax credit for alternative fueling infrastructure. Again, the 75 percent is applied equally. However, since propane's infrastructure costs significantly less than others... 10 percent or less as much as CNG infrastructure, the benefit from this program to propane is only 10 percent as much (or less). If the State of Oklahoma incentivizes one propane refueling station and one CNG refueling station, the incentive or benefit paid for the CNG station will be approximately 10 or more times higher. This has left some in the propane industry wondering if these incentives have helped or hurt propane's position in this market. Plus, there's additional concern that promotion of CNG and CNG infrastructure appears to be official state policy. O.S. 74, Sec. 78f states that it's in the public interest to increase access to public CNG refueling stations in Oklahoma. Further, it states that the goal is to have one CNG refueling station every 100 miles along the interstate highway system by the year 2015 and one or more every 50 miles by 2025. O.S., 74 clearly references CNG...not alternative fuels.

Policy Consideration: Incentives that apply more fairly and equitably should be considered as current incentives favor certain fuels over others. A federal incentive for alternative fuels may be appropriate for further study/review. This program offers a \$0.50 per gallon tax rebate on approved alternative fuels. There are no other variables such as price. A \$0.50 tax rebate is applicable to each and every gallon of consumed alternative fuel. Additionally, legislators should review O.S. 74, Sec. 78f to determine if this is appropriate state policy. It's important to point out that these matters have not been formally reviewed by the organizations that represent the state's propane industry and no official position has been taken. This analysis is that of the author only.

The future of the Low Income Home Energy Assistance Program (LIHEAP) is also of concern to the propane industry. LIHEAP provides assistance to low income families with their winter heating bills including propane. While this program is critically important to many Oklahomans, LIHEAP will likely come under increased scrutiny from Congress and could be a target for cuts in the coming years. The Energy Information Administration predicts that average household heating bills for natural gas, propane and heating oil will increase between 3 and 8 percent this winter. This would obviously drive home heating costs higher. At the same time, the Super Committee in Congress has been charged with eliminating \$1.2 trillion or more in federal spending over the next 10 years.

If LIHEAP benefits are reduced as home heating bills continue to rise, the effect on low income families will be pronounced as will the effect on propane marketers and others who provide the fuel.

Policy Consideration: We would hope that federal cost cutting efforts would focus on spending other than that which assists those in this country who are most in need. Reducing benefits from LIHEAP would have a minimal effect on the goal of cutting federal spending by \$1.2 trillion or more. However, any reduction to LIHEAP, no matter how small, would be felt

by these families. Consideration should be given to shielding LIHEAP and similar programs against these cost cutting efforts as we believe the effects could be difficult for some of these families to overcome.

The balance between domestic propane production and domestic propane demand plus propane exports is delicate. According to the Propane Education & Research Council (PERC), propane production in the U.S. increased a healthy 44 percent between 2012 and 2015. However, PERC also says propane exports increased a staggering 259 percent up to 9.4 billion gallons during the same period. Analysts say they expect propane exports to increase even more. In spite of this, they say the U.S. should still have excess capacity. Propane exports are being monitored more closely now because of the substantial increases and because increased propane exports were identified as one of the factors that contributed to the dramatic price increases and product short falls during the winter of 2013-2014. Propane marketers who find it difficult to find the product to meet their customers' demands say they wonder if it's in the public interest for the U.S. to lead the world in propane exports.

Policy Consideration: Propane prices aren't regulated...by the Oklahoma Corporation Commission or by any other entity. Instead, prices are set in the marketplace. By and large, Oklahoma propane marketers support this freer, unregulated approach. Philosophically, it may be more difficult to regulate propane exports alone. In fact, it seems inherently problematic to require that a commodity be sold to domestic buyers at a lower price than exports. On the other hand, more than 50 million Americans depend on propane. Plus, here in the U.S., propane serves 900,000 commercial customers, 168,000 industrial customers, 320,000 agricultural customers, 500,000 forklifts and 150,000 automobiles. Plus, propane is the third most prevalent fuel for school buses. Customers who choose propane presumably do so because they have been assured that propane supplies are dependable and propane prices are steady. Many believe that this industry has a first, primary responsibility to domestic (U.S.) customers, and they support a policy that places the needs of domestic (U.S.) buyers before those of buyers from other countries. The recent rise in U.S. propane exports (259 percent) is unprecedented. Safeguards may be needed, at least temporarily, to ensure that recent increases in domestic propane production continue to keep pace with increasing domestic demand plus the unprecedented demand for propane from abroad.

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Oklahoma positioned to capitalize on demand for wind power, natural gas

Daisy Creager, The Journal Record, April 30, 2019

Increased consumption, a simultaneous stall of production and record-breaking electric capacity additions in 2018 were among key findings of a study of clean energy trends, discussed Monday by a panel at the state Capitol.

Produced by Bloomberg New Energy Finance for the Business Council for Sustainable Energy, the 2019 Sustainable Energy in America Factbook was published in February, providing an overview of key findings about the energy industry based on 2018 data.

Stephen Munro, policy analyst and editor of Bloomberg NEF, said energy consumption grew faster than the economy in 2018, which is significant.

According to the Factbook, energy consumption grew by 3.3% nationally in 2018, while gross domestic product grew 2.9%. Energy productivity declined 0.4%.

In the last 10 years, energy consumption has grown 7.5%, GDP has grown 22% and energy productivity has increased 14%

Munro said the study found two possible factors contributing to the change. The manufacturing sector, the “most energy-intensive” part of the economy, grew, using 4.7% more energy in 2018 than in 2017.

Additionally, there was rapid growth in energy consumption among stores, restaurants and residential areas due to a rise in “cooling degree days,” a measure of how much hotter it is than normal, requiring more air conditioner use.

According to the study, 2018 had the most cooling degree days since 1990. Heating degree days, a measure of how much cooler it is than normal, requiring more use of heat, also hit the highest number since 2014.

Munro said the increase in cooling and heating degree days indicates short-term climate change between 2017 and 2018.

During the panel discussion, Munro also discussed electric capacity additions. Almost 40 gigawatts of capacity additions were made, the highest since 2003.

Munro said the low prices of natural gas and need to make up for lost capacity as coal-fired plants are taken offline have caused natural gas build to double from 2017, adding 20 gigawatts in 2018.

The panel also discussed other key findings of the Fact-



From left, Heath Herje, with Tradewind Energy, speaks as Jonathan Gray, with Enel Green Power; Lisa Jacobson, with the Business Council for Sustainable Energy; and Stephen Munro, with Bloomberg New Energy Finance; listen during a briefing at the Oklahoma state Capitol Tuesday. (Photo by Daisy Creager)

book, including the rise in power decarbonization, growth of employment in the industry and continued affordability of energy in the United States.

Heath Herje, senior director of development southwest region for Enel Green Power subsidiary Tradewind Energy, discussed the state and future of Oklahoma’s clean energy.

Herje said Oklahoma ranks third nationally in installed wind capacity at 8,072 megawatts, while 32% of the state’s electricity is produced by wind.

He said Tradewind and NextEra Energy have worked with Walmart, Target and AT&T to increase the use of renewable energy.

“As we look at the future and as we continue to diversify our economy in the state of Oklahoma, we want to attract these businesses ... they are attracted by clean industry,” Herje said.

Munro said Oklahoma is one of the few states that can capitalize on access to wind and natural gas.

“Oklahoma is in a uniquely advantageous position because it has these great wind resources and a lot of natural gas,” Munro said. “Those are the two (of the three) fastest-growing generation sectors.”

The full Sustainable Energy in America Factbook can be viewed on the BCSE website.

Can American utilities profit from the energy transition?

The Economist, July 27, 2019

It is hard to ignore the wind hurtling across the green expanse of southern Minnesota. On highways, gusts nudge cars. Corn stalks shimmy in the breeze. And towering overhead, white turbines swirl. xcel Energy bought its first wind farm in the state in 2008. The utility's turbines now stretch to the horizon—its ambitions, far beyond. This month xcel, still dependent on coal to generate electricity, proposed big investments in solar and wind power in the upper Midwest, part of its bid to produce carbon-free electricity in the eight states it serves by 2050. It is one of many firms making multi-billion-dollar gambles on the shift to cleaner energy.

The opportunity is vast. Last year America's power sector generated 4.2bn megawatt-hours of electricity and 1.8bn tonnes of carbon dioxide (a third of America's total). Only 17% of power generation is currently from renewable sources, and another 19% from nuclear energy. If the \$400bn industry were a country, it would be the world's fourth-biggest emitter, ranking between India and Russia. Some see benefits in moving slowly to cleaner sources of power. Duke Energy, America's biggest utility, this month proposed large investments in natural gas in Indiana and will keep a giant coal plant there open for another 20 years. xcel is among those that sniff profits in the winds of change.

For decades, to describe electric utilities as dull was not an insult but a summary of corporate purpose: keep lights on, rates low and returns steady. The somnolence of their corporate offices, a seasoned visitor quipped, was disturbed only by the periodic whirr of a printer. A push in the 1990s to break up the power monopolies that still dominate America's electricity market lost steam after blackouts in California in 2000-01 curbed enthusiasm for deregulation. It suspended retail choice for consumers soon after. Today just 15 states have competitive retail electricity markets.

The business model of utilities seems designed not to speed up innovation but to stifle it. Some firms corner the market for transmission. Vertically integrated monopolists generate power, too. To keep them in check, a utility commission reviews a regulated utility's investments, then sets rates that cover costs, plus an annual return on invested capital of about 10%, net of depreciation.

This soporific status quo has served utilities rather well. In recent years regulators have authorised big investments in transmission and distribution, and profits from these have helped to support utilities' dividends and share prices (see chart).

Now things are heating up. Some companies must contend with the impact of global warming. Pacific Gas and Electric, California's largest power company, is battling regulators, politicians and investors over its alleged role in causing devastating wildfires during recent droughts. Other companies are trying to make their infrastructure more resilient to floods along coasts, tornadoes in the Midwest and other climatic disruptions.

Wind in their sales

Total stockmarket returns, 2013=100



Source: Edison Electric Institute *47 US investor-owned electric-utility companies

The Economist

The politics of green electricity, too, are evolving. Clean-power plans feature prominently in the Democratic presidential primaries. States led by Democrats, and even some led by Republicans, have set goals for clean electricity; in all, 29 have set targets for raising its share. Utilities face scrutiny from green-minded asset managers. In February institutional investors with \$1.8trn under management urged them to adopt targets for carbon-free electricity. Credit Suisse, a bank, estimates that utilities need to spend over \$100bn by 2030 to meet states' renewables goals.

Most important, the economics of power is being turned on its head by the falling costs of renewables. The "levelised" cost of electricity—which includes capital and operating spending to generate it over a plant's lifetime—is now lower for wind or solar power than it is for coal. Coal's share of power generation has sunk from about half in 2005 to 27% in 2018. It will fall further, despite President Donald Trump's plan, announced in June, to loosen regulation of coal plants.

The big question for utilities is how much of coal's declining share to replace with natural gas, and how much with renewables. The answer depends partly on their location. The high cost of shipping natural gas and oil to Hawaii is one reason why that state has particularly bold goals for renewables. On July 10th Hawaiian Electric filed an ambitious proposal to solicit bids for new wind and solar power. Some of the states where xcel serves customers are blue and others red, but all are among America's gustiest. That made it easier for Ben Fowke, its chief executive, to espouse a renewables strategy. That it appeals to

climate-friendly investors is “icing on the cake”, he says.

Regulated utilities make money by investing capital; the variable costs of fuel are borne by consumers. But wind has the benefit of being free, no matter how hard it blows. So Xcel settled on a strategy to please both investors and customers: invest more in wind farms, on which it can earn a regulated return, and spend less on fossil fuels, on which it cannot. In the long term, consumers save money and utilities make more of it.

Shareholders have welcomed this “steel for fuel” strategy, as Mr Fowke calls it. Last year Xcel’s earnings per share grew by almost 10%. Utilities such as cms, in Michigan, are following its lead.

For others, accelerating the move away from fossil fuels holds less allure, and not simply because they operate in places with less wind or sun. Securing land for wind farms in America’s densely populated north-east is costlier than in the Midwest. Retiring an ageing coal plant is one thing, points out Michael O’Boyle of Energy Innovation, a research group; scrapping a newer or newly refurbished one is another. Some states continue to prop up coal. Ohio’s senate passed a bill this month to subsidise coal plants in which Duke holds stakes.

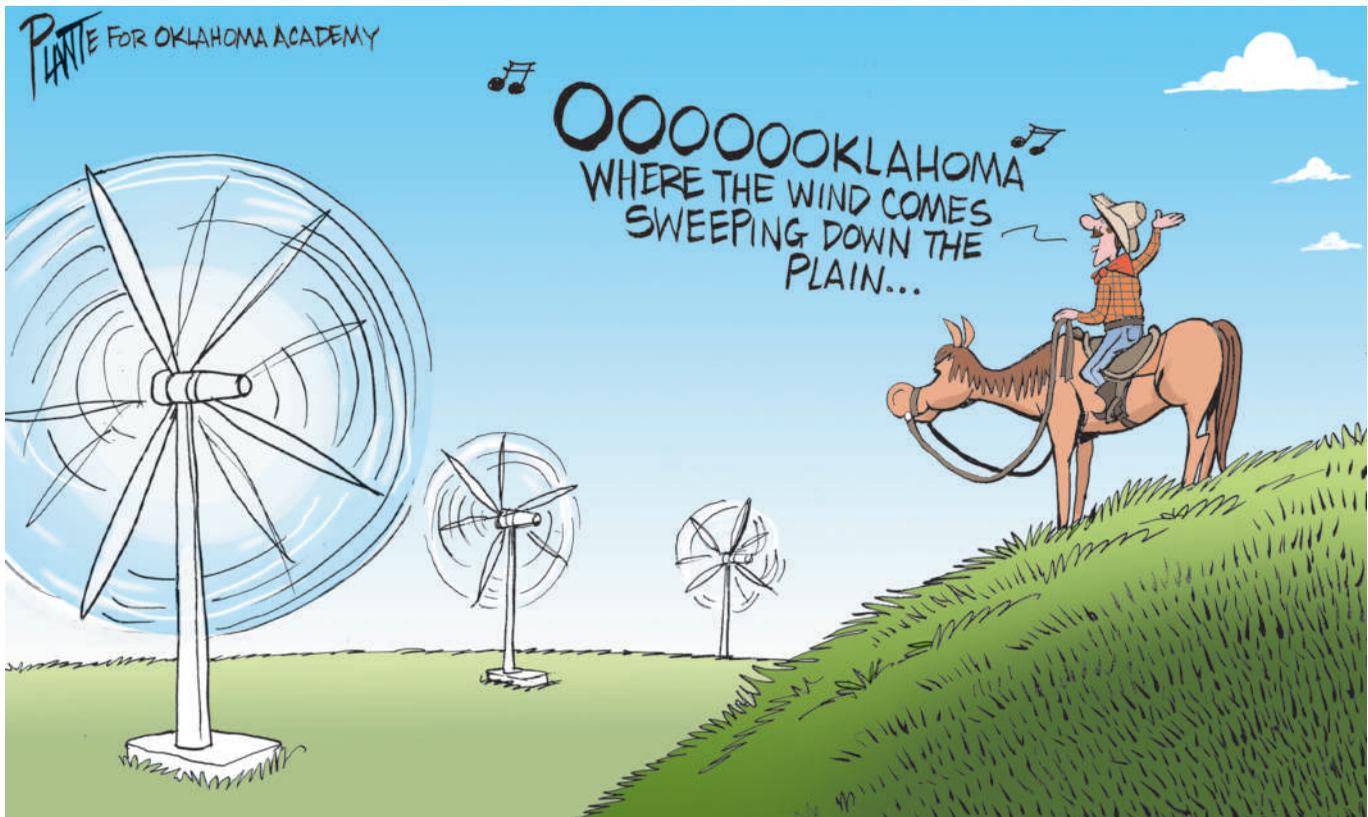
Natural gas complicates the picture further. Most investors reckon that some gas is necessary to balance the intermittent power of the wind and sun—at least until storage becomes cheaper and more efficient. The question is, how much? The availability of cheap gas has dissuaded many utilities in the region that sits atop the shale-rich Marcellus formation in America’s east from investing much in renewables, says Michael Weinstein of Credit Suisse. Renewables struggle to compete in Florida, too, where newish, efficient gas plants owned

by a subsidiary of NextEra, a giant power company, offer cheap electricity. The Energy and Policy Institute, a pro-renewables think-tank, recently analysed America’s 22 dirtiest investor-owned utilities. It found that about half, including Duke, Dominion and American Electric Power, plan to decarbonise more slowly in the coming decades than they did from 2005 to 2017 mainly because of investments in gas plants. In proposals for new investments in Indiana and the Carolinas, Duke argues that natural gas is needed to keep prices low and power reliable.

Despite Xcel’s clean-power plans, which include nuclear energy on top of renewables, even Mr Fowkes says that eschewing gas altogether would be “a little short-sighted”. His firm’s plan for the upper Midwest is for gas to generate a quarter of electricity by the mid-2030s.

But big investments in gas—such as Duke’s plan for it to account for two-thirds of the Carolinas’ new generating capacity—carry risks. The first is that some gas plants, like coal ones before them, become uneconomic as renewables keep getting cheaper. In April, Indiana’s utility commission rejected a proposal for a gas plant by Vectren, another utility, for just that reason. If America one day sets a price on carbon emissions, customers could be left paying for utilities’ bad bets on fossil fuels.

The second risk is that if utilities do not offer enough clean power, customers may get it elsewhere. Homeowners are installing solar panels on their roofs. Big corporate buyers of electricity, including Google and General Motors, this year launched a campaign to ensure an affordable supply of clean power. Such challenges make life for utilities less boring. Tackling them head on could make it more lucrative.



Wind farm making same power with 80% fewer turbines

Mead Gruver, The Associated Press, August 14, 2019

Bigger, more efficient equipment will allow an electric utility to redevelop Wyoming's first commercial wind farm so it produces the same amount of power with far fewer turbines, an example of the growing feasibility of renewable energy in the top U.S. coal-mining state.

Portland, Oregon-based PacifiCorp plans to replace 68 wind turbines at the Foote Creek I wind farm with 13 turbines. The wind farm atop the barren and blustery ridge called Foote Creek Rim west of Cheyenne will continue to generate about 41 megawatts, or enough electricity to power nearly 20,000 homes.

Solar power often gets attention for efficiency gains but many U.S. utilities also are working to squeeze more megawatts out of wind, PacifiCorp spokesman Spencer Hall said.

"Just imagine buying a new cellphone today versus in '98," Hall said, referring to when the wind farm's first turbines were installed. "It's becoming a thing where we can't even get labor on some of them, there are so many projects going on."

PacifiCorp has 1.9 million customers in Wyoming, Utah, Idaho, Washington state, Oregon and California and wants to get more electricity from wind power in the years ahead, while reducing what it generates from coal.

Environmental groups are waiting for an October announcement by PacifiCorp outlining its future plans for coal-fired power. PacifiCorp has been weighing whether to shut down as many as nine coal-fired generating units at power plants in Colorado and Wyoming over the next several years.

"All indications are showing it will include some early retirements on at least some of the units," said Hall.

Increasingly efficient renewables and inexpensive gas-fired electricity are bad news for Wyoming's coal mining industry, which employs about 4,700 miners and supplies over 40 percent of U.S. coal. Several bankruptcies, including one that shut down two of the top-producing U.S. coal mines in the state's northeastern Powder River Basin area of rolling grasslands, have hit the industry in recent years.

At Foote Creek Rim, PacifiCorp plans to replace its 600-kilowatt Mitsubishi wind turbines with 2- and 4-megawatt Vestas turbines. The Vestas turbines will have larger blades spanning 120 yards (110 meters) and 149 yards (136 meters).



This May 6, 2013 file photo shows a wind turbine farm owned by PacifiCorp near Glenrock, Wyo. Bigger, more efficient equipment will allow a western U.S. electric utility to redevelop an aging Wyoming wind farm with far fewer turbines while generating the same amount of power. Portland, Oregon-based PacifiCorp plans to replace 68 wind turbines at the Foote Creek I wind farm with 13 turbines over the next year. (AP Photo/Matt Young)

As the new turbines go up, the existing ones will be decommissioned next April.

The redevelopment includes PacifiCorp's buyout of another utility's 21 percent ownership stake in Foote Creek I. The Eugene Water & Electric Board will get \$1.7 million for its share.

Other major wind projects in the works in Wyoming include Power Company of Wyoming's plans for a 3,000-megawatt wind farm about 50 miles (80 kilometers) southwest of Foote Creek Rim.

Report: wind and solar account for 44% of state's power production

Daisy Creager, The Journal Record, August 23, 2019

Oklahoma produces 44% of its electricity through wind and solar generation, placing it among only four states surpassing 40%, according to a recently released report.

Renewables on the Rise 2019, produced by the Environment America Research and Policy Institute and Frontier Group, outlines what it calls “explosive growth” in renewable energy technology over the last decade.

From 2009 to 2018, Texas, Oklahoma and Kansas led the nation in added wind power during the time period, with Oklahoma ranking second at 24,895 gigawatt-hours in added capacity. The state ranked 41st in solar growth, however, with only 77 gigawatt-hours in added solar capacity.

As a nation, the U.S. produced almost five times the amount of electricity from solar and wind in 2018 as it did in 2009, with those sources now producing 10% of total electricity. Nationwide, wind power alone tripled, while solar production is now 40 times higher.

Wind and solar efforts have improved electric efficiency nationwide, saving enough electricity in 2017 to power 2.5 million homes — twice the amount saved in 2009, the report found. Oklahoma's electricity efficiency increased by 0.37%.

Rob Sargent, energy program director at the Environment America Research and Policy Center, said the report's findings were not surprising to his team.

“There are some who would be discouraged, because we still have a long way to go, but if you take a look at the rate at which renewables are growing and the prospects for it ... there's much more room for optimism,” Sargent said. “It should give people the confidence we can and should aim high.”

Sargent said he hopes the study encourages the continued development of wind and solar power. The report's numbers should provide confidence to aim high and take the industry to the next level, he said.

“When you expand these technologies and start deploying them, people see it, they like it, they want more. There are powerful interests that have a stake in stalling that progress, particularly the fossil fuel energy,” Sargent said. “But it's an idea whose time has come. It's what the people want

and certainly it's what's needed to ensure quality of life and health for future generations.”

JW Peters, president of Solar Power of Oklahoma, a company that installs residential and commercial solar panels in Oklahoma and Missouri, said the report's results were in line with his expectations, particularly for solar.

Despite ranking sixth in solar potential in a March Solar Energy Industries Association market report, Oklahoma ranked almost at the bottom for solar installation in the Environment America Report.

Peters said the state's lag in solar is largely due to low utility costs, lack of awareness and the prevalence of the oil and gas industry in the state's economy.

“A lot of (people) think ‘(solar is an option) if you live in a cabin out in the woods and you have a bunch of batteries to store your power.’ A lot of people don't understand that we now have what's called a grid system that allows us to put power back on the grid, gain credits for any excess power put on the grid and use those credits at night when the sun's down,” Peters said.

Additionally, both Peters and Sargent said wind power has benefited from state incentives in Oklahoma while solar power has not. Sargent said there is a strong correlation between state policies and progress with renewables. “With solar, like many of these things, you need good policies in place both to provide access to solar ... but also a recognition that it's just smart and forward-thinking,” Sargent said.

For his part, Peters said Solar Power of Oklahoma is hosting a series of town hall meetings in communities around Oklahoma City to teach people and local leaders about solar energy.

Despite the lag in solar installation, the numbers in the Environment America report show “there's signs of progress everywhere,” Sargent said.

“Different places have different strengths and weaknesses, but in every place, for anybody that's thinking it's too much of a heavy lift to make a transition to clean, renewable energy, they should take a look at the rate of which all this is accelerating and take heart to it,” he said.

Southwest Power Pool expanding real-time energy market west

Daisy Creager, The Journal Record, June 18, 2019

The Southwest Power Pool announced Monday plans to launch a new energy imbalance service market as part of efforts to expand west.

Planned to launch in December 2020, the Western Energy Imbalance Service will be administered on a contract basis through four-year western joint dispatch agreements, with the option for utilities to become SPP members if they like the service.

SPP launched an energy imbalance market for customers in the Eastern Interconnection, which includes Oklahoma, in 2007. In an energy imbalance market, SPP charges or credits buyers and sellers based on the projected and actual amounts of energy produced or consumed in five-minute increments.

“These markets work on a regional basis to match buyers and sellers in five-minute increments and keep the bulk electric system balanced in essentially real time,” SPP Supervisor of Corporate Communications Derek Wingfield said.

In 2014, the system transferred to the Integrated Marketplace, where SPP commits generators to be online a day in advance based on the load forecast. Wingfield said the change came because participants saw more value in the system, which provides better price certainty. The Integrated Marketplace extends across SPP’s operations in all or part of 14 states, spanning a 546,000-square-mile service area.

WEIS could evolve to an integrated marketplace eventually if customers prefer it, he said.

SPP President Nick Brown said in a press release the organization is invested in “the power of partnership” and wants to do more than expand its wholesale electricity market with WEIS.

“We want to work with utilities to understand the challenges they face and develop smart solutions that benefit the whole region. That’s how we operate as an RTO, and it’s how we plan to administer this and other contract services in the west,” Brown said.

Westward growth has been an ongoing project for SPP. In August 2018, the organization announced plans to administer the Western Interconnection Unscheduled Flow Mitigation Plan for six utilities.



Power transmission lines in Bixby. (Journal Record file photo)

Through the plan, SPP oversees the use of devices to address reliability-threatening circumstances on behalf of a group of qualified owners and operators.

Additionally, Wingfield said the organization is on track to offer reliability coordination services in the Western Interconnection in December, which he compared to being an air traffic controller – not owning a stake in the airlines, but monitoring to ensure safety.

“We are going to be doing that with electricity. So we don’t own the power plants, we don’t own the transmission lines, but we’ll be watching it on behalf of a dozen or so customers in the west,” Wingfield said.

The Time Has Come to Recycle Oklahoma's Aging Wind Infrastructure

Randy Gibson-Black, Oklahoma Policy Review, Volume 4, 2019

The Great State of Oklahoma certainly stays true to the lyrics of the State's song when it describes Oklahoma as a place "...where the wind comes sweeping down the plain!" Oklahoma has capitalized on this fact and has become host to a growing sector of wind energy. Oklahoma has been one of the leading producers in wind energy for years, but it is time to look at what happens to the aging turbines once they have been decommissioned. The average lifespan of a wind turbine is between 20 and 30 years, which means a large portion of Oklahoma's wind infrastructure is ready to be decommissioned. Repurposing and recycling have become common and necessary since wind energy has been popularized, leaving many to think of ways to repurpose decommissioned wind turbines. Oklahoma's public and private sectors have a unique opportunity to become innovators in the field of recycling and repurposing decommissioned wind turbines which would continue to propel Oklahoma forward in the energy sector and ensure wind farms have the smallest environmental impact possible.

First, at the end of 2018, Oklahoma was home to 3,984 wind turbines which accounted for 31.7% of the state's energy use and could power 2,653,200 homes. Oklahoma has consistently been a top 3 producer of wind energy for years and it is obvious that the state is not going to be slowing down anytime soon as evidenced by a number of wind projects being built throughout the state. The economic impact of the wind energy sector must not be understated since it employs over 7,000 individuals, pays \$23 million in taxes, and pays out over \$20 million in lease agreements annually which stimulates local economies and provides a clean energy alternative in a state where oil is king. More importantly, the point of utilizing a renewable energy resource is to avoid using as many non-renewable forms of energy. In 2018, the environmental benefits of wind in Oklahoma included 5.2 billion gallons of water being saved along with avoiding releasing 11.1 million metric tons of CO₂ emissions into the atmosphere. While Oklahoma benefits economically and utilizes forms of renewable energy, it is imperative that it takes a further step to ensure that decommissioned wind turbines are not simply tossed into a landfill. Allowing any portion of a wind turbine to be thrown away, instead of looking for a way to repurpose it, would be contradictory to the point of having them in the first place. Those 3,984 turbines will, at some point, be decommissioned which means there is a growing need for a way to repurpose them.

Second, it is important to consider how recyclable each part of a turbine currently is before we try to find useful ways to repurpose them. Wind turbines consist of several main components which include the base, tower, gearbox, generator and the blades. The towers are made of steel which is recyclable and easy to repurpose. Many of the components

of the gearbox and generator are recyclable, exempting only the rare earth materials found in the generator. Turbine blades are made with fiberglass or carbon fiber which is not currently easy to recycle and are the main reason for concern. The blade materials were chosen as they make the overall turbine lighter and more efficient. Some wind turbine blades that consist primarily of reinforced plastic, are downcycled and used in cement products while others have been repurposed as outdoor seating, art installations, and playground equipment. Some decommissioned wind turbines in the U.S. and other countries that have a growing wind sector have been sold to other countries where they are recommissioned. Exporting decommissioned wind turbines, while only a temporary solution, would allow Oklahoma to have an international impact that would propel the utilization of wind energy to countries that may not be able to develop wind farms on their own. Despite there being a few ways to deal with decommissioned wind turbines, Oklahoma can innovate a model for others to follow.

Third, Oklahoma can look to other parts of the country and the world to see what is being done to address the growing issue of recycling decommissioned wind turbines. Currently, the leading way to recycle wind turbines is the heat the fiber glass to 1112 degrees Fahrenheit and the recycling the separated materials, but this process creates a large environmental footprint. At Aarhus University in Denmark, a team of scientists are working on a project called "DreamWind" which has the goal of creating a chemical substance that will make it possible to separate the composite materials found in turbine blades in order to increase the recyclability of the blades. If Oklahoma were to invest in a more eco-friendly way to heat the materials in order to achieve separation, that could potentially reduce the difficulty of recycling. It appears that DreamWind is the future of recycling of these materials, which is why if Oklahoma is going to invest in recycling decommissioned wind turbines, it should start with working with chemical engineers to adopt similar methods.

In conclusion, there is currently no effective way to recycle turbine blades. Oklahoma, whether within the public or private sector, can lead the world in efforts to recycle these materials. With a growing fleet of aging turbines, the need for effective ways to recycle the blades will become apparent which means the overall environmental impact of a turbine will be lessened than if it ends up in a landfill. The answer to this problem is currently not being worked on in the state which is why it might be time for state agencies and private companies to look elsewhere to see what others in the field are doing. While Oklahoma continues to innovate more efficient turbines, it is imperative that the state takes the next step to pass legislation or promote innovation that will create the means to recycle turbine blades.

The state of the U.S. solar industry: 5 questions answered

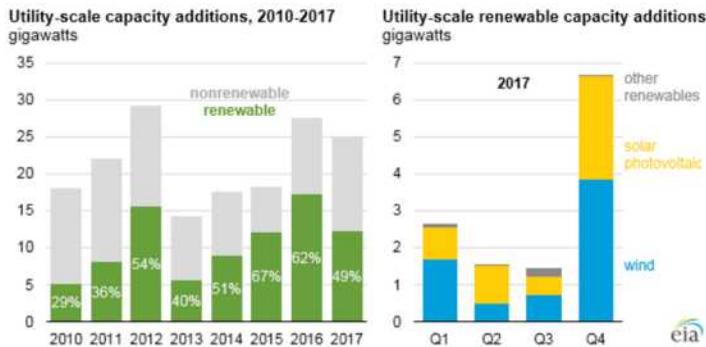
Joshua D. Rhodes, *The Conversation*, January 27, 2018

On Jan. 22, 2018, the Trump administration announced plans to impose punitive duties on solar panels imported from abroad. This decision came in response to a complaint filed by two solar companies, but much of the industry opposes the action, which trade groups say will increase the cost of solar projects and depress demand. To illustrate what's at stake, energy scholar Joshua Rhodes provides some context on the U.S. solar industry and its opportunities and challenges.

How big is the U.S. solar industry, and what is its growth trajectory?

The U.S. solar industry generated US\$154 billion in economic activity in 2016, including direct sales, wages, salaries, benefits, taxes and fees. Its revenues have grown from \$42 million in 2007 to \$210 million in 2017.

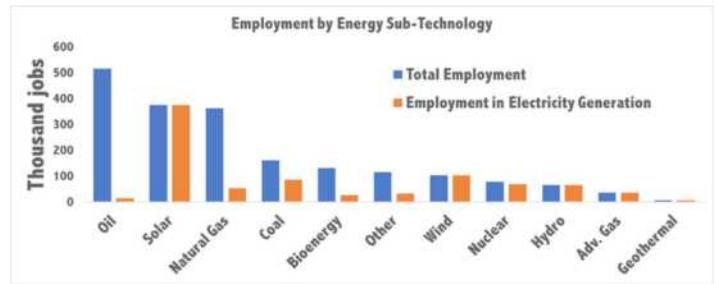
About 25 percent of total new power plant capacity installed in 2017 came from solar. Total installed U.S. solar capacity is over 50 gigawatts – the equivalent generating capacity of 50 commercial nuclear reactors.



Solar is projected to continue to grow for the foreseeable future. However, recent events such as the solar trade tariff and tax code changes could dampen that trend. According to one estimate, the tariff alone will reduce solar installations by 11 percent from 2018 through 2022.

The industry directly or indirectly employs about 370,000 people in the United States, of which 260,000 are full- or part-time. Solar photovoltaic installers make up about half of this workforce. In fact, solar PV installer is currently the fastest-growing job in the nation, with a median annual salary of nearly \$40,000.

For comparison, the coal industry only supports about 160,000 jobs. Electric power generation from solar and wind energy combined contributes about three times as many jobs as electricity production from fossil fuels.



Why are most of the solar panels that are installed in the United States manufactured overseas? Is this pattern likely to change?

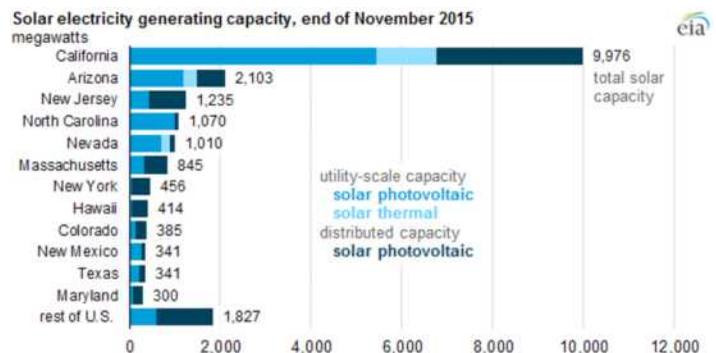
About 80 percent of solar panels installed in the United States last year were built overseas. While the industry was invented here, China has poured up to \$47 billion into tax breaks and incentives in order to develop what it views as a strategic capability. Along with an abundant supply of cheap skilled labor, these investments reduced the price of solar panels by 80 percent between 2008 and 2013.

Some foreign solar panel manufacturers are negotiating to open factories in the United States, much as foreign car manufacturers did during the Reagan administration. However, any new manufacturing is likely to be highly automated, so it might not generate major numbers of new jobs.

Which sectors and states produce the most solar power today?

About 60 percent of total U.S. solar generating capacity is in a relatively small number of very big projects owned by power companies. The rest is what's known as distributed capacity, meaning small-scale projects that generate energy at many sites. It includes rooftop solar power on homes, community solar projects and commercial installations, such as solar panels on the roofs of big-box stores like Walmart.

California has nearly half of all U.S. solar electricity generating capacity, followed by Arizona, New Jersey and North Carolina. Alaska, North Dakota and South Dakota are the only states with less than one megawatt of small-scale solar photovoltaic capacity.



How affordable is solar power for customers who aren't affluent?

Affordability can be a barrier to going solar, but there are ways to reduce it. For example, some utility customers can subscribe to community solar programs – projects that serve multiple customers in a single area – and even reduce their rates by doing so. Community solar projects do not usually require customers to own their homes, so renters can take part.

There are also peer-to-peer networks that allow homeowners with solar to donate their excess energy to those in need. Instead of receiving credit from their utility for generating more electricity than they use in a given month, these households authorize the utility to apply that credit to a needy household's bill.

It is also important to note that utility-scale solar power can lower the cost of electricity for all of that utility's customers. In Texas, where I live, adding wind and, soon, solar generation has kept wholesale electricity prices low as the price of renewable electricity has fallen. Keeping these prices low makes it harder for power companies to justify raising electricity rates, which directly helps lower-income customers.

What are the biggest challenges that U.S. solar companies face today?

There are signs that the residential solar market is slowing down. Some companies are shifting their focus from deploying as much capacity as possible to trying to maximize revenue by

scaling back expansion, so that they can focus on a few states that offer the best returns on investment.

In some major markets, such as California, bringing large amounts of solar generation online is depressing wholesale electricity market prices, which erodes the value of the electricity that these systems produce. This makes projects gradually less economic to install.

The Trump administration's solar tariff will be more challenging for utility-scale solar projects than for residential, because the modules account for a larger share of the total cost of large projects. A 30-percent tariff will likely increase the costs of solar installations by about 11 cents per watt, or roughly 10 percent, which could reduce the amount of solar installed over the next 4 years by five to eight gigawatts of capacity, mostly at the utility scale.

In my view, the biggest challenge for U.S. solar companies – particularly installers – is uncertainty. Congress recently tried unsuccessfully to cancel tax credits for installing new solar capacity, and the tax cut bill that was enacted in December includes some changes that may affect credits for investing in solar. Companies need certainty to create value and jobs – and for solar and other renewable energy sources, certainty is in short supply at the moment.

Joshua D. Rhodes is a Research Fellow of Energy at the University of Texas at Austin.



WFEC, NextEra plan wind, solar, battery storage project

Daisy Creager, The Journal Record, July 23, 2019

Western Farmers Electric Cooperative announced Wednesday plans to add solar and battery storage projects to the Skeleton Creek Wind Farm, currently under construction by NextEra Energy Resources in Garfield, Alfalfa and Major counties near Enid.

The projects are part of a power purchase agreement between WFEC and NextEra and will be built in phases, with the wind farm going online at the end of 2019 and the other two projects beginning commercial production at the end of 2023.

It will be the first combined project of its kind in Oklahoma and the largest of its kind in the nation, the cooperative said. The solar project will add 250 megawatts of generation capacity and the four-hour battery storage project will add 200 MW. The wind farm, which was announced earlier this year, will produce 250 MW.

Together, the projects will produce enough electricity to power more than 177,000 homes a year, said Dave Sonntag, WFEC vice president of special projects. Peak construction during each phase will create 300 jobs, and six to 10 full-time positions will be permanently created by the projects, NextEra Energy Resources spokesperson Bryan Garner said.

Sonntag said the cooperative will need the additional power generation within the next five years to meet demand. “The technology for battery storage, we think, is there,” Sonntag said. “There’s some pretty good federal tax incentives in place we’re trying to take advantage of, so the combination of all those items leads us to this project.” Advanced Power Alliance Vice President Mark Yates said the projects bring exciting growth to solar energy and battery storage in Oklahoma and the Southwest Power Pool, a regional transmission organization charged with coordinating the transmission of reliable electricity generation in Oklahoma and 13 other states.

Commercial-scale solar projects and energy storage are a novelty in the state and will require a refinement of technology and processes as WFEC and NextEra coordinate the projects’ impact on the grid, peak load and demand, he said. “It is a kind of pilot to see what’s working, what’s not working and how we progress forward,” Yates said. “That, as an industry, is where we are today.”

Sonntag said he anticipates more regulatory than technology and process roadblocks in bringing the storage and solar projects online.

Garner said battery storage is becoming more cost-effective and the industry is learning more about the best way to pair



Solar panels at a Western Farmers Electric Cooperative wind farm in Cyril. (Courtesy WFEC)

it with energy sources such as solar and wind power. Solar and wind power generation pair well together since their peak generation is during opposite hours – solar peaking during the day and wind turbines peaking in the evening. Combined with energy storage technology, these intermittent resources will “take the edge off of the peak demand periods,” he said.

“We think the time is right for renewable energy,” Garner said. “Pairing wind and solar together with batteries really adds new flexibility and cost-effectiveness for Oklahoma utilities and Western Farmers and this investment is really leading the way.”

The battery storage project will improve the dependability of the system, Yates said.

“Obviously, wind is an intermittent resource, solar is an intermittent resource and batteries bridge the gap,” he said. “It makes the grid more flexible, more dynamic and reliable.”

The project also will help Oklahoma’s standing in solar energy use. A recent market report from the Solar Energy Industries Association in 2018 showed Oklahoma had the sixth-highest potential for developing solar power, but ranked No. 43 in the installation of new solar photovoltaic capacity.

Research and advocacy group Solar Power Rocks awarded Oklahoma an “F” for its 2019 solar energy policy, but credited the state for “remarkable progress” in wind power. Garner said NextEra hopes it is the first of many similar projects to come in Oklahoma.

“It’s exciting because it’s the leading edge of what is going to be a transition as we move into more solar and more storage. ... I think it’s great for the grid and great for Oklahoma,” Yates said.

Oklahoma near last in adding new solar capacity

Daisy Creager, The Journal Record, March 25, 2019

Oklahoma has the sixth-highest potential among all 50 states for developing solar power. Yet, Oklahoma was among the nation's worst in adding new solar capacity in 2018, according to the Solar Energy Industries Association's latest market report.

According to the report, the state was No. 43 in the installation of new solar photovoltaic capacity last year, a sharp drop from No. 31 in 2017.

Dan Whitten, SEIA's vice president of public affairs, attributed some of Oklahoma's lag in solar power to "the evolution of the energy sector." He said solar investment tends to follow investment in wind, as the state has made in recent years.

"It's a matter of evolution. It's going to happen in Oklahoma," Whitten said. "When solar was more expensive 10 years ago, it made a lot of sense not to do solar, so Oklahoma didn't do it. But now the cost argument is just too good."

Surrounding states varied in their rankings, with Texas moving to No. 2 in 2018 from No. 4 in 2017. Arkansas jumped to No. 18 from No. 43, while Missouri jumped to No. 32 from No. 39 and New Mexico went to No. 21 from No. 26. California maintained its No. 1 ranking, which it held in 2017 and 2016.

Solar Power Rocks, a research and advocacy group, awarded Oklahoma an "F" for its solar energy policy. The organization, however, credited the state for "remarkable progress" in wind power.

Whitten said states like California began investing in solar power about 10 years ago, before it became as profitable as it is now. Other states are catching up, he said.

Whitten said Oklahoma's higher ranking in 2017 could be due to one big project.

"(Large jumps are) reflective of states that have not yet adopted solar at a very high rate," Whitten said. "(Oklahoma is) a state with incredible potential, but in states like Oklahoma one big project can make the difference between a good year and a bad year."

The market report projected continued growth in residential solar projects and a rebound of utility-scale solar projects, which will lead to national growth in solar projects in 2019 and 2020.

According to the state Department of Commerce, solar power can provide up to 44.1 percent of electricity in Oklahoma

from 19,300 solar panels.

In 2010, the state Legislature enacted House Bill 3028, the Oklahoma Energy Security Act, calling for 15 percent of total installed generation capacity in Oklahoma to be derived from renewable sources by 2015.

The policy received criticism from solar energy advocate groups like Solar Power Rocks for being voluntary, not containing a solar carve-out or specific target for solar energy, and the lack of a stricter net metering policy.

Whitten said while some policies are better for boosting solar power, the recognition of the value of solar power is just as important for states.

"There certainly are policies that have led to greater adoption," he said. "There's also more of a commitment to clean energy than there was before. Now people are seeing they can invest in clean energy at a lower cost. It just makes too much sense."

In 2016, the Oklahoma Corporation Commission reported the 2015 capacity for electricity generated by renewable energy to be 25.9 percent, a 5.05 percent increase from the previous year.

Kenneth Wagner, Oklahoma secretary of energy and environment, said while the state has not come close to reaching its solar power potential, it is important to consider the strides it has made in other areas that "far outpace the majority of other states in the country."

"We're among the leaders in emissions reductions," Wagner said. "It's just we've accomplished ours through the introduction and conversion of natural gas and the introduction of wind."

Wagner said Gov. Kevin Stitt's administration is working to remove barriers preventing solar energy from reaching its potential in the state.

"I think solar needs to be an important and vital part of our diversification of fuel sources," Wagner said. "We want Oklahomans, whether they're individuals or businesspeople, to be able to make informed decisions about which fuel source is right for them."

Despite Oklahoma's low ranking, Whitten said SEIA is excited about the state's solar prospects.

"It is an energy state," Whitten said. "We think solar is going to stack up well over the next few years."

Nuclear Power

Larry O'Dell, Oklahoma Historical Society

The Atomic Energy Act of 1954 ended the U.S. government's control over nuclear technology, allowing individuals and companies to expand into the market. In Oklahoma this industry was not based on the state's natural resources, but in the 1950s uranium was discovered (mainly in southwestern Oklahoma), and some entrepreneurs mined it. Most of Oklahoma's nuclear energy history revolves around a homegrown corporation. On May 8, 1952, the Kerr-McGee Company purchased the Navajo Uranium Company in Arizona, diversifying the conglomerate and bringing it into the nuclear age. The first oil company involved in uranium prospecting, Kerr-McGee soon built a processing mill near Shiprock, New Mexico.

By 1956 the company had organized Kermac Nuclear Fuels Corporation, owned almost 25 percent of the nation's uranium reserves, and had purchased a refinery in Cushing, Oklahoma, which they later used to produce nuclear reactor fuel materials. In 1965 the Cushing plant received a large government contract to process thorium into briquets to be used as fuel in reactors. In 1966 the first of several tragedies occurred at Cushing when an explosion killed one employee and injured two others. In 1965 Kerr-McGee completed its Cimarron Nuclear Fuel Facility near Crescent and in 1966 decommissioned the Cushing plant. The Crescent establishment converted uranium into fuel elements for nuclear reactors, and in 1969 the company announced it would build an adjacent plutonium plant, processing the man-made metal into fuel for nuclear-powered electrical generating plants.

At this time Kerr-McGee had almost completed its Sequoyah County facility near Gore. The plant converted uranium concentrate into uranium hexafluoride, which would be shipped to Crescent for further processing. In 1987 the Sequoyah plant expanded its operations, producing uranium tetrafluoride, a component in the production of armor-piercing shells. With these three factories Oklahoma stood in the forefront of the emerging nuclear industry.

Other nuclear-related enterprises developed in the Sooner State. Both Oklahoma State University (1957) and the University of Oklahoma (1958) hosted small research reactors to study and teach nuclear engineering. From 1958 to 1970 near Tulsa the Kaiser Aluminum Company smelted magnesium and thorium metal alloys, extracting the magnesium and disposing of the radioactive material. In Muskogee from 1958 to 1989 Fansteel Metals produced tantalum and columbium metals, which contain trace amounts of thorium and uranium. In 1976 Eagle-Picher Industries in Ottawa County received a contract from the Energy Research and Development Administration (ERDA) to produce boron 10, which is used in nuclear research and production programs. In 1973 the Public Service Company of Oklahoma (PSO) announced plans to build two nuclear reactors near Inola.

In 1974 Karen Silkwood, an employee at Kerr-McGee's Cimarron plant, died in a mysterious car accident prior to a meeting with a New York Times reporter and a national representative of the Oil, Chemical, and Atomic Workers Union (OCAW). She reportedly was going to give the journalist evidence that Kerr-McGee workers tampered with fuel rods to hide their deficiencies, as well as report on the plant's safety violations. She was contaminated by radiation, but the company charged that she had contaminated herself. In 1976 Silkwood's estate filed suit against the company. Although in 1979 the federal court awarded the estate \$500,500 for property and injury damage and \$10 million in punitive damages, after a long process of appeals and legal maneuvering the case was finally settled out of court in 1986, with Kerr-McGee paying the estate \$1.38 million. Karen Silkwood became a national symbol for antinuclear protesters and the basis for the 1983 movie *Silkwood*.

In Oklahoma, activists including Carrie Dickerson, Ilene Younghein, and the umbrella organization the Sunbelt Alliance, successfully fought PSO's proposed reactor, which the company had named the Black Fox Nuclear Power Plant. In 1982 PSO discontinued the construction of the reactors. Protests, funding problems, and the 1979 incident at the Three Mile Island Nuclear Plant in Pennsylvania contributed to the decision. In 1986 an accident at Kerr-McGee's plant near Gore killed one worker, sent eighty-two people to the hospital, and spread a large, tainted cloud over the area. The Cimarron plants permanently shut down in 1976, and in 1988 Kerr-McGee sold the Gore facility to General Atomics. After continuing difficulties and incidents the Gore plant closed in 1993.

At the end of the twentieth century no nuclear-related plants existed in Oklahoma. The federal government offered incentives to American Indians to store nuclear waste on tribal lands. None of the Oklahoma nations have accepted, but the Tonkawas had a close vote (58 to 44) before rejecting the offer in 1994. In 1983 Oklahoma joined Nebraska, Kansas, Louisiana, and Arkansas forming the Central Interstate Low-Level Radioactive Waste Compact to identify and to develop a storage site for the members. In 1989 the organization selected a site in Nebraska, but in 1999 Nebraska rejected the proposal and withdrew from the compact. At the turn of the twenty-first century the Nuclear Regulatory Commission (NRC) had listed several radioactive waste sites in Oklahoma that it was in the process of decommissioning: the site near Gore, Kerr-McGee's facilities at Crescent and Cushing, Fansteel near Muskogee, and Kaiser Aluminum at Tulsa. Although there are no reactors active in the state (OSU's closed in the 1970s and OU's in the 1980s), activists were still vigilant, objecting to a proposed route that would bring nuclear waste through Oklahoma to Nevada.

Company says the future of nuclear energy is smaller, cheaper and safer

Jeff Brady, NPR: Environment And Energy Collaborative, May 8, 2019

Nuclear power plants are so big, complicated and expensive to build that more are shutting down than opening up. An Oregon company, NuScale Power, wants to change that trend by building nuclear plants that are the opposite of existing ones: smaller, simpler and cheaper.

The company says its plant design using small modular reactors also could work well with renewable energy, such as wind and solar, by providing backup electricity when the wind isn't blowing and the sun isn't shining.

The 98 nuclear reactors operating in the country now are large because they were designed to take advantage of economies of scale. Many are at risk of closing in the next decade, largely because they can't compete with less expensive natural gas and renewable energy.

To respond to this dilemma, "we've developed economies of small," says Jose Reyes, chief technology officer and co-founder of NuScale.

Instead of one big nuclear reactor, Reyes says his company will string together a series of up to 12 much smaller reactors. They would be built in a factory and transported by truck to a site that would be prepared at the same time.

"You're making your [reactor] pool and all that stuff on-site," says Reyes. "In parallel, you're manufacturing the modules, and then that cuts the construction schedule to about half."

NuScale says it also has simplified how the plants are operated in ways that make them safer.

The 2011 Fukushima disaster in Japan happened when a tsunami knocked offline the emergency generators that cooled the reactors and spent fuel, leading to reactor meltdowns.

"We've looked at ways the systems have failed in the past and tried to remove those kind of failure modes from our design," says Karin Feldman, vice president for the company's Program Management Office.

NuScale's design doesn't depend on pumps or generators that could fail in an emergency because it uses passive cooling. The reactors would be in a containment vessel, underground and in a huge pool of water that can absorb heat.

That means that even a reactor that fails would still be safe. "It doesn't require any additional water," says Feldman. "It doesn't require AC or DC power. It doesn't require any operator action. And it can stay in that safe configuration for as long as is needed."



Artist rendering of NuScale Power's nuclear power plant design, which would use small modular reactors.

A backup power source for wind and solar

NuScale plans to build its first nuclear power plant at the Idaho National Lab. The electricity will power the lab and go to Utah Associated Municipal Power Systems, or UAMPS, which serves 46 member utilities in six Western states.

The organization was looking for a carbon-free source of electricity to generate power when intermittent sources, such as solar panels and wind turbines are offline. And it turns out NuScale's modular design is good for that.

Big nuclear reactors run all the time, but NuScale's collection of smaller reactors can be ramped up and down relatively quickly. Batteries can back up intermittent sources of renewable energy, too, but UAMPS CEO Doug Hunter says NuScale's reactors are cheaper.

"Each module would have enough fuel in it for up to two years of operations, so it's like we're a battery that has a two-year charge to it," says Hunter.

NuScale still must convince the Nuclear Regulatory Commission that its plant design is safe. The company cleared the first phase of that review last year.

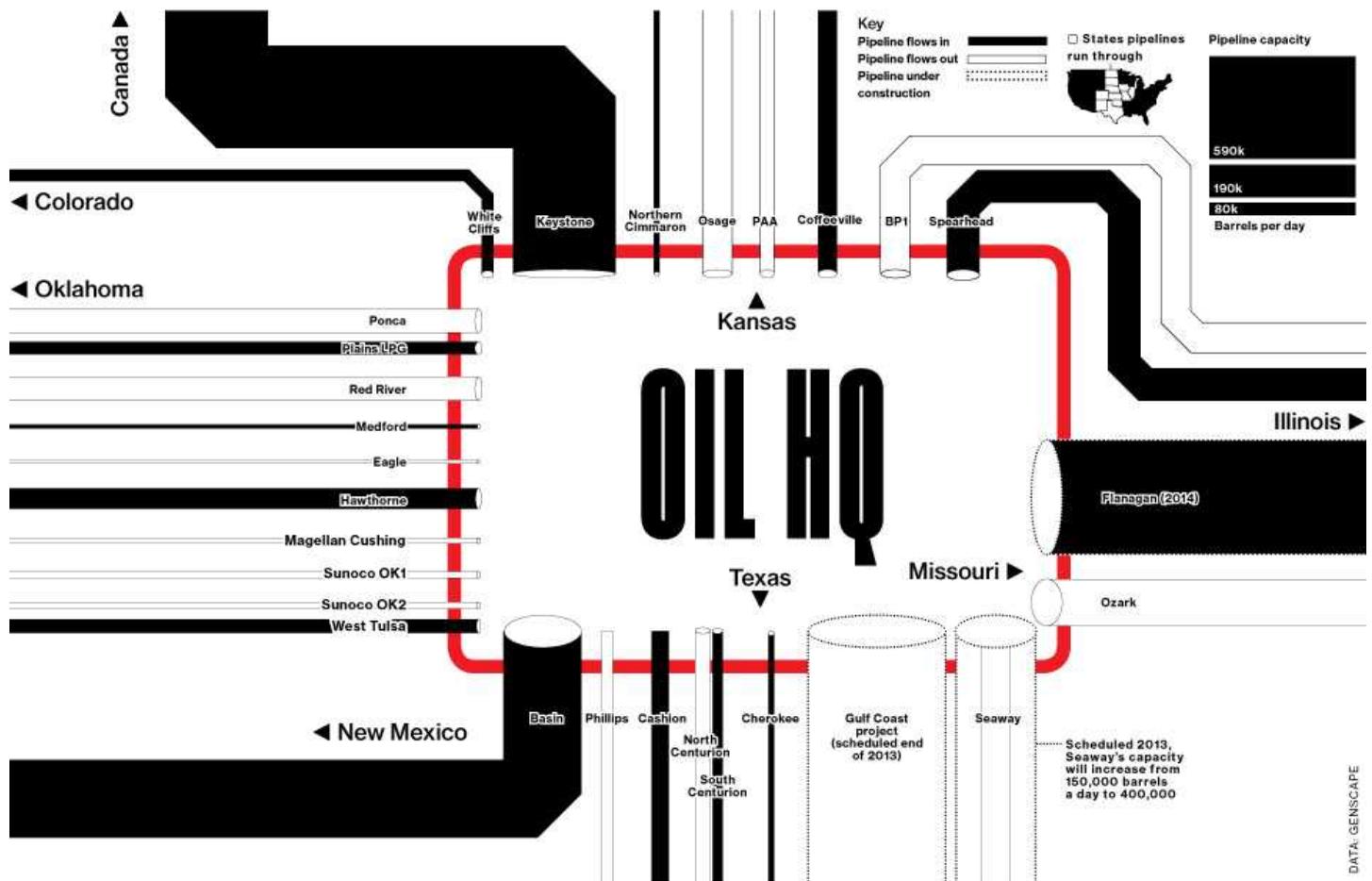
Licensing this design is challenging. It's so different from existing plants that regulations must be changed to accommodate it. That worries some watchdogs and critics.

"My concern about NuScale is that they believe so deeply that their reactor is safe and doesn't need to meet the same criteria as the larger reactors, that it's pushing for lots of exemptions and exceptions," says Edwin Lyman, acting director of the Nuclear Safety Project at the Union of Concerned Scientists.

Lyman argues that even with NuScale's passive safety design, things could go wrong. He'll be among those watching regulators closely as NuScale pushes to have its first power plant built and operating in 2026.

Oklahoma's Cushing Oil Hub Illustrated

Joe Wertz, StateImpact Oklahoma, October 9, 2012



This illustration by *Businessweek* shows the pipeline pathways in and out of the crude oil storage hub at Cushing. Fields of tanks are fed by an 11-state pipeline network that stretches from North Dakota to the Gulf Coast of Texas.

(Source: Bloomberg Businessweek)

It's hard to wrap your head around the oil hub in Cushing, Oklahoma.

Much of the pipeline infrastructure is underground, and what is visible is as expansive as it is unrevealing: Hulk-ing, featureless cylinders in fenced-off fields. Thick steel obscures valuable oil storage and transport data, forcing traders to spy on the vast tankscape with satellites, sensors and infrared cameras.

It might be impossible to know exactly how much crude is in those tanks at any given moment. Even a good estimate could be worth millions.

But it's a little easier to find out who can move the crude in and out of Cushing, and where it's coming from. And the graphic gurus over at *Businessweek* have assembled an elegant schematic of the major pathways to and from Cushing.

\$1.6B pipeline proposed to move North Dakota crude oil to Cushing

James MacPherson, The Associated Press, June 11, 2019



Two companies are proposing a \$1.6 billion pipeline to move North Dakota crude oil, making it the biggest such project in the state since the Dakota Access pipeline that sparked violent clashes between protesters and law enforcement in 2016 and 2017.

Houston-based Phillips 66 and Casper, Wyoming-based Bridger Pipeline announced the joint venture called Liberty Pipeline on Monday. It's designed to move 350,000 barrels of oil daily from western North Dakota's oil patch to the nation's biggest storage terminal in Cushing, Oklahoma. From there, the companies said shippers can access multiple Gulf Coast destinations.

The route of the 24-inch pipeline has not been disclosed, though the companies said in a statement the project "will utilize existing pipeline and utility corridors and advanced construction techniques to limit environmental and community impact."

The companies did not immediately return phone calls to provide further details Tuesday.

North Dakota's Public Service Commission must approve the pipeline's route in the state. Spokeswoman Stacy Eberl

said the agency has not seen any plans from the companies, which said in their statement they hope to have the pipeline operational in the first quarter of 2021.

"The route will have to be determined before they apply to us because we approve the route," Eberl said Tuesday. "Nothing has been filed with us at all."

The companies' statement said they plan to begin booking shipping commitments from suppliers "at a later date."

North Dakota is the nation's second-biggest oil producer behind Texas. The state's oil production is pegged at 1.4 million barrels daily.

The \$3.8 billion Dakota Access oil pipeline, which has the capacity to move about half of the oil produced daily in North Dakota, has been moving North Dakota oil through South Dakota and Iowa to a shipping point in Illinois since June 2017.

Native American tribes and other groups that feared environmental harm from the pipeline staged large protests that resulted in more than 760 arrests in southern North Dakota over a six-month span beginning in late 2016.

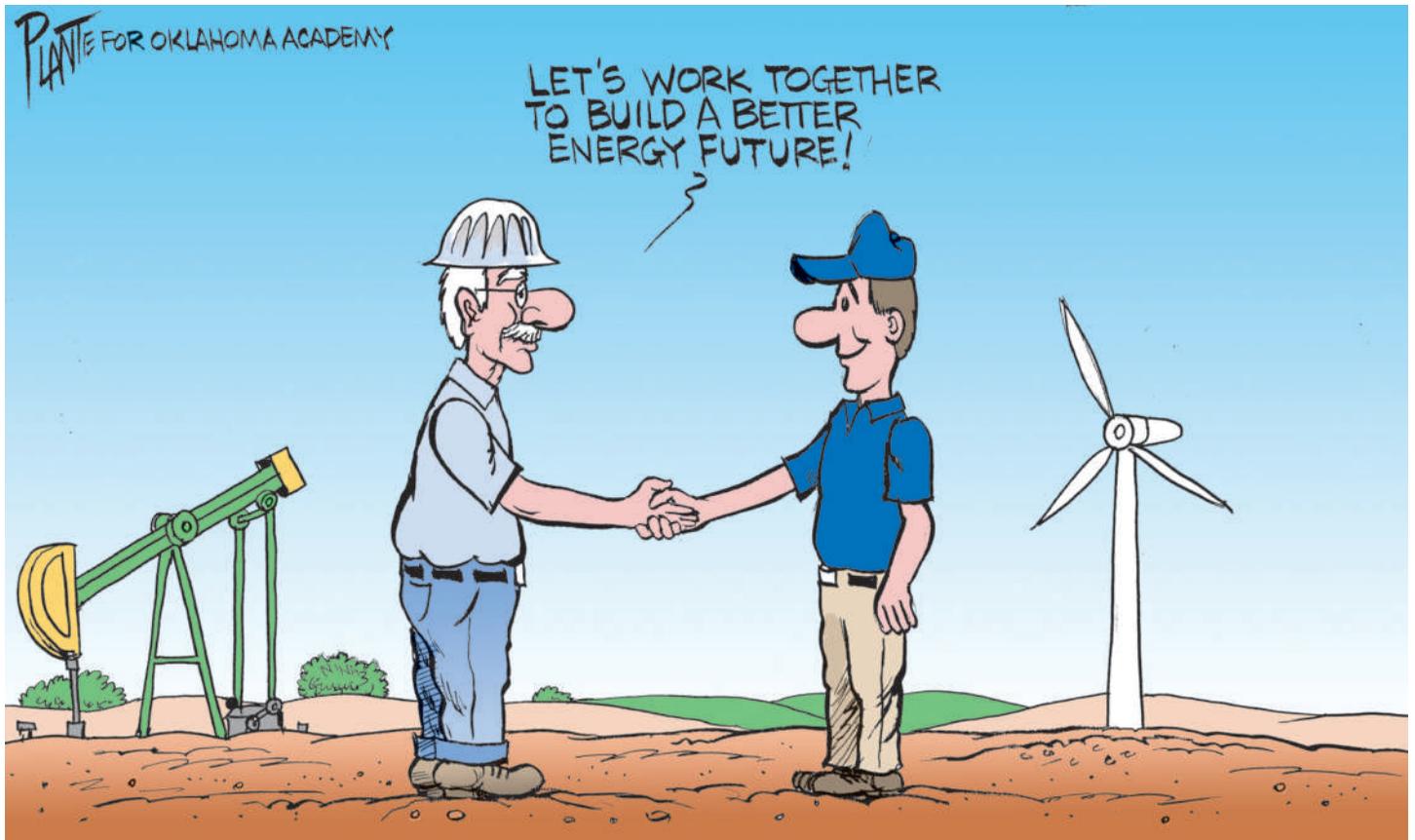
Section 3
Energy and the Enviroment

The Environment vs. Energy-Producing States

Craig Knutson, Town Hall Research Chair, August 26, 2019

States:	Natural Environment (1)	Environmentally Friendly (2)
Texas	40	41
Pennsylvania	38	24
Wyoming	17	47
Oklahoma	42	42
West Virginia	41	49
N. Dakota	36	46
Colorado	31	21
New Mexico	23	34
Louisiana	50	50
California	5	43
Ohio	44	35
Illinois	43	22

- (1) U.S. News and World Reports, 2019; Air and Water Quality + Pollution (<https://www.usnews.com/news/best-states/rankings/natural-environment>)
- (2) WalletHub, 2019; 27 metrics in three categories: Environmental Quality, Eco-Friendly Behaviors, and Climate Change Contributions (<https://wallethub.com/edu/greenest-states/11987/>)
- Rank: 1 = Best for the Environment, 50 = Worst for the Environment



BP, Shell pledge \$1M for carbon tax push

Timothy Cama, E&E News: Climatewire, May 20, 2019



BP PLC and Royal Dutch Shell PLC are backing efforts to enact a price on carbon. Mike Mozart/Flickr (BP); Shell

Oil giants BP PLC and Royal Dutch Shell PLC are each pledging \$1 million to Americans for Carbon Dividends, a Republican- and corporate-backed effort to impose a price on carbon.

BP and Shell are joining fellow oil majors Exxon Mobil Corp. and ConocoPhillips Co. in making some of the largest public contributions to the advocacy group.

Exxon pledged \$1 million, and ConocoPhillips promised \$2 million, both last year. Paris-based EDF Renewables Inc. is also putting money behind the plan, with a \$200,000 promise.

The pledges are boosting Americans for Carbon Dividends' hopes that the United States' business community is coming on board with its plan.

"This is another indication of growing momentum behind a carbon dividends approach to solving climate change," Greg Bertelsen, the group's senior vice president, said in a statement.

"The momentum is clearly building among the business community, who are increasingly coming together and rallying behind market-based solutions to drive significant emission reductions in the economy."

BP and Shell said their contributions put weight behind their calls for federal carbon pricing legislation. They will also be among dozens of companies lobbying lawmakers on Capitol Hill this week on the issue.

"For more than two decades BP has publicly acknowledged that climate change is an important issue that justifies global action. That is why we support the Paris goals and have for many years advocated for a well-designed, economy-wide price on carbon to help deliver them," Susan Dio, president of BP America, said in a statement.

"With our \$1 million pledge to the work of the Climate Leadership Council, we aim to make further progress on this front — and to keep advancing the transition to a lower-carbon future."

Shell U.S. President Gretchen Watkins said the company believes the carbon tax-and-dividend idea is "well thought out and reflective of societies' growing desire to address climate change."

"It's our hope Shell's support of AFCD and like-minded coalitions ultimately leads to legislation that establishes a national price on carbon," she said.

BIPARTISAN SUPPORT

Americans for Carbon Dividends is the advocacy arm of the Climate Leadership Council, which was launched in 2017.

Together, they are formulating and pushing a plan written by former Republican White House chief of staff James Baker and former Republican Secretary of State George Shultz that would charge companies \$40 per ton of carbon dioxide they emit, and return the funds to taxpayers via quarterly checks.

The group also announced new polling data today that found majority support across party lines, including 53% of Republican voters, for a plan to tax companies' greenhouse gas emissions and return the money to taxpayers.

The poll was commissioned by Americans for Carbon Dividends and conducted by the firm of GOP pollster Frank Luntz.

“It shows even greater support among the American public for ambitious climate action, and a carbon dividends proposal in particular, than before,” Bertelsen said, pointing specifically to the 7-to-1 support among Republicans younger than 40 for a carbon tax-and-dividend policy, “a really encouraging finding.”

Shell and BP are among more than 70 companies sending leaders to Washington, D.C., this week to push for carbon pricing policies through business-focused advocacy group Ceres, in an effort the group has dubbed the Lawmaker Education & Advocacy Day (LEAD) on Carbon Pricing.

“Congress needs to create a stable, predictable policy environment that sends a transparent price signal to business. A well-designed, strong, equitable carbon pricing mechanism offers just the sort of signal to which businesses will respond with new investments in clean technologies,” the organization said of its effort.

“Congress must put forward a policy response equal to the severity of the challenge — and that should include a meaningful price on carbon.”

Oil and natural gas companies could stand to benefit from carbon pricing, which would likely reduce demand for coal as an electricity source, to be replaced with demand for natural gas.

REPUBLICAN BILLS

GOP lawmakers may start being more receptive to the message than they've been before. Still, strong divisions remain within the party.

Sen. John Cornyn (R-Texas) said last week that he and other members were preparing “innovation” legislation intended to fight climate change (E&E News PM, May 16).

Sen. Lamar Alexander (R-Tenn.), a top Senate appropriator, has similarly talked about a “New Manhattan Project” focused on energy innovation (E&E Daily, April 12).

GOP members pushing a price on carbon are, however, fewer. One of them, Rep. Francis Rooney (R-Fla.), is pushing a carbon tax bill alongside Rep. Ted Deutch (D-Fla.) (Greenwire, Jan. 24).

Notes

This is a resource document for you to use.

Take notes, highlight, use as a text book.

Xcel's 2030 plan: Ditch coal, expand solar, extend nuclear

Jeffrey Tomich, E&E News: Energywire, May 21, 2019



Xcel Energy Inc. announced plans to retire all of its remaining Midwestern coal plants, including the last unit at the Sherco plant in Minnesota (pictured), by 2030 under an agreement with environmental and labor groups.

One of the Midwest's largest utilities is upping the ante on clean energy by closing its remaining coal-burning plants a decade earlier than scheduled as part of a broader push to clean up its fuel mix.

Minneapolis-based Xcel Energy Inc. announced yesterday the closures of its two remaining coal plants in the region by 2030 under a pact with environmental and labor groups. The company will shut its Allen S. King Generating Station by 2028 and the remaining unit at the Sherburne County (Sherco) plant by 2030.

Under the agreement, Xcel also agreed to add 3,000 megawatts of solar by 2030, do more energy efficiency work and operate Unit 2 at its Sherco plant on a seasonal basis until it's retired in 2023. In exchange, clean energy groups won't oppose Xcel's \$650 million purchase of a natural gas plant.

While other large Midwest utilities are planning to exit coal by 2040 or 2050, Xcel has continued to accelerate the transition to cleaner energy sources and slash carbon emissions at an even faster pace.

Xcel's announcement lines up with the company's plan to reduce carbon emissions 80% by 2030 and puts it on a path to 100% carbon-free energy by 2050, said Chris Clark, president of Xcel's Upper Midwest utilities.

In the Upper Midwest, Xcel's carbon goals also include extending the operating license for the Monticello Nuclear Generating Station northwest of the Twin Cities.

The 671-MW, single-reactor plant is currently licensed to operate through 2030. Xcel said it wants to run the plant at least another decade.

"We don't want to try to exit coal and nuclear at the same time," Clark said in an interview. "Nuclear gives us that dispatchable carbon-free resource that makes this plan truly nation leading because we are able to get these carbon reductions on our system and get them so quickly."

Xcel will detail its long-range plan for meeting energy demand in an integrated resource plan (IRP) to be filed with the Minnesota Public Utilities Commission on July 1.

The company released an overview of the plan yesterday in conjunction with the agreement involving the Mankato Energy Center, the natural gas-fired plant.

Aaron Klemz of the Minnesota Center for Environmental Advocacy said the agreement to accelerate coal retirements is significant and leaves just one coal plant in the state for which a retirement date hasn't been set — Minnesota Power's Boswell Energy Center.

"It is a substantial move forward for Xcel," Klemz said.

Meanwhile, the solar build-out will provide a significant new source of carbon-free energy, and Xcel will give preference to proposals that maximize the creation of local jobs.

Clean energy groups were willing to drop their opposition to the 760-MW plant in return for commitments to shutter coal units and add more clean energy. Xcel already had long-term contracts in place to buy energy from the natural gas-fired plant.

Xcel said it wants to own the plant solely because it's cheaper for consumers. The utility has pledged as part of its carbon strategy to keep power bill increases for its customers at or below the rate of inflation.

The utility also agreed to continue to evaluate the economics of the gas plant as part of future IRP cases.

As with the nuclear plants, the Mankato plant and another combined-cycle gas plant to be developed next decade enable the company to shutter coal plants and pursue significant amounts of wind and solar generation.

"The transition from dispatchable baseload to a really heavy fleet of intermittent generation is not taken lightly by us," said Jonathan Adelman, Xcel's vice president of strategic resources and business planning. "We've embedded a lot of reliability considerations in the plan and are 100% confident around that balance of reliability as we transition forward."

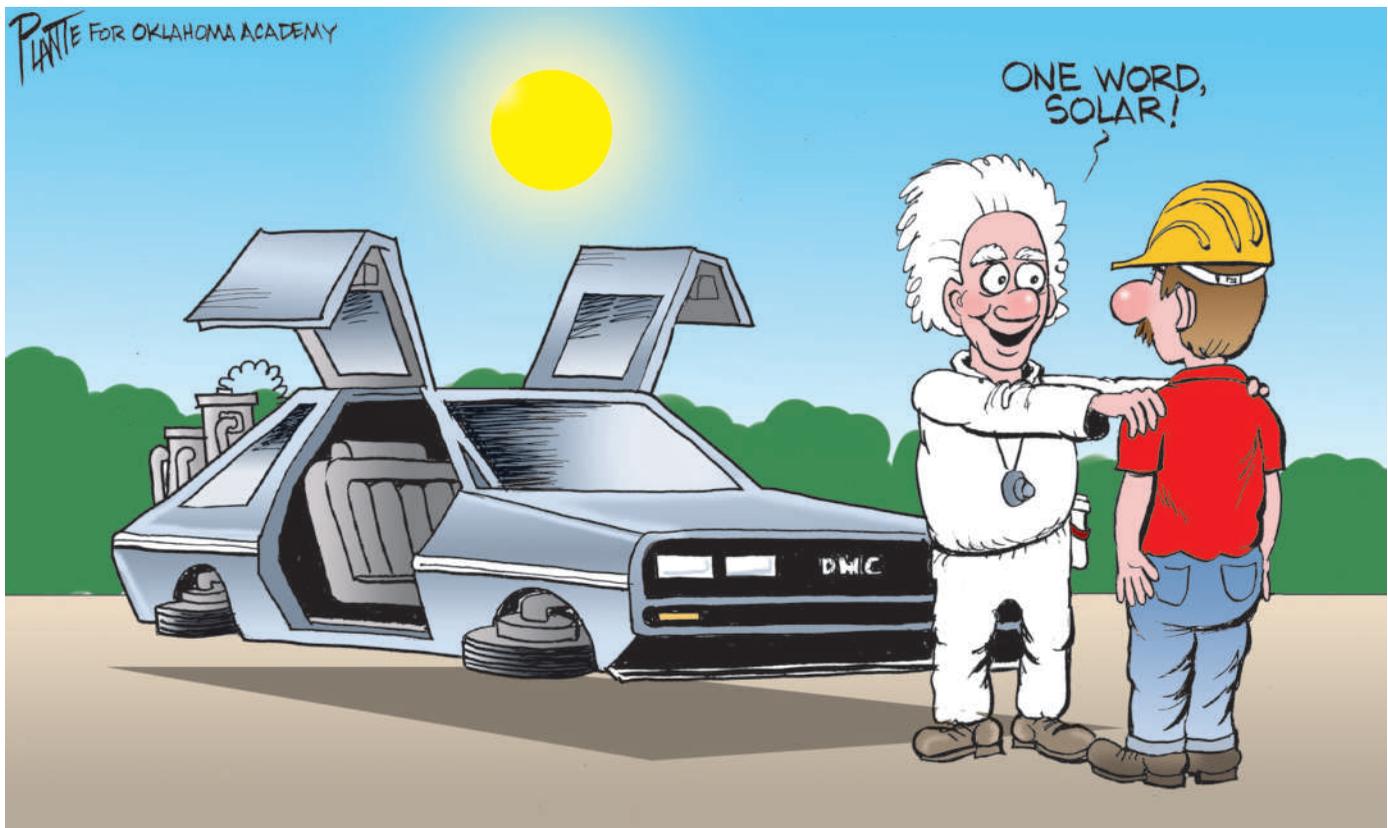
The solar additions specifically will more than triple the amount of solar generation on Xcel's Upper Midwest system and complement almost 3,000 MW of wind online by 2022.

Adelman said the wind and solar capacity are complementary, with new solar providing higher capacity values and more energy during peak hours. Meanwhile, solar prices are continuing to fall in a way that Xcel can add the solar capacity at a "small cost premium."

Plans being filed with regulators in the coming months will further define how Xcel meets its 80% carbon reduction goal by the end of next decade. Meanwhile, it puts the company in position to help meet its goal of being 100% carbon-free by 2050.

How Xcel achieves the goal will play out in the coming years, Xcel's Clark said.

"We recognize that there is going to be all sorts of opportunities for innovation and technology and that much of this will unfold in the 2020s, including perhaps with technologies that we can see right now that aren't in the money and technologies that are more on the R&D side of the coin," he said.



Global climate goals in peril as reactors close — IEA

Nathanial Gronewold, *E&E News: Climatewire*, May 28, 2019

The world is on track to lose a quarter of existing nuclear capacity by 2025, leaving clean energy and climate goals in jeopardy, according to a report released today.

The Paris-based International Energy Agency argues that the 25% of existing nuclear power capacity will be lost in six years and up to two-thirds by 2040.

The report marks IEA's first public assessment of the state of the nuclear power industry in about two decades.

Renewable energy builds are unlikely to fill the gap, the agency predicts, meaning nations will probably replace lost nuclear generation with natural gas or coal, thus potentially increasing carbon dioxide emissions by up to 4 billion metric tons per year.

The share of nuclear energy in the United States' electricity fleet could fall from around 20% of power generation today to just 8% by 2040 given current trends, IEA analysts conclude.

"We expect a steep decline of the existing nuclear fleet," IEA Executive Director Fatih Birol said during a call with reporters.

In language that echoes past arguments made by the Trump administration, IEA is recommending designing electricity markets in ways that reward reliable baseload sources of power as opposed to variable renewables. The report calls to "design the electricity market in a way that properly values the system services needed to maintain electricity security, including capacity availability and frequency control services."

Energy Secretary Rick Perry has in the past suggested favorable market treatment for baseload electricity sources that meet the Trump administration's definition of energy security, but Perry's aim was to bolster coal-fired power generation as it loses market share. IEA, on the other hand, would only apply this standard to emissions-free power sources such as nuclear.

Otherwise, to meet the gap created by lost nuclear generation without fossil fuels, the world would have to install new wind and solar photovoltaic generating systems at rates five times faster than what has been achieved over the past 20 years, according to the IEA study. That would spike electricity bills, the agency argues, because massive new transmission infrastructure would be needed to connect it all, even if it could be built.

Simply extending the lifetimes of existing nuclear reactors would be far cheaper, IEA says.



A quarter of existing nuclear power is set to be retired within six years, and renewable energy is unlikely to make up the gap in providing electricity, according to a new report. Lawrence Livermore National Laboratory.

However, "there are major challenges in building new power plants, on top of that getting lifetime extensions of existing plants," Birol said. "We think this situation may well have serious implications for our fight against climate change and at the same time electricity security for the countries around the world."

Birol noted that the global share of low-carbon sources of electricity — wind, solar, nuclear and hydropower — has been stuck at 36% for several years despite the rapid build-up of wind and solar energy. The lack of progress is due to faltering nuclear energy, he said.

To further clean the world's grid, IEA proposes introducing new market incentives and explicit government support for carbon-free baseload sources of power such as nuclear energy.

IEA warns that abandoning nuclear, one of the main sources of emissions-free energy, will make it that much harder for the world to decarbonize the power sector.

That includes efforts to reduce greenhouse gas emissions in the United States, IEA says, where climate change activists stress solar and wind energy and remain hostile to nuclear power. Reactors currently generate more emissions-free electricity in the United States than solar and wind energy generation combined.

"We also need to see other low-carbon technologies to make the contribution," Birol said.

The new IEA report calls out the overemphasis on the two popular sources of renewable energy, with analysts there expressing concerns over the consequences of activists

and governments promoting emissions reduction strategies based solely on wind and solar, as both those sources are variable and inconsistent.

Peak solar and wind generating periods don't correspond with peak demand for electricity.

Solar photovoltaic generation works only in daylight and best at high noon on sunny days, but grid operators say demand peaks later in the afternoon toward the evening hours, as people return from work and turn on their lights, appliances and air conditioners. Land-based wind power systems often see their strongest generation occur overnight, when people are asleep and grid demand is lowest.

IEA says nuclear can and should be relied on to make up for this variability and to stabilize power supplies.

"Nuclear plants help to keep power grids stable," the authors say in the executive summary. "To a certain extent, they can adjust their operations to follow demand and supply shifts. As the share of variable renewables like wind and solar photovoltaics rises, the need for such services will increase."

But the fate of nuclear in the United States and elsewhere is entirely dependent on government policy, IEA's analysts conclude.

The agency estimates that the average U.S. nuclear reactor is now at least 39 years old, hitting up against the typical 40-year "original design lifetime for operations."

And even where plants are designed to operate longer, unfavorable economics and politics are seeing early retirements of reactors. Some 90 nuclear reactors in the United States have planned life spans of 60 years, but early retirements of these units are mounting, according to the report.

It's much the same story in Europe and Japan.

For instance, most independent analysts think the Japanese government will only succeed in getting a relative handful of shuttered nuclear reactors back online because of public opposition, delays and a refusal by regulators to offer lifetime extensions for aging reactors.

The European Union is at risk of losing over 100 gigawatts

of nuclear power capacity, the largest total potential decline of any jurisdiction, according to IEA. Nuclear power's share of the European Union's grid could slide from some 25% today to just 4% by 2040.

The agency acknowledges that economics have had a major role in nuclear's bleak outlook.

"Low wholesale electricity and carbon prices, together with new regulations on the use of water for cooling reactors, are making some plants in the United States financially unviable," IEA says, while lamenting that nuclear power isn't afforded government incentives like feed-in tariffs or loan guarantees extended to other zero-emissions generation.

Reversing the economic misfortunes of nuclear power stations would mean "more intrusive policy intervention given the very high costs of projects and unfavorable recent experiences in some countries," the authors said.

IEA makes several new policy recommendations to save nuclear power.

The agency calls on governments to consider halting early retirements of units and recommends instead authorizing lifetime extensions for reactors, keeping them running "for as long as safely possible." The report also suggests that governments extend financial incentives to nuclear as they do to wind and solar projects, given that both are emissions-free energy sources.

Governments, IEA says, should clear the red tape necessary to get a new nuclear power plant built or to get the lifetimes of existing reactors extended, as well as provide government-supported project financing mechanisms.

Analysts there say they would also like to see faster deployment of proposed small modular reactor technologies.

But Birol was careful to note that IEA is not recommending nuclear energy for countries that simply don't want it or cannot afford to build it.

"Our main audience for this report is the countries who want to keep" existing nuclear energy generating capacity "but have serious market and economic challenges," he said. "I hope our report will help them to make better policies."

Switching to renewables will not be as rapid as many hope

Special Report: *The Geopolitics of Energy*, *The Economist*, March 15, 2018

Clean energy may not yet have reached a tipping-point

HE CALLS IT “the geopolitics of the gap”. Carlos Pascual of IHS Markit, a consultancy, says that one of the biggest challenges for the world’s policymakers in coming years will be to strengthen pledges made in the Paris agreement. They still amount to barely one-third of what is necessary to keep global temperatures from rising more than 2°C above pre-industrial levels.

Renewable-energy advocates talk of a “tipping-point” at which renewables become cheap enough to drive fossil fuels out of the electricity mix. To hear them talk about falling costs, you would think the world was almost there (see chart). Yet excluding hydropower, renewables still produce only 8% of the world’s electricity, and far less of the energy needed for heating, cooling and transport, which are harder to decarbonise.

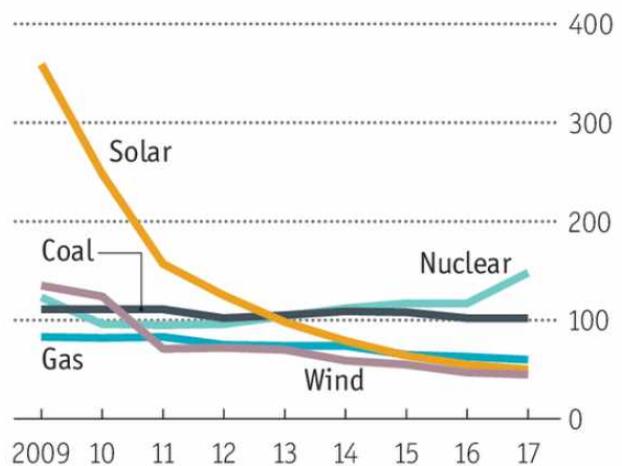
A few statistics in a new book, “Taming the Sun”, by Varun Sivaram, of the Council on Foreign Relations in Washington, DC, highlight the obstacles to be overcome before solar photovoltaics become a mainstream energy source. However fast the price of a kilowatt-hour of electricity generated by solar panels has fallen, he writes, the price of a gigabyte of data storage in a microchip has fallen a million times faster. The recent drop in solar prices has been due to economies of scale, not improvements in performance.

Moreover, Mr Sivaram argues that although solar panels are cost-competitive as a niche energy source, their economics become less attractive the more they are deployed. That is because they cannot be turned on and off, so they flood the electricity market when the sun is high, driving down wholesale prices. The more solar power is added to the grid, the lower its value.

Batteries could help solve that problem by storing the power for times of strong demand. But no one has yet invented a lithium-ion battery capable of storing solar energy for long periods of time to even out seasonal variations in sunlight. Electric vehicles (EVs) could speed up the energy transition, by cleaning up the transport component of energy and offering a way to store electricity, too. But mass

Clean equals cheap

North America, average cost of energy
\$ per MWh



Source: Lazard, levelised cost of energy analysis

Economist.com

electrification brings its own problems.

In order to incorporate large quantities of renewables, interconnected power systems will be needed so that those with an abundance of clean energy can share it with those who lack it. The risk is that these will recreate the vulnerabilities of cross-border pipelines. Karen Smith Stegen of Jacobs University in Germany argues in “The Geopolitics of Renewables” that interconnected grids are relatively safe because all the countries involved want to keep the electricity flowing smoothly. But high-voltage, direct-current transmission lines, such as those now being proposed between north Africa and Europe, may be more at risk of meddling.

None of these problems are insurmountable. New, more efficient solar technologies are being developed. Financial innovation is creating new ways of investing in renewable energy. Elon Musk, of Tesla and SpaceX fame, may yet produce lithium-ion batteries cheap enough to revolutionise transport. In the West he gets most of the attention, but China is also doing much pioneering work, from EVs to supergrids.

State Renewable Portfolio Standards and Goals

National Conference of State Legislatures, February 1, 2019

States have been very active in the past year revising their Renewable Portfolio Standards (RPS), which requires that a specified percentage of the electricity that utilities sell comes from renewable resources. States have created these standards to diversify their energy resources, promote domestic energy production and encourage economic development. Renewable energy policies help drive the nation's \$64 billion market for wind, solar and other renewable energy sources. These policies can play an integral role in state efforts to diversify their energy mix, promote economic development and reduce emissions. Roughly half of the growth in U.S. renewable energy generation since 2000 can be attributed to state renewable energy requirements.

Iowa was the first state to establish an RPS and since then, more than half of states have established renewable energy targets. Twenty-nine states, Washington, D.C., and three territories have adopted an RPS, while eight states and one territory have set renewable energy goals.

State renewable portfolio standard policies vary widely on several elements including RPS targets, the entities they include, the resources eligible to meet requirements and cost caps. In many states, standards are measured by the percentage of retail electric sales. Iowa and Texas, however, require specific amounts of renewable energy capacity rather than percentages and Kansas requires a percentage of peak demand. While most state targets are between 10 and 45 percent, seven states—California, Hawaii, Massachusetts, New Jersey, New York, Oregon, and Vermont, and Washington, D.C.—have requirements of 50 percent or greater. RPS requirements can apply only to investor-owned utilities (IOUs), although many states also include municipalities and electric cooperatives (Munis and Co-ops), sometimes with a lower target. Utilities that are subject to these mandates must obtain renewable energy credits or certificates (RECs)—which represent the environmental benefits of one megawatt-hour of renewable energy generation. RECs are created when renewable energy is sent out to the grid and are used to verify that utilities are meeting their targets. Eligible resources for RPS compliance include wind, solar, biomass, geothermal and some hydroelectric facilities—depending on the size and vintage. Several states also include additional resources such as landfill gas, tidal energy, combined heat and power, and even energy efficiency. According to Lawrence Berkeley National Laboratory, 20 states and Washington, D.C., have cost caps in their RPS policies to limit increases to a certain percentage of ratepayers' bills. One state caps RPS gross procurement costs.

To promote a diversified resource mix and encourage deployment of certain technologies, states have established carve-outs and renewable energy credit multipliers within their RPSs for specific energy technologies, such as offshore wind or rooftop solar. Carve-outs require a certain percentage of the overall

renewable energy requirement to be met with a specific technology, while credit multipliers award additional renewable energy credits for electricity produced by certain technologies. At least 21 states and Washington, D.C., have credit multipliers, carve-outs, or both for certain energy technologies in their RPS policies.

In recent years, the role of RPS policies has diminished, accounting for only 34 percent of renewable energy capacity additions in 2017. Although RPS policies are still important to encouraging deployment of renewables, other factors, including declining renewable energy costs and other state energy policies, such as net metering, are also driving growth. As renewable energy becomes increasingly competitive, some states are considering whether RPS policies are still needed to drive growth. In 2017, at least three states—Maryland, Montana and New Hampshire—enacted legislation to study the costs and benefits of their RPS policies.

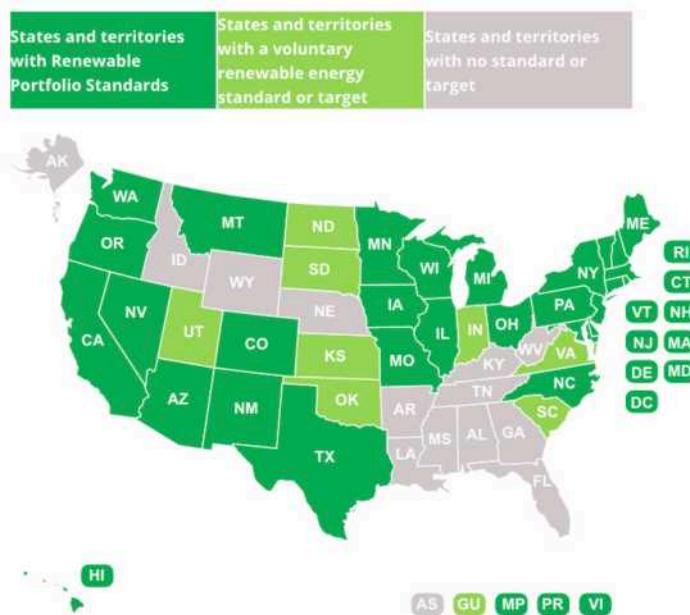


Table: Renewable Portfolio Standards or Voluntary Targets

Note: States and territories listed in italics have voluntary renewable energy goals.

On the following page are the top 10 energy producing states that have a Renewable Portfolio Standards or goals. Throughout the document we have shown you the top 12 energy producing states, however as shown above, Wyoming and Louisiana have no standards or target goals for renewable standards.

California

- **Title:** Renewables Portfolio Standard.
- **Established:** 2002.
- **Requirement:** 44 percent by 2024; 52 percent by 2027; 60 percent by 2030. Also requires 100 percent clean energy by 2045.
- **Applicable Sectors:** Investor-owned utility, municipal utilities.
- **Cost Cap:** Determined by the California Public Utilities Commission.
- **Details:** A 2013 amendment allows the California Public Utilities Commission to adopt additional requirements.
- **Enabling Statute, Code or Order:** [Cal. Public Utilities Code §399.11 et seq.](#); [Cal. Public Resources Code §25740 et seq.](#); [Assembly Bill 327 \(2013\)](#); [Senate Bill 350 \(2015\)](#); [Senate Bill 100 \(2018\)](#).

Colorado

- **Title:** Renewable Energy Standard.
- **Established:** 2004.
- **Requirement:** 30 percent by 2020 (IOUs); 10 percent or 20 percent for municipalities and electric cooperatives depending on size.
- **Applicable Sectors:** Investor owned utility, municipal utilities, cooperative utilities.
- **Cost Cap:** 2.0 percent.
- **Details:** Distributed Generation: 3 percent of IOU retail sales by 2020, 1 percent of cooperative retail sales by 2020 (for those providing service to 10,000 or more meters) or 0.75 percent of cooperative retail sales by 2020 (for those providing service to less than 10,000 meters). The state has several credit multipliers for different technologies.
- **Enabling Statute, Code or Order:** [Colo. Rev. Stat. §40-2-124](#); [Senate Bill 252 \(2013\)](#).

Illinois

- **Title:** Renewable Portfolio Standard.
- **Established:** 2001 (voluntary target); 2007 (standard).
- **Requirement:** 25 percent by 2025-2026.
- **Applicable Sectors:** Investor-owned utility, retail supplier.
- **Cost Cap:** 1.3 percent.
- **Details:** Distributed Generation: 1 percent of annual requirement beginning in 2015 for IOUs. Wind: 75 percent of annual requirement for IOUs, 60 percent of annual requirement for alternative retail electric suppliers. Photovoltaics: 6 percent of annual requirement beginning in 2015-2016.
- **Enabling Statute, Code or Order:** [Ill. Rev. Stat. ch. 20 §688 \(2001\)](#); [Ill. Rev. Stat. ch. 20 §3855/1-75 \(2007\)](#); [Senate Bill 2814 \(2016\)](#).

New Mexico

- **Title:** Renewables Portfolio Standard.
- **Established:** 2002.
- **Requirement:** 20 percent by 2020 (IOUs); 10 percent by 2020 (co-ops).
- **Applicable Sectors:** Investor-owned utility, cooperative utilities.
- **Cost Cap:** 3.5 percent.
- **Details:** Solar: 20 percent by 2020 (IOUs). Wind: 30 percent by 2020 (IOUs). Other renewables including geothermal, biomass and certain hydro facilities; 5 percent by 2020 (IOUs). Distributed Generation: 3 percent by 2020 (IOUs). The state has a credit multiplier for solar energy that was operational before 2012.
- **Enabling Statute, Code or Order:** [N.M. Stat. Ann. §62-15](#); [N.M. Stat. Ann. §62-16](#).

Ohio

- **Title:** Alternative Energy Resource Standard.
- **Established:** 2008.
- **Requirement:** 12.5 percent by 2026. [Senate Bill 310 \(2014\)](#) created a two-year freeze on the state's standard while a panel studied the costs and benefits of the requirement. The freeze was not extended in 2016.
- **Applicable Sectors:** Investor-owned utility, retail supplier.
- **Cost Cap:** 1.8 percent.
- **Details:** Solar: 0.5 percent.
- **Enabling Statute, Code or Order:** [Ohio Rev. Code Ann. §4928.64 et seq.](#)

Oklahoma

- **Title:** Renewable Energy Goal.
- **Established:** 2010.
- **Requirement:** 15 percent by 2015.
- **Applicable Sectors:** Investor-owned utility, municipal utilities, cooperative utilities.
- **Enabling Statute, Code or Order:** [Okla. Stat. tit. 17 §801.1 et seq.](#)

Pennsylvania

- **Title:** Alternative Energy Portfolio Standard.
- **Established:** 2004.
- **Requirement:** 18 percent by 2020-2021.
- **Applicable Sectors:** Investor-owned utility, retail supplier.
- **Cost Cap:** None.
- **Details:** Tier I: 8 percent by 2020-2021 (includes photovoltaic). Tier II (includes waste coal, distributed generation, large-scale hydropower and municipal solid waste, among other technologies); 10 percent by 2020-2021. Photovoltaic: 0.5 percent by 2020-2021.
- **Enabling Statute, Code or Order:** [Pa. Cons. Stat. tit. 66 §2814](#).

North Dakota

- **Title:** Renewable and Recycled Energy Objective.
- **Established:** 2007.
- **Requirement:** 10 percent by 2015.
- **Applicable Sectors:** Investor-owned utility, municipal utilities, cooperative utilities.
- **Enabling Statute, Code or Order:** [N.D. Cent. Code §49-02-24 et seq.](#)

Texas

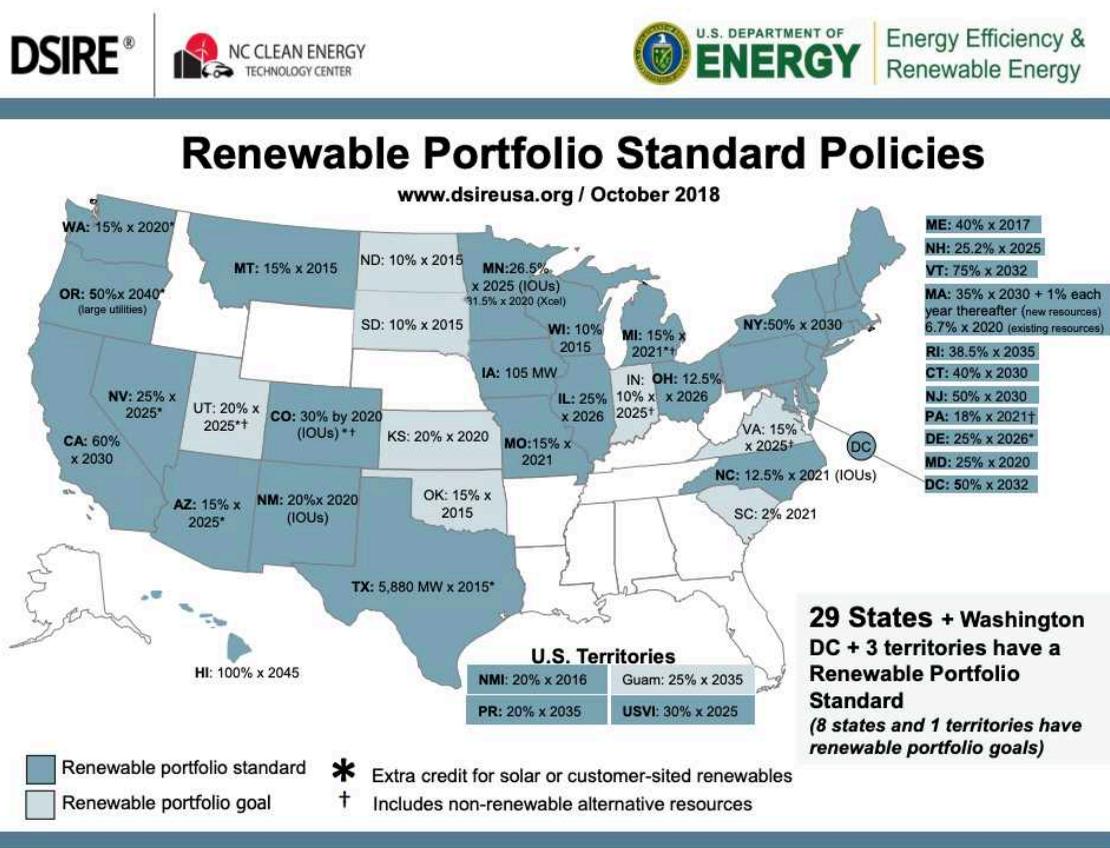
- **Title:** Renewable Generation Requirement.
- **Established:** 1999.
- **Requirement:** 5,880 MW by 2015. 10,000 MW by 2025 (goal; achieved).
- **Applicable Sectors:** Investor-owned utility, retail supplier.
- **Cost Cap:** 3.1 percent.
- **Details:** Non-wind: 500 MW (goal).
- **Enabling Statute, Code or Order:** [Tex. Utilities Code Ann. §39.904](#).

West Virginia

- **Title:** *Alternative and Renewable Energy Portfolio Standard- REPEALED.*
- **Established:** 2009; *Repealed 2015.*
- **Requirement:** 10 percent from 2015-2019, 15 percent from 2020-2024, 25 percent by 2025.
- **Details:** Goal is applicable to IOUs that serve more than 30,000 residential customers. Goal includes alternative energy sources, including coal technology, coal bed methane, natural gas, combined cycle technologies, waste coal and pumped storage hydroelectric projects.
- **Enabling Statute, Code or Order:** [W. Va. Code §24-2F](#); [Repeal: House Bill 2001](#).

Oklahoma Renewable Energy Goal

DSIRE, June 22, 2018



In May 2010, the Oklahoma Legislature enacted the Oklahoma Energy Security Act, establishing a renewable energy goal for electric utilities operating in the state. The goal calls for 15% of the total installed generation capacity in Oklahoma to be derived from renewable sources by 2015. There are no interim targets, and the goal does not extend past 2015.

The Oklahoma Energy Security Act also established a natural gas energy standard to declare natural gas as the preferred choice for any new fossil fuel generating facilities and added capacity to existing fossil fuel generating facilities beginning January 1, 2011, through January 1, 2020. Any electricity generation entity in the state choosing a fossil fuel source other than natural gas may provide evidence to the Oklahoma Corporation Commission as to why it is in the best interest of the state’s electric consumers.

The Oklahoma Corporation Commission reported that 25.9% (6417 MW) of installed capacity came from eligible renewable energy resources and demand side management in 2015, which is 5.05% higher than the year of 2014.

Eligible Technologies

Eligible renewable energy resources include wind, solar, photovoltaics, hydropower, hydrogen, geothermal, biomass,

landfill gas, distributed generation from an eligible renewable energy resource where the generating facility or any integrated cluster of such facilities has an installed generating capacity of not more than five (5) megawatts, other renewable sources approved by the Oklahoma Corporation Commission, demand side management and energy efficiency as provided in Title 17, Oklahoma Statutes, Section 801.6. Energy efficiency and demand-side management may be used to meet up to 25% of the renewable energy goal (i.e., 3.75% of total installed generation capacity).

Compliance

Unlike the renewables portfolio standards adopted by other states, Oklahoma’s renewable energy goal does not require utilities to purchase and retire renewable energy credits to demonstrate compliance. Instead, each utility in Oklahoma that owns or operates electricity generation facilities must file a report with the OCC each year by March 1. The report must document the total installed capacity of all generation facilities, the number of kilowatt-hours (kWh) generated by each facility, and the energy source for each facility.

In April 2015, Oklahoma enacted SB 351, which amended the renewable energy goal by allowing steam export capacity at qualified renewable energy sources to count toward the 15% capacity goal.

How artificial intelligence will affect the future of energy and climate

David G. Victor, *The Brookings Institution*, January 10, 2019

Editor's Note: This report is part of "A Blueprint for the Future of AI," a series from the Brookings Institution that analyzes the new challenges and potential policy solutions introduced by artificial intelligence and other emerging technologies.

In a 2017 article for *Foreign Affairs*, Kassia Yanosek and I advanced the hypothesis that the biggest impacts of the information technology (IT) revolution may be felt far outside IT—in the traditional industries of oil, gas, and electricity.[1] That's because IT was transforming how those industries function. That logic of transformation may be especially profound when looking at a subset of the IT revolution: artificial intelligence (AI).

Other essays in this series explain what's happening with AI and why it is such an important technical revolution. In this essay, I'll look at how AI might be affecting the supply and demand for energy and the implications of AI for how modern society uses energy: climate change. In a nutshell, the message is that AI helps make markets more efficient and easier for analysts and market participants to understand highly complex phenomena—from the behavior of electrical power grids to climate change.

But AI itself won't assure that outcome without clear policy incentives. Ironically, extremely smart energy markets lubricated by AI may make it easier to design good policy incentives while also making it easier for consumers to make choices about which energy services and products to buy that avoid the need to cut emissions. Even a big effort to control emissions will leave a lot of climate change—meaning that, in the future, much of "climate policy" will be focused on adapting to climate impacts and implementing quick responses in case of climate emergencies. Extremely intelligent systems for adapting to climate change impacts may make the cost of that adaptation more transparent and thus politically difficult to muster.

The impacts of AI are numerous, but four clusters of impacts seem most likely to affect energy and climate—two will alter the supply and demand for energy, and two will affect the ability of societies to understand how emissions are affecting the climate and how to manage those impacts.

AI IMPACTS ON ENERGY SUPPLY

Most visible in the energy and climate space is the impact of AI on how energy is supplied. That's because more intelligent energy supply systems, in effect, shift outward the supply curves. They take resources that are hard to tap and lower the cost. For example, machine learning systems can improve the ability to map and understand the size and value of underground deposits of oil and gas—in turn, making

it easier to tap those resources at lower cost.

The same logic applies not just to traditional hydrocarbons that make up the backbone of the world's energy system but also new non-hydrocarbon energy supply options. For example, AI-assisted training for the design and operation of wind and solar farms can make these systems much more efficient in how they take financial resources (i.e., capital) and generate electricity. In the case of wind farms, the turbine heads can be oriented actively to capture a greater fraction of the incoming wind—something that has been doable for a long time and can be made more efficient with machine learning. Similar learning can improve the quality of solar forecasting—for example, leading to better day-ahead and hour-ahead predictions of how clouds and other weather formations affect solar output. In turn, better forecasts can make it easier and more lucrative for solar generators to participate in electricity markets.

An interesting question is whether there is a "bias" in how AI-related technologies are affecting energy supply, such as whether they making traditional hydrocarbon suppliers more productive faster than they make zero-carbon renewables more productive? This is a hard question to answer because it requires disentangling the effects of many other technological changes (e.g., improved drill bits, control systems for horizontal drilling, better materials for wind turbine blades, and less costly solar cells) from the specific effects of AI. At the moment, my sense is that AI is having a bigger impact in oil and gas than in renewables because the kinds of activities that are unlocking new hydrocarbon resources—notably the shale revolution in oil and gas which requires mapping complex underground reservoirs and tailoring drilling methods—are particularly well-suited to the recursive, complex learning processes that AI is well-suited to deliver.

AI IMPACTS ON ENERGY DEMAND AND MARKETS

While it isn't clear whether AI will favor higher or lower carbon supplies of energy, the impacts of AI on energy demand are easier to pin down. All else being equal, systems that have large amounts of intelligence—and the capacity to update quickly in light of real-world conditions—are probably systems that are a lot more efficient. Efficiency will lower demand for energy and lower emissions. The effects are likely larger than one percent—already, simple "nudge" interventions in power markets, for example reminding customers about the need to reduce energy consumption during peak periods and changing the default settings on thermostats—yield energy savings up to a few percentage points. A hyper-smart AI-driven energy system should deliver even bigger reductions, in part because the changes needed (e.g.,

aligning energy consumption with real-time changes in energy markets) can be automated. That said, the savings are unlikely to be as large as the 60 to 100 percent reduction in emissions that scientists say will be needed in order to stop global warming.

One of the great promises of adding AI to energy markets lies with linking what customers want (e.g., light and heat) with the exact range of options and market conditions for supplying those energy services. Machine learning is ideally suited for making fine-grained determinations of what customers want and then adjusting energy purchasing decisions accordingly. In theory, they could make a number of services that are already offered in today's markets more powerful, such as:

- Purchasing green energy credits. Today, customers typically either “go green” or don't. What they pay for green is a decision made rarely (often just at the time when a customer signs up). AI systems could better embed information about what customers are willing to pay for green energy and also offer different shades of green. Today, the green debate focuses on renewable power almost exclusively. In the future it could include other offers—for example, output from new nuclear reactors that are emission free.
- Adjusting power purchasing decisions. As power grids shift to play a much larger role for variable renewable generators, the price of power will become more variable, creating a greater social value from real-time adjustments in power purchasing. In California, for example, power prices may reliably become negative mid-day (when solar output is highest) and then spike as the sun sets but demand for air conditioning and lighting rises in the late afternoon. This is one reason why the default tariff for electricity starting in 2019 will be “time of use.” AI can allow even small consumers to automatically adjust their power consumption in real time with prevailing prices—something that ordinary people won't do unless they like sitting at home staring at real-time data from power markets. (Some people do that; most prefer to live their lives.)
- Making electric supplies more reliable and bespoke to consumer needs. AI schemes could integrate data from hazards (e.g., extreme storms and fires) and then adjust grid operations accordingly—making the grid safer, more efficient, and more reliable. Already, a few utilities have installed self-healing grid systems—that is, automated surveillance and switching equipment that can identify faults on a grid, isolate them and restore power automatically. Conventionally, when the utility detects a fault—often because an irate customer calls, complaining of lost power—the response is to send a bucket truck with two guys who drive the lines, finding the trouble and then manually closing switches once the problem is fixed. Similarly, many customers now demand levels of reliability higher than what the grid can offer—and they purchase costly power conditioning, generation, and storage technologies. AI can help make purchase and operation of those systems much more efficient.

At present, the potential for these AI uses is barely tapped. A few utilities are experimenting with systems, some large customers are actively managing energy systems with AI-based systems (because they can afford to amortize the cost over large savings), and some firms like Stem are emerging as intermediaries—making explicit AI offers to customers and providing the expertise needed so that even small customers can utilize these systems.

HOW AI WILL IMPROVE CLIMATE MODELING

Most human-caused changes in climate are rooted in how we use energy—in particular fossil fuels that, when combusted, intrinsically generate carbon dioxide (CO₂). Thus, the changes discussed above—some leading to higher emissions, others to greater efficiency and lower carbon intensity—will affect the rate at which emissions flow into the atmosphere and accumulate. If the central message from the above discussion is that AI makes it possible for energy markets to reflect real-world conditions—and to be more efficient in matching consumer preferences with supplies—then there is no reason to believe that these more efficient markets, on their own, will tackle the carbon problem. Instead, they will require overt policy signals. For years, it has been thought that people often don't respond readily to price signals, which is one reason why many analysts (and an even larger fraction of politicians) like direct regulation as a means of inducing reductions in emissions. Better and more efficient markets that can help consumers become more responsive to real-world conditions could help tamp down that enthusiasm for regulation and make practical a greater reliance on market-based instruments—such as carbon taxes.

AI could help radically improve the assessment of climate change. Today's climate impact assessments rely on global-scale models of the climate system that are then downscaled to regional and local assessments. The downscaling process is complex and imperfect, in part because lots of local factors affect how broad changes in the climate are manifest where people actually live—along coastlines, near wildfire zones, in cities struggling with heat stress, and the like. AI makes it possible to connect the imperfect downscaling process with real information about actual impacts—reflected in insurance claims, weather extremes, the arrival of migrants, observed outbreaks, the spread of disease, and such. Already, the community of scientists that perform climate-impact studies are making use of such diverse data sources. AI could help automate and enrich that process, making real-time adjustments in climate-impact assessments feasible.

While these frontier opportunities are new, the idea of using machine feedbacks to improve model quality is hardly new in meteorology and climate modeling. For roughly two decades, there has been a systematic effort to compare climate models in terms of performance—that is, skill at forecasting temperature, precipitation, ice cover, and such. Those

comparisons have probably made the models better and have also made the community much more aware of which models work best for different conditions. They have also made it easier for the Intergovernmental Panel on Climate Change (IPCC) and other bodies that conduct climate-science assessments to determine where the climate modeling community agrees and disagrees.

HOW AI WILL IMPROVE CLIMATE POLICY

Since the chief protagonist in the climate change story, CO₂, has a long atmospheric lifetime, there is only a sluggish relationship between changes in emissions and the accumulated concentrations; in turn, those concentrations have a sluggish impact on the climate. Even if AI were part of some massive transformation in the energy system, the built-in inertia of that energy system, along with the inertia in the climate system, virtually guarantees that the world is in for a lot of climate change. All this is grim news and means that widely discussed goals, such as stopping warming at 1.5 or 2 degrees Celsius are unlikely to be realized.

These geophysical and infrastructural realities give rise to a new policy reality: adaptation is urgent. They also mean that emergency responses to extreme climate impacts—for example, solar geoengineering, might be needed as well.

Existing research shows that there is a huge difference in the impact on public welfare from scenarios where climate change affects a society that doesn't have an adaptation plan compared with a society that takes active adaptive measures. For example, the most recent U.S. climate-impact assessment released in November 2018 demonstrates that active adaptation measures can radically reduce losses from some climate impacts—often with benefits that far exceed the costs. Extreme climate change is going to be ugly and will require hard choices—such as which coastlines to protect or abandon. Without smart adaptation strategies, it will be a lot worse.

One of the central insights from the science of climate impacts is that extreme events will cause most of the damage. A world that is a bit warmer and wetter (and a bit drier in some places) is a world that societies, within reason, can probably adapt to—especially if those gradual changes are easy to anticipate. But a world that has more extreme events—put differently, climate events that have a higher variance—is a world that requires a lot more preparedness. A farming area that faces a new, significant risk of truly extreme drought for example, such as a decade-long dust bowl, will need to prepare as if that extreme event is commonplace. It will need irrigation systems, the option of planting hardier crops and other possible interventions that sit ready when the extreme events come.

Once those systems are purchased, much of the expense is borne and it makes sense to use them all the time. This has been the experience, for example, with the Thames river barrier or a similar Dutch flood barrier—these systems

were designed and installed at vast expense with extreme events in mind, and now they are being used much more frequently. Climate impacts are, fundamentally, stochastic events centered around shifting medians—a warmer world, for example, is one where median temperature rises and where the whole distribution of temperatures from cold to hot shifts hotter. But the tails in that statistical distribution also probably fatten, and for some impacts, those tails get a lot fatter. Machine learning techniques will probably improve the ability to understand the shapes of those tails.

This logic of extreme events as the main drivers of climate impacts and response strategies has some big implications for how societies will plan for adaptation and how AI can help—possibly in transformative ways.

First, AI can help focus and adjust adaptation strategies. Because uncertainty is high and extreme events are paramount, policymakers, firms, and households will not know where to act nor what expense is merited. They will have a large portfolio of responses, each with an option value. Machine learning can help improve the capacity to assess those option values more rapidly. Such techniques might also make it possible to rely more heavily on market forces to weigh which options generate private and public welfare—if so, AI could help reduce one of the greatest dangers as societies develop adaptation strategies, which is that they commit vast resources to adaptation without guiding resources to their greatest value. High levels of uncertainty, along with acute private incentives that can mis-allocate resources—for example, local construction firms and organized labor might favor some kinds of adaptive responses (e.g., building sea walls and other hardened infrastructure) even when other less costly options are available—mean that adaptation needs could generate a massive call on resources and thus a massive opportunity for mischief and mis-allocation.

Second, most adaptation efforts are intrinsically local and regional affairs. As a matter of geophysics, climate change harms public welfare when general perturbations in the oceans and atmosphere get translated into specific climatological events that are manifest in specific places—specific coastlines, mountainous regions, public lands, and natural ecosystems. As a matter of public policy, the actors whose responses have the biggest leverage on local impacts are managers of local infrastructures—coastal and urban planners, developers, city managers, and the like. Politically, this is one of the reasons why, despite all the difficulties in mobilizing action to control emissions, it is likely that as communities realize what's at stake with adaptation, they will respond. Local responses generate, for the most part, local benefits. A big challenge in all this local response, however, is that local authorities are intrinsically decentralized and usually not steeped in technical expertise. Getting the best information on climate impacts and response strategies—let alone keeping that information aligned with local circumstances and shifting odds for climate impacts—is all but impossible. AI could help lower that cost and, in effect,

democratize quality climate impacts response.

Third, and perhaps most importantly, the single strongest result from studies assessing climate impacts is that poor communities will be hit harder than the rich. That's because responding to climate impacts is often costly and because the kinds of factors that help explain wealth—good government and low levels of corruption—also explain which societies are most likely to adopt smart adaptation measures. The poor are on the front lines of climate change and, for the most part, will suffer the most as reflected in relative loss of welfare and loss of life and opportunity. To the extent that AI democratizes and improves the quality of understanding and responding to climate impacts, it may differentially help the societies that otherwise would be least able to respond. From a climate perspective, then, the AI revolution could end up being a vitally important part of assuring and promoting economic development amongst the world's least well off—a topic that another paper in this series explores.

FINAL THOUGHTS

To close, I will make two points. First, AI has the potential to make energy markets a lot more powerful—by unlocking new supplies, reducing transaction costs, and making it easier for users to specify what they want to buy in the market. Efficient markets are great, but they also mean that

market failures can become more rampant. Climate change is perhaps the largest market failure the world has seen so far—emissions of warming gases have global external consequences and the failure to impose emission taxes or other incentives means that firms and individuals are causing higher emissions and greater externalities than warranted. AI can transform markets, but the markets won't transform emissions without clear signals. Mustering the political ability to put those signals into place and coordinate across countries remains as much a problem today as it was 30 years ago—and AI has had essentially no impact on that.

Second, as the world grapples with climate impacts and adaptation, it will probably discover that the line between “adaptation policy” and “good development” gets blurry. Some of the most important adaptation policies are also among the most important development policies. For example, one way to cut the impacts of climate change on agriculture is to adopt early warning crop forecasting systems—so that farmers can adjust seeds, cropping methods, and planting times (among other variables) to reduce harmful impacts from the vagaries of weather. Those same systems make sense even without a changing climate. AI could help make these kinds of development-oriented activities and policies more efficient economically, and politically, administratively easier to adopt, and more democratic in their orientation. Insofar as that happens, AI will further blur the line between adaptation and development.

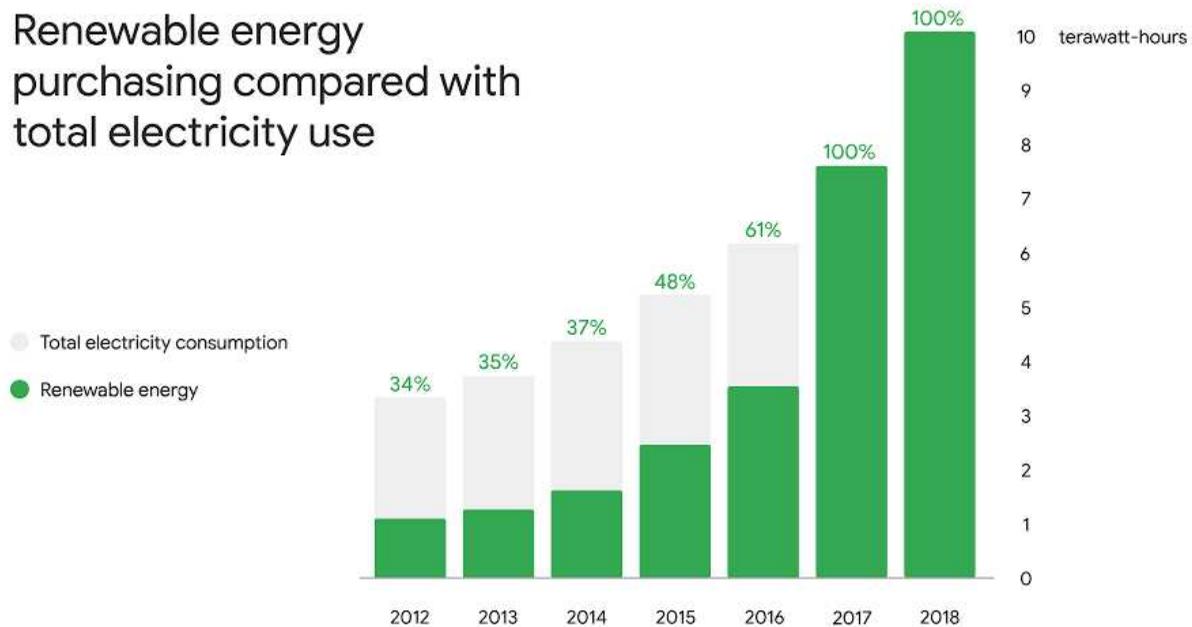
Notes

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Google in 2018 bought 100% renewable energy to power offices, data centers

Abner Li, 9to5Google, June 5, 2019

Renewable energy purchasing compared with total electricity use



Google

For 2017, Google was able to purchase enough renewable energy to match its global usage. The company reached that goal again in 2018, thus making it the “first organization of [its] size to achieve 100 percent renewable energy two years running.”

In 2018, the company’s total electricity usage increased to 10 terawatts-hour from around 7.5 the year prior. Renewable energy resources include solar and wind, with Google’s global usage comprised of data centers and offices. To meet the goal, its “first priority” is using as little energy as possible.

Thanks to advances in artificial intelligence and chip design, our data centers are seven times more energy efficient today than they were five years ago. Our latest Environmental Report shows that computing using centralized cloud services is up to 85 percent more efficient than using on-premises servers, which is good news for our users and the planet.

Buying energy involves Google signing Power Purchase Agreements (PPAs) to get electricity from wind or solar farms built near data centers. According to the company, these long-term contracts have “more impact than other purchasing methods.” Compared to Renewable Energy

Credits, PPAs can often result in new renewable energy projects being created.

In 2018, our energy purchasing kept pace with our demand thanks to several PPA-driven projects—including three wind farms in Scandinavia, dozens of massive wind turbines in Oklahoma, and more than 120,000 solar panels in the Netherlands.

Google is increasingly partnering with utility companies to buy energy through new programs that other businesses can also take advantage of in the U.S. The idea is to have companies opt for renewable energy directly from utilities. Other strategies around the world include partnering with others to buy energy as a consortium in the Netherlands.

Looking forward, Google wants to switch to carbon-free energy full-time, but this is still difficult due to the intermittent nature of renewable sources.

To bridge the gap between intermittent renewable resources and the constant demands of the digital economy, we’ll have to test new business models, deploy new technologies, and advocate for new policies. Yet aiming for 24×7 carbon-free energy reflects reality—ultimately, it’s where the world must go.

Williams 2018 Sustainability Report Highlights

Williams, June 2019



Where We Stand On Sustainability

Williams works to be a good corporate citizen by responsibly managing our environmental, social and governance performance. We also recognize the important role natural gas can play in helping to address environmental concerns about air quality and climate change, particularly when it comes to displacing more polluting fuels.

- Natural gas is a clean, reliable source of energy that is ready now. It can help the U.S. make even more strides in reducing emissions until even cleaner forms of energy become available.
- According to the U.S. Energy Information Administration, between 2005 and 2017, CO₂ emissions from the electric sector declined by 3,855 million metric tons. Simply put, related CO₂ emissions fell by 28 percent over that period. More than 60% of this total was attributed to natural gas replacing coal- and oil-based generation resources.
- We are proud that our infrastructure played an important role in helping our country reach this achievement. We are eager to continue to help our country meet its climate goals with low carbon natural gas solutions that are ready now.
- Our strategy to connect the best supplies to the best markets means natural gas is traveling shorter distances, improving cost-effectiveness and significantly reducing emissions.

The Northeast Supply Enhancement Project

Williams' Northeast Supply Enhancement (NESE) project aligns with New York's Clean Energy Transition Policy, creating energy infrastructure necessary for National Grid to continue its planned oil to natural gas conversion program. NESE will help ensure that reliable gas supplies are available to support these conversions, displacing 900,000 barrels of heating oil and reducing CO₂ emissions by 200,000 tons in year one. The project will ultimately allow National Grid to displace approximately 13 million barrels of heating oil and reduce CO₂ emissions in New York City and Long Island by up to 3 million tons per year.

The long-term CO₂ emissions reductions are the equivalent of removing nearly 500,000 cars from the road. In addition, these conversions will reduce local emissions by 300 tons in the first year and 4,300 tons over the life of the heating equipment, including smog, acid rain and particulates that have negative health and environmental effects.



Environment

As we develop and operate the large-scale infrastructure that makes energy happen, we incorporate environmental considerations into our decision-making. We want to preserve the environment for future generations while improving standards of living today. We take care to reduce emissions, safeguard biodiversity and manage natural resources responsibly.

- Reduced our reported methane emissions from gas processing plants and transmission compressor stations more than 53% since 2012
- Submitted a proposal to execute a voluntary Transco Emissions Reduction Program projected to reduce nitrogen oxide emissions by an estimated 72%
- Joined the ONE Future coalition, a group of natural gas companies working to voluntarily reduce methane emissions associated with natural gas

Social

We operate in a manner that protects our employees and contractors while safeguarding the public. We also recognize our responsibility to positively impact local communities through trusted relationships, meaningful investments and economic opportunities.

- We consistently promote a strong safety culture that includes a robust pipeline integrity management program and a strong commitment to safety and operational discipline
- Our goal is to create an inclusive and supportive environment, so our people can achieve their personal and professional goals
- We are performing better than the industry benchmark for total recordable injury rate
 - 50% reduction in process safety incidents from 2017 to 2018
 - 25% decrease in recordable injuries compared to 2017

Governance

Williams acts ethically and with integrity. We actively engage with shareholders and other stakeholders to communicate our viewpoints and performance on topics that impact our business results. In 2018, we developed a formal Human Rights Policy and Statement that outlines our commitment to respect human rights and avoid complicity in human rights abuses.

In developing our Sustainability Report, Williams conducted a thorough materiality assessment to better understand the sustainability topics most critical to our company and our stakeholders. The report references the Global Reporting Initiative standards, the most widely adopted global standards for sustainability reporting. For more information, visit the 2018 Williams Sustainability Report.



Reduced the number of reportable spills to soil and water by 44% from 2017 to 2018

Achieved our goal to reduce notices of non-compliance by 15% from 2017 and set a new goal to reduce notices of non-compliance by an additional 15% in 2019



Contributed \$9.4 million to nearly 2,000 charitable organizations in the U.S.

Spent \$3.5 million on corporate and technical training for employees

Maintain positive relationships with nearly 85,000 landowners across the U.S.



25% of our board of directors are female

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williams.com

Carbon Capture: Will It Save the Climate, or the Fossil Fuel Industry?

Marco Poggio, Climate Liability News, March 13, 2019

Climate scientists have for decades researched ways to extract carbon dioxide from the atmosphere as a way to slow climate change, but while their work has progressed from a handful of fringe theories to promising technologies, they remain controversial. That's partly because they have drawn an unlikely backer: the fossil fuel industry.

Since at least the 1980s, researchers have devised and tested technologies aimed at capturing CO₂ from the air—a field broadly referred to as carbon dioxide removal or negative emissions technologies.

Governments and private investors have begun to hail those technologies as a viable path toward slowing global warming and a report by the Intergovernmental Panel on Climate Change (IPCC) mentions them as necessary to meet the terms of the Paris Climate Agreement. They have drawn significant investment from oil, gas and coal companies looking for ways to continue developing fossil fuels as the world moves toward cleaner energy.

But some scientists and policy makers are alarmed that a reliance on these technologies will continue our dependence on fossil fuels and will impede the transition to renewable energy sources.

A recently published study by the Center for International Environmental Law warned that some technologies, in particular carbon capture, utilization, and storage (CCUS) technologies, could slow the transition to renewables.

“CCUS is valuable to the fossil fuel industry in three key ways: it expands oil production, provides a lifeline to a declining coal industry, and further entrenches the overall fossil fuel economy,” the report says. “Incentivizing CCUS through policy and relying on it in planning will likely slow the transition away from fossil fuel investments and undermine broader efforts to mitigate climate change.”

The debate comes with few black-and-white solutions. Touting technology and innovation has become a talking point in dealing with climate change by Republicans who feel they can no longer run from the issue altogether, but climate activists argue it is little more than their latest cover for pushing climate action indefinitely into the future. And none of the technologies are close to being developed at a scale large enough to have a true impact on global warming, a process that would have to be coordinated among many countries on a vast global scale.

At the same time, many climate scientists argue negative emissions technologies are absolutely necessary to fend off the worst impacts of global warming.

For the fossil fuel industry, which sees the cost of renew-

ables falling rapidly, negative emissions technologies provide a scenario in which fossil fuels—in particular coal, by far the largest contributor to the world's CO₂ emissions—can survive the transition to cleaner energy.

An Array of Ideas

Negative emissions technologies differ widely in terms of techniques and results. Some involve natural ways to extract CO₂ from the air, such as planting more trees, restoring wetlands or modifying the soil to make it absorb more CO₂.

Others require elaborate feats of engineering. Carbon dioxide can be captured from the smokestacks of power plants, refineries, iron, steel, or cement plants; or it can be extracted directly from the air, where it's more rarefied, by way of giant fans, with a process called direct air capture.

Some negative emissions technologies have failed to produce tangible results and others have produced little more than skyrocketing costs: one high-profile carbon capture and storage project in Kemper, Miss., was supposed to be the vanguard of clean coal technology but ended up costing \$7.5 billion and the technology was scrapped altogether in favor of burning natural gas.

Other technologies, like direct air capture—which works to separate carbon dioxide from the air and then store it—are on the rise, thanks to innovations that are making it less expensive and more appealing to investors.

Harvard engineer David Keith has estimated the direct air capture system he devised could cut the cost of CO₂ extraction from \$1,000 per metric ton to a range between \$94 and \$232 per metric ton. His company, Carbon Engineering, received investments from billionaire Bill Gates, oil magnate Murray Edwards, and more recently, oil giants Chevron and Occidental.

Captured CO₂ with negative emissions technologies is either stored in deep underground geological formations in the case of carbon capture and storage, or used for production of chemical fuels, biofuels and heating system fluids.

The vast majority of captured CO₂, however, is currently used to extract oil. In a process called enhanced oil recovery, compressed CO₂ is injected into depleted oil reservoirs, causing oil to expand and flow more easily to surface.

The role of CO₂ in oil extraction is what makes many critics think carbon capture and storage won't help with climate change.

Steven Feit, a lawyer and one of the authors of the Cen-

ter for International Environmental Law report, said the unbreakable relationship between fuel combustion and CO₂ removal helps sustain a vicious circle where fuel is burned, CO₂ is produced, then captured, then used to produce more fuel.

“We’re talking about a system that would be making fossil fuels harder to transition away from, while also making it easier for old companies to make more oil. There’s a kind of perverse relationship between all these moving parts,” Feit told Climate Liability News.

Feit said he believes the majority of researchers and engineers studying negative emissions technologies are well-intentioned, but their solutions will not avoid the need for drastic CO₂ emissions cuts and the boosting of solar and wind energy.

“What is required to effectively deal with climate change is a transition from the kinds of systems we have to ones which are sustainable and low or zero carbon,” he said.

A Well-Funded Effort

The U.S. government has long supported negative emissions technologies projects, with the Department of Energy having funded research since at least 1997. Last month, Secretary Rick Perry awarded \$24 million in funds to eight companies for research and development of CCUS technologies. The funds, which will come from the Office of Fossil Energy, will add to the \$28.9 million in research fund awarded during fiscal year 2018.

“By 2040 the world will still rely on fossil fuels for 77 percent of its energy use. Our goal is to produce them in a cleaner way,” Perry said in a statement.

The federal government also provides tax credits to fossil fuel companies that incorporate CO₂ capture and storage systems in their operations.

All major oil companies have invested in negative emissions technologies. Currently, there are 23 large-scale CCUS projects around the world that are either operating or under construction.

In its “2019 Energy and Carbon Summary,” ExxonMobil reported investments of more than \$9 billion in the development of lower-emission energy solutions that include carbon capture and storage. The company boasts having 30-year expertise in storing captured CO₂ underground “in a safe and secure fashion.”

In its “Sky Scenario,” Shell projected the deployment of 10,000 large-scale carbon capture and storage (CCS) facilities by 2070, in a world with net-zero CO₂ emissions.

Chevron has invested more than \$75 million in CCS research and development over the past decade. The company is also part of the CO₂ Capture Project, an industry group

of four major companies, which include BP, that have joined resources into CCS research.

Those investments, while they may sound large, are tiny compared to the overall research and development budgets of the oil companies. Exxon, for one, plans to invest \$200 billion in the next seven years on traditional oil and gas projects around the world.

It’s All About Scale

While engineers, scientists, governments and industry all look for the magic bullet of some kind of carbon capture and storage, the reality is none of today’s existing technologies are feasible on any kind of realistic scale. And even if they were, not all climate engineers are convinced that transforming captured CO₂ into products would be viable on a large enough scale to make a difference.

Massachusetts Institute of Technology engineer Howard Herzog believes the best way to deal with carbon dioxide is to store it underground. He also thinks direct air capture technology is not cost effective, is too complicated and has the potential of removing only 1 or 2 percent of global emissions.

“I’ve been very critical of direct air capture in my writings. I think the people who are promoting it are under-realistic. I just think it’s too expensive. Let me just say: I don’t believe the cost numbers that they’ve put out,” he said.

Herzog, who discloses that he receives funding from Exxon to research CCS technologies, said they won’t solve the issue of climate change.

“Carbon dioxide removal and negative emissions can be an important part of climate change policy. It doesn’t replace current efforts or lack of current efforts,” he said. “The best way to take CO₂ out of the atmosphere is not put it there in the first place.”

A spokesperson from Climeworks, a Europe-based direct air capture company, said in an email that even with tight climate regulations in place, negative emissions technology are still needed to offset the CO₂ currently in the atmosphere.

“We have already passed the point of an either/or-decision. To reach the Paris agreements, all means of promoting renewable energies and emission reductions have to be deployed together,” the email said.

The Center for International Environmental Law report points out Climerwork’s partnership with car maker Audi in creating fuels made with captured CO₂ that can be used alongside regular fuel as an example of a lingering influence fossil fuels still have on markets, and a sign of the industry opposition to change.

The report also highlights the role of government funding

and private investments in negative emissions technologies in helping the fossil fuel industry build new infrastructure.

A new network of pipelines will have to be built in order to transport the CO₂ from the capture facilities to appropriate geological formations underground where it will be stored for hundreds of years. Those storages will have to be monitored to ensure the carbon dioxide doesn't find its way up to the surface. The massive amount of work that will be required to maintain a system highly reliant on negative emissions technologies will be dangerous step backwards, the report says.

"We need to transition away from reliance on fossil fuels. Anything that moves us toward greater reliance will not be a solution," the report says.

Herzog disagreed with the main claim in the Center for International Environmental Law report—that negative emissions are helping the fossil fuel industry.

"Fossil fuel is 85 percent of our energy economy. There's good and bad. With climate change, the point is to keep CO₂ out of the atmosphere. So if you can use fossil fuels without putting CO₂ into the atmosphere, what's wrong?" he said.

Herzog said the public has preconceived ideas about climate change.

"On the right, they deny climate change, because they don't want to deal with it. On the left, they want to use climate change as reason we just do renewables. 'We don't need nuclear, we don't need CCS, we've just got renewables' That's not right, either. Renewables can't do it all. It's

going to be very hard to get to net zero emissions, and you really need every technology you can to help you."

Sven Teske, a German engineering and researcher at the University of Technology, Sydney, said renewables have the potentials to replace fossil fuels sooner than most people think. For over 20 years, Teske researched the market potential of solar and wind technologies, and came up with scenarios where renewables are able to sustain the world's power demand.

"Those will be by far the dominating technologies in the next decade or two," he said. "CCS is much more expensive than renewables, because renewables are already cheaper than coal, and if you had new equipment then it's even more expensive. And also, you have all the structural cost to get the CO₂ underground and keep it there."

Teske said he understand the fossil fuel industry is feeling cornered by the advancing of ever cheaper renewable power technology. However, he said, fossil fuel companies have the capital to experiment a pivot to renewables. As an example, he mentioned Shell, which invested in offshore wind power, including a recently built wind turbine project off the coast of Norway.

Teske believes the negative emissions technology has been surpassed and the right direction is now in renewables.

"This industry is moving in this direction," he said. "CCS has been discussed over the last 20 years. At the end of the day, close to nothing has been delivered, while renewables now are the main part of newly built power plants. It is actually already happening."

Notes

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Energy transition: Carbon capture is clean energy, too

Brad Page, Utility Dive, February 14, 2019



The following is a contributed article by Brad Page, CEO of the Global CCS Institute, an international climate change think tank backed by governments and companies.

Politicians, academics and energy experts globally are debating the paradigms of the energy transition. Which sources of energy qualify as clean energy? While the debate reflects competing political economic interests, it also demonstrates an elusiveness for the complexity of the energy transition ahead.

The challenge of decarbonization and limiting global warming to 1.5 degrees is unprecedented, both in scale and action required. While the world has witnessed a fantastic and necessary scale-up of renewables in the recent past, at best, it represents only the start of an energy transition, and certainly does not reflect the challenges it will bring. Data shows that the growth of renewables has merely kept up with energy demand driven by a global boom in population and economic growth. Since 1990, fossil fuel energy consumption has hovered around 80% of total energy consumption.

While energy efficiency and renewables are forecast to deliver the majority of emissions reductions through mid-century, it is wrong to discount other clean energy technologies, including carbon capture and storage (CCS), and the

role these technologies have to play alongside renewables. CCS' inclusion in 3 of 4 pathways in the latest Intergovernmental Panel on Climate Change (IPCC) report has attracted renewed attention to CCS in the climate change context. With new attention, misconceptions and misunderstandings have also arrived — from the meaning of the term carbon capture, to cost and viability.

Let's clear this up. Starting with the definition, carbon capture and storage (CCS) includes a set of technologies that remove CO₂ from the exhaust gasses of power plants and industrial facilities like cement and steel factories, and permanently stores the CO₂ underground. Due to the scale of such projects, CCS is able to deliver large-scale emissions reductions. The Century Natural Gas Plant, for example, captures 8.4 million tonnes of CO₂ every year.

However, carbon capture in the broader sense also includes natural solutions such as soil and forestry sequestration, Direct Air Capture (DAC) — sucking carbon out of the air — and bio energy carbon capture and storage (BECCS) — a negative emissions technology involving burning biomass and capturing the emissions from the process. These carbon capture applications are all expected to be necessary, but it is important to understand that none of them are a silver bullet, either. Models demonstrate that we will need all of the carbon capture solutions combined, not just one of them.

The *raison d'être* for CCS deployment is emissions elimination at very large scale in both the power and the industrial sector. The International Energy Agency (IEA) shows that CCS is expected to deliver about 7% of total emissions reductions by 2040, alongside all other sources of clean and renewable energy.

There is a big role for CCS to play in decarbonizing electricity supply — from both coal and gas-fired plants alongside and complementing increasing renewables deployment. The ongoing new build of both gas and coal-fired power plants to deliver reliable power grids around the world is incompatible with the Paris agreement targets. Applying CCS to many of these facilities will be necessary.

But CCS is more than a one-trick pony. The so-called 'hard to decarbonize' sectors — industrial processes including fertilizer production, cement and steel — where electrification is not a solution — will require CCS. Industries like this account for a quarter of emissions globally. Despite the clear evidence, many continue to refuse CCS the clean energy label.

The most cited reason: CCS is unproven and too expensive. There are 43 large-scale facilities globally — 18 in operation, 5 under construction and 20 in various stages of development. Those in operation are capturing and permanently storing more than 33.3 mtpa of CO₂ — roughly as much as the total emissions of Ecuador.

High cost is often touted as the reason behind CCS' failure to scale based on simplistic measurements such as the levelized cost of electricity (LCOE), which fails to reflect the cost of intermittent generation to the grid. Considering analyses that take into account the broader cost of mitigation — such as the IPCC AR5 — it becomes clear that achieving deep decarbonization is 138% more expensive without CCS.

While cost of more than \$100/tonne of CO₂ stored for a

power plant sounds high, there are carbon capture applications, for example, on ethanol production, where it can be as low as \$20/tonne of CO₂ stored. CCS cost often depends on the purity of the CO₂ waste stream. The higher the CO₂ content, the less expensive it is to capture it.

As more facilities are being deployed, cost will come down, just as they did for solar and wind. Innovation will also help. In Texas, a new generation zero emissions natural gas plant is being tested and early results show it is competitive with conventional combined cycle generation.

The conclusion from this analysis is that the slow deployment of CCS is not a technology problem. Rather, it is a lack of clear and stable policy mechanisms that can drive the deployment through placing a value on carbon. The IEA has concluded that as much as 450 million tons of CO₂ can be captured and stored with a commercial incentive as low as \$40 per tonne of CO₂.

In the U.S., legislators last year passed the reform of the 45Q tax credit, an incentive, which eventually will provide — pending implementation of the Internal Revenue Service — \$35 for each ton of CO₂ stored via enhanced oil recovery, and \$50/tonne for geologic sequestration.

A recently released report estimates that the incentive can drive projects capturing as much as 100 mtpa of CO₂. In the U.S. power sector specifically, experts estimate that about 49 mtpa of CO₂ could be captured by 2030. While this is a step forward, it is far away from the global scale necessary, which models estimate at roughly 2000 mtpa of CO₂ captured by 2040.

Discounting clean energy technologies beyond renewables while touting climate ambition equates to turning a blind eye to the realities of the energy transition. It also prevents us from advancing on the path towards decarbonization. Carbon capture is clean energy, too.

Carbon capture and storage

Chris Woodford, ExplainThatStuff.com, November 28, 2018

Earth is warming, glaciers are thawing, seas are rising—and so far we're doing little or nothing to stop it. The consequences of climate change could be utterly catastrophic unless we act very soon. What can we do? One option is to switch to renewable energy that produces less carbon dioxide (CO₂)—the gas most of the world's scientists consider is responsible for global warming. But that will take decades, at least, and in the meantime we're still locked into using coal, gas, and oil and producing even more CO₂. Another option is to keep burning fossil fuels but to prevent the CO₂ they release from entering the atmosphere. That idea is called carbon capture and storage (CCS) and it's currently one of the hottest topics in the field of energy technology. What is it and how does it work? Let's take a closer look!

What's the problem with carbon dioxide?

Let's quickly recap on global warming and climate change. The current scientific consensus is that they're "very likely" happening because people are using huge quantities of fossil fuels such as coal in power plants and oil in cars and trucks. Burning carbon-rich fuels releases very handy supplies of energy, but it involves a chemical reaction called combustion that lets carbon dioxide (CO₂) gas escape into the atmosphere as a byproduct. This invisible (and mostly harmless) gas builds up and wraps around our planet like a blanket, making it hotter than it would otherwise be. Now a warming planet might sound "cool" if you're currently shivering away in winter, but what global warming actually means in practice is a major change in Earth's climate that will make the planet much harder for most people to live on. Find out more in our main article on global warming and climate change.

What is carbon capture and storage?

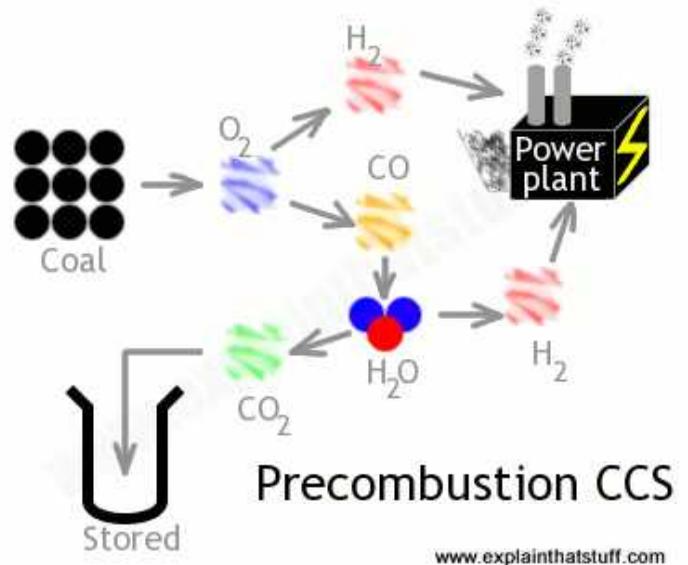
If you're got a power plant burning mountains of coal and releasing clouds of carbon dioxide into the air through its smokestacks, solving the problem sounds simple in theory. All you have to do is catch the CO₂ as it drifts upward through the pipe and stick it somewhere it won't cause any problems (like underground or deep in the ocean). This idea is called carbon capture and storage (CCS). It's an artificial version of carbon sequestration, which is what plants and trees do naturally during photosynthesis: powered by sunlight, they suck carbon dioxide from the air and use it to build their roots, shoots, and leaves. As the name suggests, CCS involves two separate processes—carbon capture and carbon storage—so let's look at each of those in turn.

Capturing carbon

There are essentially three ways to capture the carbon dioxide from a power plant: before the fuel is burned (precombustion), after the fuel is burned (postcombustion), or by burning the fuel in more oxygen and storing all the gases produced as a result (oxyfuel).

Precombustion

Diagram at the top of the next column illustrating the process of precombustion CCS.



Artworks: Precombustion carbon capture and storage removes carbon from coal before it gets to a power plant.

In precombustion, the aim is to remove the carbon from coal fuel before it's burned. The coal is reacted with oxygen (O₂) to make syngas (synthesis gas), a mixture of carbon (CO) monoxide and hydrogen (H₂) gases. The hydrogen can be removed and either burned directly as fuel or compressed and stored for use in fuel-cell cars. Water is added to the carbon monoxide to make carbon dioxide (which is stored) and additional hydrogen, which is added to the hydrogen previously removed.

Postcombustion

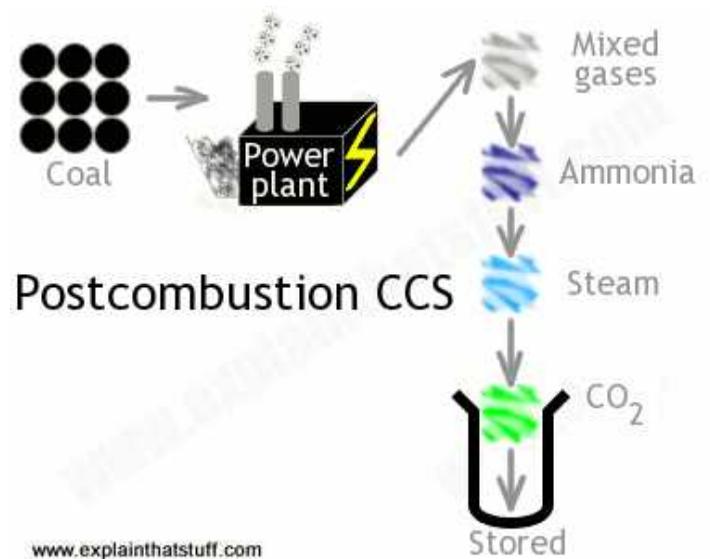


Diagram illustrating how CCS works after the carbon fuel has been burned. Artworks: Postcombustion carbon capture and storage removes carbon dioxide after the carbon has been burnt in a power plant.

In postcombustion, we're trying to remove carbon dioxide from a power station's output after a fuel has been burned. That means waste gases have to be captured and scrubbed clean of their CO₂ before they travel up smokestacks. The scrubbing is done by passing the gases through ammonia, which is then blasted clean with steam, releasing the CO₂ for storage.

Oxyfuel (oxycombustion)

CCS would be much easier if power plants produced pure CO₂ as their smokestack waste. Then, instead of laboriously separating out the CO₂ from other waste gases, we could trap the entire output from the smokestacks and store the lot. The trouble is that power plants don't produce pure CO₂: because there's often not enough oxygen for complete combustion they produce other pollutant gases as well. One way to purify the exhaust is to blow extra oxygen into the furnace so the fuel burns completely producing relatively pure steam and CO₂. Once the steam is removed (by cooling and condensing it to make water), the CO₂ can be stored.

Which is best?

Each of these techniques has its advantages and disadvantages. In theory, postcombustion CCS can be applied to any power plant burning any carbon-based fuel, so it could be retrofitted (at a price) to the world's thousands of existing power plants. Precombustion and oxyfuel both alter the fuel before it enters the station and are more suitable for newly built plants. Postcombustion is the best option for cleaning up the plants we have already; precombustion and oxyfuel could help us build cleaner plants in future.

Storing carbon

Once you've captured the carbon dioxide, there's the small matter of where you store it. Carbon dioxide is a gas under everyday conditions so it takes up a huge amount of space—and we're producing it in vast quantities too. Stuffing it in a tank somewhere and closing the lid isn't really an option: the tank would probably need to be the size of a country! The best option is to turn the carbon dioxide into a liquid (so it takes up a tiny fraction as much room) and then pump it either deep underground or into the deep ocean where it will remain safely for perhaps 1000 years or more.

Storing carbon dioxide under Earth's surface is called geo-sequestration and uses things like worked out oil fields, aquifers, or other rock formations deep underground. It might sound like hugely impractical science fiction, but oil companies already routinely pump CO₂ into underground rocks to help them flush oil to the surface of declining wells, so it's actually a reasonably well-understood process. Less well understood is the idea of storing CO₂ in the oceans. The main problem here is that carbon dioxide reacts with water to form acid, so the oceans could become significantly more acidic with potentially devastating consequences for marine ecosystems. But another difficulty is that the CO₂ would also eventually return to the atmosphere. A third option is to store CO₂ by reacting it with minerals, though that requires a lot more energy.

Pros and cons of carbon capture and storage

Most people are either heavily in favor of CCS technology or heavily against. Environmentalists tend to see CCS as a distraction from the need to convert humankind quickly to renewable energy. They argue that investing in carbon capture is a waste of mon-

ey when we could be putting the same investment to better use perfecting such things as building insulation, solar energy, wind turbines, tidal power—and perhaps even nuclear plants (themselves hugely controversial). Another drawback is that CCS uses considerable extra energy (increasing the cost of electricity by as much as 40 percent) and could double the cost of electricity; both are very unwelcome at a time when energy is becoming increasingly expensive and humans are having trouble meeting their energy needs.

Where opponents see coal as a problem—a filthy polluting fuel that should be left underground at all costs—supporters prefer to call it “clean coal” and see it as a part of the solution. Their argument is that the world is hugely dependent on a giant fleet of aging power plants that will continue to be operational for decades to come. According to this view, if humans must make dramatic cuts in their carbon emissions while old power plants are still running, and before other technologies can be rolled out, back-fitting CCS could be a vital way of cutting the world's overall emissions when it matters most. The latest biomass power plants are already carbon neutral, because biomass (such as fast-growing trees and straw) takes in CO₂ as it grows and releases it again when it's burned. So if we fitted CCS to them, we'd effectively have a way of pulling net carbon dioxide from the atmosphere—which would be even better.

Unfortunately, despite some very promising small-scale experiments, CCS is still a very expensive and relatively untried technology and the argument is unlikely to be settled one way or the other until more work has been done to demonstrate its real costs and benefits. With that in mind, many people are eagerly watching progress at Petra Nova, currently the world's largest post-combustion CCS plant, which has been operating in Houston, Texas since 2016. But skeptics are pointing to the failure of Kemper County, a \$7.5 billion CCS project in Mississippi, as evidence that the technology is fundamentally unachievable. In June 2017, after several years of controversy, Kemper finally abandoned coal altogether and opted to burn gas instead. In the UK, the government has repeatedly tried and failed to get CCS projects off the ground with the help of private-sector power plant operators. In November 2018, it announced new funding for the technology, with more emphasis on reducing carbon emissions from heavy industry.

Carbon capture and storage in other industries

It's important to remember that power plants aren't the only source of smokestack carbon dioxide emissions; cement, concrete, steel, and fertilizer plants also release large amounts of CO₂. Although modern plants are more efficient than older ones, significant cuts in industrial emissions can only really be achieved by applying CCS to these sorts of plants as well. In the case of cement-making, pre-combustion doesn't apply, which leaves post-combustion and oxyfuel. Several pilot schemes are currently in place around the world to see which method works best. A number of fertilizer plants are also capturing their CO₂ for reuse. In 2011, for example, Chaparral Energy started piping CO₂ captured from a fertilizer plant in Kansas to Oklahoma to increase oil production from its fields there. Closely related to cement is the production of concrete (which uses cement as one of its ingredients); you can find a brief discussion about lower-carbon, more environmentally friendly ways of making that in our article about concrete.

An FAQ on 45Q: What federal carbon storage tax credit means for Midwest

Frank Jossi, The Energy News Network, July 10, 2018

A federal tax credit passed earlier this year could increase the amount of carbon being stored underground. The revamped “45Q” tax credit boosts the amount of money available to companies willing to capture and store carbon emissions in geologic formations or use CO₂ to extract oil from existing wells.

Support for the legislation was led by the Carbon Capture Coalition, a project of the Minneapolis-based Great Plains Institute and the Center for Climate and Energy Solutions. The coalition has members from business, labor and environmental communities.

The Great Plains Institute’s vice president of fossil energy, Brad Crabtree, leads the coalition. Getting legislation through Congress as part of the tax bill proved to be a test of will and time, he said.

“I spent six years of my life on this piece of the U.S. tax code,” Crabtree said with a laugh. “When you’re young, you think what will you do with your life? You don’t think of working on an obscure part of the tax code for six years.”

The result of the credit, he believes, is that the United States now has an “incentive policy for a technology that is proven and can be brought into the marketplace and deployed at scale.”

The credit likely will be used by power plants, factories, ethanol producers and companies pulling greenhouse gases out of the atmosphere. Crabtree recently spoke to the Energy News Network about how 45Q could be a catalyst for reducing carbon emissions in the Midwest. The conversation has been lightly edited for length and clarity.

Q: How does the 45Q tax credit work?

It’s like the wind production tax credit in how it functions. Instead of offering a credit for wind production it offers the credit for the capture and geologic storage of a ton of CO₂ that would otherwise be emitted by an industrial facility or power plant.

Q: How much is the credit?

The tax credit offered \$10 per metric ton for enhanced oil recovery previously. That will ramp up to \$35 a ton by 2024. A \$50 a ton tax credit will be available for companies doing carbon capture and storage (CCS) in geologic formations.

Q: Why the difference?

If you only store CO₂ and don’t produce any oil you receive no additional revenue. The policy recognizes that difference.

Q: What is enhanced oil recovery?

Carbon is injected back into existing wells, a process that increases the volume of oil and allows producers to extract more oil.

Q: How does that help with reducing carbon?

The International Energy Agency estimates an average 37

percent net reduction in CO₂ emissions using enhanced oil recovery. It compared a barrel of oil produced conventionally with a barrel of oil produced through enhanced oil recovery. More CO₂ gets injected into the formation than results from the oil production. That’s where the climate benefit comes in.

Q: How will this legislation impact the Midwest?

There are two ways. One is that if a power plant emits more than 500,000 tons annually it is eligible for the tax credit. There may be utilities in the region near geologic formations willing to store their emissions. Businesses emitting under 100,000 tons and above of CO₂ can now take advantage of the tax credit.

Q: Why is that important?

This opens the door to participation for a whole range of industries and in the Midwest the prominent example will be ethanol. And the Midwest has the advantage of having vast saline formation reservoirs for storing carbon.

Q: Ethanol?

I think there will be a huge incentive to install CO₂ compression equipment at ethanol plants to transport CO₂ to where it can be stored. The ethanol industry is trying to figure out how to reduce its carbon footprint and companies could use the tax credit to invest in pipelines linked to oil producers and underground storage.

It’s cheaper to capture CO₂ from an ethanol plant than from a power plant because it has a higher concentration of gas. I think there’s a chance the US ethanol industry will be the first industry in the world to capture most of its CO₂ emissions.

Q: Does any ethanol plant store carbon now?

Archer Daniels Midland (ADM) began storing (in 2017) 1.1 million tons of carbon emissions a year from a corn processing facility in a saline formation at its ethanol plant in Decatur, Ill. ADM is taking responsibility for those emissions but not every company will be willing to do that.

Q: Will the Midwest see other projects emerge with the 45Q tax credit?

I see Kansas, Oklahoma, Illinois and Michigan have significant amounts of CO₂ that can be stored through enhanced oil recovery. I don’t think the power sector will store as much CO₂ because of the cost, but there are plants in Canada and Houston doing it. Other industries making products using hydrogen and ammonia such fertilizer companies have a strong presence in the Midwest.

Q: When will we begin to see the effect of 45Q?

What we think will happen is you will begin to see projects being announced in the next few months to within year. White Energy and Occidental have announced their intent to capture CO₂ from two Texas ethanol plants. Things are starting to happen.

Induced Earthquakes

USGS Earthquake Hazards Program

Myths and Misconceptions

Fact 1: Fracking is not directly causing most of the induced earthquakes. Disposal of waste fluids that are a byproduct of oil production is the primary cause of the recent increase in earthquakes in the central United States.

Wastewater disposal wells typically operate for longer durations and inject much more fluid than hydraulic fracturing, making them more likely to induce earthquakes. In Oklahoma, which has the most induced earthquakes in US, only 1-2% of the earthquakes can be linked to hydraulic fracturing operations. The remaining earthquakes are induced by wastewater disposal.

Fact 2: Not all wastewater injection wells induce earthquakes.

Most injection wells are not associated with felt earthquakes. A combination of many factors is necessary for injection to induce felt earthquakes. These include: the injection rate and total volume injected; the presence of faults that are large enough to produce felt earthquakes; stresses that are large enough to produce earthquakes; and the presence of pathways for the fluid pressure to travel from the injection point to faults.

Fact 3: Wastewater is produced at all oil wells, not just hydraulic fracturing sites.

Most wastewater currently disposed of across the nation is generated and produced in the process of oil and gas extraction. As discussed above, saltwater is produced as a byproduct during the extraction process. This wastewater is found at nearly every oil and gas extraction well.

The other main constituent of wastewater is leftover hydraulic fracturing fluid. Once hydraulic fracturing is completed, drilling engineers extract the fluids that are remaining in the well. Some of this recovered hydraulic fracturing fluid is used in subsequent fracking operations, while some of it is disposed of in deep wells.

Fact 4: The content of the wastewater injected in disposal wells is highly variable.

In many locations, wastewater has little or nothing to do with hydraulic fracturing. In Oklahoma, less than 10% of the water injected into wastewater disposal wells is used hydraulic fracturing fluid. Most of the wastewater in Oklahoma is saltwater that comes up along with oil during the extraction process.

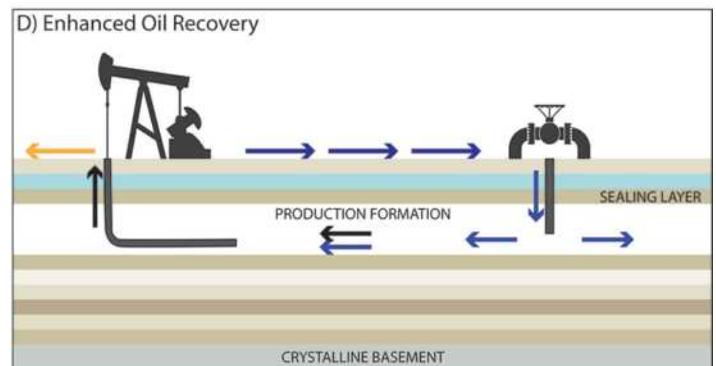
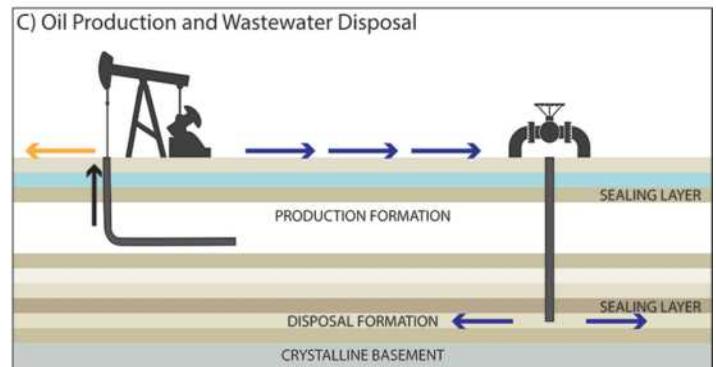
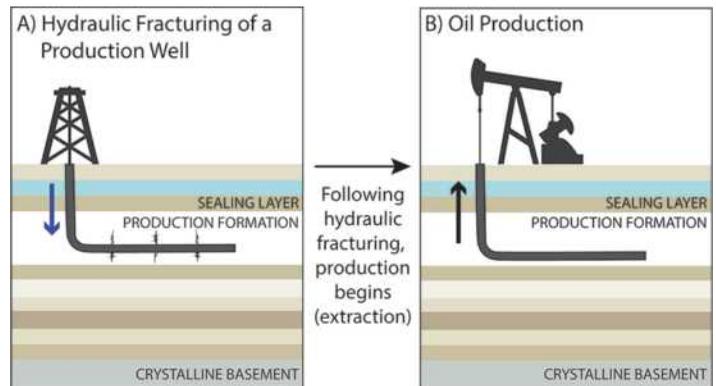
In contrast, the fluid disposed of near earthquake sequences that occurred in Youngstown, Ohio, and Guy, Arkansas, consisted largely of spent hydraulic fracturing fluid.

Fact 5: Induced seismicity can occur at significant distances from injection wells and at different depths.

Seismicity can be induced at distances of 10 miles or more away from the injection point and at significantly greater depths than the injection point.

Fact 6: Wells not requiring surface pressure to inject wastewater can still induce earthquakes.

Wells where you can pour fluid down the well without added pressure at the wellhead still increase the fluid pressure within the formation and thus can induce earthquakes.



Groundwater Protection Council report evaluates reuse potential for water produced by oil, gas wells

Jack Money, The Oklahoman, June 25, 2019

Oil and gas operators produce about 900 billion gallons of water from their wells per year, with about 55% of that disposed of by those operators.

But in an environment where a changing climate and growing populations are putting pressure on available freshwater supplies, operators and regulators alike are rethinking the economics and long-term sustainability of traditional produced-water management practices.

A report issued Monday by the Groundwater Protection Council evaluates those trends, promotes potential ways produced water might be appropriately reused and examines challenges associated with that goal.

A key question that must be answered, the report states, is whether reusing produced water in some parts of the country could be the right thing to do in cases where its beneficial use would outweigh costs to manage, treat, store and move produced water around.

Beyond costs, other factors that also must be considered include health and environmental risks and legal and regulatory matters involving ownership and liability issues.

The council involved about a half dozen top-level state regulators from Oklahoma, including Shellie Chard, director of the water quality division at the Department of Environmental Quality.

Chard served as the water quality co-chair for the study.

“Oklahoma is a national leader in addressing the importance of water, energy and environmental challenges, so having a voice in this report was critical to its success,” she said. “The produced water report maintains that water reuse is possible and may be cost effective in some situations, which is important for drought susceptible areas of our state where the reused water makes fresh water available for drinking.

“This is an incredibly important step forward in water management.”

The report’s summary notes the quality of produced water, which can include significant amounts of mineral salts, other organic contaminants, metals and radioactive materials, varies widely depending on where it is produced and from what formation it flows.

Because of that, treatment, risk management and regulatory strategies could vary.

The report consists of three modules. The first evaluates current legal, regulatory, and operational frameworks of produced-water management, (usually prescribed by the federal government through its discharge and injection programs and enforced by state environmental regulators).

The second evaluates seven oil and gas basins, seeing how and

where produced water is reused by oil and gas operators. Operators need water, for example, to complete today’s horizontal wells and must handle the water that completed wells produce.

In cases where water is disposed, produced water is temporarily stored at a well site until it can be piped or trucked to a disposal well.

In cases where the produced water is reused by oil and gas operators, a significant amount is used for enhanced oil recovery operations or is treated so that it can be used to complete another well. In the latter case, it usually is piped or trucked to a treatment and blending facility before going into storage until it is needed.

The basin reusing the highest percentage of produced water, the report states, was the Appalachian, at about 67%. Reuse of produced water in all others, however, averaged less than 15%, the report shows.

The final module evaluates potential other ways produced water could be reused, and what types of research might be needed to get there.

It includes an overview of various treatment technologies that exist or are being actively researched today within academic, governmental, and industrial arenas and identifies hundreds of published, peer-reviewed studies and other reports that might help assess the possibilities by identifying knowledge gaps and current limitations.

In short, the report is described by the council as an effort to work with various stakeholders to evaluate opportunities and challenges associated with using produced water, as well as to make suggestions that policy makers, researchers, regulators, and others can use to address them.

Mike Paque, executive director of the Groundwater Protection Council, wrote in an introduction the council engaged geologists, engineers, lawyers, toxicologists, soil experts, public health experts, the petroleum industry and state regulators to create the report.

He noted participants reviewed thousands of papers and studies as they researched the topic and held dozens of meetings before writing, editing and producing the report.

He wrote the report “contains the most current information available about regulatory frameworks, produced-water use in oil and gas operations, and potential future uses of produced water outside of oil and gas operations.

“While we believe the report is exhaustive, it is by no means the final word with respect to produced-water reuse,” Paque continued. “We expect future efforts to continue developing a more mature understanding of produced-water characteristics and reuse potential.”

DEQ: Its Mission for Our Great State and Its Impact on the Lives of Oklahomans

Scott Thompson, Executive Director, Oklahoma Department of Environmental Quality, July 2019

The Oklahoma Department of Environmental Quality (DEQ) impacts the life of every Oklahoman every single day. How? Well, DEQ is the state agency charged with ensuring the safety and cleanliness of Oklahoma's drinking water, outdoor air, and land. So the water you drink, the air you breathe, and the land you live on is cared for by DEQ. Also, DEQ is tasked with the protection of public health. In short, DEQ works tirelessly to make Oklahoma a healthy place to live, play, work, and raise a family.

DEQ accomplishes its mission of protecting public health and the environment through its many programs that permit, monitor, and analyze pollutants that are introduced into our environment. DEQ also has many non-regulatory programs focused on customer assistance to help the regulated community comply with sometimes complex environmental requirements.

DEQ has made great strides in its twenty-six year history. In Oklahoma, air emissions have been reduced dramatically due in part to more stringent vehicle emission standards as well as more restrictive permit limits. Industry's increased awareness as to the benefits of environmental stewardship has played a key role as well. As a result, Oklahoma is a healthier state.

One program solely dedicated to the health of Oklahomans is DEQ's air monitoring. DEQ has a network of air monitors across the state to keep track of certain pollutants that can have negative health effects. Those monitors issue alerts when pollutants reach unhealthy levels. This focus on monitoring and reporting helps citizens make informed decisions about their health. Real time health advisories are issued by DEQ, and anyone can sign up for those alerts by visiting www.deq.ok.gov.

Energy efficiency is an incredibly important message DEQ works to convey to Oklahomans. Not only does DEQ help residents, business owners, and municipalities increase their energy efficiency, DEQ also practices energy efficiency in its office. In 2018, DEQ averaged 45% less power usage than in 2012. This was accomplished by retrofitting light fixtures and bulbs with newer, more energy efficient models, replacing powered exit lights with photoluminescent signage, installing motion switches to automatically turn off lights in empty rooms, and several other ongoing projects.

For Oklahoma to remain a healthy place to live, play, and work, the public and future generations have to be aware of what they can do to help our state's environment. To that end, DEQ has an Environmental Education program that distributes informative resources throughout the state, as well as training teachers on how best to teach their classes about environmental issues. Presentations and informational material are provided at no cost to schools, neighborhood associations, and community groups. DEQ's Environmental Education Program helps schools reduce their environmental footprint by getting classes involved in hands-on activities such as launching recycling programs, establishing community gardens, creating aquaponics labs, and much more. Further, DEQ supports the Oklahoma Green Schools Program. The Green Schools Program provides resources, funding opportunities, and curricula that engages students in environmental service-learning and hands-on investigations around the topics of energy efficiency and renewables, water quality and conservation, waste and recycling,

and much more. The program guides students to become leaders in their school and owners of their education experience. Through these efforts, DEQ is encouraging Oklahoma's next generation of environmental stewards.

DEQ handles a wide array of duties when it comes to protecting Oklahoma's land. DEQ helps prevent pollution by inspecting and permitting hazardous waste and solid waste treatment, storage, and disposal facilities. Additionally, DEQ restores previously contaminated land to safe and useful conditions through our Brownfields, Superfund, Site Cleanup Assistance, Voluntary Cleanup, and Land Restoration projects. DEQ oversees the safe management of radioactive materials throughout the state. The Tire Recycling Program cleans up illegal tire dumps, manages tire-recycling facilities, and cooperates with other entities in producing rubberized asphalt pavements.

All public water systems in Oklahoma are certified and regulated by DEQ. These facilities are held to both state and federal drinking water standards. In addition to managing public drinking water, DEQ regulates facilities that treat, transport, store, and discharge wastewater. DEQ also cooperates with other state agencies to maintain safe water quality standards in Oklahoma's rivers, lakes, and streams.

The State Environmental Laboratory Services division of DEQ is vital in maintaining the aforementioned water quality standards. The laboratory conducts organic and inorganic sample analysis, provides customer service to other state agencies, and offers private well water analysis. Additionally, the lab is a central part of ensuring wastewater facility compliance, hazardous waste compliance, environmental complaints analysis, and emergency response to disasters such as flooding or tornadoes.

It's clear that DEQ has many environmental programs that affect the state, and the people who live here, on a big picture level. But it's also important to bring things down to a local level. This is why DEQ maintains 20 field offices throughout the state, in addition to the regional office in Tulsa, and the main office in Oklahoma City. At each of our 22 offices, locally based environmental specialists have a hand in managing nearly all of DEQ's programs. These field employees provide regulatory inspections and technical assistance to every DEQ-permitted facility in Oklahoma. Additionally, they handle all aspects of the on-site sewage program – including soil tests, system design, inspection of system installations, and oversight of certified installers and septage pumpers & haulers. Their most important task, however, is to respond to and investigate all citizen complaints regarding environmental pollution.

The mission of the Oklahoma Department of Environmental Quality is to protect people through the air we breathe, the water we drink, and the land on which we thrive, helping to make Oklahoma an even better place to live. This overview illustrates how seriously DEQ takes its mission, and the means DEQ uses to achieve it. An overview such as this only begins to touch on the hard work, dedication, and passion our staff have for Oklahoma. It is through their efforts that DEQ is able to make Oklahoma a healthy place to live, play, work, and raise a family.

The ChargeOK Program: Leading the Charge for Electric Vehicle Transportation in Oklahoma

Erin Hatfield Oklahoma Department of Environmental Quality Communications Director

The Oklahoma Department of Environmental Quality (DEQ) is extremely excited and optimistic about the positive impacts of the ChargeOK Program will have on Oklahoma. Until now, driving an electric vehicle has been difficult when traveling outside urban areas and traversing the open lands of Oklahoma. ChargeOK was born out the VW Settlement and the \$20.9 million awarded to Oklahoma. ChargeOK grants are expected to kick-start the creation of a network of publically accessible charging stations throughout Oklahoma.

In 2017, former Governor Mary Fallin designated DEQ as the lead agency for the administration of Oklahoma's Volkswagen settlement trust funds. The Office of the Oklahoma Secretary of Energy and Environment (OSEE) is providing oversight and final approval of the mitigation plan.

To encourage the purchase of electric vehicles, DEQ, with help from the OSEE, the Oklahoma Department of Transportation, and the Oklahoma Corporation Commission, developed the ChargeOK program. The program requested proposals from eligible applicants to install Electric Vehicle (EV) charging stations throughout Oklahoma.

In 2016, the United States settled claims against Volkswagen, et al., concerning the use of a "defeat device" installed on diesel vehicles which resulted in air pollution emissions from these vehicles exceeding federal guidelines. States are allocated a portion of the settlement based on their number of affected vehicles. Each of these vehicles can emit up to 40 times more than the legal limit for nitrogen oxides, which negatively impact Oklahoma's air quality.

Through the ChargeOK program, Oklahoma seeks to build a strategic network of electric charging stations to increase the use of EVs in place of gas-powered vehicles to mitigate nitrogen oxides, decrease particular matter and greenhouse gas emissions, and reduce EV range anxiety across Oklahoma.

A maximum of 15 percent (approximately \$3.1 million) of Oklahoma's trust allocation will be used to fund light-duty electric vehicle supply equipment (EVSE) projects. With consideration for existing and planned investments of electric charging stations within Oklahoma, The ChargeOK Grant Program will be implemented in two categories of projects: 1) direct current fast charging (DCFC) projects on designated electric vehicle transportation corridors and 2) DCFC/Level 2 EVSE charging projects for single point locations.

The ChargeOK Grant Program is funded as a reimbursement grant program. Grant payments are disbursed as reimbursements after the work is completed, verified, and approved.

Transportation Corridors listed below, identify where proposed projects are to be located.

Designated transportation Corridors:

I-35----- Guthrie to Kansas border
I-40----- Shawnee to Arkansas Border
I-44----- Newcastle to Texas Border
US-69----- US-412 JCT to Durant
US-75----- Okmulgee to US-69 JCT
US-412----- Woodward to Sand Springs
US-64----- Boise City to Bryans Corner
US-183----- Clinton to Texas Border
US-270----- Woodward to Geary
SH-3----- US-69 JCT to Broken Bow

Grantees are required to provide a minimum 20% match. If a higher percentage is matched, then additional points were awarded during the scoring process. The projects submitted by grantees must also meet a series of minimum requirements to ensure the charging stations are safe, publicly accessible, and well maintained. These requirements include, but are not limited to: amenities at or near the host site, 24/7 access to charging stations and customer service for said charging stations, 5-year maintenance contracts, Payment Card Industry compliance, and equipment safety requirements.

The application period for proposed projects closed on March 1, 2019. The ChargeOK committee has made preliminary project selections; Recipients and project locations will be announced on the DEQ website once all projects have been finalized. It is anticipated that all charging stations resulting from this program will be installed within one year of the project finalization date, and will greatly expand the electric vehicle infrastructure throughout Oklahoma.

For more details on ChargeOK and other Volkswagen funding programs, as well as future announcements on finalized project selections, visit DEQ's website at <https://www.deq.ok.gov/air-quality-division/volkswagen-settlement/>.

Charged up: EV use growing in Oklahoma

Christian Tabak, The Journal Record, July 2, 2019

Walmart announced Tuesday it would be adding electric vehicle charging stations to five of its locations in Oklahoma as part of a partnership with Electrify America aimed at expanding alternative fuel routes across the nation.

Electrify America charging stations are available for public use 24 hours a day at Walmart Supercenters located in Ardmore, Bristow, Moore, Vinita and Weatherford. The chargers at these locations feature 150-kilowatt and 350-kilowatt DC fast chargers, which Electrify America said are capable of charging vehicles at speeds of up to 20 miles of range per minute. Walmart also offer CCS connectors and CHADeMO chargers, allowing for compatibility with the majority of electric vehicles.

“Along with providing our customers with an enhanced shopping experience through added convenience, this initiative also allows us to contribute to the expansion and accessibility of our nation’s EV charging station infrastructure,” said Mark Vanderhelm, vice president of energy for Walmart Inc. “Many of our Walmart associates and customers are EV drivers, so providing access to these stations is the right thing to do for our customers, our business and the environment.”

Oklahoma’s charging stations are a fraction of the 120 EV charging stations opened at Walmarts across 34 states, which the retail store chain promised back in April 2018 as part of its commitment to increase its sustainability efforts. It also is in line with the Federal Highway Administration’s goal of promoting alternative fuel corridors, its designation for key interstate routes it is looking at to provide fueling stations for the nation’s alternative fuel vehicles.

A significant number of EV charging stations in the U.S. are on the East and West coasts and in urban areas. With Electrify America EV charging stations at Walmarts along interstate routes, Walmart Director of Sustainability Communications Micah Ragland said travelers now have alternate routes open to them.

“In many cases, EV drivers have the option to solely recharge at Walmart stores during their travels,” Ragland said. “EV users will have expanded access to additional driving routes in other sections of the country and can now travel across the country on major interstates and highways.”

Electrify America has said it will invest \$2 billion in electric vehicle infrastructure and education over the next 10 years, with a plan to deploy more than 2,000 chargers at

484 sites across 17 metropolitan and highway locations

“This milestone marks an important moment in the expansion of our charging station network,” said Brendan Jones, chief operating officer at Electrify America. “We look forward to continuing our work with Walmart to make electric vehicle charging faster and more convenient for consumers across the country and, in turn, encourage more adoption of zero-emissions vehicles.”

In Oklahoma, these charging stations come at a time of increased interest and focus on electric vehicles and charging infrastructure. The Department of Environmental Quality announced last year it would be accepting proposals for the installation of electric vehicle charging stations throughout the state as part of its ChargeOK grant program.

Funded through approximately \$3.1 million from the Volkswagen State Environmental Trust, the program will reimburse up to 80 percent of the cost for charging station projects that are what the agency designates as transportation corridor and single-point locations.

“Having access to chargers really does encourage people to then consider an electric vehicle if they know there are going to be places they can charge it,” said Erin Hatfield, DEQ communications director. “It’s kind of twofold – reduction in emissions and also building confidence that you can charge your electric vehicle.”

As for emissions, Hatfield said, the program is expected to contribute to a significant decrease in emissions, including 27 tons of nitrogen oxides, 32 tons of volatile organic compounds, 330 tons of carbon monoxide and 3,788 tons of carbon dioxide.

While Oklahoma lags behind other states in populating the streets with electric vehicles, the state has seen an uptick in electric vehicle registrations in recent years. The U.S. Department of Energy records Oklahoma with a total of 1,380 registered electric vehicles as of April 2019. This number is far from neighboring Texas’ 14,390, but is a significant increase over what the agency reported in previous years.

“The increase in EV registrations in the state are showing that EVs are becoming more popular and there’s a need for charging infrastructure,” said Angela Hankins, special projects planner with the Association of Central Oklahoma Governments. “The increase in electric vehicle charging infrastructure throughout Oklahoma will drive those registrations up.”

The 2018 State Energy Efficiency Scorecard

American Council for an Energy-Efficient Economy, October 2018

EXECUTIVE SUMMARY

It has been a dynamic year for energy efficiency, with a mix of often competing forces at the national and state levels. In states including Virginia, New York, and New Jersey, policymakers unveiled plans for increased investment in clean energy and energy efficiency, driven in particular by concerns regarding climate change. Some states, in response to a possible loosening of federal vehicle and appliance standards, worked to keep efficiency standards in place at the state level. Others, like Iowa and Connecticut, saw attacks against efficiency within their states through legislation that results in reduced energy and utility bill savings. Despite a few setbacks, reasons for optimism remained abundant. Across the country, new opportunities for efficiency and distributed resources continued to arise through improved data access, policy innovations, and technological advancements like smart control systems, geographic targeting, electric vehicle grid integration, and energy storage.

States spent approximately \$7.9 billion on energy efficiency in the utility sector in 2017 and saved close to 27.3 million megawatt-hours (MWh), a 7.3% increase from 2016. While average national investments and savings have leveled off somewhat in recent years, efficiency continues to make new inroads in the Southeast and in other states where it has been slower to take hold. With many states continuing to strengthen emissions reduction goals, policymakers and utilities are exploring new ways for efficiency to contribute to meeting climate targets. Overall, plenty of signs are pointing to policymakers' growing appreciation of efficiency's economic and environmental benefits and its role in strengthening the grid and transitioning to a clean energy economy.

The 2018 State Energy Efficiency Scorecard, now in its 12th edition, ranks states on their policy and program efforts, not only assessing performance but also documenting best practices and recognizing leadership. The report captures the latest policy developments and state efforts to save energy and highlights opportunities and policy tools available to governors, state legislators, and regulators.

Energy efficiency remains the nation's third-largest electricity resource, employing 2.25 million Americans and typically providing the lowest-cost way to meet customers' energy needs. Other benefits include improving air and water quality, strengthening grid resilience, promoting equity, and improving health and comfort. By calling attention to recent policy and programmatic successes, the Scorecard

seeks to help states, utilities, and businesses realize all these benefits.

KEY FINDINGS



Figure ES1. 2018 State Scorecard rankings

Figure ES1 shows the states' rankings, divided into five tiers for easy comparison. Later in this section, table ES1 provides details of each state's scores.

Massachusetts, California, and Rhode Island continued to set the pace for energy efficiency in 2018, occupying the top three spots thanks to advances on multiple policy fronts.

Massachusetts retained its hold on first place while capping off a busy year. Policymakers launched statewide energy efficiency planning efforts to set new three-year savings targets. The state's Three-Year Energy Efficiency Plan also incorporates a fuel-neutral savings target. This reflects a growing trend among northeastern states to take a holistic approach to energy savings, including not only electricity and natural gas but also nonutility heating fuels. In addition, the state's Department of Public Utilities issued an order in May approving \$220 million in utility investment in grid-side modernization technologies over the next three years to improve efficiency and reliability and to pave the way for smart meter deployment. The state's General Court also passed legislation that authorizes "strategic electrification" and carbon-reducing use of renewable energy through efficiency programs. The new law revitalizes progress toward statewide goals to slash greenhouse gas (GHG) emissions 80% by 2050 per the state's Global Warming Solutions Act of 2008.

Finishing in second place and closing in on the lead was California, which passed several regulations to advance

energy efficiency over the past year. In late 2017 the state's Public Utilities Commission adopted long-term energy savings goals informed by SB 350 and AB 802. These major pieces of 2015 energy legislation called for doubling electric and natural gas savings by 2030 and shifted the energy use baseline to existing conditions in order to better target below-code savings. In 2018 the California Public Utilities Commission (CPUC) approved the first-ever set of business plans for the state's investor-owned utilities, providing sector-level strategies and metrics to align utility programs with the new savings goals. This spring the state adopted new net-zero electricity building energy codes that will require all new single-family homes and low-rise apartment buildings to use solar and efficiency to zero out the building's electricity demand. California also joined with eight other states in rolling out an updated zero-emissions vehicle (ZEV) action plan. This strategy pushes for the adoption of policies to accelerate the purchase of ZEVs in response to the US Environmental Protection Agency's decision earlier in the year to freeze GHG emission standards for light-duty vehicles.

Rhode Island continued to hold its ground in third place. It achieved electric savings exceeding 3% of sales, among the highest reported levels anywhere in the United States, driven by an ambitious Three-Year Energy Efficiency Procurement Plan. In February the state also adopted a voluntary residential stretch code, based on elements of the US Department of Energy's Zero Energy Ready Home program and the EPA's WaterSense program. The code is intended to support sustainable energy goals described in the Resilient Rhode Island Act of 2014 to cut emissions 45% by 2035. Clean energy advocates ran into roadblocks on other policy fronts, however, with a bill stalling in the General Assembly that would have made the state the first in the nation with a carbon tax. Meeting a similar fate were proposed efficiency standards for lighting, computers, plumbing products, and other appliances. Yet the state continued to perform well in multiple Scorecard policy categories to finish in the top three for the second year in a row.

Vermont and Connecticut appeared in fourth and fifth place, respectively. Vermont's legislature passed H410 in May, enacting 16 new state appliance efficiency standards for computers and monitors, fluorescent tubes not covered by federal efficiency standards, plumbing fixtures, and other appliances. Among the 16 are three federal standards that were completed in recent years but never implemented. By 2025 the standards are expected to save consumers 435 million gallons of water and 59 million kilowatt-hours (kWh) of electricity annually, equating to roughly \$17 million in savings per year.

Also in the top 10 this year were New York, Oregon,

Minnesota, Washington, and Maryland. Each of these states has well-established efficiency programs and policies and continues to push the boundaries by refining ways to enable energy savings. New York announced in the spring a plan to reduce energy consumption by 185 trillion Btus from forecast levels by 2025, a 50% increase over prior goals. The governors of Oregon and Washington also both signed major executive orders since the last Scorecard to accelerate energy efficiency in the built environment. Enacted last November, Oregon's EO 17-20 lays out an ambitious plan to cut energy use and carbon emissions from state buildings and residential and commercial construction, directing updates to building energy codes to require electric vehicle-ready building construction as well as zero energy-ready homes. Similarly, Washington's EO 18-01 calls on state agencies to prioritize the lease and purchase of low-emission vehicles and construction of zero energy or zero energy-capable state-owned buildings.

STATES RISING AND FALLING

The most-improved state this year was New Jersey. Other substantially improved states were Missouri, Colorado, South Dakota, and Connecticut. They posted the largest point increases over their previous year's scores.

New Jersey improved by 4 points this year, the most of any state, and rose in the ranks from 23rd to 18th. Energy efficiency received a huge boost in the Garden State with the passage of Senate Bill 2314, establishing new annual energy savings targets for electricity and natural gas of 2% and 0.75% of sales, respectively, to be achieved within the next five years. The legislation also creates a new energy storage target, strengthens the state's renewable portfolio standard, and sets energy benchmarking requirements for commercial buildings with more than 25,000 square feet of space. Missouri improved by 2.5 points this year, rising from 37th to 33rd. Following a challenging 2016 in which energy efficiency programs were briefly suspended due to prolonged negotiations between utilities and state regulators, Missouri rebounded in 2017 with annual electric utility savings of 0.78%, the highest it has ever reported. The states' electric utilities seem poised to build on their success, with Ameren Missouri filing plans in June 2018 to invest nearly \$92 million annually in energy efficiency over the next six years and develop 15 new programs. The utility also introduced plans in February to incentivize the rollout of electric vehicle charging stations across the state and encourage commercial customers to transition to electric vehicles.

Other states making improvements included South Dakota and Colorado, which also added 2.5 points each. While South Dakota has long appeared in the bottom tier of the Scorecard, it rose three positions in this year's ranking thanks to efforts to strengthen efficiency in the buildings

sector. While South Dakota's state-adopted building energy codes remain voluntary, many communities within the state have nevertheless updated local codes based on the 2015 IECC. Colorado moved up a spot into 14th place in recognition of the state public utilities commission's raising the bar on utility savings. The commission approved new energy savings goals for Xcel Energy, an increase from 1.3% of electric sales to approximately 1.6%.

Connecticut also added 2.5 points, improving from sixth to fifth place, in part by advancing efficiency in the buildings sector through the adoption of the 2015 IECC. However, as mentioned, a raid of the state's energy efficiency fund in late 2017 could negatively impact Connecticut's standing in future Scorecards.

Not to be overlooked, Nevada also showed sizable progress in the wake of major state energy legislation passed in 2017. The law directs the Public Utility Commission to establish utility energy savings goals for NV Energy, allow program approval if the portfolio of utility energy efficiency programs is cost-effective, include nonenergy benefits in benefit-cost analysis, and require a minimum spending level for low-income efficiency programs. While the PUC is still working with stakeholders to establish formal targets, NV Energy's Joint Integrated Resource Plan and

three-year Demand Side Management (DSM) Plan submitted earlier this year aim for annual savings of 1.15% in the next three years, a significant improvement on the state's past efficiency efforts. The Silver State has also taken steps to strengthen sustainability in its transportation sector with the implementation of a statewide complete streets policy to design and retrofit streets and highways in a way that improves accessibility for all users, including pedestrians, cyclists, and people with disabilities.

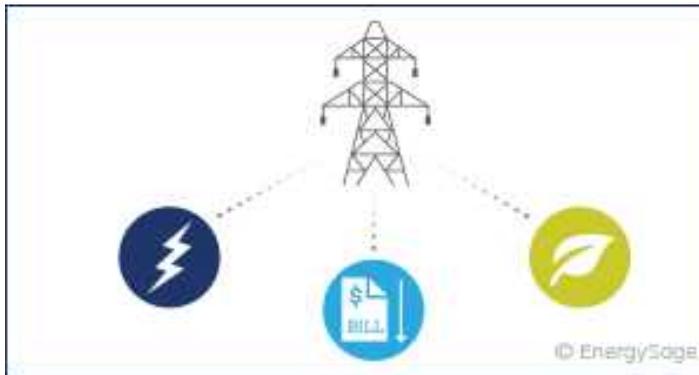
By contrast, 18 states fell in the rankings this year and 19 lost points, because of changes in their performance as well as adjustments in our methodology, the latter including new metrics in the building policies chapter and the shift of 1 point toward appliance standards. Iowa fell the farthest, losing 3.5 points. This drop was largely due to the signing earlier this year of bill SF2311, which imposes a restrictive spending cap on efficiency programs, removes efficiency program requirements that had been placed on municipal utilities and co-ops, and allows customers to opt out of paying for efficiency programs that fail to satisfy the ratepayer impact (RIM) test, a cost-effectiveness measure rejected by most states as inequitable. Early indications from utility filings point to a forecast drop in savings of 25–50% for electric programs and 75–80% for gas programs, further jeopardizing Iowa's rank in future Scorecards.

Notes

**This is a resource document for you to use.
Take notes, highlight, use as a text book.**

Why your utility offers energy efficiency programs

EnergySage, November 16, 2018



Many of the energy efficiency programs available to homeowners and businesses across the United States are sponsored by utilities. A utility encouraging its customers to use less energy and reduce their monthly bills might seem counterintuitive at first glance, but energy efficiency measures have benefits for property owners and utilities alike. Efficiency is the least expensive way to source new electricity, and in many states, utilities are required to invest in it. Energy efficiency can also help utilities manage times of high demand, which makes it easier to provide reliable service to customers.

Energy efficiency programs are less expensive (and faster to implement) than other new energy resources

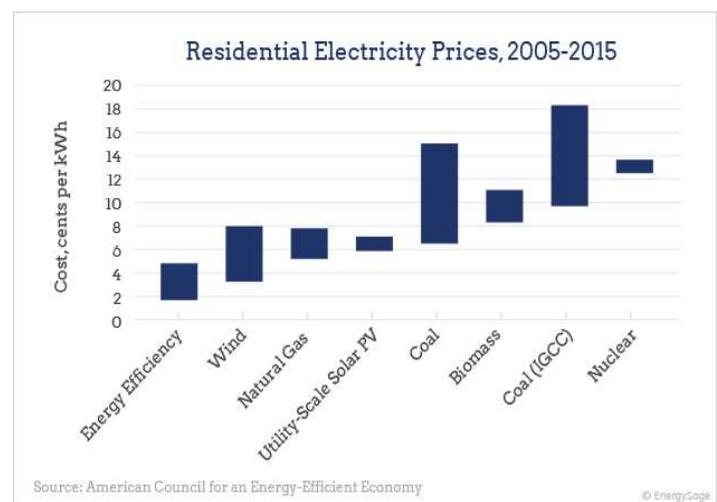
Utilities are constantly managing changes in energy demand. In areas where energy use is increasing, utilities often have to find new ways to produce energy for their customers. However, building new infrastructure to produce electricity or deliver gas can be expensive.

If you think of efficiency as an energy resource like solar, wind, natural gas, or coal, it's easy to understand why your utility would invest in it. Energy efficiency is the least expensive way to source "new" electricity. Think of it this way: if your utility can reduce each customer's electricity use by just three percent, it frees up three percent of its electricity resources, which could prevent the need for constructing a new power plant.

In addition to its low cost, energy efficiency can provide new energy resources in much less time than it takes to build a new power plant. Natural gas and coal-fired power plants can take three years or more to build, and nuclear power plants take even longer. By comparison, most energy efficiency improvements can be completed in a matter of months.

The easiest way to compare across different energy resources is to look at the levelized cost of energy, or LCOE. LCOE shows the lifetime cost of a resource per kWh. The LCOE of electricity from coal, for example, takes into account both the cost of building a coal-fired power plant and the cost of buying and burning coal. The LCOE of a home solar panel system includes the expense of buying solar panels and installing them on your roof.

According to the American Council for an Energy-Efficient Economy (ACEEE), the levelized cost of one kWh "generated" as a result of energy efficiency costs \$0.02-\$0.04. Natural gas costs approximately \$0.05-\$0.08/kWh, and coal can cost as much as \$0.15/kWh. On average, energy savings from energy efficiency programs come at one-third the cost of new energy generation resources.



In some states, utilities are required to invest in energy efficiency programs

You may already be familiar with the renewable portfolio standard (RPS), which require states to generate a certain percent of their electricity from renewable energy. Some states also have an energy efficiency resource standard (EERS), which sets long-term energy efficiency targets. In some cases, states are required to reduce their energy sales by as much as 2.5% every year. According to ACEEE, 26 states have an EERS as of early 2017.

In states with an EERS, utilities or public sector programs work with utility customers to implement energy efficiency efforts. Often, these programs offer financial incentives that can help reduce the cost of energy efficiency measures for property owners.

Energy efficiency helps utilities manage times of high demand

Electric utilities have a complex task. They have to provide enough electricity to meet demand across their entire territory, which means anticipating when demand will rise. It can be both costly and difficult to meet demand when it's high – such as hot summer afternoons when homeowners and businesses are running their air conditioning on full blast – but not doing so will result in less reliable electricity service for everyone.

Helping utility customers improve the efficiency of their homes and businesses is a great way for utilities to help manage demand during those peak hours. If a utility can make it easier for customers to use high-efficiency air conditioners and ensure that their buildings are properly insulated, their energy use on those hot summer afternoons will be lower. It's a win-win for customers and utilities: customers reduce their bills when they have more efficient appliances, which makes it easier for utilities to provide

enough electricity to meet demand.

Utilities want to help customers manage their energy use. Nobody likes the unpleasant surprise of a higher-than-expected bill, and utility bills are no different. Utilities know that their customers want to manage their energy costs, and want to give them tools to manage their usage and avoid sudden bill increases. That's another place where energy efficiency comes in – in addition to helping you save money on your electricity bill, energy efficient appliances and products can help property owners manage their energy use.

For example, many energy efficiency programs offer incentives for smart thermostats. Smart thermostats help utility customers manage their heating and cooling so that they aren't wasting energy but can still maintain a comfortable environment in their homes. Energy efficiency measures can also reduce electricity use in the home to “make room” for other environmentally friendly measures like electric vehicles, which many utilities actively support.

Notes

This is a resource document for you to use.

Take notes, highlight, use as a text book.

About the OERB

Fact sheet from the Oklahoma Energy Resources Board

The Oklahoma Energy Resources Board is the nation's first energy checkoff program. Created by the state legislature in 1993 at the request of the oil and natural gas industry, the OERB is voluntarily funded through a one-tenth of 1 percent assessment on the sale of oil and natural gas. The OERB's mission is to restore orphaned and abandoned well sites and to educate Oklahomans about the importance of the oil and natural gas industry. The OERB is governed by an unpaid 21-member board.

ENVIRONMENTAL CLEANUP

- 17,000 sites cleaned up.
- Land restored in 72 of Oklahoma's 77 counties.
- \$121 million spent on environmental cleanup program.

ENERGY EDUCATION

- OERB reaches all academic grade levels – from elementary through college – with its energy education programs, including:

K-12 curricula

- Developed by Oklahoma teachers for Oklahoma Teachers
- Intended to supplement lessons teachers are already using
- Localized science and math concepts
- Nine programs consisting of Math, Science, Language Arts and Social Studies
- Curricula meets the Oklahoma Academic Standards
- Each program has a kit of materials that goes along with all of the lessons. The kits are given to the teachers for free and valued at \$300-\$1,100 in classroom materials.

Teacher Workshops

- 14 workshops held each year in various locations around the state.
- All 9 curricula are offered at every workshop.
- Workshops are completely free.
- Each teacher that attends the workshop receives: Professional development hours, \$50 stipend, curriculum guide and kit of materials, lunch, and T-shirt.
- Over 16,500 teachers trained in 98% of Oklahoma school districts
- Petro Pros
- Oil and natural gas professionals who volunteer their time to visit classrooms and show children the science and business side of the industry.

PetroTech Program

- The PetroTech program is offered at Francis Tuttle and Tulsa Tech.

- Developed for individuals interested in acquiring the knowledge and certification necessary to pursue a career in Oklahoma's oil and natural gas industry.
- Provides a certification for a Geological, Engineering or Land Technician.
- Classes taught by industry professionals
- Students are a mix of industry professionals and people trying to enter the industry.

OERB Petroleum Scholar Program

- Scholarship program through which the OERB distributes up to \$500,000 each year to Oklahoma college students majoring in industry-related fields.
- #### **Field Trip Program**
- Partnerships with 16 museums across the state to enhance energy education and provide free field trips for classes that have completed the OERB curricula.

OERBHomeRoom.com

- Website completely devoted to OERB's student education programs.
- Designed specifically for OERB teachers, it houses copies of curricula, PowerPoints and white board lessons.
- Teachers are able to access virtual labs, message boards and additional industry information for each of the OERB curricula.
- Site brings in fun elements aimed at students, such as virtual field trips and career interviews with Petro Pros.

Well Site Safety Program

- Established in 1996 after a fatal explosion killed three teenagers. The goal is to keep kids from playing around oil & natural gas equipment.
- Free safety-related materials (videos, posters and pocket folders) for classrooms
- TV, Radio, Internet & Print Advertising (Duh & Lucky)
- Annual Well Site Safety education contest
- Well Site Safety Day – State "holiday" in April honoring education program

THE COMMITTEE FOR SUSTAINING OKLAHOMA'S ENERGY RESOURCES (SOER)

- SOER's mission is to encourage new processes and technological advancements in order to sustain the oil and natural gas industry for the future benefit of Oklahoma citizens and to advance activities to support marginally producing oil and natural gas wells.

Section 4
The Economy

The Oklahoma Economist

Chad Wilkerson, Federal Reserve Bank of Kansas City, September 5, 2019 (Excerpted from a longer document)

The recent extended period of slower job growth in Oklahoma is not unprecedented. Oklahoma job growth also lagged the nation from 1982 to 1989, but by a much wider margin than in recent years. However, the effects of weaker overall job growth the past six years have begun to add up. From mid-2013 through mid-2019, Oklahoma employment has grown only 4 percent, even as national employment grew 11 percent. Moreover, as highlighted in recent editions of the Oklahoma Economist, Oklahoma has had more residents move to other states in recent years than have moved in—especially those with college degrees.

Looking across broad categories of industries, for which timely monthly data are available, the largest drops in Oklahoma jobs over both the past year and the past six years have been in the mining sector. This decline has been driven by both the sharp downturn in oil prices in 2014-15 as well as by subsequent and historic efficiency gains in the sector, as detailed in the second quarter 2018 Oklahoma Economist. In addition to mining, the state's manufacturing sector also has lost jobs over the past year and past six years, even as the sector expanded nationally. Employment in Oklahoma's state and local government sector also is down slightly.

Meanwhile, several broad sectors of the Oklahoma economy have continued to add jobs over both the past year and the past six years, with the fastest growth in transportation and construction. However, for both expanding and declining industries in the state, looking at more detailed breakdowns of industries provides more insight into what kinds of jobs are being gained and lost, whether they are becoming more or less concentrated in Oklahoma than in the nation, and their relative pay.

The biggest employment decline in Oklahoma since 2013 has been in oil and gas extraction, which lost over 6,000 jobs—more than a quarter of its total employment. Even with this large shrinkage, the extraction industry remains over 11 times as concentrated in the state as in the nation, based on location quotient. As such, the industry will continue to play a sizable, even if slightly diminished, role in the state's economy.

Two oil and gas-related manufacturing industries in the state also shed about 2,000 jobs each from 2013 to 2018. The largest subcomponent of “other general purpose machinery manufacturing” in Oklahoma is pumps and compressors, including oil field pumps. And over 70 percent of the Oklahoma jobs in “agriculture, construction, and mining machinery” are in oil field equipment and machinery. Difficult agricultural conditions in recent years also have hurt these two industries. Despite their recent sizable reductions in staffing, these industries remain much more concentrated in Oklahoma than in other states.

Two health-care industries in the state likewise reduced employment significantly—home health care services and local government-owned general hospitals. These reductions occurred even as several other health-care industries added considerably to their employment in recent years, as will be noted in the following section.

Two other state and local government industries also shed over 1,000 jobs, as revenues at the state and local level have been hurt by the state's relative economic sluggishness. Public elementary and secondary schools have lost nearly 2,400 jobs, or 3 percent of their 2013 workforce, while over 2,000 jobs were lost in the administration of human resource programs at the state level.

Although Oklahoma job growth has lagged the nation by a sizable margin the past six years and a number of industries substantially shed jobs, some industries in the state have grown considerably. One of the tables lists the 16 Oklahoma industries that each added more than 1,500 jobs from 2013 to 2018. This group was led, by far, by restaurants, which added over 14,000 jobs, with sizable growth among both full-service and limited-services restaurants. However, a variety of other services and goods-producing industries also have thrived.

While a variety of industries have seen large declines in employment in Oklahoma since 2013, a likewise diverse set of industries has thrived and added thousands of jobs. The pay of both growing and declining industries in the state also varies widely. Depending on how the industries are compared, the typical wage across all declining industries either greatly exceeds or only slightly exceeds that of industries that have grown rapidly.

Overall, the average annual Oklahoma wage of the 16 industries losing the most jobs from 2013 to 2018—weighted by the number of jobs lost—was more than \$65,000. However, the median pay for these industries was under \$47,000. The highest-paying industry in Oklahoma, by far, is oil and gas extraction—the industry that has shed the most jobs since 2013 (Table 3). Among other declining industries, though, half of them paid below the average pay across all Oklahoma jobs in 2018: \$46,724. Only four of the other declining industries paid an average wage above \$60,000.

Oklahoma employment has grown much slower than in the nation since 2013. This largely has been driven by difficulties in the oil and gas sector, but technological changes in other sectors also have taken a toll on jobs—such as in the newspaper, telemarketing and auto rental industries. At the same time, however, some Oklahoma industries have thrived during this overall sluggish period in the state. The pay in many of these industries is similar to the pay of jobs in industries that have been declining, although the overall average pay is lower, the warehousing and storage industry has more than doubled its number of jobs in the state since 2013, and the high-paying aerospace industry has nearly done so. Several health-care industries also have grown rapidly, as have well-paying blue-collar industries such as building equipment contractors and pipeline construction. In the hospitality realm, restaurants, casinos and recreation centers likewise have added thousands of jobs. And while the state's computer systems design industry remains smaller than in the country as a whole, its rate of employment growth has outpaced the nation since 2013.

Read full report at <https://www.kansascityfed.org/publications/research/oke/articles/2019/3q-job-growth-lagged>

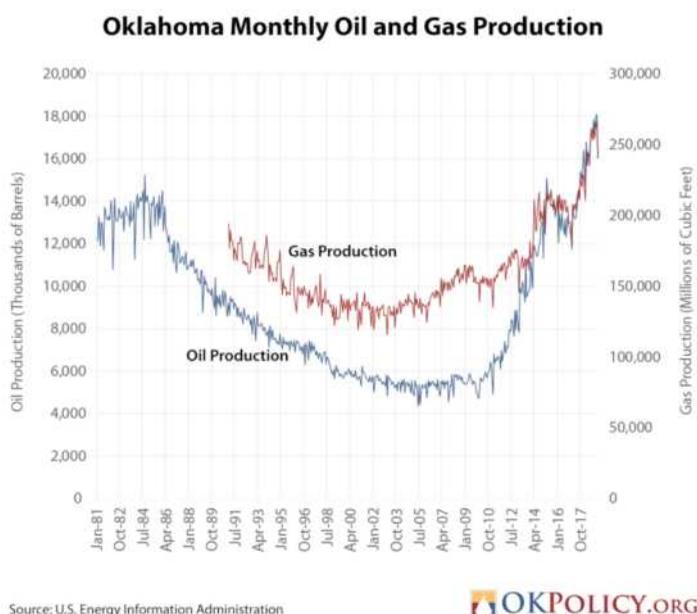
Increased gross production taxes are fueling state's revenue boom

David Blatt, Oklahoma Policy Institute, June 5, 2019

Oklahoma is currently enjoying a period of exceptionally strong revenue growth. As we near the end of FY 2019, General Revenue collections have already come in \$360 million ahead of the year's estimate, which will ensure a large end-of-year deposit to the Rainy Day Fund. Next year's revenues collections are projected to be more than 20 percent higher than last year's, which has allowed the Legislature to approve two straight years of substantial funding increases.

Much of the credit for the prosperous fiscal situation is due to rising oil and gas revenues. In recent sessions the Legislature curbed tax breaks for the oil and gas industry that had allowed a growing share of production to be taxed far below the standard 7 percent rate. Until 2017, some older wells were taxed at just 1 percent during their first three years of production while new wells were taxed at just 2 percent for three years. In 2017, the Legislature restored the rate for all existing wells to 7 percent and then in 2018 restored the rate on new wells to 5 percent for the first 36 months.

Some in the oil and gas industry warned lawmakers that higher tax rates would stifle production and harm the energy industry and overall state economy. This has not appeared to be the case. As can be seen from the graph below, oil and gas production is currently at all-time highs in Oklahoma as well as nationally. Over the 12-month period through February 2019, Oklahoma oil production averaged 17 million barrels, which is 30 percent higher than during the peak years of the early 1980s.



Source: U.S. Energy Information Administration

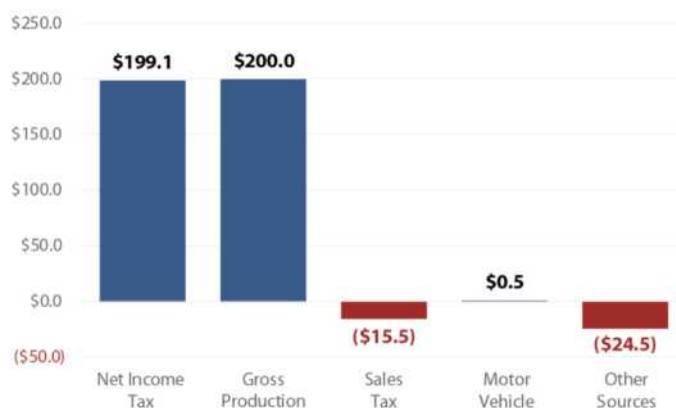
OKPOLICY.ORG

Gross production collections are skyrocketing

The restored tax rates and growth in production have given state revenues a significant boost. Through April, gross production tax revenues to the General Revenue Fund are at \$583.9 million, which is 132 percent above last year (FY 2018) and \$200 million, or 52 percent, above the certified estimate.

Overall, General Revenue collections are \$360 million above the estimate through the first ten months of FY 2019. Gross production taxes account for over half of this surplus, as the graph shows.

FY 2019 General Revenue Collections, Actual vs. Estimate, YTD thru April (in \$M)



OKPOLICY.ORG

The increase in the initial tax rate on gross production from 2 to 5 percent approved by the Legislature last year accounts for a substantial share of this year's increase in gross production tax revenues. The higher rate, which took effect in September, accounted for \$260 million in increased GPT revenue through April, according to data from the State Treasurer's Office. This is already \$90 million (53 percent) in excess of what the higher GPT rate was expected to generate for all of FY 2019, with two more months of collections still to come. Overall, total GPT collections are 38 percent higher this year than they would have been had lawmakers not boosted the rate from 2 to 5 percent. We do not have data to determine the impact of restoring the 7 percent rate on older wells on revenue collections, but it is likely substantial.

Thanks to surging gross production tax collections, along with income tax revenues, which are \$199 million, or 10 percent, above the estimate, the state will likely see a General Revenue Fund surplus of well over \$400 million at the end of FY 2019. This surplus is automatically deposited to the Rainy Day Fund. The deposit will bring the Fund's balance, which is currently \$453 million, close to its current

constitutional cap of roughly \$890 million.

Strong gross production revenues are fueling budget growth

The FY 2020 budget approved by the Legislature appropriated \$7.999 billion across state government, \$434 million (5.7 percent) above the original budget for FY '19. In addition, lawmakers set aside \$187 million in available certified revenue for the Revenue Stabilization Fund (the Fund also received \$13 million from a revolving fund).

Of the roughly \$600 million in growth revenue for the FY 2020 budget, at least one-third is due to increased gross production tax collections. Gross production

“Overall, Gross Production Tax collections are 38 percent higher this year than they would have been had lawmakers not boosted the rate from 2 to 5 percent.”

tax collections available to appropriate in FY 2020 are \$740 million, which is \$213 million more than gross production taxes that were available for the FY 2019 budget (see note 1 below).

Oil and gas taxes are an especially volatile revenue source, and there is good reason to be concerned about the state’s vulnerability to future drops in collections. However, the state has created a safeguard in the Revenue Stabilization Fund, which received a \$200 million deposit this year and will likely grow by at least \$200 million more in FY 2021.

The bottom line

Strong oil and gas tax collections, due in substantial part to lawmakers’ willingness in 2017 and 2018 to restore the gross production tax to higher rates, are a major contributor to the state’s fiscal health. They are resulting in a large anticipated deposit to the Rainy Day Fund as well as significant funding increases and increased savings as part of the FY 2020 budget.

(1): Based on FY 2020 February certification, schedule 7, comparing 95 percent of proposed FY-2020 estimate (column 7) to 95 percent of FY-2019 Estimate (column 3).

Notes

**This is a resource document for you to use.
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Oklahoma Oil and Gas Manufacturers Look to Mexico for International Sales Opportunities

Oklahoma Department of Commerce, January 3, 2019

Oklahoma oil and gas manufacturers and services can look to international markets to buffer changes in the domestic market of oil and gas prices. With Mexico's current administration looking to increasing oil production by 45% by 2025, Oklahoma's excellence in technology, product and service compliments Mexico's need to advance their production objectives.

The Oklahoma Department of Commerce-Mexico Trade Office was able to help two Oklahoma companies increase exports into the Mexican market during the Mexico Petroleum Congress (CMP) show this past September.

While Kimray already had a Mexican distributor in the market, the company was able to benefit from exhibiting in the Oklahoma Pavilion and having Commerce's Mexico Trade office assist with booth logistics and B2B (business to business) services to identify additional sales opportunities in the market. In the end, it was a win-win-win opportunity for state, company and their distributor.

"The OK-Mexico Trade Office made show participation simple for both Kimray and [Kimray distributor in Mexico] FCM. The synergy from all participants contributed to a successful outcome," Carlos Sandoval, International Business Development Manager. "Through continuous planning and meetings facilitated by the OK-Mexico Trade Office, Kimray was equipped with valuable information not only about attending the show, but also about the Mexican economy and the importance of investing in Mexico. We will be glad to continue to participate with the OK-Mexico Trade office for future events."

By working together with the OK-Mexico Trade Office at CMP 2018, Kimray showed customers their connection to Oklahoma and were able to network with other Oklahoma Companies.

"The marketing and booth set-up were highly professional which facilitated meetings with customers," said Sandoval. "During the show, Kimray visited several customers with one interaction leading to an immediate sale. Finally, Kimray had the opportunity to proudly showcase its distributor in Mexico, Flow Control & Measurement (FCM)."

Arrow Engine, a segment of the TriMas Corporation, came to the show with a business strategy to look at the Mexico market for new-to-export opportunities based on demand

for their product-line and services. Prior to the show, Luis Domenech, Oklahoma's Mexico Trade Representative, and his team provided the company with various services including market entry consulting, a comprehensive market research report, a vetted distributor search as well as services at show.

"Commerce was an extraordinary help in paving the way for Arrow to conduct business in Mexico. From our initial request for assistance in this matter, their prompt response, meetings at the our plant, and numerous conference calls helped us address a multitude of details to fast track the initiative," said Al Malizia, VP-Operations, Specialty Products-TriMas Corporation. "The display booth Commerce and the Mexico Trade Office teams put together at the Mexico Petroleum Congress was excellent and afforded us the opportunity to highlight our products and meet numerous business leaders in the Mexican market."

Commerce helped to coordinate eight top-level management personnel meetings from different companies at that show that were key potential customers for Arrow.

"Because of the meetings Commerce organized and the translation assistance they provided, we have received several requests for quotes already and we have begun to engage with the respective management personnel," said Malizia. "We are extremely appreciative for the energetic, professional and productive assistance in establishing a business footprint in Mexico."

Commerce's International Trade Office in Mexico (Mexico ITO) has worked in Mexico's Oil and Gas sector for more than 17 years.

"Throughout these years, the recipe for success has been helping Oklahoma companies develop alliances with local industry participants and the Mexican Petroleum Congress has been the main showcase of Oklahoma's equipment, technology and services offer," said Luis Domenech, Oklahoma's Mexico Trade Representative. "To help Oklahoma companies get the most out of their participation in the show, the Mexico ITO interviews pre-qualifies and identifies Mexican companies interested in exploring business opportunities."

Commerce will be exhibiting at the 2019 Mexican Petroleum Congress (June 19-22, 2019; Leon, Mexico).

Tribal Impact and the Energy Economy of Oklahoma

Stephen Greetham, Chief General Counsel, Chickasaw Nation Division of Commerce

“This is not a problem, it’s an opportunity . . . What we have is an intergovernmental environment in which, if we could just quit thinking of Indian tribes and nations as problems and start thinking of them as peoples, communities, and governmental units, we can get on with business and make it happen.”

Bruce Babbitt, former Governor of the State of Arizona and Secretary of the United States Department of the Interior

A Threshold Question

American Indian tribal nations occupy a unique place in the United States’ legal and political system—not to mention history, culture, and economics. Broader dynamics notwithstanding, any meaningful discussion of public policies that may affect Tribes ought to start with a note regarding Tribal legal and political status. While that starting point will not dictate a particular result, it will inform what options might be available and the feasibility of any given approach.

Not to put too fine a point on it, but—especially given how conflict and polarization seems to so characterize public discourse lately—Tribal legal and political status presents a threshold question for policy makers: Do you work with that status, or do you ignore or otherwise seek to unilaterally overcome its implications? History shows that policy approaches based on common interest and collaboration fare much better than those that seek to sideline Tribal interests. And maybe particularly when it comes to our energy economy, the unique status of Tribal sovereigns presents opportunities that should not be overlooked.

Relations Based on Comity, Not Conflict

Pursuant to the United States Constitution and rulings of the Supreme Court, the Federal government recognizes more than 570 sovereign Tribes, of which nearly 40 are in Oklahoma. Federal law protects these Tribes in their rights to self-government, and since the 1970s (in stark contrast to prior Federal policy eras), the United States has implemented Indian policy based on a pragmatic and abiding respect for Tribal rights to self-government and the Federal-Tribal government-to-government relationship. President Richard Nixon first announced this shift, and it bears noting he did so not out of any spirit of intergovernmental generosity or altruism. He acted instead in simple accord with Federal self-interest.

His administration, as has each since, recognized the indefensible and unsustainable costs associated with riding rough-shod over Tribal legal and political status, costs that could be measured in dollars, in social unrest and trauma, and in legal instability and uncertainty. Since then, Presidents Reagan and Clinton deepened the Federal administrative policy framework implementing this critical shift, and Congress supported that work with the enactment of robust statutory mechanisms to foster stability and predictability. As a result, Tribal governments have been freed to focus their energies on growing Tribal self-sufficiency within the broader fabric of local and national governance, and the results have been impressive.

While a daunting amount of work remains to ameliorate generations of neglect, abuse, and conflict, the legacy of the Federal shift to a more collaborative Federal-Tribal government-to-government relationship has contributed to a steadily improving quality of life for Tribal citizens—as well as for their non-Tribal neighbors who live and work in communities that benefit from Tribal health and success.

Tribes and the Energy Economy

Energy is fundamental to the Oklahoma economy, but today, Tribes are likewise critical to the State’s overall economic health. Tribes are now Oklahoma’s third-largest employer, drawing dollars and investment from outside the State’s borders and providing Oklahoma a walloping \$12.9 billion in economic impact. Tribal economic activity is based largely on Tribal government entrepreneurship in the development of the local gaming market from the ground up, starting nearly 30 years ago, but Tribal economic development initiatives are increasingly diversifying and growing new opportunities—as well as energy demands.

The Federal government actively supports innovation in the development of Tribal energy resources and the meeting of Tribal energy demands. Last month, for example, the U.S. Department of Energy’s Office of Indian Energy Policy and Programs announced its award of \$14 million for Tribal land energy projects, and last summer, the DOE-funded National Renewable Energy Laboratory released its Tribal Energy Atlas, a web-based tool that “gives tribes unprecedented access to data” on the “significant energy resource potential that exists on their lands.” Meanwhile, in the commercial sector, Tribes have aggressively pursued use of

new technologies to satisfy the growing energy demands of Tribal economic activity—championing, for example, the development of lower-impact microgrid systems. All of this outlines a dynamic ripe with collaborative opportunity.

Working Together

The fundamental work of Tribal government is to enhance the quality of lives of Tribal citizens (most of whom in Oklahoma are also Oklahomans). As such, Tribes are valuable potential partners to other governments, as well as to private sector actors. But to develop those partnerships, policy makers will need to continue to find ways to work together within the unique intergovernmental dynamic that shapes Oklahoma.

The diversity of Tribes in the United States, even just in Oklahoma, defies easy generalization, but a unifying commitment among all Tribal peoples is a general commitment to continuance. That commitment, though, does not much differ from what the average Oklahoman (many of whom are also citizens of a Tribe) wants for his or her State. Nor does it much differ from the average American's commitment to protect and improve our country. Those

complementary commitments are an asset, and each of us deserves the benefit of creative policy work that facilitates intergovernmental comity and builds on common interests and shared goals.

Oklahoma Native Impact, <http://www.oknativeimpact.com/>; “Study Pegs Oklahoma Tribes’ Economic Impact at \$12.9B,” Public Radio Tulsa (Jul, 18, 2019), <https://www.publicradiotulsa.org/post/study-pegs-oklahoma-tribes-economic-impact-129b>

U.S. DOE Office of Indian Energy Policy and Programs, <https://www.energy.gov/indianenergy/office-indian-energy-policy-and-programs>); see funding announcement, <https://www.energy.gov/articles/doe-announces-16-million-14-tribal-energy-infrastructure-deployment-projects>.

“NREL-Developed Tribal Energy Atlas Puts Resource Data in Tribes’ Hands (Jul. 18, 2018), <https://www.nrel.gov/news/program/2018/nrel-developed-tribal-energy-atlas-puts-resource-data-in-tribes-hands.html>.

E.g., “This Casino’s Microgrid Might Be the Future of Energy,” WIRED (May 16, 2019), <https://www.wired.com/story/casino-microgrid-future-of-energy/?verso=true> ; “Microgrid System Saves Tribe \$200,000 a Year,” YALE CLIMATE CONNECTIONS (Mar. 22, 2019), <https://www.yaleclimateconnections.org/2019/03/microgrid-system-saves-tribe-200000-a-year/>.

Notes

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Oklahoma Needs an Ongoing Greenhouse Gas Report

Mark C. Snead, Ph.D., Economist and President, RegionTrack Inc.

Oklahoma has a lot at stake in the ongoing debate over greenhouse gas (GHG) emissions. The relatively carbon-intensive makeup of the state economy leaves Oklahoma vulnerable to mandated reductions in carbon dioxide (CO₂) and other GHGs. The state is a major oil and gas producer, home to several refineries, has a large industrial base, relatively hot summers and cold winters, above average driving mileage, and significant agriculture. These are some of the key characteristics you would point to when identifying states that will be most affected in a carbon constrained future.

To date, efforts in the U.S. to cut GHG emissions have largely been undertaken at the state or region level. Some individual cities are also working toward mandated cuts in GHGs. But future legal requirements to cut GHG emissions seem likely to be imposed on Oklahoma and the other states through federal mandates. This is being encouraged through increased pressure from the international environmental community as well.

In trying to formulate forward-looking energy policy in Oklahoma, what we don't have in place is a framework for addressing the potential risk of future constraints on GHG emissions. Whether you view GHG emissions as a coming apocalypse for the world or merely a temporary issue that technological innovation can handle with ease, ignoring the potential for future GHG constraints leaves the state unprepared for a risk that could affect a wide swath of the state economy.

A key problem underlying this policy dilemma is access by policymakers to readily available data and analysis. Most Oklahomans, including policymakers, have had little exposure to information about state GHG emissions. There is also little widespread understanding of the major sources of emissions or changes that are underway in the mix of emissions. This relative lack of available data and analysis severely hampers the state in formulating sound energy policy.

My simple policy recommendation is that Oklahoma require and begin to prepare an annual GHG report and analysis to better inform debate on energy policy within the state. The state Department of Environmental Quality (DEQ) provides some federal data on individual facilities and has periodically collected data submitted from individual remitters, but this does not provide the type of broad evaluation of total GHG emissions needed to form sound energy policy. All states do some form of annual emissions reporting and many provide comprehensive evaluations of GHG emissions. This information gap must be overcome in Oklahoma before effective policy can be formulated.

To provide a view of some of the information that would be contained in a GHG emission report, Figure 1 (located on the following page) summarizes both total GHG emissions (and share of total GHG emissions) in Oklahoma in 1990, 2000, 2010, and 2016. Emissions totals are calculated using the U.S. Environmental Protection Agency's (EPA) State Inventory Tool (SIT). The report captures six key GHGs: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), perfluorocarbons (PFC), hydrofluorocarbons (HFC), and sulfur hexafluoride (SF₆). Four major sources of GHG emissions in the state are tracked: direct energy use, industrial processes, agriculture, and waste. Most emissions are in the form

of CO₂; the source of most emissions is energy combustion.

In 2017, total gross Oklahoma greenhouse gas emissions were 139.34 million metric tons carbon dioxide equivalent (MMT-CO₂E) as shown in Figure 1. This is a decrease of 9.84 MMT-CO₂E (6.6%) from 2010. This decline in GHG emissions in Oklahoma is consistent with reductions at the national level and in many states.

Figure 1 illustrates several key dimensions of the changing mix of GHG emissions in Oklahoma that are relevant to state energy policy:

1. The largest source (79.5%) of GHG emissions in Oklahoma is direct energy use. While this is typically the case in every state, the mix of emissions by both source and fuel type vary greatly across the states.
2. Approximately 70% of total GHG emissions from combustion are in the form of CO₂ emissions, with the remaining 9.7% coming from other GHG emissions such as methane and nitrous oxide.
3. Emissions from combusted fuels are produced most heavily by electric utilities (25.2% of total emissions). Transportation accounts for 23.6%, and industrial processes 16.5%, of CO₂ emissions from combustion. The emissions share of electric utilities has fallen significantly since 2000, while the transportation and industrial shares increased slightly in the period.
4. Among emissions from combusted fuels for energy, CO₂ production is traced to natural gas (27.9% of total emissions), petroleum (27.0% of total emissions), and coal (14.9% of total emissions).
5. The emissions share of coal fell by nearly half from 2000 to 2016, while the natural gas share increased by nearly six percentage points. This shift from coal to natural gas in electric power production has reduced the carbon-intensity of electricity production in Oklahoma in recent years.
6. GHG emissions other than CO₂ are traced to four sources: stationary combustion at fixed sites such as power plants and factories (0.2% of total emissions); mobile combustion primarily by cars and trucks (0.2% of total emissions); coal mining (0.1% of total emissions); and natural gas and oil systems (9.3% of total emissions).
7. Crude oil and natural gas systems (production, transportation, and distribution) generated an estimated 12.9 MMT CO₂E in emissions in 2016, or 9.3% of total state emissions. These emissions are primarily in the form of methane rather than CO₂. The share attributed to oil and gas nearly doubled from 4.8% in 2000 to 9.3% in 2016. However, the increase reflects the approximate doubling of oil and gas production in the state since about 2003. Most of the oil and gas-related emissions (8.0% of total) are traced to natural gas rather than oil (1.2% of total).

8. Agriculture is the second largest source of GHG emissions in Oklahoma with 17.39 MMTCO₂E in 2016, or 12.5% of total state emissions. Agriculture emissions decreased by 2.47 MMTCO₂E (12.5%) from 2000 to 2016.
9. Industrial processes contributed 6.73 MMTCO₂E in GHG emissions in 2016, or 4.8% of total state emissions. Total emissions from industrial processes has more than doubled since 1990.
10. Waste systems (including processing, transportation, and long-term storage) produced an estimated 4.46 MMTCO₂E in GHG emissions in 2016, or 3.2% of total emissions. These emissions have steadily increased by half since 1990.

fuel type. A state GHG report would go beyond this to include more historical data, additional categories for the various emission sources, and comparative data relative to the nation and similarly structured states. Importantly, the summary report does not include potential carbon sinks that can reduce emissions, such as carbon storage or emissions from land use, land use change, and forestry (LULUCF). More detailed state-specific data on agriculture and waste processing would also improve the estimates.

In short, the potential for federally mandated restrictions on GHG emissions presents a clear risk to many sectors of the broader Oklahoma economy. Recent improvements in data availability and enhanced modeling tools now make an annual state-level GHG report both feasible and cost-effective. There is little reason for the state not to produce one. The formation of energy policy in Oklahoma would benefit greatly from this type of disclosure and analysis going forward.

The example summary report in Figure 1 is intended to provide some insight into Oklahoma GHG emissions by both source and

Figure 1. Oklahoma Greenhouse Gas Emissions								
million metric tons carbon dioxide equivalents (MMTCO ₂ E)								
GHG Emissions by Source	Emissions (MMTCO ₂ E)				Share of Gross Emissions			
	1990	2000	2010	2016	1990	2000	2010	2016
ENERGY	98.12	108.13	118.49	110.76	81.1%	79.4%	80.0%	79.5%
CO₂ from Fossil Fuel Combustion	88.90	99.81	105.73	97.18	73.5%	73.3%	71.4%	69.7%
By Fuel Type:								
Coal	26.80	35.55	32.28	20.69	22.1%	26.1%	21.8%	14.9%
Petroleum	29.11	35.58	36.76	37.62	24.1%	26.1%	24.8%	27.0%
Natural Gas	32.99	28.68	36.68	38.87	27.3%	21.1%	24.8%	27.9%
Total	88.90	99.81	105.73	97.18	73.5%	73.3%	71.4%	69.7%
By User Type:								
Residential	3.86	4.22	4.09	3.21	3.2%	3.1%	2.8%	2.3%
Commercial	2.52	2.55	2.73	2.97	2.1%	1.9%	1.8%	2.1%
Industrial	23.22	18.89	20.31	23.06	19.2%	13.9%	13.7%	16.5%
Transportation	23.91	30.29	31.61	32.84	19.8%	22.2%	21.3%	23.6%
Electric Utilities	35.38	43.85	46.98	35.09	29.2%	32.2%	31.7%	25.2%
Total	88.90	99.81	105.73	97.18	73.5%	73.3%	71.4%	69.7%
Other GHG Emissions (non-CO₂)	9.22	8.32	12.76	13.58	7.6%	6.1%	8.6%	9.7%
Stationary Combustion (primarily electricity)	0.27	0.31	0.31	0.25	0.2%	0.2%	0.2%	0.2%
Mobile Combustion (primarily transportation)	1.15	1.37	0.53	0.31	1.0%	1.0%	0.4%	0.2%
Coal Mining	0.06	0.09	0.07	0.12	0.0%	0.1%	0.0%	0.1%
Natural Gas and Oil Systems	7.74	6.55	11.86	12.90	6.4%	4.8%	8.0%	9.3%
Natural Gas	5.45	5.02	10.30	11.19	4.5%	3.7%	6.9%	8.0%
Oil	2.29	1.53	1.56	1.71	1.9%	1.1%	1.1%	1.2%
INDUSTRIAL PROCESSES	3.21	4.77	5.89	6.73	2.7%	3.5%	4.0%	4.8%
AGRICULTURE	16.64	19.86	19.43	17.39	13.8%	14.6%	13.1%	12.5%
WASTE (solid waste & wastewater)	3.03	3.41	4.38	4.46	2.5%	2.5%	3.0%	3.2%
GROSS EMISSIONS	121.00	136.16	148.18	139.34	100.0%	100.0%	100.0%	100.0%

Notes: Emission estimates are formed using the U.S. Environmental Protection Agency's (EPA) State Inventory Tool (SIT).
Natural gas and oil systems includes emissions released during production, distribution, and transportation.

Assessment highlights tax contributions of oil and gas industry

Daisy Creager, The Journal Record, March 28, 2019

An assessment of Oklahoma tax policy regarding the oil and gas industry released Thursday highlights the need for lawmakers to focus on the wider tax contributions of the industry versus limiting the discussion to production taxes, such as severance and ad valorem taxes, an economist said.

The Oklahoma Oil and Gas Activity and Tax Contribution assessment, produced by the State Chamber Research Foundation and economic research firm RegionTrack, is an update to a 2016 report and includes data collected during an oil-and-gas-driven statewide recession, said Mark Snead, RegionTrack economist and author of the report.

Snead said the goal of the assessment was to prove to policymakers the idea that the industry receives preferential treatment, primarily due to the severance tax, is false.

“What we tried to do is look at the broader tax contribution so the policy question about oil and gas taxation is not just one form of taxation, but tries to encompass as much as possible,” Snead said. “Setting state tax policy goes way beyond arguing about the severance tax.”

Last year, state lawmakers approved legislation raising the gross production tax on new oil and natural gas wells from 2 percent to 5 percent. After 36 months of production, those wells will be taxed at 7 percent, under state law.

According to the assessment, the recession acted as a “near-controlled experiment” for assessing the industry’s economic influence, revealing the nature of the state economy’s sensitivity to changes in the industry and the importance of assessing more than production taxes in creating policy.

The assessment attributes the \$2.25 billion decrease in state tax revenue during the period to a response in the slowdown of oil and gas. A net 25 percent decrease in tax revenue can be caused by an extended slowdown of the industry.

Also found in the review of the recession impacts was an average reduction of \$102 million in state tax revenue for a reduction of \$1 billion in oil and gas industry GDP.

In the context of the recession, the assessment reviews the effects of production, business and industry taxes on the industry and reviews data and changes in taxes during the

2014 to 2016 period.

Lessons from the recession were the state economy’s sensitivity to changes in oil and gas and the importance of assessing more than production taxes in creating policy, Snead said.

“What it highlighted was that not only is severance tax not the primary or single source of revenue in the industry when the industry is growing, it is also not the primary or single source of falling tax revenue when the industry is under pressure and shrinking,” he said.

Russell Evans, an associate professor of economics at Oklahoma City University, said while the discussion has focused on the best rate for severance taxes, the report will provide lawmakers with context for the tax burden of the industry so it is easier to compare Oklahoma to other oil and gas states.

“We want to make sure we have a tax rate that encourages capital investment and oil production activity in Oklahoma,” Evans said. “So it’s about trying to strike that balance.”

Jennifer Lepard, executive director of the State Chamber Research Foundation, said the assessment provides context and a broader picture of the impact of taxes for when the chamber is advocating for business at the Capitol.

“If you are the person who is trying to look at the future growth of an industry and to grow more jobs, you are going to be looking at how much money comes out of the pockets of the company, regardless of where it ends up, and the severance tax is only one part of that,” Lepard said.

Chad Warmington, president of the Oklahoma Independent Petroleum Association – Oklahoma Oil and Gas Association, said in a statement the report reiterates the effect of depressed oil and natural gas prices on state government.

He said the sensitivity state tax revenue has to changes in oil and natural gas industry activity is heightened by repeated tax increases in recent years.

“To offset that, our state must broaden its tax base and ensure tax dollars from the oil and natural gas industry are used prudently,” Warmington said in the statement.

State Chamber provides new analysis on oil, gas industry's impact on Oklahoma's economy and tax revenues

Jack Money, The Oklahoman, March 29, 2019

You can't judge the oil and gas industry's impact on Oklahoma's economy and state government revenues using just gross production tax and employment numbers alone.

Backers of both the industry and Oklahoma State Chamber officials said Thursday they hope a study they released this week by the State Chamber Research Foundation that looks at the impact of oil and gas' latest slowdown drives that point home.

"This report highlights the impact depressed oil and natural gas prices have on state government," said Chad Warmington, president of the Oklahoma Independent Petroleum Association — Oklahoma Oil and Gas Association on Thursday.

"The study offers further proof that overall state tax revenue is highly sensitive to changes in oil and natural gas industry activity because the industry has a significant impact in nearly every tax stream collected by the state. That sensitivity has only been heightened following repeated tax increases on our industry in recent years that have made state government even more dependent on tax receipts from oil and natural gas production."

Like a previous foundation study undertaken by RegionTrack issued in September 2016, this one also evaluates what types of impact oil and gas industry activities have on state tax revenues.

What makes this study a little different, RegionTrack said, is that it evaluates the industry between the third quarter of 2014 and the third quarter of 2016, a period when activities were significantly depressed.

It reports Oklahoma's oil and gas industry lost 21,500 jobs and \$8.9 billion in earnings during the period.

Beyond that, another 48,300 jobs and \$22 billion in earnings were eliminated across other sectors of the economy, the study estimates.

State revenues from various tax streams also suffered, dropping \$1.5 billion, or 15.4 percent, in total revenues and falling \$2.25 billion below what previously had been estimated as future collections.

This week's report also examines how the oil and gas industry and its employees and independent contractors pay state taxes, evaluates their contributions to the state's gross domestic product and looks at the share of household earnings that can be attributed to the industry.

Based on changes made to gross production taxes in Oklahoma last year, the study calculates that the state's effective gross production tax for Fiscal Year 2019 is 5.1 percent, which is fifth highest among the 16 largest oil and gas producing states in the nation.

Adding in ad valorem taxes, Oklahoma oil and gas companies paid a tax rate of about 6.4 percent on the value of produced product in Fiscal Year 2019, about average for producers within the top 16 states.

In the realm of corporate taxes, Oklahoma oil and gas companies paid a total of \$2.43 billion in 2016 alone, accounting for 21.2 percent of all corporate taxes paid by state businesses that year.

The study estimates the corporate tax burden for Oklahoma's oil and gas industry businesses as a share of production value was third highest among the top-16 states.

Personal income tax payments as a share of production in Oklahoma also were high, compared to the other 16 states, as were sales tax payments.

Combined, the study estimates the oil and gas industry, its employees and independent workers paid 11.7 percent in taxes on the value of produced product during the study's time frame, fifth-most among the 16 largest producing states and more than a full percentage point above the group average.

As for oil and gas workers' contribution to Oklahoma's economy, it estimates Oklahoma's gross domestic production grew an average of 2.41 percent annually between 2003 and 2017 and that the state's oil and gas industry was responsible for 40 percent of that gain.

The share of earnings in Oklahoma derived from oil and gas activities averaged 9.3 percent between 2003 and 2017, reaching a peak of 15.6 percent in 2008 and declining to about 5 percent in 2017.

"Most evaluations of oil and gas taxation continue to focus solely on production-related taxes ... and ignore the broader tax contribution of the industry," the report's executive summary states.

"The slowdown provided a rare opportunity to isolate the effects of fluctuations in the oil and gas sector on both state tax revenue and the broader state economy ... (providing) a near-controlled experiment for gauging the economic influence of the oil and gas sector."

Oklahoma's Oil and Natural Gas Industry Economic Impact

OERB, Economic Impact Fact Sheet

OKLAHOMA RANKS

3RD IN THE NATION & **4TH IN THE NATION**
in natural gas production in crude oil production

ECONOMY

The oil and natural gas industry is the
LARGEST SOURCE OF TAX REVENUE
IN THE STATE

- \$331 MILLION** ➤ Public Education
- \$81.9 MILLION** ➤ Local School Districts
- \$47.4 MILLION** ➤ Common Education Technical Fund
- \$47.4 MILLION** ➤ Higher Education Capital Fund
- \$47.4 MILLION** ➤ Oklahoma Student Aid Revolving Fund
- \$81.9 MILLION** ➤ Returned to Counties for Roads

IN FISCAL YEAR '15:
THE INDUSTRY PAID \$2 BILLION IN
DIRECT TAXES

JOBS

1 in 5 jobs in Oklahoma are directly or indirectly supported by the industry

In 2015, there were

150,000

oil and natural gas employees in Oklahoma



The industry supports more than **291,000** jobs in other industry sectors through the

SPILLOVER EFFECT

State must broaden tax base

Chad Warmington, The Journal Record, March 29, 2019

The oil and natural gas industry is Oklahoma's defining industry and will be for the foreseeable future. But as anyone who is even remotely familiar with the industry knows, it is cyclical and impacted by worldwide events and economic factors far outside the control of anyone in Oklahoma.



Chad Warmington

The ebbs and flows of commodities markets are part of doing business in the oil and natural gas industry, and Oklahoma's producers and the businesses that support them have become adept at spending conservatively in times of higher prices in order to weather future downturns.

The state of Oklahoma must learn to do the same.

The oil and natural gas industry plays an outsized role in the state's overall economy, and because of that, it also has an outsized impact on state tax collections.

A new report from the State Chamber of Oklahoma authored by economist Dr. Mark Snead highlights the impact depressed oil and natural gas prices have on state government. Not only do policymakers see a decline in taxes directly from oil and natural gas production, they also see declines in virtually every other revenue stream due to ac-

companying decreases in personal income taxes, corporate taxes, sales taxes, motor fuel taxes and other miscellaneous taxes paid by the industry in day-to-day business.

According to Snead, when crude oil prices fell at the end of 2014, the extended slowdown in the energy sector resulted in a 25 percent decline in tax revenue below projections. The study offers further proof that overall state tax revenue is highly sensitive to changes in oil and natural gas industry activity because the industry has a significant impact in nearly every tax stream collected by the state.

That sensitivity has only been heightened after repeated tax increases on our industry in recent years that have made state government even more dependent on tax receipts from oil and natural gas production.

To offset that, our state must broaden its tax base and ensure tax dollars from the oil and natural gas industry are used prudently. We must embrace Gov. Kevin Stitt's call to expand the state's Rainy Day Fund so that tax dollars in times of higher prices are available to fund core government services in the inevitable times of lower prices.

Chad Warmington is president of OIPA-OKOGA, the newly formed oil and natural gas industry trade association created by the merger of the Oklahoma Independent Petroleum Association and the Oklahoma Oil & Gas Association.

Advancing inclusion through clean energy jobs

Mark Muro, Adie Tomer, Ranjitha Shivaram, & Joseph W. Kane, The Brookings Institution, April 18, 2019

The transition to a clean energy economy continues. Motivated by mounting scientific evidence, shifting market forces, and in some cases policy, U.S. industries are installing more zero-carbon energy sources, developing more energy-efficient products, and adopting more environmentally-sensitive standards. More recently, debates have broken out in Congress over the need for an ambitious Green New Deal centered on clean economy employment. The result: Shifts in “green jobs,” carbon emissions, electricity consumption, and resilience to climate shocks have become some of the highest profile, most discussed trends of the decade.

Considerably less attention has been paid to the types of workers, activities, and skills needed in years to come. We still know relatively little about the nature of the work associated with the clean energy transition and the specific occupations necessary to deliver a vibrant clean energy economy moving forward.

Focused squarely on the workforce side of the clean energy transition, this analysis aims to help energy sector professionals, state and local policymakers, regional education and training sector leaders, and community organizations get a clearer look at the nature, needs, and opportunities associated with the future clean energy workforce. In particular, this analysis explores the extent to which such occupations will offer pathways to inclusive economic opportunity.

WHY CLEAN ENERGY JOBS MATTER

The report employs federal datasets and industrial classifications from prior clean energy economy research to conclude that:

The transition to the clean energy economy will primarily involve 320 unique occupations spread across three major industrial sectors: clean energy production, energy efficiency, and environmental management. These occupations represent a range of workplace responsibilities, from jobs unique to the energy sector to support services found throughout the broader economy.

Workers in clean energy earn higher and more equitable wages when compared to all workers nationally. Mean hourly wages exceed national averages by 8 to 19 percent. Clean energy economy wages are also more equitable; workers at lower ends of the income spectrum can earn \$5 to \$10 more per hour than other jobs.

Even when they have higher pay, many occupations within the clean energy economy tend to have lower educational requirements. This is especially true within the clean energy production and energy efficiency sectors, which include sizable occupations like electricians, carpenters, and plumbers. Roughly 50 percent of workers attain no more than a high school diploma yet earn higher wages than similarly-educated peers in

other industries.

Occupations within the clean energy production and energy efficiency sectors tend to require greater scientific knowledge and technical skills than the average American job. Conversely, knowledge and skill requirements in environmental management occupations trend towards national averages.

The clean energy economy workforce is older, dominated by male workers, and lacks racial diversity when compared to all occupations nationally. Fewer than 20 percent of workers in the clean energy production and energy efficiency sectors are women, while black workers fill less than ten percent of these sector’s jobs.

MAKING CLEAN ENERGY SECTORS MORE INCLUSIVE

The relative accessibility of clean energy work has the potential to attract and employ workers from all backgrounds. And yet, a number of obstacles are preventing underrepresented populations from accessing these relatively high quality jobs. One obstacle is a lack of young talent entering the clean energy economy, where the median age of workers continues to edge higher. Another issue is that employers frequently note hiring difficulties for new workers, who are said to lack relevant training, experience, and technical skills. And there is the continuing lack of racial and gender diversity in certain occupations.

Given these challenges, there is an urgent need now to develop a clean energy workforce playbook to modernize clean energy related education, improve the alignment of training, and to reach underrepresented workers and students. At least three priorities should anchor such a playbook, informed by multiple emerging models in use around the country:

Modernizing and emphasizing energy science curricula should be a priority at all levels of education. Extracurricular, supplemental, and short-term programs as well as associate degree programs will be especially important.

Improve the alignment of education and training offerings—including through the use of “experiential” or on-the-job learning. Public/private partnerships and on-the-job learning will be imperative.

Reach underrepresented workers and students. Rooting out bias in key segments of the sector is a prerequisite for progress, as will be early inclusion, pre-apprenticeships, gender- or race-focused cohort strategies, and locally-grounded neighborhood outreach.

Read the full report “Advancing inclusion through clean energy jobs” at https://www.brookings.edu/wp-content/uploads/2019/04/2019.04_metro_Clean-Energy-Jobs_Report_Muro-Tomer-Shivaram-Kane.pdf

Oklahoma Oil & Gas Today—Technology and Efficiency, Scarce Capital, Low Price...and the implications on Oklahoma's future

Allen Wright, V.P. Public & Gov. Affairs, Devon Energy, August 27, 2019

The great shale revolution, that began almost twenty years ago, has greatly benefited Oklahoma, transformed the world's energy supply as well as geo-politics. The combination of hydraulic fracturing and horizontal drilling, once thought of as “unconventional,” has now become common practice. This revolution has now reached the mature phase of its lifecycle.

This phase will resemble a manufacturing approach where low cost production will be the key to success—even survival. Continued advancements in technology unlock new resources at lower costs. This drive for efficiency, however, will disadvantage high-cost operating areas and place continued pressure on companies with weak balance sheets. Even healthy companies will seek consolidation, merger or divestiture opportunities to remain competitive.

Capital has abandoned the energy sector, especially the exploration and production (upstream) portion of the industry. Historically, up to 15% of the stock market has been comprised of energy stocks. Today energy represents less than 5% of the market, with only 1% related to upstream. Some estimates have nearly \$700 billion exiting the sector within the past five years. This has resulted in a major collapse in capital available to the upstream sector. Recently, investor's priorities have changed away from production growth and to rewarding free cash flow. Thus, only the highest rate-of-return wells are drilled. This explains, in part, to the current shift in capital away from Oklahoma to the Permian basin in Texas and New Mexico.

So, what does all this mean to Oklahoma and the future funding of essential state services? The recent battle over the gross production tax (GPT), which took several years to resolve, had both emotional and economic dynamics. Arguments over special treatment of the industry and paying its “fair share” were triggers that added “fuel” to drive change. What was lost, rather ignored, in the debate was the logical consequence of raising the GPT—dependency by the state budget on a very volatile revenue stream. Efforts to create a GPT reserve fund to moderate the boom and bust cycles were rejected in favor of using all available funds for current needs.

Oklahoma has quality oil and gas resources that can continue to provide prosperity to our great state. These resources also must compete, as do Oklahoma energy companies, in a very dynamic and ever-changing market. In this competitive environment, capital and drilling will move rapidly to more profitable oil basins.

This is not a plea for industry tax breaks or incentives, but an appeal to use the current windfall to grow and diversify our economy, our tax base and continue the government reforms that will help ensure those dollars are used as effectively as possible.

Oklahoma can choose to be proactive, not acting in a crisis, or just follow the old oil patch prayer that says, “Lord give me one more boom and I promise not to screw it up.”

Legislature can turn on jobs in Oklahoma with the power of the sun

Dick Jackson, The Tulsa World, February 27, 2019

In 2016, Oklahoma's state budget shortfall was estimated to be almost \$870 million, resulting from lower fossil fuels prices, years of income tax cuts and controversial subsidies to businesses and industries.

The outlook for state income in early 2019 is much better, but not good enough.

Even if it were, it's too risky for anyone to be certain today's future income estimate will be reached in a world that's so unpredictable.

Oklahoma voters are not receptive to raising taxes. This puts legislators who want to keep their jobs squarely between the voter rock and any tax-increase hard place.

Borrowing Gov. Kevin Stitt's State of the State language: Increasing the number of taxpayers is the more pragmatic way to fund needed services than higher tax rates.

Isn't jobs-creation always a common-ground legislative goal? If so, isn't Oklahoma overlooking the potential for new jobs and revenue that expansion of a solar industry in our sunny state offers? Consider these facts:

- Based on average sun hours, Oklahoma ranks eighth in solar power generation potential, but it ranks 49th among states in solar power capacity.
- Solar power costs have fallen so rapidly that the cost of solar electricity generation is now lower than the cost of electricity generated by coal and nuclear power, and it is rapidly closing in on the cost of electricity generated by natural gas.

Why has solar panel purchasing or leasing not expanded in Oklahoma?

Three existing solar disincentive laws prevent the three major solar leasing companies headquartered in California from expanding into Oklahoma.

What's new this year?

- The worst of those laws requires that solar panels can only be leased to a utility company. A 2018 Oklahoma Attorney General opinion declares that law invalid. House Bill 2184

and Senate Bill 525 have been introduced to implement that opinion.

- Sale of excess solar-generated electricity by a homeowner or business to a utility company was limited to 30 days. Senate Bill 529 increases that limit to one year, as is the case in Arkansas.

- What's sometimes referred to as the "sun tax" allows utilities to add a fee to monthly bills of homes or businesses generating solar panel electricity for their own use. The Oklahoma Corporation Commission denied a request from OG&E to charge this penalty. It remains on the books; a bill to void it has not been introduced yet.

Would passage of these bills and leasing of solar panels by local and national solar companies create a significant number of new jobs and state income?

A 2016 Guardian article says leasing of solar panels provided 8,700 jobs in Nevada that year. The population of Nevada at that time was less than 3 million. That's a good indicator of jobs potential in a state with a population of a little under 4 million.

You can help create thousands of new solar jobs in Oklahoma by telling your district legislators, House Utility Committee Chairman Mike Sanders (mike.sanders@okhouse.gov) and Senate Energy Committee Chairman Mark Allen (allen@oksenate.gov) that HB 2184, SB 525, and SB 529 are priorities that need to be heard in committee and passed in the Legislature.

Pass this message on to anyone you know who'd also like to help Oklahoma develop a solar industry and thousands of new jobs!

Dick Jackson has been a volunteer in various local environmental projects and partnerships for many years. He helped lead startup of the nationally recognized Community Action Project of Tulsa County free tax preparation program and from 2000 to 2011, chaired the Tulsa Children's Coalition Board, which oversaw funding construction of nine early-childhood education buildings leased to CAP and creation of a buildings replacement reserve.

OG&E's average retail rate was lowest in nation in 2018

Daisy Creager, The Journal Record, June 21, 2019

The nation's lowest average retail price of electricity in 2018 belongs to Oklahoma Gas & Electric, which provides power to 850,000 customers in Oklahoma and Arkansas, according to a market intelligence report released earlier this month.

The S&P Global Market report Regulated Retail Price of Electricity considered the average price of electricity for retail customers of major investor-owned electric utilities in the U.S. from 2016 to 2018.

OG&E provided power at an average retail price of 7.31 cents per kilowatt-hour in 2018, followed by Entergy at 7.32 cents per kWh and Alrenewable lete at 7.44 cents.

Tulsa-based Public Service Co. of Oklahoma, which serves about 550,000 customers in the state, had an average retail price of 7.76 cents per kWh in 2018. Statewide, the average price of retail power was 7.55 cents per kWh in 2018, well below the national average of 10.81 cents.

S&P Global Principal Analyst Tom Serzan said a factor for OG&E's ranking is the low cost of producing power in the region.

"The embedded cost of electricity is something that plays the biggest part," Serzan said. "That particular region is one of the lower-cost areas."

The report considered residential, commercial and industrial customers in its analysis, and OGE Energy had the lowest prices for each category. The utility's largest sales volume, 40%, was commercial customers, with residential customers making up 35% and industrial customers making up 25%.

OG&E spokesman Brian Alford said geography and a good regulatory environment have helped the company. He said the company's workforce is about the same size it was in the 1960s, but with more than double the customers. Also, the low cost of energy can be a significant tool in luring new businesses to Oklahoma.

"The biggest driver for us is managing our costs and ensuring that we are being good stewards with our dollars," Alford said. "Low rates are an economic development driver, and when companies that are big electricity users are looking to relocate, they're looking for low-cost providers."

Alford said the utility's low rates are a byproduct of the hard work of its employees.



A worker with Oklahoma Gas & Electric Co. maintains power lines at NW 12th Street and Harvey Avenue in Oklahoma City. (Journal Record file photo)

"We simply can't rest on those numbers," Alford said. "We have to keep looking for opportunities to improve and get better at what we do."

Serzan said the fall in prices seen nationally in 2018 was the result of the industry updating previously overlooked, old infrastructure and low fuel prices.

"We've had a trend going on of new investment," he said. "Offsetting that is a decline in fuel prices, and that has helped avoid major net increases for customer rates."

Renewable energy jobs on the rise

Daisy Creager, The Journal Record, June 17, 2019



Tod Hanley, with Delta Energy & Design, inspects a residential solar panel installation in Norman. (Journal Record file photo)

Worldwide employment in the renewable energy industry grew and shifted to new markets in 2018, according to a report by the International Renewable Energy Agency.

Released Thursday, the Renewable Energy and Jobs Annual Review found the industry had 11 million jobs worldwide in 2018, compared to 10.3 million in 2017. In the U.S., employment in the construction and installation segment and in operations and maintenance is concentrated in Texas, Oklahoma, Iowa, California and Kansas. Globally, employment is concentrated in China, Brazil, the U.S., India and European Union countries, with China making up 39%, or 4.1 million jobs.

However, countries such as Vietnam, Thailand and Malaysia were responsible for an increasing share of growth as all three countries increased production and exports as a result of foreign investment. Because of this, Asia retained 60% of total renewable energy jobs.

In the U.S., renewable energy fields with the highest employment are liquid biofuels, solar and wind.

Employment in the U.S. solar industry decreased for the second consecutive year and uncertainty about U.S. tariff policy delayed utility-scale projects, but project announcements surged once tariffs were lifted.

However, U.S. wind power industry employment increased 8%.

Solar jobs in Oklahoma increased from 739 in 2017 to 838 in 2018, but have fluctuated in recent years, according to The Solar Foundation.

Advanced Power Alliance Vice President Mark Yates said the wind power industry will see a continued growth in Oklahoma in coming years, with about 1,300 megawatts of undeveloped capacity, 15% of existing capacity.

Job growth should also remain steady, with a focus on ancillary jobs, such as manufacturing and maintenance of wind farms, Yates said.

A market report released by the Solar Energy Industries Association in March found that while Oklahoma ranks sixth in the U.S. for solar potential, it ranked 43rd in installation of new solar photovoltaic capacity in 2018.

SEIA Vice President of Public Affairs Dan Whitten attributed the lag to “the evolution of the energy sector,” with solar power investments usually following wind.

“It’s a matter of evolution. It’s going to happen in Oklahoma,” Whitten said. “When solar was more expensive 10 years ago, it made a lot of sense not to do solar, so Oklahoma didn’t do it. But now the cost argument is just too good.”

Yates said the shift toward investing in solar energy is underway in the state and will be more visible in coming years.

“There is so much development in the pipeline across the Southwest Power Pool, that it’s just kind of getting in line. I think you’re going to see several large utility scale projects online in Oklahoma in the next couple years,” he said.

Smithfield to buy power from new Allete wind farm

Daisy Creager, *The Journal Record*, June 14, 2019

Minnesota-based Allete Clean Energy announced Friday a power sales agreement with Smithfield Foods Inc. for 75 megawatts of output from the Diamond Spring Wind farm planned for Johnston and Pontotoc counties.

Allete bought the project May 3 from Apex Clean Energy. The purchase included 15-year power sales agreements with Starbucks and Walmart. The 12-year agreement with Smithfield will account for the remaining power produced by the project.

Construction on the 303-MW wind farm will begin by January and the farm is expected to be brought online by December 2020.

Diamond Spring will be Allete's first wind site in Oklahoma to have contracts with corporate customers and will be its largest wind facility. It will produce enough power for 114,000 homes, increasing the company's total wind capacity to about 1,000 megawatts across nine sites.

The site is expected to pay \$48 million in taxes and \$54 million in payments to landowners.

Smithfield is a pork processing company based in Virginia. While the contract terms are confidential, the agreement with Smithfield is a "great complement" to the other contracts for Diamond Spring Wind, said Allete Business Development Vice President Wells McGiffert.

"It's a great location from landowner and local community support and very strong transmission system in the area," McGiffert said. "The market itself has been very strong, so we're very pleased to work in the Southern Power Pool. As the locals

know it's a great wind resource area."

"We're certainly very excited to be doing business in Oklahoma."

Independent power producers are gaining a growing number of corporate and industrial customers as more companies pursue sustainability goals, according to an Allete press release.

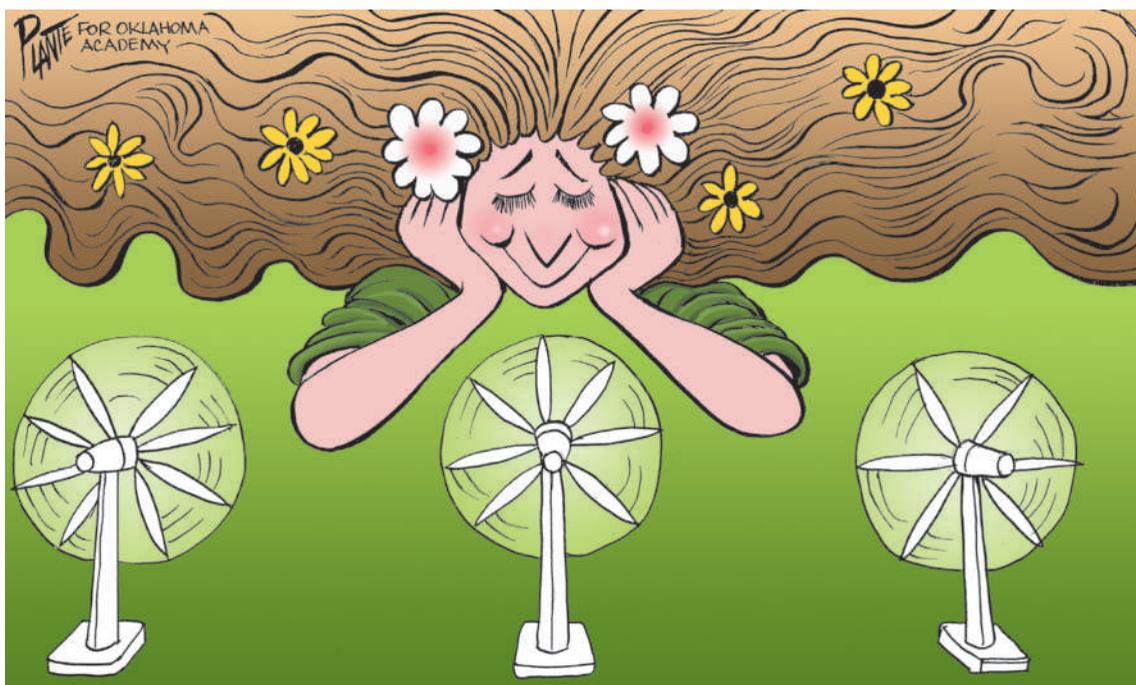
Walmart set an ultimate goal for renewable resources to produce all of its operating energy, with a more immediate target of 50% of its energy to come from renewables by 2025.

Smithfield's sustainability goals include reducing its greenhouse gas emissions by 25% by 2025, and the contract with Allete is part of a "multifaceted and comprehensive approach" to achieve it, according to a press release.

"The carbon-free energy generated through the Diamond Spring project is projected to account for more than 15% of our total energy usage across the United States, allowing us to power a substantial portion of our operations using sustainable energy," said Kraig Westerbeek, senior director of hog production environmental affairs at Smithfield, in a press release.

McGiffert said Allete is looking to continue expansion in Oklahoma and elsewhere.

"We've got projects all the way from the West Coast to the East Coast and we're very excited to be expanding south now in a big way. We're continuing to look for opportunities in this region and we feel confident we will expand our footprint in that area," McGiffert said.



The shale revolution isn't just about cheap energy, it's changing geopolitics

Mark J. Perry, Washington Examiner, May 8, 2019

The new buzzword in the energy industry is “geopolitics.” The role of America’s oil and natural gas companies has never been more consequential in shaping the global political order. If history is a good signpost, the change being driven by our nation’s energy industry will have a significant worldwide impact on technologies and policies that will last for decades.

As a free-market economist, count me among those who are buoyed by America’s emergence as the dominant oil and gas producer in the world. This is a welcome development in two ways.

First, the case for expanding natural gas production in the global effort to reduce greenhouse-gas emissions is quite promising. Second, and more importantly, the export of petroleum products and especially liquefied natural gas is helping Europe break Russia’s grip on its energy supply and recognize the reality that there are some things private markets do better than governments.

New drilling techniques have allowed U.S. oil production to soar over the past decade to new record highs, enabling our country to become the swing producer in the global energy market, undercutting the ability of OPEC to influence global oil prices. At the same time, the U.S. is now a major supplier of natural gas to countries like China and India that want to curb air pollution from coal for power generation.

That’s just the beginning. The dramatic growth in exports of natural gas by pipeline to Mexico is one of the most promising developments in strengthening Mexico’s economy and checking emigration to the United States. This has been made possible by the shale revolution, which has unlocked massive new supplies of natural gas, and the construction of new pipelines to carry natural gas from the prolific Permian Basin in Texas and New Mexico.

Geopolitically, the most important regional market for U.S. oil and gas is Europe. Since July 2018, exports of LNG to Europe from the U.S. have increased by an amazing 272%. This stunning surge has allowed the U.S. to assume

a strategic position never imagined before — a counterbalance to Russia’s natural gas. Russian gas usually is cheaper than U.S. sources, but even the availability of American gas helps countries like Ukraine and Lithuania with leverage. American gas is weakening the geopolitical influence of Russia in Europe, which has relied for too long on Russia’s energy supplies.

Already, huge benefits from the U.S. shale revolution are reaching consumers in this country and abroad every day. Sustained lower oil prices are contributing to economic stability in many parts of the world.

As the price of oil in the U.S. tumbled from above \$100 per barrel in 2014 to below \$50 per barrel a year later, consumers saved hundreds of dollars. The daily cost of driving, for example, fell by half. Although oil prices have risen since then, they remain relatively low, thanks to a remarkable increase in U.S. oil production — by more than 32% in just the last two years to a new record high of 12.3 million barrels per day at the end of April.

The idea that the American shale revolution could provide significant geopolitical gains is not as fantastic as it might sound: European countries that currently rely heavily on Russian natural gas are now building terminals, pipelines, and other infrastructure to make use of America’s LNG, creating a powerful push to reduce energy dependence on Moscow. That’s why the benefits from the surge in U.S. oil and gas production pose such a threat to Russian President Vladimir Putin — and represent such a huge step forward in creating thriving economies that allow citizens to take greater control over their lives.

Mark J. Perry (@Mark_J_Perry) is a contributor to the Washington Examiner’s Beltway Confidential blog. He is a scholar at the American Enterprise Institute and a professor of economics and finance at the University of Michigan’s Flint campus.

Senate approves bill protecting state revenues from oil and gas volatility

Daisy Creager, The Journal Record, May 21, 2019

A bill strengthening safeguards to state revenue from oil and gas volatility was approved by the state Senate Tuesday.

Authored by state Sen. Roger Thompson, R-Okemah, Senate Bill 1072 would amend the existing Revenue Stabilization Fund, which the state draws from in the event of a revenue failure.

The state maintains the fund with all revenue exceeding the five-year average from the gross production tax on oil and natural gas and 75% of income tax exceeding the five-year average.

SB 1072 would amend appropriations to the fund, limiting them to 3% or less of the State Board of Equalization General Revenue Fund certification.

Additionally, the bill adds a provision that in the event a revenue decrease is expected in any of the Revenue Stabilization Fund revenue sources, total deposits will be reduced in accordance with the decrease.

Thompson said the bill is good for the state, aiming to maintain a manageable savings account.

Oklahoma Independent Petroleum Association-Oklahoma Oil and Gas Association President Chad Warmington said in a statement efforts to lessen the impact on the state in instances of economic downturn are important.

“The agreement between legislative leaders and the governor ensures the state will be able to build ample reserve funding and the impact of reduced commodity prices is mitigated,” Warmington said. “Our lawmakers should be applauded for this common-sense approach to fiduciary stability.”

Oklahoma Energy Producers Association President Mike Cantrell said he considers it a fiscally responsible cleanup bill, and the organization supports any effort to maintain the



A rig operated by Continental Resources inc. southwest of Blanchard. (Journal Record file)

integrity of the state budget and supports a rainy day fund.

The updates included in the bill increase safeguards for the Revenue Stabilization Fund and the state budget against changes in the oil and gas industry, which the Oklahoma Oil and Gas Activity and Tax Contribution assessment showed has strong influence on the state’s economy.

Produced by the State Chamber Research Foundation and economic research firm RegionTrack, the assessment revealed the state’s reliance on revenue from the industry, assessing dates from 2014 to 2016.

It attributed a \$2.25 billion decrease in state tax revenue during the period to a slowdown of oil and gas and showed a net 25% decrease in tax revenue can be caused by an extended slowdown of the industry.

The assessment also showed an average reduction of \$102 million in state tax revenue for a reduction of \$1 billion in oil and gas industry gross domestic product.

Technology takes center stage at OSU energy conference

Jack Money, The Oklahoman, May 24, 2019

Technology and its effect on the electrical and oil and gas industries was featured Thursday morning at Oklahoma State University's annual energy conference in Oklahoma City.

The conference began with a presentation made by OGE Energy Corp. CEO Sean Trauschke, who spoke with the 200-plus guests at the event about the impact technology and regulations are having on the utilities industry.

Trauschke discussed how technological advances have enabled the utility to gather significant amounts of data that, in turn, allows it to manage its system's operations more efficiently.

The added information, he said, enables the operation to analyze energy usage patterns, keep on top of up-to-second information about its generating facilities, immediately pinpoint outages and, in some cases, reroute the energy to minimize the number of customers affected.

He emphasized the company's response was greatly aided by that technology in dealing with the latest rounds of severe weather affecting the state.

On the generating side of the business, Trauschke said technological advances have made it possible for the utility to boost its capabilities by adding natural gas-fired turbines that can more quickly and cleanly generate needed power.

He noted OG&E has spent about \$6 billion since 2011 to upgrade its generation fleet, substantially reducing emissions levels while keeping its rates among the most affordable in the nation.

That, in turn, he said, is attractive to economic development efforts aiming to bring new industries and people into Oklahoma.

But just as important, Trauschke said, is technology's impact on customers' behaviors.

"Now we are communicating via text messages with customers and sending them pricing signals so they can control their own bills, if they want to," he said. "The world has just opened up."

Trauschke said business leaders face uncertainties ahead, regardless of their industries.

"We are all running headlong into the future, really uncertain about what it holds," he said. "We all have to be

change-ready."

The morning's second speaker was Devon Energy Corp. CEO Dave Hager, who discussed how his company deploys technology to transform its operations and improve its performance.

Hager noted it is important for exploration and production companies to operating in "good rock" areas where hydrocarbons can be economically recovered, adding that Devon has positioned itself well in that regard.

But Hager said technology also has played a key role in the company's success, dating back to when it helped bring pioneering new techniques to produce hydrocarbons from shales into the mainstream as it drilled and completed its earliest horizontal wells in the Barnett Shale field more than a decade ago.

That led to robust industry growth, particularly during the first half of this decade.

Since oil's latest price collapse, Hager said the industry's mindset dramatically shifted into something he calls "Shale 2.0."

Companies today are capitalizing on technological advances to push well costs lower through increased accuracies that have led to reduced time frames on drilling and completions and helped Devon's staff greatly increase its operational efficiencies by using real-time monitors and control systems that put people and information together.

Other technological advances, such as artificial intelligence applications, have helped its staff quickly sift through "gushers" of data that are recovered these days from every well that's drilled.

Hager said the goal is to operate a business that can make money where the West Texas Intermediate price for a barrel of oil is less than \$50 a barrel, which is where he said Devon is at, thanks to its employees' hard work and the technological assist.

"I have passed my 40th anniversary of being in this business, and I can tell you I don't think I have ever been in a situation where I could say this business is easy," Hager said. "You always are facing challenges of one type or another, and you are already pushing limits, because in places where oil and gas are easy to find, it already has been done."

Report: Growth in oil and gas production tied to unconventional resources

Daisy Creager, *The Journal Record*, May 31, 2019

A “game changer” revolution in the production of oil and gas in the U.S. is partially driven by innovative technologies that have sparked production growth and investment, particularly in the SCOOP and STACK plays of Oklahoma, according to a report.

The Economic Contribution of Independent Operators, commissioned by the Independent Petroleum Association of America, is an update to a 2011 study using data from 2016-2018, produced by IHS Markit. The report assesses the economic impact of oil and natural gas production by independent companies, or those focused on upstream oil and gas developments, said one of its authors, Curtis Smith, director of IHS Markit upstream consulting.

Smith said unconventional drilling in the SCOOP, STACK and other U.S. plays had a big impact in the years studied.

“They’re (focusing on) rocks that 10-15 years ago were not economic to produce, because the quality of the rocks were not sufficient and technology had not developed to the point where we could produce oil and gas out of them economically,” Smith said. “It has opened up a whole-new vast selection of reservoir rocks that heretofore were not considered producible.”

“Unconventional” drilling areas are also “continuous,” covering several counties, as opposed to drilling areas that are traditionally smaller, he said.

Improvements in technology used for horizontal drilling have

also made advancements in recent years, he said.

“You’re going to get a lot more contact with the reservoir,” Smith said. “Newer technologies that have allowed us to focus more in that direction. Horizontal drilling has been around for a while, but it’s been refined over the last five years.”

The report concluded that 90% of U.S. oil and natural gas activity will continue to be conducted by independent companies.

It found the companies influenced about \$1.2 trillion in national sales activity, leading to a contribution of about \$573 billion, or 2.8%, of U.S. gross domestic product and supporting 4.5 million jobs.

Oklahoma oil production increased by almost 17% during the study period, reaching 482,747 barrels per day and 5% of total U.S. production in 2018. Capital investments expenditures in the state also increased by \$5 billion to \$12.38 billion from 2016 to 2017.

The new well count in Oklahoma increased by 578 between 2016 and 2017, but is projected to decrease in 2020 and 2025, with the number of producing wells projected to steadily increase from 47,170 in 2018 to 54,900 in 2025.

In 2018, Oklahoma producers supported almost 348,000 jobs, paid more than \$1.77 billion in state and local tax revenue and added \$37 billion of economic value.



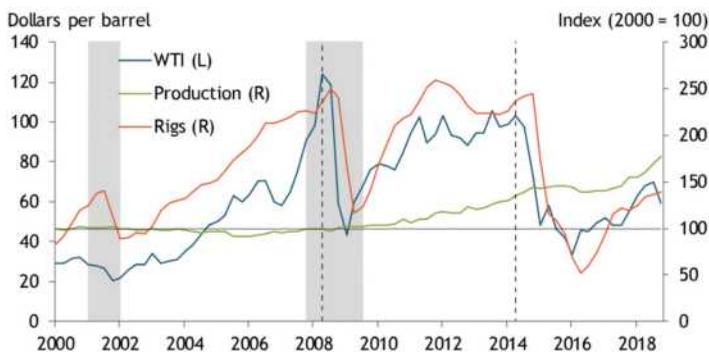
Drilling Productivity in the United States: What Lies Beneath

Jason P. Brown, David Rodziewicz and Colton Tousey, *kcFED: Main Street Views*, May 22, 2019

We construct new measures of drilling productivity and find that productivity increased sixfold from the mid-2000s to early 2017. Gains in below-ground efficiency—the number of barrels produced per foot of drilled wells—have largely driven this increase in overall productivity. The large oil price declines during the Great Recession and from 2014 to 2016 also played a role. However, further large increases in productivity are unlikely absent additional improvements in technology or a subsequent large downturn in oil prices.

U.S. production of crude oil has steadily trended higher in recent years despite declines in crude oil prices. Chart 1 shows that the price of benchmark West Texas Intermediate (WTI) crude oil fell starting in mid-2014 and was followed promptly by a large reduction in the number of active drilling rigs. However, U.S. oil and gas production has continued to increase almost uninterrupted. In fact, in 2018, the United States became the world's largest producer of crude oil (Energy Information Administration 2018). The steady rise in production at a time when oil prices and rigs declined suggests that productivity within the oil and gas sector has increased.

Chart 1: U.S. Oil Production Increases Despite Lower Oil Prices



Notes: Grey shading denotes NBER-defined recessions. Dashed vertical lines mark the 2008 oil price peak, and the recent peak (June 2014) of crude oil prices.

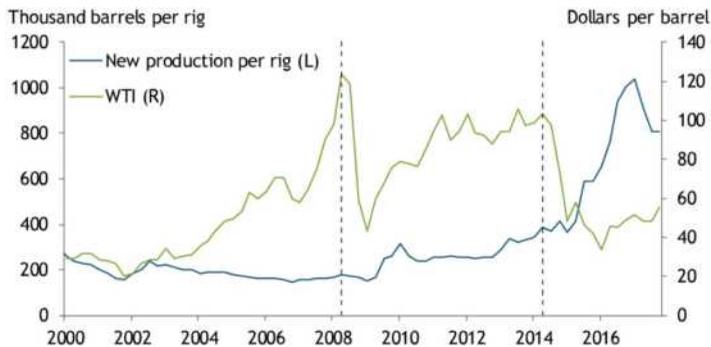
Sources: Baker Hughes, Bloomberg, and Energy Information Administration (Haver Analytics).

To explore this possibility, we construct a new measure of drilling productivity, or the amount of oil and gas produced in the first 12 months of new wells on a per rig basis. We focus on active drilling rigs, as rigs are a commonly used measure of drilling activity and one of the primary forms of capital used in the extraction of oil and gas (Baker Hughes). Our productivity measure includes information from the lower 48 states on the number of on-shore producing wells that each rig drills, the depth of each well, and the amount of oil and gas each well generates in the first 12 months of production. We measure the combined production of oil and gas on a barrel of oil equivalent (BOE) basis. This measure of drilling productivity is innovative in that we provide insight into the below-ground components of efficiency—average drilled foot per well and production per drilled foot—not highlighted in alternate measures of efficiency (EIA 2019). In our measure, drilling productivity is

determined by rig productivity and well productivity, which approximate above- versus below-ground components.¹

Our measure reveals that drilling productivity had a relatively flat to slightly declining trajectory until 2008. Chart 2 shows an accelerated rise in productivity following the 2008 and 2014 oil price peaks, highlighted by the dashed vertical lines. After the 2014 oil price peak, productivity skyrocketed to just above 1.0 million barrels per rig in the first quarter of 2017. Although drilling productivity was on a slightly positive trajectory after 2009, the dramatic price decline from June 2014 to February 2016 catalyzed an accelerated rise in productivity. When prices fall, drillers are known to shift their focus to higher-quality resources and operate only the most productive rigs and crews. This process is known as “high grading,” and will tend to drive up productivity levels while prices are in decline. As prices rise, firms return to drilling lower-quality assets and begin to use lower-productivity (higher-cost) capital (Kleinberg and others 2018). Indeed, as oil prices rebounded from their 2016 lows, drilling productivity slowed to 800,000 barrels per rig by the end of 2017.

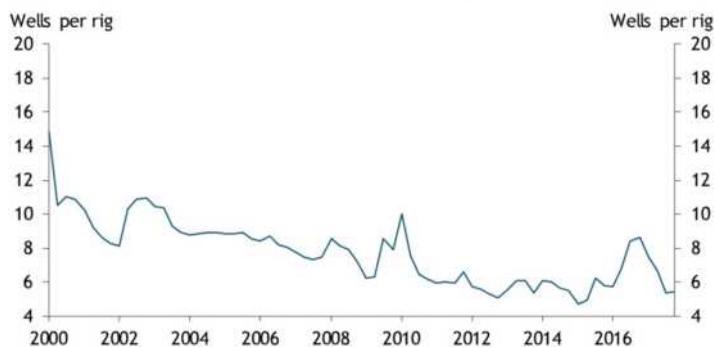
Chart 2: Drilling Productivity Measured as First 12-Month Production per Rig



Notes: Dashed vertical lines mark the 2008 and 2014 oil price peaks. Rigs are lagged by one quarter to align them with the start of production. All data are seasonally adjusted according to the Census X-13 program.

In addition to oil price dynamics and high grading, technology-driven changes in above- or below-ground efficiency could explain longer-term changes in overall drilling productivity. Technologies such as hydraulic fracturing and horizontal drilling have fostered several changes in domestic oil production over the past decade (Çakir Melek 2015).² For example, rigs used in horizontal drilling are able to drill multiple wells on the same well pad rather than uprooting and moving (EIA 2012). However, this advantage does not seem to have led to a significant boost in above-ground productivity. Chart 3 shows that the number of producing wells drilled per rig was actually on a steady decline from 2000 to 2009. Aside from brief spikes in 2010 and 2016, rig productivity has been relatively flat at around six producing wells drilled per rig in each quarter. Thus, increases in overall drilling productivity cannot be explained by above-ground rig productivity, as this component is

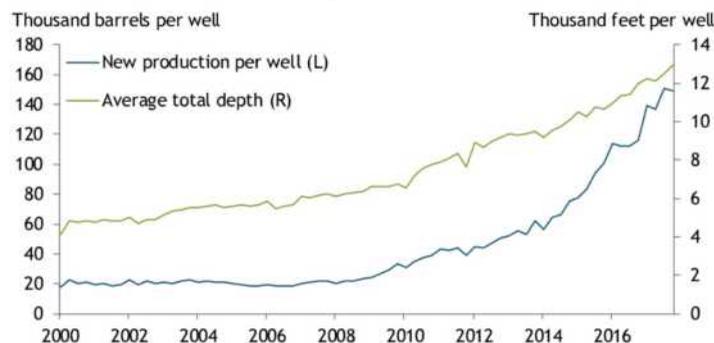
actually a flat or negative contributor to overall productivity over time.



Notes: Rigs are lagged by one quarter to align them with the start of production. All data are seasonally adjusted according to the Census X-13 program.
Sources: Drillinginfo, Baker Hughes (Haver Analytics), and authors' calculations.

While rig productivity has been relatively flat over the past two decades, well productivity has surged. The number of barrels of new production per well increased sixfold from 20,000 barrels in 2000 to over 150,000 barrels in 2017 (Chart 4). Over the same period, the average depth of a producing well also increased from about 6,000 feet to 13,000 feet. While our data do not distinguish between vertical depth and horizontal length, Montgomery and O'Sullivan (2017) show that the increase in average total depth is a result of longer horizontal wells being drilled to expose more of the rock formation in preparation for hydraulic fracturing.

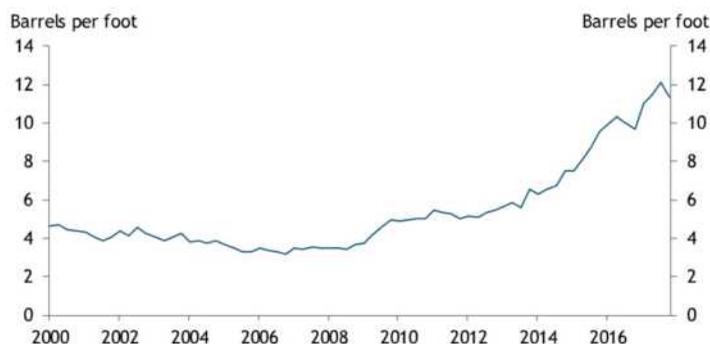
Chart 4: Well Productivity and Total Depth of Wells



Note: All data are seasonally adjusted according to the Census X-13 program.
Sources: Drillinginfo and authors' calculations.

The increase in well productivity is not just due to longer wells. Chart 5 shows that the number of barrels per foot drilled has also increased over time. Wells drilled in the early to mid-2000s yielded around 4 to 5 barrels of oil per foot in their first year of production. By 2017, new wells yielded around 12 barrels of oil per foot. This below-ground productivity increase is attributable to both technological improvements and the increased use of inputs such as frac sand and proppant to fracture the rock formations and extract hydrocarbons (Oxford 2017).

Chart 5: Below-Ground Efficiency Measured as Barrels of New Production per Foot Drilled



Note: All data are seasonally adjusted according to the Census X-13 program.
Sources: Drillinginfo and authors' calculations.

Overall, our analysis suggests that the recent increases in drilling productivity were mostly driven by what lies beneath—that is, increases in below-ground efficiency (production per well) rather than above-ground efficiency (the number of wells drilled per rig). However, it is unclear whether these increases will continue. As oil prices moved higher throughout 2017, drilling productivity decreased. Despite the more recent softening in productivity, U.S. oil production will likely continue to advance in the near future, as WTI in the \$60–64 per barrel range is currently priced above reported average profitable prices in the first quarter of this year (KCFed Energy Survey 2019). However, additional large increases in drilling productivity are unlikely unless drilling technology continues to improve or until oil prices turn down.

1 Specifically, $\text{Drilling Productivity} = \text{Rig Productivity} \times \text{Well Productivity}$, where $\text{Rig Productivity} = \text{Wells Drilled} / \text{Rig}$, $\text{Well Productivity} = \text{New Production per Well} = (\text{New Production} / \text{Drilled Feet}) \times (\text{Drilled Feet} / \text{Well})$. Rig counts are from Baker Hughes. Wells drilled, new production, and drilled feet are tabulated using data from Drillinginfo. Data are quarterly.

2 Unconventional or shale oil and gas production became an increasing share of U.S. production, rising from roughly 4 percent in 2000 to over 50 percent in 2017 (Rodziewicz 2018).

Jason P. Brown is an assistant vice president and economist, David Rodziewicz is a senior commodity specialist, and Colton Tousey is an assistant economist at the Federal Reserve Bank of Kansas City. The views expressed are those of the authors and do not necessarily reflect the positions of the Federal Reserve Bank of Kansas City or the Federal Reserve System.

‘Stranded costs’ mount as coal vanishes from the grid

Jeffrey Tomich, E&E News: Energywire, May 29, 2019

When Wisconsin’s largest utility announced in 2017 that it would shut down one of the state’s largest coal-burning power plants, environmental groups celebrated the news as a victory for climate and air quality.

The decision meant the 1,210-megawatt Pleasant Prairie plant would no longer send electrons to the grid. And its giant smokestack would no longer pump out pollutants into the skies over southeast Wisconsin.

But while the plant sits idle, the meter is still running for consumers and likely will for the next 20 years until the remaining balance on the plant is repaid, as well as a profit for shareholders. The tab will approach \$1 billion over the next two decades, according to recent filings with the Wisconsin Public Service Commission.

Milwaukee-based We Energies said customers will nonetheless save money — a lot of it — compared with what they would pay if the plant had continued to run. The utility estimates net savings of \$2.5 billion, mostly in avoided operating and maintenance costs and capital investments.

Pleasant Prairie’s situation isn’t unique. Across the country, utilities are shuttering older coal plants as they’re squeezed out by cheaper, cleaner alternatives. Many others are expected to join the list as renewable and battery storage costs continue to fall.

A study by consultants Vibrant Clean Energy LLC and Energy Innovation said the United States has reached “the coal crossover,” at which renewables could replace almost 75% of the U.S. coal fleet and at an immediate savings to customers. By 2025, the number is set to rise to 86%.

But in most cases, what’s left behind as utilities pull the plug on old coal plants is more than industrial shells awaiting demolition. They’re also leaving behind millions of dollars of so-called stranded costs on the companies’ books — costs someone must shoulder.

Consumer advocates are still crunching the numbers tied to the Wisconsin plant’s closure. Tom Content, executive director of the Citizens Utility Board of Wisconsin (CUB), a utility watchdog, said the group is still evaluating whether shutting the plant was in customers’ best interest.

The group doesn’t dispute that We Energies should get to recover its investment in Pleasant Prairie, which served customers for more than three decades before changing market forces made it uneconomical. But the group is questioning whether the utility should earn a 10% return on that investment, an amount that exceeds \$350 million, if the plant is sitting idle.



We Energies shut down the 1,200-megawatt Pleasant Prairie coal-fired power plant last spring, but consumers are being asked to pay nearly \$1 billion over the next 20 years to pay off the remaining balance on the plant and a return to utility shareholders.

We Energies/MCT/Newscom

“The question really comes back to, ‘Is it used and useful for the ratepayers in 2020?’” asked Content.

In deregulated states like Ohio, companies must write off the plants’ value (unless they get subsidies). That’s what American Electric Power Co. did in 2016 when it wrote off \$2.3 billion to align the value of its Ohio generating fleet on its books with the actual market value.

But in more than two fully regulated states, such as Wisconsin, monopoly utilities say the “regulatory compact” entitles them to recover those stranded costs and earn a profit.

“From the utility perspective, there’s not a burning need to change that system because they’re guaranteed a return on equity,” said Jeff Waller, a principal with the Rocky Mountain Institute’s sustainable finance practice.

For others, the stranded cost issue is increasingly seen as a barrier to speeding up the shift away from coal. That’s because shutting down older generation and replacing it with new, cleaner plants could saddle customers with paying for both at the same time.

That’s a concern for consumer advocates in Wisconsin, a state that already has the second-highest retail electric rates in the Midwest.

Earlier this year, Gale Klappa, the CEO of WEC Energy Group, We Energies’ holding company, told analysts the

company may file for approval of a utility-scale solar project. More recently, he suggested there could be additional coal plant shutdowns if the company determines, like in the case of Pleasant Prairie, there are cheaper options available.

For now, utility spokesman Brendan Conway said in an email that We Energies has no immediate need to replace energy and capacity from Pleasant Prairie. And even if capacity is needed in the future, the savings from closing Pleasant Prairie are so significant that customers would still save more than \$1 billion.

‘Grand bargain’

Environmental and consumer advocates, utilities, and regulators across other states in the coal-heavy Midwest are trying to find balance between cutting carbon and keeping utility bills affordable.

A potential solution to accomplish those goals is securitization — refinancing higher-cost debt with low-interest, ratepayer-backed bonds.

The concept isn’t new. It was used in Florida to save money when utilities rebuilt the grid following hurricanes in 2004 and 2005. More recently, legislation in the same state enabled the issuance of \$1.3 billion in bonds to cover the cost of the early retirement of Duke Energy Corp.’s Crystal River Unit 3 nuclear reactor, saving hundreds of millions of dollars.

The latest application for securitization is helping accelerate the shift to clean energy.

In recent weeks, New Mexico, Colorado and Montana legislatures have passed securitization bills. Lawmakers in Kansas and Missouri held hearings on similar measures. And parties in other states, including Wisconsin, have talked about it.

Ashok Gupta, a senior energy economist for the Natural Resources Defense Council, helped craft the bills debated in Missouri and Kansas, states where coal fueled 73% and 39% of electricity generated by the states in 2018, respectively.

While utilities opposed the bills, he believes changes can be

made to win their support for legislation, which is necessary to get rock-bottom interest rates that are the linchpin of securitization programs.

Gupta is careful when talking to legislators in deep-red states — where climate change isn’t a policy drive — to emphasize that securitization is a financing tool, not a coal killer.

Done right, he said, its uses go beyond helping cut carbon. It can benefit consumers by holding down electric bills, and it can keep utilities whole financially, or better. Lowering interest payments on coal plant debt can enable utilities to make new capital investments in renewables, grid modernization or electric vehicle-charging infrastructure.

“That’s the grand bargain here,” Gupta said. “Securitization creates more headroom to do the things that can be done and should be done.”

Back in Wisconsin, the issue of stranded costs has already been teed up for debate by utility regulators, environmental and consumer groups, and utilities, including We Energies.

New PSC Chairwoman Rebecca Cameron Valq listed stranded costs associated with aging coal plants as an issue at the top of her mind.

And just weeks ago, officials with We Energies and utility Alliant Energy Corp., the Wisconsin PSC staff, the Sierra Club, and CUB gathered with other industry experts at Sundance Mountain Resort in Utah as part of the Rocky Mountain Institute’s e-Lab accelerator program to discuss securitization and the role it could play in Wisconsin’s transition away from coal.

Content, the consumer advocate, wasn’t part of the meeting. But a CUB financial analyst did attend.

Like Gupta, Content believes there’s potential for a grand bargain.

“I think there’s hope that all sides can coalesce on this issue,” he said. “If we’re in the middle of this energy transition, then let’s do it in the most orderly and cost-effective way possible.”

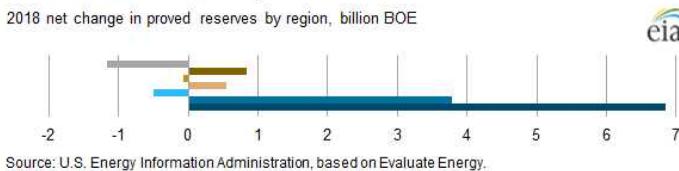
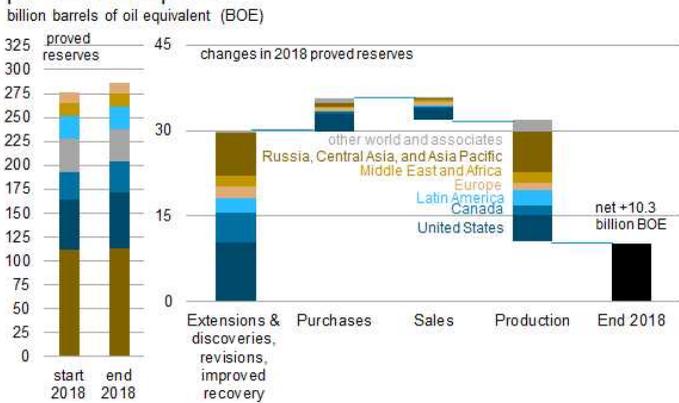
Oil company finding costs reached a 10-year low in 2018

EIA: This Week in Petroleum, May 30, 2019

In 2018, a group of the world's largest crude oil and natural gas producers added more hydrocarbons to their resource base than in any year since at least 2009, according to the annual reports of 116 exploration and production (E&P) companies. During 2018, these companies collectively added a net 10.3 billion barrels of oil equivalent (BOE) to their proved reserves, which totaled 286 billion BOE at the end of the year. Total exploration and development (E&D) costs incurred in 2018 for these companies increased 4% from 2017 levels, but declined 9% from 2017 when calculated as dollars per BOE of proved reserves added. This analysis is based on published financial reports of these 116 companies and does not necessarily represent the financial situation of private companies that do not publish financial reports.

Of the 116 companies, the top 18 held more than 80% of the 286 billion BOE in proved reserves at the end of 2018. Although many of these companies have global operations, some are national oil companies with reserves and operations concentrated in their home countries including Russia, China, and Brazil. Proved reserves change from year to year because of revisions to existing reserves, extensions and discoveries of new resources, purchases and sales of proved reserves, and production. Figure 1 illustrates the 116 companies' combined proved reserves changes during 2018. Organic additions to proved reserves—those added through

Figure 1: Regional proved reserves for 116 exploration and production companies

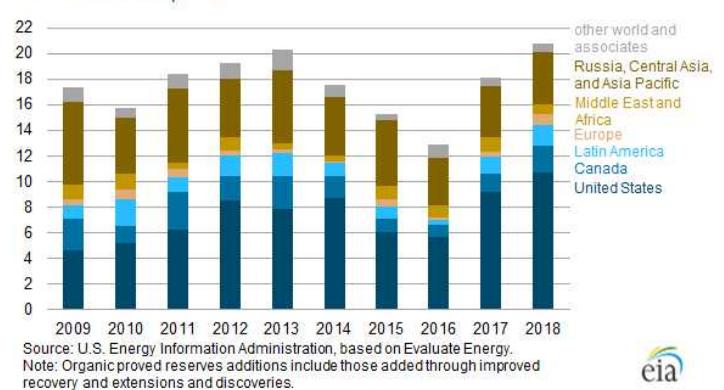


improved recovery and extensions and discoveries—are linked directly with expenditures in E&D. Proved reserves acquired through purchases and sales represent transfers of assets between companies (including companies outside this group) but are not reflected in E&D expenditures. Revisions to proved reserves can be highly influenced by changes in crude oil and natural gas prices but less directly influenced

by E&D investment.

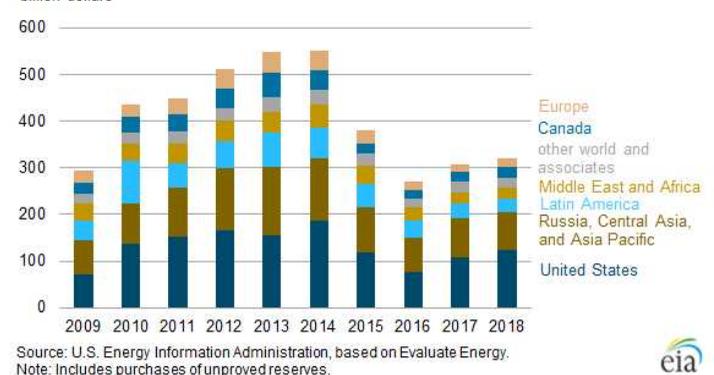
Of the 21.0 billion BOE in organic proved reserves added in 2018 (that is, before accounting for revisions, net reserves purchased, or how much the companies produced), slightly more than half (10.7 billion BOE) came from the United States, while the Russia, Central Asia, and Asia-Pacific region accounted for 4.0 billion BOE (19%). Canada added 2.1 billion BOE (10%) and Latin America added 1.6 billion BOE (8%). Europe and the Middle East and Africa region each added fewer than 1.0 billion BOE, accounting for about 4% of global organic proved reserves additions each (Figure 2). Global E&D costs incurred increased for the second consecutive year in 2018, increasing 4% to \$319 billion. Of this

Figure 2: Regional organic proved reserves additions for 116 exploration and production companies



total, 38% (\$122 billion) came from the United States, with the Russia, Central Asia, and Asia Pacific region accounting for 26% (\$83 billion) and all other regions accounting for less than 10% each. Changes in nominal year-over-year E&D costs incurred varied across regions, increasing by 33% in Europe, 13% in the United States, and 3% in the Middle East and Africa region. Costs incurred declined by 2% both in the Russia, Central Asia, and Asia Pacific region and Latin America, while spending in Canada was essentially flat compared with 2017 (Figure 3).

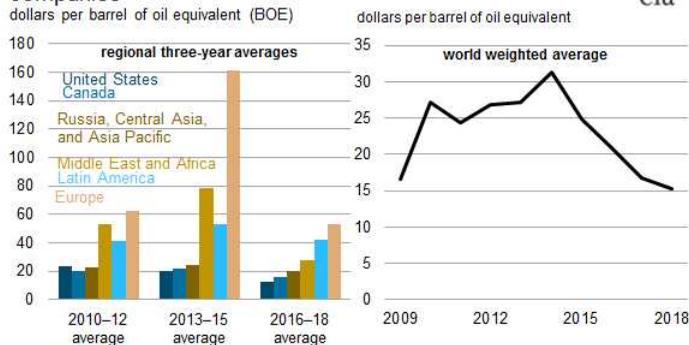
Figure 3: Regional exploration and development costs incurred for 116 exploration and production companies



Because significant cost deflation has occurred in the oil and natural gas industry since 2014, nominal costs incurred in different years may not be directly comparable. Finding costs provide an indicator of the expenditures needed to add a barrel of proved reserves. Because of the disparity between the timing of companies' capital expenditures and the formal reporting of changes to their proved reserves, standard practice is to average the results over several years.

Analyzed this way, three-year average costs declined on a per BOE basis in 2016–18 compared with both the 2013–15 and the 2010–12 averages (Figure 4). The three-year average E&D costs incurred per BOE of organic proved reserves additions in 2016–18 were lower than their respective 2013–15 and 2010–12 averages in all regions except Latin America, where the 2016–18 average was slightly higher than its 2010–12 average. On an annual basis, the 2018 E&D costs incurred of \$15.20 per additional BOE of proved reserves was the lowest since at least 2009.

Figure 4: Finding costs for 116 exploration and production companies



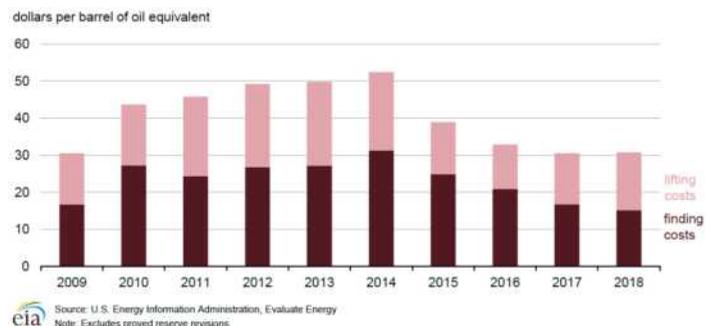
Source: U.S. Energy Information Administration, based on Evaluate Energy.
 Note: Finding costs are defined as costs incurred acquiring unproved reserves, exploration, and development per BOE of organic proved reserves additions. Left chart excludes other world and associates.

For further analysis and a list of the companies included in this study, see EIA's annual Financial Review. Later this year, EIA will issue its annual U.S. crude oil and natural gas proved reserves report which focuses exclusively on proved reserves located in the United States, including all U.S. producers (publicly traded and privately owned companies).

Key findings

- Brent crude oil daily average prices were \$71.69 per barrel in 2018—35% higher than 2017 levels
- The 116 companies analyzed in this study increased their combined liquids and natural gas production 2% from 2017 to 2018
- Proved reserves additions in 2018 approached their highest levels in the 2009–18 period
- Finding plus lifting costs were essentially flat from 2017 to 2018
- The companies reduced debt in 2018 by more than \$60 billion, the most for any year in the 2009–18 period
- Refiners' earnings per barrel declined slightly from 2017 to 2018

Finding plus lifting costs were essentially flat from 2017 to 2018



Source: U.S. Energy Information Administration, Evaluate Energy
 Note: Excludes proved reserve revisions

Notes

This is a resource document for you to use.
 Take notes, highlight, use as a text book.

U.S. Spend Ten Times More On Fossil Fuel Subsidies Than Education

James Ellsmoor, Forbes, June 15, 2019

A new International Monetary Fund (IMF) study shows that USD\$5.2 trillion was spent globally on fossil fuel subsidies in 2017. The equivalent of over 6.5% of global GDP of that year, it also represented a half-trillion dollar increase since 2015 when China (\$1.4 trillion), the United States (\$649 billion) and Russia (\$551 billion) were the largest subsidizers.

Despite nations worldwide committing to a reduction in carbon emissions and implementing renewable energy through the Paris Agreement, the IMF's findings expose how fossil fuels continue to receive huge amounts of taxpayer funding. The report explains that fossil fuels account for 85% of all global subsidies and that they remain largely attached to domestic policy. Had nations reduced subsidies in a way to create efficient fossil fuel pricing in 2015, the International Monetary Fund believes that it "would have lowered global carbon emissions by 28 percent and fossil fuel air pollution deaths by 46 percent, and increased government revenue by 3.8 percent of GDP."

The study includes the negative externalities caused by fossil fuels that society has to pay for, not reflected in their actual costs. In addition to direct transfers of government money to fossil fuel companies, this includes the indirect costs of pollution, such as healthcare costs and climate change adaptation. By including these numbers, the true cost of fossil fuel use to society is reflected.

Following The Trend

Nations worldwide have continued to support the natural gas and petroleum industries. This is evident by the energy policies of the United States and Australia, who have continued to rely heavily on fossil fuels. Meanwhile the world's largest subsidizer of fossil fuels, China has actively looked to follow efficient fossil fuel guidelines and continues to spend record-amounts on fossil fuels.

As the prices associated with fossil-fuel power generation continue to increase and become harder for utility companies to justify, the price of renewable energy has also plummeted. Along with the IMF report, the International Renewable Energy Agency (IRENA) released its own study looking into how the renewable energy industry has grown over a similar time period. The cost of onshore wind power generation has dropped 23% since 2010, while solar electricity saw a decrease of 73%.

With renewable energy production becoming cheaper and fossil fuels following the opposite trend, it has left many industry experts asking why subsidies for the latter have increased. The IMF's study identifies more than just direct subsidies to the fossil fuel industries but also the costs on society, public health and climate change that are caused by the coal, petroleum and

natural gas sectors.

The combination of the fossil fuel industry's investment within its sector and the high profit margins have led many companies to protect their subsidies. The fossil fuel lobby has actively worked in many countries to protect their subsidies and avoid the imposition of carbon taxes. Doing so protects their profits.

Fossil Fuel Inefficiency

Whilst cheaper renewable energy creates more competition in the energy markets, it also decreases the cost-effectiveness of fossil fuel subsidies. Simon Buckle, the head of climate change, biodiversity and water division at the Organization for Economic Co-operation and Development explains: "Subsidies tend to stay in the system and they can become very costly as the cost of new technologies falls. Cost reductions like this were not envisageable even 10 years ago. They have transformed the situation and many renewables are now cost competitive in different locations with coal."

Buckle's analysis of the inefficiency of fossil fuel subsidies is illustrated best by the United States' own expenditure: the \$649 billion the US spent on these subsidies in 2015 is more than the country's defense budget and 10 times the federal spending for education. When read in conjunction with a recent study showing that up to 80% of the United States could in principle be powered by renewables, the amount spent on fossil fuel subsidies seems even more indefensible.

IMF leader Christine Lagarde has noted that the investments made into fossil fuels could be better spent elsewhere, and could have far reaching positive impacts: "There would be more public spending available to build hospitals, to build roads, to build schools and to support education and health for the people. We believe that removing fossil fuel subsidies is the right way to go."

Although some nations are taking steps to reduce their reliance on fossil fuels and cutting back on investment within those industries, others are not. Domestic policies are largely responsible for the continued support for the fossil fuel industries. Yet, with the continued drop in the costs of renewable energy, private entities are taking over and ensuring that the clean energy transition continues despite the unwavering support the fossil fuel industry receives from both governments and businesses.

Renewable energy is set to overtake fossil fuels as the energy source of the future, with or without the subsidies paid out for coal, petroleum and natural gas. Fossil fuel advocates have long made the case that removing direct and indirect subsidies would be damaging to the global economy - but the IMF clearly disagrees.

Section 5
Regulation and Policy

Energy development: free market purists vs. the state

Analysis, Power Technology, June 18, 2018

Governments commonly provide subsidies or other support mechanisms for energy development to align the market with strategic goals, especially with regards to decarbonization.

But some argue that state intervention is a poor substitute for a free market dictated by consumer needs. How does the free market vs. state support debate shake out, and does it all boil down to perceptions of the urgency of the climate change crisis?

In an essay appearing in the March/April 2018 issue of Foreign Affairs, Council on Foreign Relations director of energy security and climate change Amy Myers Jaffe issued a warning call to the US.

Jaffe's article, along with the editorial she wrote for the Houston Chronicle, argued that the US is in danger being left behind as it enjoys the benefits of its domestic oil and gas production boom, while its chief international rival, China, transitions powerfully towards renewable energy sources and technologies, supported by billions in direct government funding, tax credits and other subsidies.

Without a proactive government willing to "devise policies to help innovation and promote the adoption of technologies that can rival Chinese products", Jaffe maintained, the US risks getting mired in the fossil fuel energies of the past while China sets the terms of the global clean energy future.

"The United States risks frittering away its dominance of the global energy market," Jaffe wrote. "But with strong leadership and a long-term commitment, it can secure its energy future for decades to come."

Central planning vs free market

Jaffe's conclusions are hardly unorthodox, and echo widespread concerns surrounding the US's planned withdrawal from the Paris climate change agreement and its potential impact on the global energy transition. Nonetheless, her articles drew a swift counterargument from Robert L Bradley, founder and CEO of free-market think tank the Institute for Energy Research. Bradley's response criticized both Jaffe's views on China's renewables pivot and the whole concept of government policy involvement in the energy markets.

"Unfortunately, too many intellectual elitists believe that government can define and direct energy policy in place

of self-interested, energy-reliant consumers – 1.4 billion in China, 300 million in the US, and billions elsewhere," Bradley wrote. "China should recast its energy policy for its citizens, and the US should reject central planning schemes at home and abroad."

The Chinese Government represents a particularly radical form of state intervention in market processes, and the impacts of the heavy subsidization of its solar panel manufacturing industry, for instance, have been well-discussed.

But countries in Europe, North America and elsewhere have commonly seen state intervention in the energy sector in the form of subsidies, incentives and other mechanisms to help align the market with strategic goals, especially in the development of clean energy technologies, as governments the world over work to meet their decarbonization commitments. With Bradley and other libertarian-minded commentators questioning the legitimacy of state subsidies of any stripe, and in the process the mainstream energy policy orthodoxy at large, it's worth delving into how the free market versus state intervention debate plays out.

Energy development: the free marketer's view

Speaking on the phone a few weeks after his response to the Foreign Affairs essay, Bradley doesn't mince words on the perspective of Jaffe, who did not respond to requests for comment.

"Amy Myers Jaffe is a critic of consumers, the market, business as usual, and so she sees a centrally planned economy doing what she thinks should be done, and she, I think very naively, thinks that somehow they know what to do and that central planning works," he says. "I think she's wrong on a holistic level."

In the broadest terms, Bradley objects to central planning based on the 'knowledge problem', a principle first defined by Austrian-British economist and social theorist FA Hayek. "The free marketers won this argument decades ago, about how knowledge of efficiency in a society doesn't exist in whole form for a central planner to get," Bradley says. "It only exists in a very decentralized way, with every consumer and every entrepreneur just working off prices and profits."

On the topic of energy, Bradley extends this objection to Chinese-style central planning to the subsidies that are commonly awarded to clean energy technologies – as well as fossil fuel industries – to incentivise development and align markets strategically. On renewables, he believes that the technical and economic issues of technologies such as wind power and grid-connected solar mean they don't stand

up to the scrutiny of the market and are being propped up by ideologically driven government policy.

“These are energies that are not being naturally chosen in the market,” he says. “So whenever the subsidies go away, the industry turns into a bust.”

Fossil fuels, in his view, are the market’s energy source of choice. In fact, Bradley believes that the economics of renewables and fossil fuels have been sown up since 1865, when British economist WS Jevons asserted the dominance of coal over renewable sources to the favorable energy density of fossil fuels – while also, it must be noted, warning of the implications of running out of coal.

“In 1865, [Jevons] understood very clearly the energy density question. He understood why there was no turning back from mineral-dense energies to very dilute wind and photovoltaics – they’re very dilute, so you need huge infrastructure to turn these into usable energies. It’s very uneconomic and fossil fuels come with their own storage – wind and solar doesn’t. The basic question of energy density is not going away, and really nuclear and uranium is really your only alternative, but then fossil fuels have made nuclear totally uneconomic. I think we could still be very young in the fossil fuel era.”

Knocking down a straw man: the case for state intervention

Bradley’s broadly business-as-usual view goes very much against the consensus on energy development, which general sees some form of state support and market guidance as inevitable, especially in light of highly challenging international agreements on carbon reduction. By lumping state-level subsidies and support mechanisms of democracies that otherwise cleave to market-driven processes in with the radical interventionist model of communist China, it could certainly be argued that Bradley and his ilk are setting up a straw man to lend weight to their general aversion to any interference with the free market.

“‘State intervention’ is quite a politically controversial term and it could be interpreted in a variety of different ideological ways,” says Greenpeace UK’s head of politics Rebecca Newsom. “I want to make very clear that Greenpeace is not taking an ideological view around this principle of state intervention or not, and whether or not, ultimately, the clean transition that we need to see is driven to a greater or lesser extent by the state or the private sector. We’re more interested in results.”

Newsom sees a necessity for state-level involvement in the creation of a cleaner and more flexible energy system, while acknowledging that its role must be limited. “The purpose of the subsidy, for any type of technology, is to create space for that technology to develop, to prove itself, to learn from mistakes in the early stages, to become more established and mature, and for costs to come down,” she

says. “And as that process happens, the subsidies need to be withdrawn.”

Neither should support be offered blindly, Newsom argues, pointing to Greenpeace’s position on the UK’s pending nuclear projects in Wylfa, Sizewell and Moorside. “In this scenario, we would say this isn’t giving good value for money, and the principle for state investment or support or intervention in this scenario for nuclear does not stack up,” she says. “Ultimately, the government has to make decisions about which technologies are going to deliver the bulk of our low-carbon power in the future.”

In Europe and elsewhere, early-stage subsidy support for renewable energy sources has driven competition and helped reduce costs massively, as is evidenced by the surge of record-low strike prices for offshore wind in northern Europe.

Nevertheless, subsidies have added to consumer energy bills; in 2016 the UK National Audit Office announced that household energy bills by 2020 were on track to rise £17 higher than previously thought due to the extensive deployment of wind farms and solar panels. As lower income households are likely to spend a higher proportion of their budgets on energy, this fuels the argument that the global clean energy transition is happening on the backs of the poor, in what Bradley describes as “perverse wealth transfer”.

“I would say it comes down to the kind of policy the government chooses to use to ensure that the distributional effects of the transition towards cleaner energy are not felt most by the poorest,” Newsom says. “There are ways around that – if poorer households were given the support to insulate their homes, that could in turn help reduce their energy bills significantly.”

Climate change: a question of urgency

In many ways, the whole state vs free market debate is skewed when it comes to energy. For a start, it could be argued that energy markets have unfairly favored traditional energy because of the disproportionate political clout wielded by fossil fuel-based generators. Bradley’s Institute for Energy Research think tank, it should be noted, has reportedly received financial contributions from fossil fuel interests, including US coal giant Peabody Energy, and has been accused of being a mouthpiece for the hydrocarbons industries.

“If that is just left to its own devices and we don’t have proactive state leadership to ensure the market shifts in line with our international climate change agreements, we as a world will experience catastrophic climate change, and who’s going to be feeling the impact of that most? It’s going to be the poorest and most vulnerable communities,” says Newsom.

For Simon Skillings, senior associate at climate change think tank E3G, the fundamentals of electricity trading already moves the sector away from free market principles.

“Electricity trading is highly administered, and that administration is necessary to ensure instantaneous balance of supply and demand,” he says. “So there isn’t really a market, as such. We’re not talking about a free market, we never have been talking about a free market. Market process is where consumers make their own independent decisions to buy things. That isn’t what’s driven the huge reduction in [the cost of] renewable technologies. What’s delivered that has been the provision of a secure future market and competition between providers trying to deliver into that.”

Ultimately, any debate on a business-as-usual, technology-neutral approach to energy policy versus a clean energy transition partially supported by the state boils down to a far more fundamental question – how imminent is the threat of climate change? For the overwhelming majority of scientists and policymakers, the answer is clear – climate change is spinning out of control and urgent action is required at the highest levels to avoid devastating environ-

mental consequences, some of which are already becoming clear. Without the conviction that the 2°C warming goal must be met, it becomes much easier to criticize public expense on the renewables, smart technologies, storage systems and grid upgrades that will be necessary to meet the challenge.

Bradley, for one, describes the effects of climate change as ‘global lukewarming’, accusing international bodies such as the IPCC of over-stating the warming effect and even advocating the “distinct ecological advantages” of climate change at the lower end of the warming estimates.

“If you don’t believe that climate change is an issue that needs tackling, then of course, green energy subsidization is bonkers, to the degree that it’s happened,” Skillings says. “The way I see it, there is an overwhelming scientific consensus that things are going in a very worrying direction, very quickly. If you look across the spectrum of science, this is one area where there is unusual consensus that action is needed. So if you agree with that, then the next question becomes how do we do this as cheaply as possible, and in a way that is deliverable.”

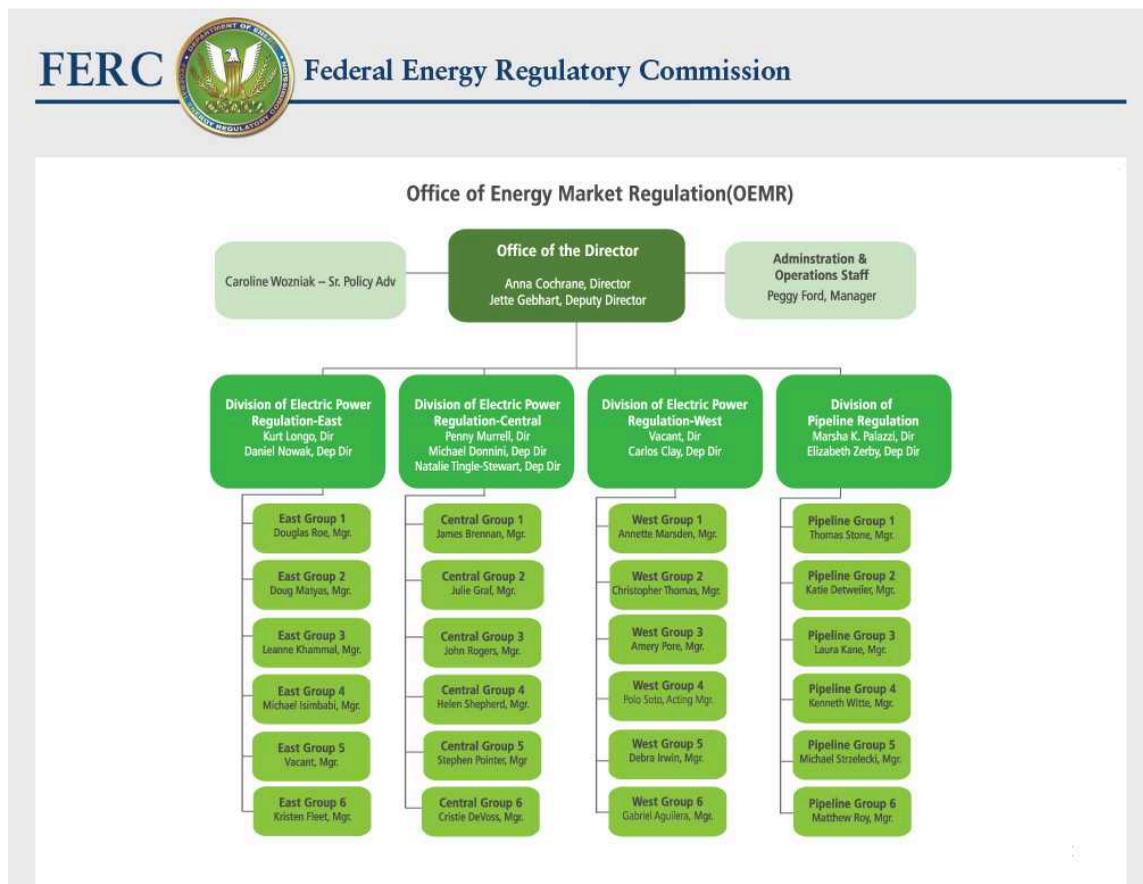
Notes

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Office of Energy Market Regulation (OEMR)

Federal Energy Regulatory Commission, March 4, 2019



What We Do

The Office of Energy Market Regulation (OEMR) advises the Commission and processes caseload related to the economic regulation of the electric utility, natural gas and oil industries. OEMR deals with matters involving energy markets, tariffs and pipeline rates relating to electric utility and natural gas and oil pipeline facilities and services. One of the Commission's primary goals is to prevent the exercise of market power by wholesale power sellers, electric transmission companies, and natural gas and oil pipeline companies. This is accomplished by striking an appropriate balance between competition and regulation. The Commission has been steadily reforming its electricity policies to find this balance in its regulation of wholesale power sales and transmission.

Major areas of responsibilities:

- 1.) Advise the Commission on the regulation of the natural gas industry, electric power industry and oil pipeline industry under the Natural Gas Act, Natural Gas Policy Act 1978, Federal Power Act, Energy Policy Act of 1992, Energy Policy Act of 2005, Energy Independence and Security Act of 2007, Department of Energy Act and other legislation;
- 2.) Advise the Commission and/or exercise delegated authority to assure just and reasonable rates and fair and

non-discriminatory transmission system and pipeline access in matters pertaining to both cost-based and market-based tariffs and rates;

- 3.) Review such matters as interlocking directorates, qualifying facilities, priority of service under NGPA and other energy regulatory matters;
- 4.) Analyze applications for electric public utility corporate transactions, including public utility mergers, issuance of securities or the assumption of liabilities, to determine if the proposed transactions are consistent with the public interest;
- 5.) Analyze Regional Transmission Organization/Independent System Operator proposals or proposals for the formation of other regional transmission entities; and,
- 6.) Analyze rate schedules for transmission service filed by Federal Power Marketing Administrations for conformance with the Pacific Northwest Electric Power
- 7.) Planning and Conservation Act and other acts relevant to specific power marketing administrations, delegations from the Secretary of Energy and the Commission's regulations.
- 8.) Analyze filings as it relates to the processing of filings dealing with the ERO budget, rules of procedure, bylaws, etc. as required under The Electric Reliability Organization (ERO) under section 215 of the Federal Power Act.

FERC orders SPP to eliminate exit fees for independent power producers

Jack Money, The Oklahoman, April 27, 2019

At 546,000 square miles, the Southwest Power Pool is big.

When it comes to its roster of voting members, though, rather the opposite is true — but perhaps not for much longer.

Earlier this month, the Federal Energy Regulatory Commission ordered SPP, a regional transmission organization, to rework its fee structure for voting members after some groups that represent independent power generators operating within the pool's area complained those fees had prohibited them from becoming members because they are far too expensive.

The American Wind Energy Association and the Advanced Power Alliance (formerly known as the Wind Coalition) took the issue before FERC.

Both groups generally represent companies that own natural gas and renewable energy plants that can generate and send more than 17 gigawatts of power onto the SPP's grid.

The grid supplies electricity to utilities, cooperatives and other entities that sell retail power to customers across 66,000 miles of lines in Oklahoma and parts or all of 13 other states between it and the U.S.-Canadian border.

The association and alliance said their members don't object to a \$6,000 annual membership fee each of SPP's current 97 members is required to pay.

But they do object to an agreement that the SPP requires voting members to make that obligates them to pay an exit fee if they decide to end that relationship.

The exit fee, they noted, requires a withdrawing member to pay a calculated share of existing debt the SPP owes at the time, which is assessed using a formula that divides the total amount of debt by the number of members, then divides that number by four.

The SPP's total debt at the end of 2017 was about \$258.2 million.

When the complaint was filed in November 2018, the association and alliance estimated that fee would be between \$700,000 and \$1 million.

"SPP's exit fee is an unreasonable practice that directly affects rates by impeding non-transmission owning or non-load-serving entities from becoming members," the complaint stated. That's important, it continued, because the SPP gives members voting rights to select directors for the organization and to vote on SPP initiatives, changes to



This map shows the Southwest Power Pool's service territory. [Oklahoman Archives]

the organization's open access transmission tariff, business practice manuals and other governing documents.

Representatives of companies that are dues-paying members also are appointed to serve on organizational committees, task forces and working groups, and can participate in closed, or executive session discussions, can request dispute resolutions and appeal decisions involving those to the SPP's board.

The exit fee, the association and alliance complained, "results in voting outcomes that are not reflective of the diversity of market participants in SPP and increases the probability that rates are unduly discriminatory and preferential."

The complaint also stated that majorities of voting members in other regional transmission organizations such as the New England ISO, the Midcontinent Independent System Operator (MISO) and the Pennsylvania New Jersey Maryland Interconnection (PJM) are non-transmission

owning or non-load-serving entities.

They said the companies they represent deserve a substantial say in how the organization is run, given independent power producers have invested hundreds of millions of dollars in projects that help supply power to SPP's grid. In 2008, wind energy made up just 3% of SPP's annual energy production. In 2018, that amount had climbed to 23%.

The SPP and members who distribute retail power to customers from the grid, however, disagreed the exit fee discouraged membership.

In its case filings, the SPP said an elimination of the exit fee would allow those companies to affect the amount of debt the organization carries without a requirement to help support it.

It stated eliminating that requirement for non-transmission owners and non-load serving entities would force it to shift between \$16 million and \$32 million in costs to members that do.

It also stated non-member generators already are allowed to provide input into decisions made by SPP's board that affect reliability and affordability issues through stakeholder groups that are called upon to provide input on those matters.

Filings by the power pool and the electricity distributors also informed FERC they didn't believe evidence had been presented by complainants that showed the exit fee deterred membership, noting that 14 independent power producers, 12 power marketers and one large retail customer are among its 97 members.

SPP calculated an exit fee for a full member at \$621,851 at the end of October, and said it expected that amount to decline over time as the organization works to reduce its debt.

Members who distribute power from the grid to retail customers stated in filings they made in the case that independent power generators that don't join as members still enjoy all the benefits SPP provides, including participation in an integrated marketplace that enables them to conduct hundreds of millions of dollars in transactions, annually. There are 252 market participants.

Through its integrated marketplace, the SPP calculates future electricity needs daily and then procures commitments from generators to provide the most reliable, affordable sources available to meet those needs.

In 2018, federal authorities determined it had provided the lowest-priced wholesale electricity across its service area in the nation.

But FERC commissioners ruled the SPP's membership exit fee as applied to non-transmission owners is unjust and unreasonable "because it creates a barrier to membership, is not needed to maintain SPP's financial solvency or avoid cost shifts, and is excessive as a means of ensuring stability in membership and members' financial commitment."

It directed SPP to submit a compliance document within 60 days that revises the exit fee provisions.

Derek Wingfield, an SPP spokesman, said the organization is reviewing FERC's order.

"It is still premature for us to comment on next steps," Wingfield said.

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10 trends shaping the power sector in 2018

Gavin Bade, Utility Dive, January 22, 2018

2017 was a whirlwind for the electric power sector.

The utility industry saw the death of two utility mega-projects, jaw-dropping prices for renewable energy and storage and a federal subsidy proposal that threatened to “blow up” the wholesale power markets.

And that was just the second half of the year.

2018 promises to be no different. From EPA speeding through a Clean Power Plan replacement to FERC’s “truncated” resilience docket and the first federal pipeline policy review since 1999, the sector’s plate is full even before state and local issues come into play.

Fortunately, events of the last year give a good indication of which issues are likely to dominate in 2018. Here’s what we’ll be watching.

Focus on resilience

Not a month into the new year and the sector’s buzzword is resilience.

Utilities and regulators have long addressed resilience — the ability to bounce back from power outages — through resources like fast-start plants and microgrids. But the concept gained new significance in September when Secretary of Energy Rick Perry positioned it as a central justification for a proposed rule at the Federal Energy Regulatory Commission to subsidize coal and nuclear plants.

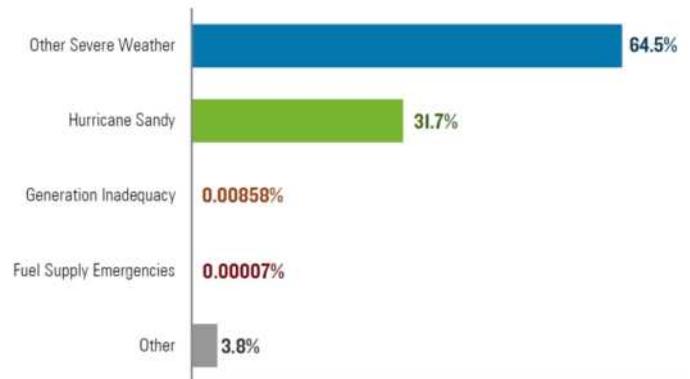
Perry’s proposal would have lent cost recovery to merchant generators with 90 days of fuel supply onsite, a requirement that critics said was unrealistic, expensive and would do little to benefit the grid. One oft-cited analysis from the Rhodium Group showed that fuel security issues hardly added to customer outage hours in recent years — and those that did largely stemmed from a single coal plant. FERC largely agreed, writing in a 5-0 rejection that DOE and its allies failed to prove the fuel security provision would improve the grid. Regulators, however, lauded the DOE’s focus on resilience, asking regional grid operators to report back in 60 days about how it can be enhanced. Perry “asked the right question,” said Commissioner Neil Chatterjee, but “proposed the wrong remedy.”

FERC’s new grid resilience docket ensures that a main focus of the power sector in 2018 will be finding technologies and market rules that can drive down the customer outage

FERC turns to resilience, utilities embrace storage and renewables face new obstacles. Here’s what we’re watching in the year ahead.

hours. Industry stakeholders have 30 days to comment on the FERC docket after the grid operators’ deadline, but the proceeding could well run longer, so expect a flurry of lobbying from power groups on how to value their “resiliency attributes” in the months to come.

Figure 1: Cause of major electricity disturbances in the US, 2012-2016
Share of total customer-hours disrupted



Source: EIA and Rhodium Group analysis

Wholesale pricing reforms

Perry’s proposal to save coal and nuclear plants filled the headlines in the last quarter of 2017, but regional grid operators have been working for years on more gradual pricing changes that could benefit the same resources.

Proposals working their way through markets like PJM, ISO-New England, MISO and others differ in construction, but have a similar aim: boost payments to existing generators in the face of low wholesale power prices. The goal is to ensure enough of these plants can recover their costs so they do not go offline, threatening reliability.

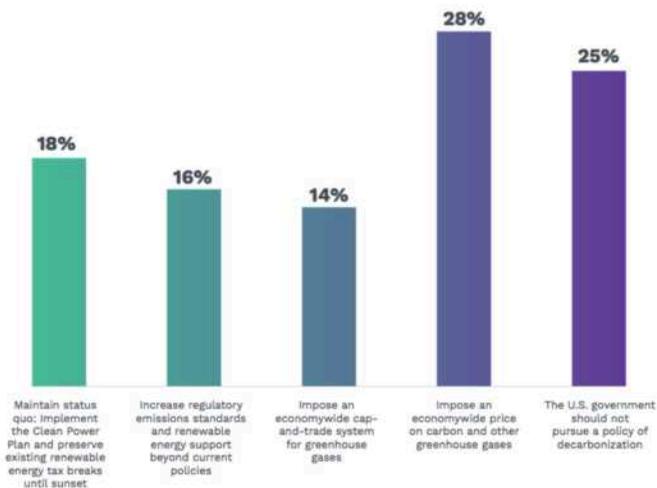
ERC held a technical conference last May on such solutions, and regulators hailed PJM and ISO-NE proposals in their rejection of the DOE grid rule, saying the pricing reforms could contribute to grid resilience. On the same day FERC issued that decision, ISO-NE filed its two-part capacity market proposal with the agency. PJM followed suit weeks later, submitting its capacity repricing proposal to FERC even before stakeholders voted on an alternative proposal.

Like ISO-NE’s plan, PJM’s would establish a two-part capacity auction. Generators would bid as they normally do in the first, then PJM would adjust awarded prices based on the amount of subsidized resources in the market. A separate proposal would boost energy market prices to benefit “inflexible” coal and nuclear generators.

The pricing reforms, however, are controversial. Environmental and consumer advocates label them as little more than an expensive ploy to bail out struggling generators that would

Obama administration. But at regulated utilities, the efforts to cut carbon regulations may not go over as well:

In your opinion, how should the U.S. federal government approach decarbonization policy?

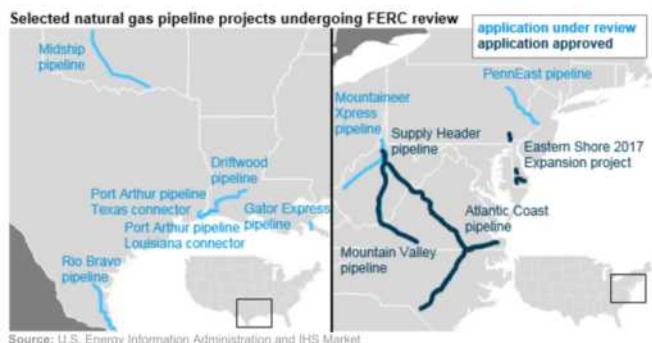


Pipeline politics heat up

All regulatory debates in 2018 promise to be contentious, but only one promises to take on a novel dimension.

On Dec. 21, new FERC Chairman Kevin McIntyre announced the agency would conduct its first pipeline policy review since 1999, saying it was time for a “fresh look” at how regulators judge the “value and viability” of project applications.

The decision comes during boom times for the natural gas industry and unprecedented public opposition to its infrastructure. FERC has only rejected two pipelines in the last 30 years, and despite being without a quorum for six months in 2017 approved more than 1,600 miles of pipelines.



Anti-pipeline groups say FERC is a rubber stamp for pipeline approvals, granting project approvals with little regard to state preference or impacts on communities and the en-

vironment. Regulators argue they are authorized by law to evaluate project need, not environmental impacts, and must authorize projects that can serve market demand.

That could be about to change. Democratic FERC Commissioners Cheryl LaFleur and Richard Glick have both expressed skepticism with FERC’s current evaluation process, particularly how FERC assesses market need. Republican Commissioners Robert Powelson and Chatterjee see no reason to change the process, and Chairman Kevin McIntyre has so far been tight-lipped about his views.

But with three Republican Trump appointees on the commission, actions to streamline pipeline approval processes are more likely than new environmental rules. Chatterjee and Powelson have voiced support for shortening approval timelines though McIntyre’s perspective remains unclear here as well.

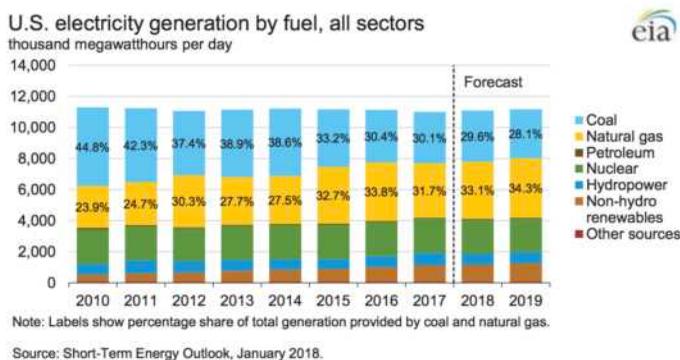
However the argument turns, the pipeline review promises to be a banner issue for FERC in 2018, and the policies it produces will shape energy infrastructure decisions for years to come.

Gas generation continues its rise

FERC’s pipeline review comes as natural gas solidifies its role as the top U.S. generation fuel.

Gas-fired plants first produced more power than coal on a monthly basis in April 2015. In 2016, gas surpassed coal for annual generation for the first time.

Gas is likely to widen that gap in 2018. The Energy Information Administration expects gas to generate 33.1% of U.S. electricity this year to coal’s 29.6%. In 2019, gas’s share grows to 34.3% as coal falls to nearly 28%.



Much of gas generation’s competitiveness in wholesale markets comes from historically low natural gas prices due to advances in hydraulic fracturing and horizontal drilling. In 2018, EIA expects prices to fall. The agency estimates Henry Hub spot prices will average \$2.88/MMBtu in 2018 and \$2.92/MMBtu in 2019. The average price in 2017 was \$2.99/MMBtu.

The trend toward gas is expected to drive more retirements

of coal generation. FERC expects 20.6 GW of coal-fired capacity to retire by 2020.

Low gas prices kept wholesale power market prices low throughout most of 2017, fueling pricing reform discussions at regional grid operators and driving the DOE to propose a controversial cost recovery package for coal and nuclear plants. Those pricing reform discussions will likely be a focus after FERC rejected the DOE plan.

Renewable energy faces speed bumps

Renewable energy enters the year with momentum. Wind, solar and hydro beat out nuclear generation for two months in 2017 thanks to flush hydro reserves, and the most recent numbers from consulting firm Lazard show renewables are at grid parity across large swaths of the country

In addition 2017 was witness to some eye-popping power contracts for large renewables and storage. In Xcel’s all-source solicitation, which received bids last year, the median wind-plus-storage bid was \$21/MWh and the median bid for solar-plus storage was \$36/MWh. Previously, the lowest known bid for similar solar resources was \$45/MWh in Arizona, released in May of 2017.

RFP Responses by Technology

Generation Technology	# of Bids	Bid MW	# of Projects	Median Bid		
				Project MW	Price or Equivalent	Pricing Units
Combustion Turbine/IC Engines	30	7,141	13	2,466	\$ 4.80	\$/kW-mo
Combustion Turbine with Battery Storage	7	804	3	476	6.20	\$/kW-mo
Gas-Fired Combined Cycles	2	451	2	451		\$/kW-mo
Stand-alone Battery Storage	28	2,143	21	1,614	11.30	\$/kW-mo
Compressed Air Energy Storage	1	317	1	317		\$/kW-mo
Wind	96	42,278	42	17,380	\$ 18.10	\$/MWh
Wind and Solar	5	2,612	4	2,162	19.90	\$/MWh
Wind with Battery Storage	11	5,700	8	5,097	21.00	\$/MWh
Solar (PV)	152	29,710	75	13,435	29.50	\$/MWh
Wind and Solar and Battery Storage	7	4,048	7	4,048	30.60	\$/MWh
Solar (PV) with Battery Storage	87	16,725	59	10,813	36.00	\$/MWh
IC Engine with Solar	1	5	1	5		\$/MWh
Waste Heat	2	21	1	11		\$/MWh
Biomass	1	9	1	9		\$/MWh
Total	430	111,963	238	58,283		

Economies of scale and the preservation of federal tax incentives in the GOP tax overhaul would typically mean renewable energy prices would continue to decline, but other policy changes threaten to slow the sector’s progress.

President Trump in January imposed a 30% tariff on imported solar cells and modules, expected to reduce solar deployment 11%, or 7.6 GW, in the next four years. And the wind sector faces some uncertainty over a provision in the Republican tax law that could hamper the tax equity market used to finance projects. How the sector responds to these new policy challenges will say much about resource deployment in the coming years.

Storage becomes a mature power resource

Like renewable energy, battery storage is in the midst of rapid price declines and a growing appreciation among utilities across the country. But unlike renewables, it does not face any overwhelming federal policy roadblocks — if anything, the opposite.

Buried beneath all of FERC’s resilience and price formation work is a proposed rulemaking to define market roles for energy storage — a proceeding commissioners have pledged to move this year. That could allow batteries to play a larger role in wholesale power markets where they so far have gained little traction.

But regardless of federal progress, energy storage is fast becoming a central part of utility planning processes in all types of markets. 2017 was the first year storage was widely included in utility Integrated Resource Plans, from Indiana and North Carolina to Arizona, New Mexico and Oregon.

Operating and planned utility-scale battery power capacity



The growing acceptance of storage comes as utilities gain confidence in its ability to replace traditional power infrastructure. In August 2017, Arizona Public Service announced it would use 8 MWh of batteries to defer a remote transmission upgrade. Then, in January, California regulators took the unprecedented step of asking Pacific Gas and Electric to consider how storage and other zero-carbon resources could replace three gas peaking plants. That order came after large battery arrays were quickly deployed to help mitigate for a natural gas shortage outside of Los Angeles.

The utility business is a notoriously cautious one, with many companies opting to adopt technologies once they’re proven by other entities. With increasing numbers of power providers demonstrating the potential of battery storage, 2018 could be the year it becomes a mature resource.

DERs prove their system worth

Similar to storage, distributed energy resources (DERs) are positioned to gain broad utility acceptance in 2018.

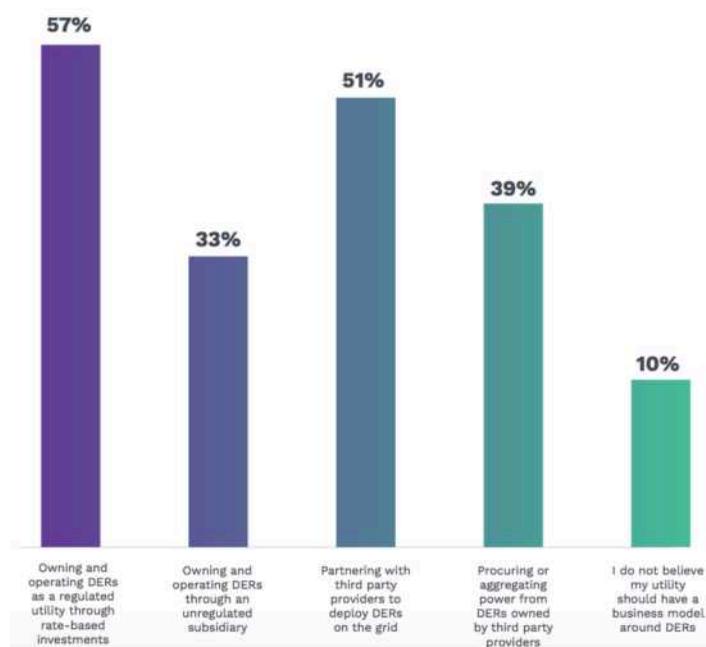
Long envisioned as a threat to reliability and finances, a number of utilities are realizing the potential of DERs to solve system needs usually reserved for bulk power assets like plants and transformers. In July, ConEd announced it would expand the best known of these non-wire alternatives (NWAs) — the Brooklyn-Queens Neighborhood

Program — after deferring a \$1.2 billion substation upgrade with 52 MW of demand reductions and 17 MW of distributed resource investments.

ConEd’s project is well known partly due to the visibility of New York’s regulatory reform proceeding, Reforming the Energy Vision (REV), but DERs are assisting utility operations across the country. In May, the Bonneville Power Association announced it would not build an 80-mile transmission line, instead turning to distributed energy, storage and demand reductions. In California, Southern California Edison (SCE) and Pacific Gas and Electric (PG&E) each have multiple NWAs to address load growth and generation retirement.

Utilities across the nation are still figuring out how best to get into the distributed energy business, but survey results indicate the vast majority are trying to figure it out:

How do you believe your utility should build a business model around distributed energy resources?



As utilities gain greater familiarity with DERs, 2018 could be the year they truly come to see them as grid assets, rather than liabilities.

State regulators push PBR — and the utility model begins to change

A chief driver of utility interest in non-wire alternatives is a trend in utility regulation away from traditional cost-of-

service ratemaking and toward more performance-based regulation (PBR).

New York’s REV docket is the most well-known of these proceedings, but California had been implementing PBR standards since the mid-aughts, and investigations into PBR are active in Ohio, Rhode Island, Minnesota, D.C. and elsewhere.

Each state gives its flavor to the debate, but the aim is similar: devise ways to compensate utilities for new energy services, like efficiency or DER deployment, that do not fit into the traditional utility ratemaking model. In places like New York, regulators are devising new markets for utility services and incentives for customer outcomes like efficiency, while in California the commission has relied more on mandates and enforcement.

In the year ahead, PBR efforts could gain momentum from the push for grid resilience. A chief motivator behind the establishment of New York’s REV was to incentivize the deployment of DERs like microgrids to enhance the grid’s durability. As more states look to beef up their power systems, commissions could turn to PBR to help them make a sturdier system.

If that happens, utilities could see their traditional rate-based revenues decline over time, replaced by new revenues from market-based activities and performance incentives. That could leave utilities in future decades quite a different business model from today:



This post has been updated to reflect the Trump administration’s solar tariff decision.

Power for Nature: Roadmap to Expand Clean Energy While Conserving Nature

The Nature Conservancy, 2018

In the face of escalating signs of climate change, soaring demands for energy, and plummeting costs of wind and solar power, the electric power industry is in a state of rapid transformation. Many governments and businesses are shifting to renewable energy as quickly as possible, and in the next decade we will see a reinvention of how we generate, store, transmit and use electricity.

The transition to renewable energy is essential to ensure a path to a stable climate. But with this transition comes an urgent challenge: The massive footprint required for wind, solar and hydropower development could have devastating impacts on ecosystems, biodiversity and communities.

With large-scale planning, we can ensure this development is sited appropriately—where it can meet growing demands for energy without endangering wildlife, habitat or people—and help accelerate the transition to clean energy. That is why The Nature Conservancy (TNC) is pursuing a coordinated, multi-pronged strategy to advance smart renewable energy siting in multiple countries around the world.

THE CHALLENGE: *Maximizing clean energy while minimizing impacts*

To avoid the most catastrophic effects of climate change, we need to limit the rise in average global temperatures to much less than 2°C above preindustrial levels. This requires achieving net-zero greenhouse gas emissions by mid-century—and to do so, the world must quickly transition to renewable energy.

Many businesses and governments are taking action, and global forecasts estimate 80 percent of new investments in power generation will go to renewables as they become the most cost-effective source of power for many countries. However, renewable energy, including wind, solar and hydropower, requires a huge amount of space. If these energy installations aren't sited carefully, they can cause significant damage to wildlife, habitats and critical ecosystem services—and even generate greenhouse gas emissions that reduce their climate benefits.

Worldwide, more than 10 million hectares of natural lands (an area the size of Iceland) could be cleared for wind and solar development. Such development would not only endanger biodiversity but also release almost 1.5 billion tons of CO₂ from disturbed soil and vegetation—equivalent to almost 10 percent of the emissions reductions nations committed to meet from renewable energy under the Paris Climate Agreement, making it even harder for them to meet their commitments.

In addition, planned hydropower dams could fragment 300,000 kilometers of free-flowing rivers. By disrupting river connectivity and altering water flows, hydropower can substantially

harm freshwater ecosystems and nearby communities. These disruptions can be especially detrimental for fisheries, a key source of food and income for hundreds of millions of people in the river basins with the most projected hydropower development.

The good news: There is enough already altered land to provide 19 times the renewable energy countries committed to under the Paris Agreement. This land is often near transmission lines, further reducing the need to develop natural areas. By using innovative science, tools and landscape-scale planning to improve siting and grid development practices, we can accelerate clean energy without sacrificing natural habitats.

TNC'S SOLUTION: *Identify the right energy mix and the right sites*

The Nature Conservancy promotes rapid deployment of renewable energy with the fewest impacts on ecosystems and communities. By anticipating future energy needs and planning on a national, regional or landscape scale, rather than a piecemeal, project-by-project approach, we can reduce the land, water and carbon footprint of renewables, safeguard ecosystem services and biodiversity, and even accelerate the transition to renewable energy.

TNC identifies previously developed lands—such as rooftops, industrial areas, former mine sites and marginal agricultural lands—that are appropriate for renewable energy, and promotes energy production near existing transmission lines and energy users. We also lay out alternative hydropower development scenarios that greatly lessen impacts to river ecosystems. In addition to encouraging stronger clean energy targets, TNC informs governments, utilities and energy developers of siting issues—which are currently not well recognized—and helps them include large-scale planning and siting conditions in their renewable energy goals and other policies.

To align market drivers and influence which renewable energy projects get built, we also collaborate with energy buyers and financiers to integrate siting considerations into major purchasing decisions and investment standards.

Siting renewable energy right will have tremendous benefits to people and nature worldwide, including improved access to clean, affordable energy; improved air quality and human health; healthy ecosystems and biodiversity; and a more stable climate for ourselves, our children and our grandchildren. By shifting renewable energy development to lower-impact areas, we will avoid harm to more than 10 million hectares of natural lands and 100,000 kilometers of rivers, and avert 1.5 billion tons of CO₂ emissions.

Regulated vs. Deregulated Electricity Markets

EnergyWatch, January 9, 2018



Traditionally, regulated electricity markets existed across the United States, restricting customer choice. It wasn't until the 1970's that the idea of deregulation came into play, with the passage of the Public Utilities Regulatory Policies Act. This act began an age of restructuring for the energy industry. Consequently, in 1992, the passing of the Energy Policy Act opened the market further. The Energy Policy Act's goals were to increase the use of clean energy and energy efficiency. It broadened choices for utilities and created new rate-making standards. Since then, deregulated energy markets have spread across various states', but what are the differences and what does the future hold for electricity markets?

What is a regulated electricity market?

A "regulated electricity market" contains utilities that own and operate all electricity. From the generation to the meter, the utility has complete control. The utility company owns the infrastructure and transmission lines then sells it directly to the customers. In regulated states, utilities must abide by electricity rates set by state public utility commissions. This type of market is often considered as a monopoly due to its limitations on consumer choice. However, its benefits include stable prices and long-term certainty.

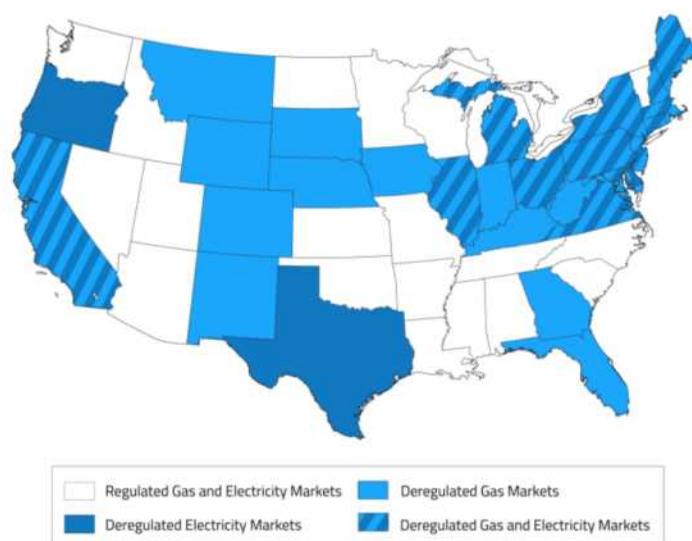
What is a deregulated electricity market?

A "deregulated electricity market" allows for the entrance of competitors to buy and sell electricity by permitting market participants to invest in power plants and transmission lines. Generation owners then sell this wholesale electricity to retail suppliers. Retail electricity suppliers set prices for consumers, which are often referred to as the "supply" portion of the electricity bill. It often benefits consumers by allowing them to compare rates and services of different third party supply companies (ESCOs) and provides different contract structures (e.g. fixed, indexed, hybrid). Also, in a deregulated market, there is an increased availability of renewable sources and green pricing programs.

While deregulated electricity markets offer a broader range of renewable energy options, there are still options for consumers

in regulated states to reap the environmental and economic benefits of green power. For instance, Power Purchase Agreements allow for the investment in a project outside of your state, providing benefits through renewable energy certificates (RECs). Although unable to incorporate renewables directly into your electricity supply contract like in deregulated markets, the green options are growing for regulated markets.

As seen below, the United States stays fairly divided on deregulated vs. regulated electricity markets. Deregulation gained large support when it was introduced in the 1990's, but has been met with some challenges along the way. For example, the California energy crisis in 2000 led to many states worrying that total deregulation may cause market manipulation. But the increase in consumer control over decision-making pushes the growth of deregulation.



Source: <https://www.electricchoice.com/map-deregulated-energy-markets/>

While there are many differences in regulated vs. deregulated electricity markets, most states see the most benefit with having a combination of the two.

On Federal Land (Onshore)

The Bureau of Land Management (BLM) has jurisdiction over almost all leasing, exploration, development, and production of oil and gas on federal and Native American lands. BLM rules and standards for drilling and production require all operations on federal land to comply with state and local regulations and protect life, property, and environmental quality. As of 2018, some federal drilling and production regulations enacted, revised, or proposed since 2008 are being re-evaluated or rescinded by the current Administration.

The National Park Service regulates the small amount of oil and gas activity in National Parks (roughly 550 active wells in 2015²¹), where the federal government owns the land surface but not the underlying oil, natural gas, or mineral resources.

Federal decisions about specific constraints on drilling and production on federal land (onshore and offshore) are based on the National Environmental Policy Act (1970). This act requires federal agencies to assess the environmental impact of major federal actions, mainly by producing Environmental Impact Statements or Environmental Assessments.

Offshore

The federal government regulates offshore exploration and production for the Outer Continental Shelf (OCS), which extends from the edge of state waters (either 3 or 9 nautical miles from the coast, depending on the state) out to the edge of national jurisdiction, 200 nautical miles from shore. The Bureau of Ocean Energy Management (BOEM) manages federal OCS leasing programs, conducts resource assessments, and licenses seismic surveys. The Bureau of Safety and Environmental Enforcement (BSEE) regulates all OCS oil and gas drilling and production. These two agencies, plus the Office of Natural Resources Revenue, which collects and disburses rents and royalties from offshore and onshore federal and Native American lands, were formed in the 2010 and 2012 reorganizations of the Minerals Management Service.

BSEE drilling and production regulations have been extensively revised in response to the 2010 Deepwater Horizon blowout and oil spill and a National Academies assessment of ways to prevent such incidents in the future. The regulations include requirements for enhanced well design, improved blowout preventer design, testing and maintenance, and an increased number of trained inspectors. The current Administration is in the process of reviewing and revising these regulations.

Regulation of Transportation, Storage, Refining, and Marketing

States regulate the operation of oil pipelines, as well as the construction and operation of natural gas gathering lines (small pipelines that move gas from the well to a processing facility or transmission line). The federal Department of Transportation (DOT)'s Pipeline and Hazardous Materials Safety Administra-

tion regulates the operation of natural gas pipelines that provide long-distance transmission and local customer distribution, as well as underground natural gas storage. The EPA regulates air emissions from refineries and fuel distribution systems, including pipelines, trucks, and fuel dispensing facilities or service stations.

The Federal Energy Regulatory Commission (FERC) regulates the transportation of oil through interstate oil pipelines but does not oversee pipeline operations. FERC also reviews applications for the construction and operation of natural gas pipelines and liquefied natural gas (LNG) export and import terminals to certify their compliance with safety and environmental laws.

The Federal Railroad Administration (part of the DOT) is responsible for railroad safety, including rail transport of crude oil and refined products. The Pipeline and Hazardous Materials Safety Administration (DOT) and the Transportation Security Administration (Department of Homeland Security) issue safety standards for railroads. Approximately 11% of crude oil and petroleum products were transported by rail in 2014, up from 2.6% in 2009.³⁴

Laws and Regulations Setting Energy Preferences

States and the federal government set requirements to encourage the use of particular energy types. Twenty-nine states have renewable portfolio standards that require electric utilities to sell a minimum percentage or amount of renewable energy. On the federal level, the Renewable Fuels Program is overseen by the EPA in consultation with the Department of Agriculture. The Energy Policy Act of 2005 and the Energy Independence and Security Act of 2007 require that set amounts of renewable fuel be used in place of gasoline, heating oil, or jet fuel. The applicable renewable fuels include ethanol, cellulosic biofuel, diesel from biomass, and other advanced biofuels. In 2018, the standards set by the EPA under authorization of the 2005 and 2007 acts require the use of 19.29 billion gallons of renewable fuels. This results in most gasoline containing 10% ethanol (E10). E15 and E85, with 15% or up to 85% ethanol, respectively, are locally available and can be used in some vehicles.

Other Regulations

Regulations not covered here include worker safety rules set by the Occupational Safety and Health Administration (see "Health and Safety in Oil and Gas Extraction" in this series for more information); regulations protecting antiquities and historic and religious sites; and the Endangered Species Act. In addition, the oil and gas industry is bound by state and federal financial reporting laws and tax regulations. Because oil and natural gas are traded globally and many oil and gas companies operate internationally, international trade rules and the laws of various other countries also impact the U.S. oil and gas industry.

The 50 State Index of Energy Regulation

Wayne Winegarden, Ph.D. and Marc A. Miles, Ph.D., Pacific Research Institute, July 2014

Executive Summary

Energy is an essential part of our daily lives. Whether making the morning coffee, traveling to work, using computers, manufacturing goods, cooking dinner, or watching TV before bed, energy touches nearly every aspect of our lives.

The energy that we consume is primarily generated from oil, natural gas, and coal. But, it also includes nuclear power, hydroelectric dams, wind farms, and solar energy. All of these energy sources are subject to regulations, both federal and state.

Federal regulations on energy are expanding. For instance, the Environmental Protection Agency (EPA) has proposed regulations in June 2014 that, if implemented, would require a 30 percent reduction in carbon dioxide emissions relative to 2005 by 2030. This proposal exemplifies the expanding reach of federal regulations as well as the timeliness and importance of evaluating energy regulations at both the federal and state levels.

The 50 State Index of Energy Regulations does not incorporate federal regulations because all states must comply with these regulations. It is important to note that equal compliance does not imply equal impact. For instance, the EPA's proposed carbon dioxide regulations will impact states with relatively more coal-fired power plants more than states with relatively fewer coal-fired power plants. Additionally, expanding federal regulations reduces the variation in energy regulations across the states, thereby impacting states differently as well.

Historically, state energy regulations have focused on utilities, gas stations, motor vehicle fuels, and the level of energy consumption. However, the energy market continues to evolve in remarkable ways, and regulations are changing in response. State regulations now also focus on how electricity can be generated and the types of energy products consumers can use. Even the regulation of utilities has changed. Your local utility likely is no longer "your father's" utility. Seventeen states now separate electricity generation and transmission in order to give residents and industries a choice from whom to purchase power. As a result, regulations increasingly affect independent electricity generators as well.

There are also monumental changes to the regulation of technologies used to produce energy, especially in the area of drilling technologies. Thanks to the hydraulic fracturing (fracking) revolution (the process of injecting pressurized fluids into wells in order to fracture the rocks and extract more oil and natural gas from each well), the price of natural gas has plummeted and the United States, once obsessed

with its dependence on the Middle East for energy, is now projected to become the world's top producer of oil by 2015. With that growth, however, this process has come under increased public scrutiny.

Amidst all this change, state regulations are altering the evolutionary path of the energy industry. To evaluate regulation's impact requires a consistent framework that can distinguish between public policy with a positive effect and policy with a negative one. Any such framework has a specific perspective, and whether the effect is positive or negative will be sensitive to the perspective chosen.

The 50 State Index of Energy Regulation is not a political perspective. It is not trying to prove whether left wing or right wing arguments are correct. It is indifferent to whether red states or blue states rank higher. Nor does the Index adopt the perspective of those who are concerned or not concerned with climate change. As economists, we have adopted a basic economic perspective, economic efficiency, defined as allocating resources to their most productive uses. The effects of policies are evaluated, as objectively as possible, solely from that perspective. Policies that promote economic efficiency receive higher scores, those that reduce economic efficiency receive lower scores. Given the regulatory variation across states, a picture emerges of where in the country the regulatory environment for energy consumption, production, and distribution is relatively more economically efficient.

This economic efficiency approach does not deny that there are other concerns such as pollution or implications for geopolitical strategy and security. Instead, the economic efficiency approach supplies a useful perspective on state energy regulations. It also provides an important contribution to uncovering what data exist for defining and measuring the relative regulatory implications across the states. We welcome efforts to extend the economic efficiency perspective to include other concerns.

The economic efficiency perspective is also indifferent to the source of data. Whether the data come from the U.S. Department of Energy, conservation groups, or energy industry organizations is not the defining factor. Data from all three are used in this study. The primary concern is that the data are consistent and reliable across all the states.

Care must be used in interpreting the final rankings. The 50 State Index of Energy Regulation is ordinal, meaning only the ranking order has information. The distance between absolute scores does not provide useful interpretation. The use of ordinal measures follows the tradition of many other well-known indices such as the World Bank's Doing Business, Transparency International's Transparency Index,

and the Wall Street Journal/Heritage Foundation's Index of Economic Freedom.

Evaluating the regulatory environment from an economic efficiency perspective requires asking the right questions. The questions must capture for each state how regulations affect all energy industries and their consumption, production, and distribution decisions. In the end we condense a state's energy industry into seven component indices or sets of questions that form the core of the Index scoring and rankings. These core issues are:

1. What are the degrees of retail choice among energy suppliers for consumer, industrial, and commercial customers?
2. How stringent are restrictions on electricity production?
3. Are there restrictions on the transportation and transmission of energy?
4. What green technology subsidies does the state provide and how do these affect economic efficiency?
5. What are the regulations designed to reduce energy consumption including appliance and building code standards, and does the resulting drop in energy use trigger de-coupling or lost revenue recovery?
6. Do producers have flexibility to allow utility prices to fluctuate with market conditions? Can utilities easily adjust prices to reflect the costs of new plants and the rise in wholesale prices? What is the ease of constructing new utility plants?
7. How do regulations affect motor vehicles? How much of the gas price is state taxes? Can station owners offer self-serve pumps? Must refiners include renewable fuels in every gallon of gasoline? Are there idling or emissions standards that must be met? Are the fuel economy standards in a state higher than federal standards?

The answers to the questions come from data. The data in turn create a 10-point scale for each of the seven component indices. A score of 1 means a state's energy regulatory environment is relatively economically efficient (easy to allocate resources to where they are most productive), and 10 means a relatively inefficient economic environment (very difficult to efficiently allocate resources).

A state's overall 50 State Index score is the simple average of the seven component indices for that state. Comparing the scores for the 50 states generates the ordinal rank. The results from the Index are summarized in Table ES-1 (located on the following page).

Several patterns emerge from the overall Index. First, there is little relationship between whether a state has substantial energy resources like oil, gas, and coal, and whether its regulations are economically efficient. Some big producing states like Texas and Alaska are ranked at the very top, yet California, another major energy producing state, is at the very bottom.

There is, however, a geographical pattern. States on the West Coast, in the Northeast, and in the upper Midwest have the most economically inefficient energy regulations. In contrast, states in the South and the heart of the country have regulatory environments more conducive to efficient allocation in production and consumption of energy.

The most interesting relationship is between a state's ranking and its economic growth rate. High ranked states on average grow faster than those ranked low. Moreover, the higher rate of economic growth is associated with faster employment growth. Energy regulation can, therefore, be an important factor in determining the eventual prosperity of a state.

This relationship makes sense. Energy is one of the essential ingredients that drives economic growth in a modern economy. Consequently, states that encourage the efficient production and consumption of energy should be expected to experience faster economic growth than those states that discourage economic efficiency in the energy marketplace. The 50 State Index of Energy Regulation supports that conclusion.

The Relative Economic Efficiency of State Energy Regulations



View the full 50 State Index of Energy Regulation report at https://www.pacificresearch.org/wp-content/uploads/2017/06/50StatesEnergy_FirstFinalWeb.pdf

Table ES-1: The 50 State Index of Energy Regulation

	Rank	Average Score	Regulations Affecting Retail Choice for Electricity	Regulations Affecting Production of Electricity	Regulations Affecting Transmission of Energy	Regulations: Subsidies & Net Metering	Regulations Affecting Consumption of Energy from Utilities	Regulations Affecting Producer Flexibility	Regulations Affecting Motor Vehicles
Alabama	1	4.29	10.0	1.0	2.0	2.0	5.0	8.0	2.0
Alaska	1	4.29	10.0	1.0	5.0	7.0	1.0	5.0	1.0
South Dakota	1	4.29	10.0	3.0	3.0	2.0	1.0	7.0	4.0
Texas	1	4.29	2.0	2.0	8.0	4.0	5.0	7.0	2.0
Delaware	5	4.48	6.3	4.0	2.0	4.0	5.0	6.0	4.0
North Dakota	6	4.57	10.0	3.0	3.0	3.0	2.0	8.0	3.0
Georgia	7	4.86	10.0	1.0	3.0	5.0	7.0	5.0	3.0
Kansas	7	4.86	10.0	5.0	6.0	3.0	2.0	5.0	3.0
Missouri	7	4.86	10.0	2.0	5.0	6.0	1.0	8.0	2.0
Oklahoma	10	5.00	10.0	4.0	3.0	6.0	4.0	5.0	3.0
Wyoming	10	5.00	10.0	2.0	5.0	5.0	3.0	8.0	2.0
Colorado	12	5.14	10.0	5.0	7.0	5.0	1.0	5.0	3.0
Mississippi	12	5.14	10.0	1.0	6.0	2.0	4.0	8.0	5.0
Ohio	14	5.24	7.7	3.0	6.0	5.0	6.0	6.0	3.0
Florida	15	5.29	10.0	2.0	6.0	4.0	5.0	5.0	5.0
Nebraska	15	5.29	10.0	1.0	2.0	4.0	5.0	10.0	5.0
Louisiana	17	5.43	10.0	2.0	5.0	5.0	5.0	7.0	4.0
Tennessee	17	5.43	10.0	1.0	7.0	4.0	4.0	10.0	2.0
Utah	17	5.43	10.0	4.0	5.0	6.0	5.0	5.0	3.0
Arizona	20	5.57	10.0	3.0	7.0	5.0	4.0	5.0	5.0
Iowa	20	5.57	10.0	2.0	5.0	6.0	5.0	7.0	4.0
South Carolina	20	5.57	10.0	1.0	6.0	5.0	6.0	7.0	4.0
Arkansas	23	5.71	10.0	1.0	10.0	5.0	5.0	7.0	2.0
Hawaii	23	5.71	10.0	3.0	4.0	7.0	4.0	7.0	5.0
Idaho	23	5.71	10.0	1.0	6.0	4.0	6.0	9.0	4.0
West Virginia	26	5.86	10.0	3.0	4.0	3.0	5.0	8.0	8.0
Rhode Island	27	6.00	4.0	4.0	5.0	5.0	10.0	8.0	6.0
Montana	28	6.05	7.3	5.0	3.0	8.0	7.0	8.0	4.0
Indiana	29	6.14	10.0	3.0	4.0	4.0	7.0	8.0	7.0
New Mexico	29	6.14	10.0	5.0	4.0	7.0	5.0	8.0	4.0
Illinois	31	6.19	5.3	6.0	5.0	9.0	8.0	6.0	4.0
Kentucky	32	6.29	10.0	2.0	6.0	8.0	7.0	7.0	4.0
Virginia	32	6.29	10.0	3.0	8.0	7.0	6.0	6.0	4.0
Minnesota	34	6.43	10.0	7.0	7.0	8.0	4.0	6.0	3.0
Vermont	34	6.43	10.0	3.0	6.0	8.0	5.0	7.0	6.0
Maine	36	6.48	6.3	9.0	8.0	6.0	1.0	8.0	7.0
New Hampshire	36	6.48	6.3	5.0	10.0	8.0	7.0	6.0	3.0
Massachusetts	38	6.52	7.7	5.0	7.0	9.0	7.0	6.0	4.0
Nevada	39	6.57	10.0	5.0	4.0	7.0	7.0	9.0	4.0
Pennsylvania	39	6.57	8.0	5.0	6.0	10.0	5.0	5.0	7.0
Oregon	41	6.62	9.3	3.0	4.0	10.0	8.0	7.0	5.0
North Carolina	42	6.71	10.0	2.0	6.0	7.0	7.0	9.0	6.0
New Jersey	43	6.81	5.7	5.0	9.0	10.0	6.0	8.0	4.0
Michigan	44	6.86	9.0	4.0	7.0	7.0	6.0	8.0	7.0
Washington	44	6.86	10.0	4.0	8.0	4.0	9.0	8.0	5.0
Maryland	46	7.10	4.7	5.0	5.0	10.0	9.0	9.0	7.0
Connecticut	47	7.14	6.0	6.0	7.0	8.0	8.0	9.0	6.0
Wisconsin	48	7.29	10.0	5.0	8.0	9.0	6.0	7.0	6.0
California	49	7.71	9.0	7.0	7.0	9.0	8.0	5.0	9.0
New York	50	7.86	8.0	9.0	8.0	10.0	7.0	6.0	7.0

Regulating Hydraulic Fracturing in the States

Liz Edmondson, The Council of State Governments, July 1, 2016

Natural gas production has increased dramatically in the United States in recent years. Advances in hydraulic fracturing and horizontal drilling have resulted in the commercial viability of vast quantities of previously untapped gas reserves in shale formations. In the past 10 years alone, production increased from 23.5 million cubic feet in 2005 to almost 33 million cubic feet in 2015. However, along with this surge in production has come growing concern regarding the environmental consequences of these techniques, including water pollution, waste disposal, air quality, and seismic activity. In addition, policymakers are also increasingly addressing the interaction between federal, state, and local regulation.

The task of balancing the opportunities inherent in increased domestic natural gas production with environmental and public protection has largely fallen to state policymakers. However, the federal government does regulate some areas related to natural gas production, most notably water and air quality. Under the Clean Water Act, on-shore oil and gas extraction facilities are prohibited from discharging pollutants into surface waters in most instances. In addition, the U.S. Environmental Protection Agency, or EPA, issued the first air quality standards for hydraulically fractured natural gas wells in 2012, which require reductions in volatile organic compounds. In May 2016, the EPA finalized rules to reduce methane emissions from new and modified oil and gas sources. These standards are expected to reduce methane emissions from the oil and gas sector 40 to 45 percent below 2012 levels by 2025, while also cutting volatile organic compound and air toxics emissions. While the federal government is getting more involved in regulating natural gas, fracking operations are at this time still predominantly regulated at the state level.

Given the rapid and increasing development of shale gas, its controversial nature, and the limited oversight on the federal level, states have taken a variety of approaches in attempting to balance environmental and public safety concerns with shale development. Indeed, states vary significantly in geology, economic conditions, geography, demographics, the extent of shale gas production and other factors, which partially contributes to the variety of regulatory approaches. However, the swift expansion of shale gas development has resulted in a patchwork of regulatory trends that states will continue to address going forward.

Outright Bans on Fracking and the Disposal of Fracking Waste

In light of the potential environmental impacts of fracking, some states have banned the practice altogether. New York and New Jersey were among the first states to act, placing moratoriums on well permitting until the environmental and health risks of the practice could be evaluated. After a seven-year review, New York Gov. Andrew Cuomo announced in December 2014 that the state would ban fracking and the state

issued a Findings Statement on June 29, 2015, to that effect.

In contrast, while the New Jersey legislature passed a bill that would have permanently banned fracking in the state in 2011, Gov. Chris Christie issued a conditional veto that placed a moratorium on the practice for just one year, which has since expired. While fracking is currently allowed in the state, no fracking operations are currently taking place.

Although Vermont has very limited deep shale deposits, the state—in a largely symbolic gesture—became the first state to ban fracking and the collection, storage, or treatment of wastewater from the practice with the passage of H. 464 in 2012. In 2015, a Maryland bill banning fracking for two and one-half years, until October 2017, became law after Gov. Larry Hogan declined to veto the legislation.

In addition, other states have passed legislation prohibiting the disposal of fracking wastes in their states. Fracking requires operators to inject large amounts of water into a wellhead. This process results in the production of significant amounts of wastewater that typically contains chemicals used in the fracking process, as well as salt, radioactive material and heavy metals. This water must be managed and is typically reused, treated and released, or injected underground.

Some states with limited or more expensive disposal options for this wastewater have opted to transport it to other states for management. In response, both Connecticut and Vermont prohibit the storage or disposal of fracking waste in their states. While New Jersey has attempted such a ban, Gov. Chris Christie has vetoed bills that would have banned the disposal of fracking waste in the state on two occasions.

The District of Columbia and other communities, counties and cities across the country are also acting to regulate or restrict hydraulic fracturing. In 2014, the District of Columbia passed a resolution urging the federal government to prohibit fracking in the George Washington National Forest, a 1.1 million acre forest in West Virginia and Virginia containing the headwaters of the Potomac River, the capital's only source of drinking water. In addition, hundreds of communities, towns and cities across the United States have banned fracking through local initiatives.

States Ban Fracking Bans and Courts Weigh in on Localities' Ability to Regulate Fracking

In response to restrictions on fracking by these localities, various actions have been taken to hinder the ability of local governmental entities to ban fracking or the disposal of fracking wastes. At the state level, both Oklahoma and Texas lawmakers voted to limit local governments from prohibiting the practice. Oklahoma's bill, SB 809, signed into law in 2015, prohibits localities from banning fracking, but allows local governments to set reasonable restrictions on noise, traffic and

fencing, and to enact reasonable setbacks for surface operations. The Texas law was enacted in response to a fracking ban imposed by the town of Denton, which halted fracking activity in the town until the legislation was signed by Gov. Greg Abbott on May 18, 2015, approximately six months after the ban became effective.

In other states, courts have found fracking bans enacted by local governments illegal. In 2013, Mora County, New Mexico, was the first county in the country to ban hydraulic fracturing. Soon thereafter, various parties filed a lawsuit in federal court against the county, alleging that the ordinance was unconstitutional and infringed on private property rights. The U.S. District Court for the District of New Mexico struck down the ban, finding that it violated the U.S. Constitution's Supremacy Clause because it contained language that stripped oil and gas companies of rights protected by federal case law and the U.S. Constitution.¹⁸ In addition, the court found that the ordinance was further illegal because it prohibited activities that are allowed under state law. Soon after the decision, Mora County rescinded the ban. A similar ordinance banning fracking wastewater disposal and enacted by a Pennsylvania township was also rejected by a federal court.

Similarly, states and localities continue to clash over to what extent local governments can place restrictions on fracking operations. In 2015, the Ohio Supreme Court considered whether a city could enforce its local zoning ordinances against an oil and gas company, which required local certifications and requirements in addition to the state's permitting scheme. Ohio laws, amended in 2004, give the state "sole and exclusive" authority to regulate the permitting, location, and spacing of oil and gas operations and repealed any portions of the previous law giving local governments authority to adopt regulations concurrent with the state. The city argued that the state's Home Rule Amendment to its constitution, which gives local control to all matters not of statewide interest, allowed it to impose its own permitting requirements on oil and gas operations.

However, in a 4-3 opinion, the court found that Ohio's Home Rule Amendment "does not allow a municipality to discriminate against, unfairly impede, or obstruct oil and gas activities and production operations that the state has permitted" under its oil and gas laws. Because the legality of restrictions and bans on fracking largely depend on the specific way the ordinance is written, the state's constitutional provisions, and the extent to which the state regulates oil and gas operations, challenges to local attempts at regulation and restriction of fracking will be case-specific and will likely continue.

Seismic Activity: How Will States Respond?

According to the U.S. Geological Survey, the number of earthquakes in the central and eastern United States has increased significantly in recent years. Beginning in 2009, earthquakes in these areas of the country increased to an average of 99 earthquakes of magnitude 3 and above compared to only 21 M3+ quakes between the years 1973–2008. By 2014, there

were 659 M3 and larger earthquakes, with rates continuing to rise.

A recent article in *Science* magazine notes that many of these earthquakes are thought to be induced by the injection of wastewater into the subsurface from hydraulic fracturing operations or enhanced oil recovery. The study found that in regions prone to seismic activity, the rate of injection was the factor that most affected the probability of an induced earthquake.

Oklahoma has thus far taken limited action on this issue. The Oklahoma Corporation Commission, which regulates the oil and gas industry, recently responded to the increase in seismic activity by requesting that producers located in the northwest area of the state reduce by 40 percent the amount of wastewater they dispose. In March, the agency developed a similar plan to reduce the total volume of wastewater disposed in central Oklahoma by 40 percent below 2014 levels over a two month period. In addition, Gov. Mary Fallin directed approximately \$1.4 million of emergency funds to addressing triggered earthquakes, which allowed the commission to add additional staff and upgrade technology.

The Kansas Corporation Commission also ordered a reduction of fracking wastewater injections in two counties that border Oklahoma as a result of increased seismic activity reported in the USGS study. Ohio now requires that seismic monitors be installed for fracking operations within three miles of a known fault. If seismic activity above a 1.0 magnitude is detected, the operation must cease pending an investigation. Well operations would be suspended if a connection between the well and the seismic activity is uncovered. Texas has taken a less restrictive approach and hired a full-time seismologist and requires more information from operators during the permitting process.

As seismic activity continues to increase in the central and eastern parts of the country and more research is conducted on the relationship between fracking and increased seismic activity, policymakers will have to make decisions as to how to regulate disposal wells.

Conclusion

Natural gas production is expected to continue to increase in the immediate future. As a result, states will continue to grapple with the economic advantages this production brings and the environmental and regulatory challenges natural gas production presents. In addition to the issues discussed above, states will address other issues such as methane emissions, severance taxes, fluid disclosure requirements and the enforceability of regulatory controls given significant revenue shortfalls in some states. In addition, the federal government is becoming more active, with the EPA engaging in studies and rulemaking that will affect the industry. State policymakers will need to be aware of the challenges in regulating fracking where local, state and federal actors are involved, in addition to being aware of the options for addressing the environmental issues surrounding the production of this booming resource.

How Has Fracking Changed Our Future?

Christina Nunez, National Geographic, April 19, 2019

The use of hydraulic fracturing to extract oil and gas from the earth dates back to the 1940s, but only in the past few years has “fracking” become an energy buzzword, alluding primarily to the shale gas boom in the United States and all of the controversy that has accompanied it. Fracking—the high-pressure injection of water, chemicals and sand into shale deposits to release the gas and oil trapped within the rock—in recent years has been combined with horizontal drilling and other improvements in technology to harvest stores of gas and oil that previously were thought commercially unfeasible to access. (See interactive: “Breaking Fuel from the Rock”)

The implications of this sea change are debatable, but the impact is undeniable. In the United States, oil production last year reached its highest level in 14 years, thanks in part to output from North Dakota’s Bakken Shale, and is expected to keep rising. Natural gas production, already at new highs thanks to shale gas, is expected to grow 44 percent in the U.S. between 2011 and 2040. (See “Natural Gas Nation: EIA Sees U.S. Future Shaped by Fracking.”)

Now countries around the world, including China, the United Kingdom and South Africa, are eyeing shale development as the potential key to unlock a similar windfall of homegrown energy. Debate rages on about whether these worldwide reserves can be tapped safely, and whether environmental damage from fracking natural gas will outweigh the gains from using a fuel that is cleaner than oil or coal, but remains a fossil fuel nonetheless. A few viewpoints on both sides of the issue follow.

Positive impacts of fracking

“The United States is in the midst of the ‘unconventional revolution in oil and gas’ that, it becomes increasingly apparent, goes beyond energy itself. Today, the industry supports 1.7m jobs - a considerable accomplishment given the relative newness of the technology. That number could rise to 3 million by 2020. In 2012, this revolution added \$62 billion to federal and state government revenues, a number that we project could rise to about \$113 billion by 2020.2 It is helping to stimulate a manufacturing renaissance in the United States, improving the competitive position of the United States in the global economy, and beginning to affect global geopolitics.” —Daniel Yergin, vice chair of global consulting firm IHS, in February testimony before Congress

“Natural gas is not a permanent solution to ending our addiction imported oil. It is a bridge fuel to slash our oil dependence while buying us time to develop new technologies that will ultimately replace fossil transportation fuels. Natural gas is the critical puzzle piece RIGHT NOW. It will help us to keep more of the \$350 to \$450 billion we spend on imported oil every year at home, where it can power our economy and pay for our investments in a smart grid, wind and solar energy, and increased

energy efficiency. By investing in alternative energies while utilizing natural gas for transportation and energy generation, America can decrease its dependence on OPEC oil, develop the cutting-edge know-how to make wind and solar technology viable, and keep more money at home to pay for the whole thing.” —Pickens Plan, a site outlining BP Capital founder T. Boone Pickens’ proposed energy strategy

“My town was dying. This is a full-scale mining operation, and I’m all for it. Now we can get back to work.” —Brent Sanford, mayor of Watford City, a town at the center of the North Dakota oil boom, in “The New Oil Landscape” (NGM March 2013 issue)

Negative impacts of fracking

“According to a number of studies and publications GAO reviewed, shale oil and gas development poses risks to air quality, generally as the result of (1) engine exhaust from increased truck traffic, (2) emissions from diesel-powered pumps used to power equipment, (3) gas that is flared (burned) or vented (released directly into the atmosphere) for operational reasons, and (4) unintentional emissions of pollutants from faulty equipment or impoundment-temporary storage areas. Similarly, a number of studies and publications GAO reviewed indicate that shale oil and gas development poses risks to water quality from contamination of surface water and groundwater as a result of erosion from ground disturbances, spills and releases of chemicals and other fluids, or underground migration of gases and chemicals.”—General Accounting Office report on shale development, September 2012

“The gas ‘revolution’ has important implications for the direction and intensity of national efforts to develop and deploy low-emission technologies, like [carbon capture and storage] for coal and gas. With nothing more than regulatory policies of the type and stringency simulated here there is no market for these technologies, and the shale gas reduces interest even further. Under more stringent GHG targets these technologies are needed, but the shale gas delays their market role by up to two decades. Thus in the shale boom there is the risk of stunting these programs altogether. While taking advantage of this gift in the short run, treating gas a ‘bridge’ to a low-carbon future, it is crucial not to allow the greater ease of the near-term task to erode efforts to prepare a landing at the other end of the bridge.”—from a study on shale gas and U.S. energy policy by researchers at MIT (also see: “Shale Gas: A Boon That Could Stunt Alternatives, Study Says”)

“Oil is a rental business. ...When the industry goes south, and it will go south, they just walk away.” —Dan Kalil, chairman of the Williams County Board of Commissioners in North Dakota, in “The New Oil Landscape” (NGM March 2013 issue)

Corporation Commission plays key role in energy sector

Matt Skinner, Oklahoma Corporation Commission Public Information Manager

The Oklahoma Corporation Commission (OCC) plays a key role in Oklahoma's energy sector. Its jurisdiction includes oil and natural gas exploration and production, electric and natural gas utility service, fuel sales and storage, and oil and natural gas transportation. While much has changed since the creation of the OCC, many of the agency's current energy rules have their roots in the early stages of Oklahoma's oil and gas industry more than 100 years ago.

The Corporation Commission was established in 1907 by Article 9 of the Oklahoma Constitution, and the First Legislature gave the OCC authority to regulate public service corporations; those businesses whose services are considered essential to the public welfare, including electric and natural gas utilities. The oil and natural gas industry was not among them.

The Second Oklahoma Legislature put oil pipelines under OCC regulation in 1909. In 1914 the OCC used that authority to restrict oil drilling and production in the Cushing and Healdton fields to "prevent waste" when production exceeded pipeline transport capacity. In 1915, the Legislature passed the Oil and Gas Conservation Act. This expanded oil and gas regulation to include the protection of the rights of all parties entitled to share in the benefits of oil and gas production.

It was in moving to "prevent waste" of Oklahoma's oil and natural gas resources that the OCC laid the groundwork for what became modern environmental regulation. Many oil and gas environmental rules had their start as "waste prevention" rules. For example, the OCC was among the first regulatory bodies in the U.S. to move to stop oil "gushers" because the oil that spewed into the air and on the ground was simply wasted. Those rules exist today (albeit in differ-

ent form) as environmental rules.

While the basic regulatory responsibility of the OCC has remained intact, many changes in state and federal laws have changed what is regulated, and how. In terms of energy, the OCC presently regulates public utilities (rates, charges and reliability of service), except those under municipal or federal jurisdiction or exempt from regulation; oil and gas drilling, production and environmental protection; pipeline transportation, the environmental integrity of petroleum storage tank systems and the quality and measurement of motor fuels sold at the retail level. The OCC also enforces federal and state regulations for underground injection and disposal of certain oil and gas waste fluids and remediation of soil and groundwater pollution caused by leaking petroleum products storage tanks. In addition, the OCC has jurisdiction over certain filings required of wind farm developers under state law, and over decommissioning of wind farms.

The OCC does not have authority to require the use of one energy source over another. The OCC does take action to ensure its regulatory structure does not unduly inhibit the development of energy sources that could be beneficial to the state's economy and consumers. For example, in 2003 the OCC became one of the first regulatory bodies in the U.S. to change rate structures to open the door for use of wind power by regulated utilities.

The 3 Corporation Commissioners have judicial, legislative and administrative authority. The Commissioners meet in public a minimum of 3 days a week, considering and voting on almost all regulatory matters within the agency's jurisdiction. Commission orders are appealable only to the Oklahoma Supreme Court.

State and Future of Power: Oklahoma

Steve Mitnick, with Dana Murphy, *Fortnightly Magazine*, June 15, 2018

Public Utilities Fortnightly (PUF): What do you do in a typical day at the OCC?

Chair Murphy: The beauty of this job is I'm not sure there is a typical day. However, there's a simple acronym that I use in my many public speaking engagements to describe what we do: TOPP — Transportation, Oil and Gas, Petroleum Storage Tanks, and Public Utilities.

If it moves by truck, train, transmission line, pipeline, or fiber line, we're the agency in the state that typically regulates that activity, as well as dealing with oil and gas exploration and production, gas stations, and utilities. This covers a wide range of responsibilities.

For example, on a given day we may be dealing with everything from earthquake directives to enforcement actions, to performance-based ratemaking cases, to daily oil and gas orders. The commissioners usually meet in public at least three days a week.

But we are actually a 24/7 agency, with staff on around-the-clock call on things like earthquake response and emergency assistance to stakeholders and other agencies on natural catastrophes such as wildfires and tornadoes, as well as emergency environmental response. As I quickly learned, our agency has to be resilient, flexible, nimble, and able to adjust to different things that may happen in a given day.

PUF: The OCC has a broad responsibility?

Chair Murphy: Given our responsibilities, I think it would be safe to say we are the most economically powerful agency in the state. If you just look in the state generally, we regulate over three thousand oil and gas operators, almost two hundred thousand oil, gas and injection wells and over forty thousand miles of pipelines. That's not counting electricity, natural gas, telecom utilities, petroleum storage tanks and thousands of trucks.

PUF: How many do you have on staff?

Chair Murphy: We have about five hundred employees, many of whom are remote employees, our field staff.

We have a main office here in the state capitol complex and also have an office where we conduct hearings in Tulsa.

On the oil and gas side, we have four district field offices across the state. But for the most part, those field inspectors on the oil and gas side work out of their trucks. That's pretty much their office.



OK Corporation Commission Vice-Chair Todd Hiatt, Chair Dana Murphy, Commissioner Bob Anthony

We have fuel inspectors, because the Commission also ensures a gallon of gasoline is a gallon at the octane level that's stated. We have transportation officers for manning ports of entry/weigh stations and to perform oversight on trucking. Additionally, the Commission has pipeline inspectors in pipeline safety.

It takes lots of employees, and a lot of those employees are outside of this building.

PUF: How do you feel the industry is going, and regulation of the industry as well?

Chair Murphy: In Oklahoma the impact of federal regulations and regional issues, most notably over emission requirements, has had a major impact. Oklahoma had two major utilities take different paths regarding some of those federal environmental regulations.

One reached a settlement agreement with the EPA and some of the environmentalists, and the other company took its battle all the way up to the Supreme Court.

The challenge of federal regulation is really the timing, especially with a different administration. The current administration rolled back the Clean Power Plan. I'm sure if you talk to different commissioners they feel a little differently across their states. But for Oklahoma, it was going to be really high costs on top of the cost of complying with other federal mandates.

Then just recently, the state commissions had to deal with the recent impact of federal tax reform.

The Southwest Power Pool, SPP, is another issue. Oklahoma is in the footprint of the SPP, and our utilities are impacted by actions taken by the SPP's Regional State Committee, in dealing with the integration of the Mountain West Group.

(After our interview, a portion of the Mountain West Group had pulled out of the integration.)

I still think a huge issue for Oklahoma and other states is cybersecurity for both our stakeholders and the agencies. We had a cyberattack on the OCC system that took us down for two or three days, as far as having the ability to have things up on our website and postings and things like that. We've recovered from that now, but I think part of it has been just the age of the system that we have, and the money that's provided to us for some of these things.

Legislative issues are always of concern. I am concerned about a disconnect between legislation and the actual impact of the legislation. For example, there was recently a push to put new taxes on wind power. You're impacting a ratepayer when it sounds like you're doing something else. Don't forget, if you tax kilowatt hours for generation, who's going to foot the bill for that?

I don't think I realized all the implications of a given action or proposal when I first took the job. Whether it's state or federal regulations and statutes, we must understand all the interests involved and balance them.

Another dynamic change is that many interveners in a case are now single-issue interveners. That makes it far more difficult to work toward a settlement in a given case than it was when I first took office ten years ago. Often, there is little room for give and take.

PUF: Looking forward the next three or four years, do you feel optimistic?

Chair Murphy: I forgot who said it, but there's always opportunity in every crisis, or there's always opportunity in every difficult situation. The one thing I can honestly say from being in this position is that I've seen our staff and others rise up to meet the challenge posed by very difficult conditions.

It makes me really proud to work with the people here as they go out of the way in the name of service. For example, we had some of our public utilities' staff travel into the field

to get a better understanding of the issues faced by utilities personnel. We're also part of the Emergency Response Team for the entire state. I think that helps us do our job well.

I see challenges, but I also see some really positive things.

Oklahoma still has among the lowest electricity prices in the nation. That's fantastic news! It's fantastic for people that are here, and to attract new businesses in manufacturing, high tech, and aeronautics and aerospace. In general, you look at 2017 data, and the Energy Global Institute shows Oklahoma as one of the third or fourth lowest states in electricity prices.

I still think cybersecurity will be a big issue. There's also the issue of dealing with congestion on the grid caused by the huge jump in commercial wind power in Oklahoma. I also think you will see more expansion of solar power in the future.

A distribution statute was passed that has had an impact on people who want to do distributive generation. Beyond Oklahoma, just about every state has utilities dealing with distributed generation and how that impacts what a traditional utility does.

I think you're going to see the paradigm of utility regulation continue to change.

As commissioners, it behooves us to learn and study and stay abreast of things that are happening. I'm just fortunate that I'm on the Electric Power Research Institute Advisory Board. It's really helpful for getting a look ahead.

It's easy to get caught in your own silo and look only at a given case or issue. You have to be thoughtful about the decisions that you make today and how they could impact the future. You also have to think about the ever-changing technology and what's happening in your state, whether it's oil and gas activity, increased population, or economic expansion.

I'm conservative, but at the same time I am progressive in also looking forward, exploring new and different ways of doing things.

As commissioners, we must keep abreast of what's going on and be thoughtful of the future as we're making decisions on the things that are right in front of us today.

Corporation Commission seeks to hear from wind businesses before updating rules

Jack Money, The Oklahoman, June 18, 2019

The Oklahoma Corporation Commission is embarking on a process that likely will tweak its wind development rules as it seeks to implement a new law that harnesses the state's wind power to support the military.

The law, approved by Oklahoma's Legislature and Gov. Kevin Stitt, clarifies processes wind farm developers in Oklahoma must follow to ensure needed federal approvals to protect low-level military training areas are obtained before construction on those projects can begin.

Those needed federal approvals must be provided by the Federal Aviation Administration and the Military Aviation and Installation Assurance Siting Clearinghouse.

The law sets out a process that developers now are required to follow with state agencies to get those approvals and sets a hefty fine of up to \$1,500 a day (per tower or other structure) for developers who violate the requirement.

"What this does is ensure everyone is communicating," Grayson Ardies, deputy director of the Oklahoma Aeronautics Commission, said earlier this year when the governor signed the bill.

An email sent out Monday by Jeff Kline, a deputy general counsel at the corporation commission, stated the agency's Public Utility Division intends to hold industry meetings to discuss the updated guidelines.

Kline's email stated the division also may initiate rulemaking proceedings concerning new compliance requirements.

On Monday, Brandy Wreath, director of the commission's Public Utility Division, said discussions with industry representatives are desired to be sure everyone understands the new requirements before the division seeks to clean up wind-related language in the commission's rules.

"We don't expect this to be too dramatic, but there will still be things we need to look at to be sure" the rules comply with the new law, Wreath said.

The new law requires wind developers to make duplicate filings of information they provide to the FAA when seeking no-flight-hazard determinations from that agency to the corporation commission and aeronautics commission, and to make additional filings with both if they submit updated plans to the FAA that changes turbine locations or heights.

The law also requires the aeronautics commission to notify the Oklahoma Strategic Military Planning Commission of proposed wind project plans so that it, in turn, can notify local base commanders and the clearinghouse of those plans.



Wind turbines near Hobart are pictured. New reporting requirements were approved this year to address concerns about the potential proposed wind farms have to impact military airspace training corridors. [OKLAHOMAN ARCHIVES]

The strategic military planning commission also is required to provide copies of notification letters it sends to the clearinghouse about pending wind farm plans to the aeronautics commission and wind energy developer, in addition to the corporation commission.

And, the law requires developers to file federal approvals with both the aeronautics and corporation commissions.

Officials have said the updated language seeks to address a myriad of headaches wind farm project developers and regulators have encountered the past several years as continued industry growth impacted low-level military training areas in Oklahoma that bases here and in surrounding states historically had used.

Budget to fund improved energy permit process

Daisy Creager, The Journal Record, May 17, 2019

Energy industry advocates applauded the state budget agreement that includes \$5.3 million to modernize the Oklahoma Corporation Commission's energy development permit processing.

OCC spokesman Matt Skinner said the commission wants to improve service to the industry and the public through digital improvements to application filing, case processing and access to data.

"The bottom line is we want to be able to offer the benefits of what's available now through various digital means. ... If you're waiting on a permit application, it's best for the industry, it's best for everybody if we can get it out the door with the same care we've always taken, but we can speed it up," Skinner said.

Oklahoma Energy Producers Alliance Chairman Dewey Bartlett said the permitting process is cumbersome and time-consuming and improvements are needed.

"Being able to utilize less paper, but also a fewer number of people holding that paper and having to approve the document, is very important. It's a very convoluted process they use now, it's a very old process that they haven't changed very much in the past several decades," Bartlett said.

The Oklahoma Independent Petroleum Association – Oklahoma Oil and Gas Association had advocated for Senate Bill 519 at the start of the legislative session, allocating

money collected from a petroleum excise tax to the commission for technological upgrades. That bill failed to advance.

OIPA-OKOGA President Chad Warmington said in a statement the commission has been "attempting to regulate 21st-century industries with 20th-century technology."

He said the proposed appropriation for technology updates would help the industry meet regulatory requirements without delays affecting development and help the commission achieve its mission.

"A growing and vibrant oil and natural gas industry requires a well-funded and well-staffed regulatory agency. ... Providing appropriate funding for critical technology upgrades at the OCC is a benefit for all Oklahomans," Warmington said.

Warmington said the whole budget proposal is "a step in the right direction," and the overall savings in the proposed budget announced May 15 – \$200 million – will help the state when the price of oil and gas inevitably falls.

"A healthy rainy-day fund that can be tapped to offset the volatility in oil and natural gas prices is key to ensuring government services continue at expected levels in times of industry downturns," Warmington said. "We applaud Gov. Stitt and leadership in the House and Senate for making budget savings a priority."

Study recommends changes for Corporation Commission

Sarah Terry-Cobo, The Journal Record, November 16, 2018

A national consultant outlined on Thursday several recommendations for the Oklahoma Corporation Commission as part of a yearlong study. Though it provided 23 suggestions in a 119-page analysis, the National Academy of Public Administration did not address whether the commission has adequate funding. Commissioner Todd Hiatt said he wished the task force would have provided revenue recommendations.

“They provided us a good framework we can use as we move forward and try to get the resources needed in the oil and gas division to regulate the industry,” he said.

The agency needs more funding so it can handle increased numbers of drilling permits and increasingly complex well-bore design. Hiatt said there is industry support to return some excise tax money to regulate the industry, which was removed from the agency years ago.

The Legislature has removed about \$7 million from the agency’s budget over the last four years, often by taking from the commission’s revolving funds and reappropriating some of the money back to it later.

The organizational assessment for the state regulator was the result of an executive order Gov. Mary Fallin signed in 2017.

The agency regulates several industries’ activities, including oil and gas drilling, wastewater disposal, utility rates, telecommunications rates and access, large semi-trailer trucking weight, petroleum storage tank integrity, intrastate pipelines, gasoline and diesel fuel quality, railroad crossing safety and the dismantling of cotton gins. In recent years the Legislature has also given the commission authority to regulate ride-hailing services and to gather and post information on wind turbine placement for pending wind farms.

Among its detailed recommendations, the contractor outlined three gaps for the agency. It lacks a mature performance management system. Though the agency tracks and measures operational data related to the number of permits issued and how long utility rate cases last, it doesn’t collect data focused on operational capabilities, said Brenna Isman, director of academic studies for the National Academy of Public Administration.

Another gap is its existing strategic plan. Even though developing one is an incremental process that takes years and the agency is making progress for building one for fiscal 2019 through fiscal 2023, the agency’s current plan doesn’t have the right focus, she said.

“We felt like it focuses more on outputs and activities than



The entrance to the courtrooms of the Oklahoma Corporation Commission in the Jim Thorpe Office Building in Oklahoma City. (Photo by Mark Hancock)

it does examining, ‘how do we ensure in five years we have improved mission effectiveness?’” Isman said.

The third gap was that the agency needs an organizational change-management process. The Public Utility Division has a process in which staff input is collected, assessed and recommendations are implemented. Even though the commission overall is fairly decentralized, it should have an organization-wide change-management process that is consistent with its overall mission, she said.

There isn’t a compelling need to change the agency’s overall structure. The contractor didn’t provide recommendations for some items, such as funding adequacy, because it wasn’t able to get granular details across all divisions.

The task force’s chairman, Energy and Environment Secretary Mike Teague, said the report is available on his website so that the governor and Legislature can review it.

Evaluation of Oklahoma's Corporation Commission doesn't recommend breaking the organization up or changing the way its leaders are elected

Jack Money, The Oklahoman, November 16, 2018

A yearlong study into the Oklahoma Corporation Commission's responsibilities and its organizational structure makes no specific recommendations to change either.

However, a review conducted by the National Academy of Public Administration for a Second Century Corporation Commission Task Force formed in August 2017 by Gov. Mary Fallin does make about two dozen recommendations that aim to improve the agency's performance in various ways.

The academy's report was presented to members of the task force on Thursday and will be forwarded to Fallin, the commissioners, the attorney general and the leaders of Oklahoma's House and Senate.

Michael Teague, Oklahoma's secretary of energy and environment and task force leader, said the task force had no preconceptions going into the academy's review, other than it sought ideas on ways to "set the commission up for success in the future."

On Thursday, Teague said he felt like that's what the academy's report "absolutely" accomplishes.

Fallin formed the task force after complaints were made by regulated electric utilities and oil and natural gas producers that the agency sometimes took too long to consider regulatory issues related to their industries.

The academy report's executive summary said it isn't mak-

ing recommendations on whether the agency should be split up into either new stand-alone organizations or whether to send pieces of it to other, existing agencies. The report also made no recommendations on whether additional commissioners should be appointed or elected to help oversee the commission.

However, it also noted that energy industries and their regulations have become more complicated as rapid market and technology changes have become the norm. The academy said the commission lacks critical capabilities it needs to handle those.

To that end, the recommendations it included seek to make the commission more mission-focused and future oriented.

Generally, it recommends the agency develop and use an inclusive strategic planning process, develop a performance management system aligned with its mission and strategic goals, and to improve how it manages its staff.

The Corporation Commission was established by the Oklahoma constitution in 1907 and has three members elected statewide who serve staggered, six-year terms. It regulates a wide swath of businesses, including oil and gas, telecom, electric and gas utilities, trucking, railroad crossings — and cotton gins.

In recent years, it also has been the state agency regulating induced seismicity linked to oil and gas activity.

Notes

**This is a resource document for you to use.
Take notes, highlight, use as a text book.**

New protocol to further address seismicity in state's largest oil and gas play

Oklahoma Corporation Commission, February 27, 2018

A new protocol has been developed to further reduce the chances of a felt earthquake resulting from well completion activities in Oklahoma's newest and biggest oil and gas play.

In December 2016, the Oklahoma Corporation Commission's Oil and Gas Conservation Division (OGCD) and the Oklahoma Geological Survey (OGS) developed a seismicity protocol for oil and gas operators that were planning operations for the South Central Oklahoma Oil Province (SCOOP) and the Sooner Trend Anadarko Basin Canadian and Kingfisher counties (STACK) plays. As expected, these areas now account for the vast majority of new oil and gas activity in Oklahoma.

OGCD Director Tim Baker says the protocol met with full cooperation from the oil and gas industry, but the data gathered since it went into effect supports new actions.

"The overall induced earthquake rate has decreased over the past year, but the number of felt earthquakes that may be linked to well completion activity, including hydraulic fracturing, in the SCOOP and STACK has increased," noted Baker. "These events are relatively rare and smaller on average than those linked to injection activity. Most importantly, the risk of such events appears to be manageable. Learning how to mitigate the risk of causing such events is an ongoing process. The changes we are announcing today are part of that process."

Among the changes being made in the seismicity protocol:

- 1) All operators in the defined area will be required to have access to a seismic array that will give real-time seismicity readings.
- 2) The minimum level at which the operator must take action has been lowered from a 2.5 magnitude (ML) to 2.0 ML. Generally, the minimum level at which earthquakes can be felt is about 2.5 ML.
- 3) Some operators will have to pause operations for 6 hours at 2.5 ML. Under the previous protocol, the minimum level requiring a pause was 3.0ML. Under the previous protocol, the minimum level requiring a pause was 3.0ML.

Baker said the data gathered over the past year indicates earlier action may be best.

"While more study needs to be done, the indications are that those operators who have their own seismic arrays and took actions when there were seismic events too small to be felt decreased the risk of having multiple, stronger earth-

quakes," said Baker.

OGS Director Dr. Jerry Boak agrees the changes in the protocol are necessary, but should only be seen as a step.

"Ultimately, the goal is to have enough information to develop plans that will virtually eliminate the risk of a felt earthquake from a well completion operation in the SCOOP and STACK," said Boak.

According to State Seismologist Dr. Jake Walter, to accomplish that goal and further reduce the risk of strong earthquakes from wastewater injection, Oklahoma must add to its existing state seismic network by building a system capable of providing the needed data 24 hours a day. Currently, the OGS seismic network detection capability ranges between 2.0-2.5 ML across the state, and earthquake verification by an analyst occurs during normal business hours, except for larger events.

"The cost associated with expanding the seismic network would be a relatively small investment that would help to ensure the safe development of Oklahoma's billions of dollars worth of oil and natural gas," said Walter. "When coupled with other data on oil and gas activities that we hope will be forthcoming, we could develop a framework that would enable operators to know before they commence operations just what the estimated seismicity risk could be, what steps to take beforehand, and what to do during operations to minimize seismic hazards. As we speak, such mitigation efforts are being implemented by operators in the SCOOP/STACK. The sharing of the resulting data with OGS will help us to learn exactly what works."

Baker, Boak and Walter agree that while important, the threat of induced earthquakes from well completion activity is much smaller than the threat linked to injection of oil and gas wastewater in the north-central area of the state, where the larger and more frequent earthquakes have occurred.

"Production within the 15 thousand square mile earthquake Area of Interest (AOI) resulted in an unprecedented amount of salt water which was already in the formation coming up with the oil and natural gas," Baker explained. "That produced water was put back underground using disposal wells. There is broad agreement among researchers that disposal of these large amounts of water into the Arbuckle, the state's deepest formation, can be linked to the high earthquake rate we saw in recent years within parts of the AOI. By comparison, the SCOOP and STACK plays have very small amounts of produced water and whatever earthquake activity there is tends to be much smaller. We currently estimate less than four percent of detectable, induced earthquake activity in Oklahoma can be linked to hydraulic

fracturing, and of that, an even smaller percentage can be felt. While the earthquake rate in the large AOI has been dropping since limits on disposal were put in place by the OGCD, disposal into the Arbuckle formation within the AOI is still the larger concern.”

SUMMARY OF REVISED WELL COMPLETION SEISMICITY PROTOCOL*

This Directive shall replace the protocol dated December 20, 2016.

Terms: Oil and Gas Conservation Division (OGCD)
 Induced Seismicity Department (ISD)
 Oklahoma Geological Survey (OGS)

Prior to initiating completion activities on a horizontal well in the defined Well Completion Area of Interest (see map), operator shall certify to the OGCD, on the frac notice form, that it has adopted a seismicity response plan related to potential seismicity within five (5) kilometers (km) (3.1 mi) of completion operations.

- While the OGS Earthquake Catalog is the magnitude of record for all events, protocol action is to be initiated upon the first detected actionable magnitude. If the OGS magnitude is higher than the magnitude detected on the operator’s private array, further protocol action will be required at the level appropriate to the OGS magnitude.

- All operators conducting Hydraulic Fracturing Operations within the OCC Completions Area of Interest shall monitor seismicity during active operations, using a seismic array. The area to be monitored shall be a 5 km radius from the well bore to be completed.

- The seismic monitoring array must be able to detect a minimum magnitude of completeness within the range of 2.0-2.5ML and allow for the operator to timely implement its seismic response plan.

- Upon request operator shall provide the ISD staff with its seismicity monitoring and response plan.

- Plan must include seismicity response procedures to the well completion design.

Operators’ actions following seismic activity within 5 km (3.1 miles) of hydraulic fracturing operations:

- If, during active operations, the operator detects a seismic event within the monitoring area at least 2.0 ML but less than 2.5 ML, the operator shall implement its seismicity response plan.

- If magnitude is at least 2.5 ML but less than 3.0 ML the operator will notify the ISD of the event.

- * If operator has not initiated its seismicity response procedures prior to a 2.5 ML event, the operator shall pause hydraulic fracture operations for 6 hrs and a

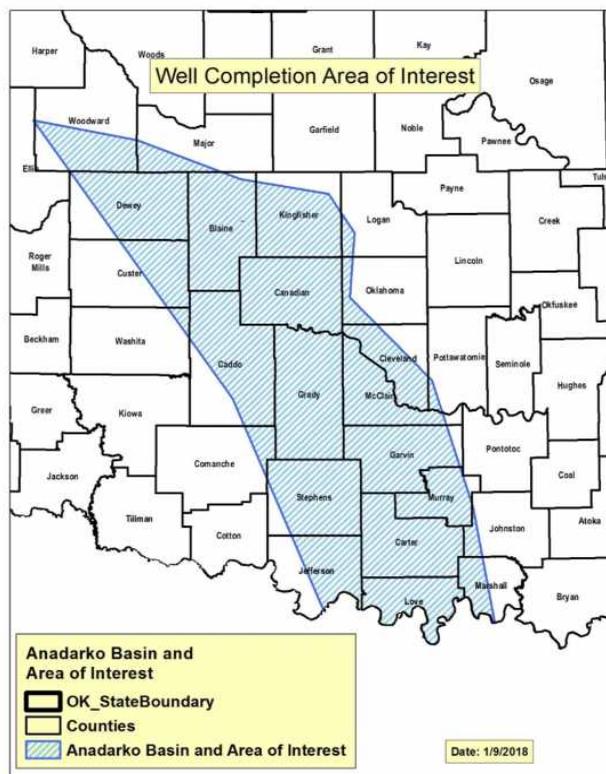
technical conference call will be held with ISD staff and operator regarding proposed seismicity response procedures.

- * If operator has initiated its seismicity response procedures prior to a 2.5 ML event, a technical conference call will be held with ISD staff and the operator regarding proposed seismicity response procedures, if any, and steps ISD deems necessary.

- If magnitude is at least 3.0 ML but less than 3.5 ML:
 - * Operator shall pause hydraulic fracture operations for 6 hours and a technical conference call will be held with ISD staff and operator regarding proposed seismicity response procedures.

- * Upon agreement between operator and OGCD staff regarding mitigation practices and reduced seismic activity, operator will be permitted to resume with a revised completion procedure.

- If magnitude is 3.5 ML or greater:
 - * Operator immediately suspends operations.
 - * In-person technical conference held with OGCD staff and operator to examine whether operation can resume with changes.



Updated guidelines from the Corporation Commission affect companies fracking wells in western Oklahoma oil fields.

Oil patch states want authority for wastewater solution

Mike Lee, E&E News: Energywire, December 20, 2018



Jeremy Jay (left) and Jon Pearson log pressures at a wastewater injection site owned by Parsley Energy Inc. in the Permian Basin near Midland, Texas. Nick Oxford/Reuters/Newscom

Regulators in three major oil-producing states are looking for new ways to handle the huge flow of wastewater produced by the drilling industry, a move that could have long-term implications for the environment and the water supply in the oil patch.

Texas, New Mexico and Oklahoma are all seeking permission from EPA to issue what are known as National Pollution Discharge Elimination System (NPDES) permits under the Clean Water Act. Their aim is to one day allow oil companies to divert their oil field wastewater to some kind of beneficial use, which could be irrigating crops, watering livestock, municipal use, or even discharging it into rivers and streams.

It's a long-term process, and it won't be cheap. Environmentalists and some residents in the oil-producing states are concerned that the idea is untested and could lead to contaminated crops or rivers.

But advocates, including oil and gas regulators in all three states, say it could help solve one of the industry's crucial logistical problems — where to dispose of the huge amounts of contaminated water that are a byproduct of oil and gas production.

In Oklahoma, regulators view it as a 10-year project.

“If we wait 10 years to try to find a solution, we're still going to be looking at a 10-year problem,” Shellie Chard, water quality division director at the Oklahoma Department of Environmental Quality, said last week at an industry conference, quoting a maxim frequently used by the state's outgoing energy and environment secretary, Mike Teague.

For decades, companies have disposed of the waste, usually known as saltwater or produced water, by injecting it deep underground. But that's becoming more difficult, according to Chard and others who spoke at the Cost-Effective Water Management Congress here in Oklahoma City.

In Oklahoma, regulators have forced the industry to cut back on injection after the practice was linked to a string of earthquakes (Energywire, April 10).

And in Texas and New Mexico, researchers are warning that some of the underground reservoirs used to store produced water are showing signs of diminished capacity. Laura Capper, an industry consultant, said underground pressures are gradually rising in at least four counties on the Texas side of the Permian Basin.

“We've been injecting in some of these formations for a very long time, and they cannot support the same injection rates that they used to,” she said.

Permian-sized problem

A lot of companies are trying to reuse produced water in their own operations. There are about 30 treatment operations in Oklahoma, speakers at the conference said. They typically consist of a series of tanks that separate any residual oil from the wastewater, and fabric-lined ponds that allow solids to settle out and other types of treatment.

But the volume of produced water is so big, the industry can't absorb it all. In the Permian Basin, companies get an average of a little less than 6 barrels of produced water for each barrel of oil, Capper said.

The Permian Basin is producing about 2.1 million barrels of oil a day just on the Texas side, which implies about 12 million barrels, or 504 million gallons, of wastewater a day. That's about five times as much water as the city of Washington, D.C., consumes in a day.

The wastewater can be highly contaminated, with everything from drilling chemicals to heavy metals and radioactive material carried up from the oil and gas formation. It can also contain as much as six times more salt than seawater.

State regulators have reported thousands of spills involving the salty waste over the years, and they're a particular concern for farmers and ranchers because the salt can do more damage to soil than an oil spill (Energywire, July 21, 2016).

It's technically feasible to clean up produced water and make it safe to drink, but it's costly, said Jeri Sullivan Graham, an assistant professor at the University of New Mexico who studied ways to reuse salty water.

It's more likely that oil companies and regulators will look for some kind of middle ground like an industrial use — using treated wastewater to offset potable water for cooling power plants, for instance.

“That's the first place we go, is replacing fresh water when we can,” she said in a phone interview.

David Burnett, a professor at Texas A&M University who also studies technology for reusing produced water, said there are likely to be limits on how much the waste can be reused.

The cost of treatment has fallen dramatically — as low as 50 cents a barrel in some cases — but that's still 10 times higher than what most farmers pay for water, Burnett said. And the cost per barrel doesn't include the expense of piping or trucking the water to an end user.

The idea has critics, too. Written comments on a white paper on the topic in New Mexico were about evenly split between trade groups that approved of the idea and local residents who opposed it.

“NOOOO!!!!!!” one woman wrote.

Cleaning water isn't easy

Treating produced water is a lot trickier than it sounds, said Dan Mueller, director of natural gas exploration and production at the Environmental Defense Fund. Most research has focused on getting the salt out of the fluid, but there can also be dozens of chemicals in the wastewater.

Ethylene glycol, for instance, is the main ingredient in most car antifreeze formulas, and it's often used in hydraulic fracturing. It can be poisonous if it's ingested, but EPA doesn't have a standard to regulate whether traces of the

chemical are safe in drinking water, Mueller said.

“Treated produced water is an industrial effluent,” he said at the produced water conference. “For the purposes of what you're doing with that water, clear doesn't mean it's clean.”

There are already a handful of examples of states allowing alternative uses for produced water, but they're on a relatively small scale.

Pennsylvania allowed oil and gas companies to send produced water to sewage treatment plants until about 2010, then scaled back the practice because of concerns about the high levels of salt in the wastewater. A few companies in Pennsylvania still have recycling facilities that discharge treated water into rivers (E&E News PM, Oct. 20, 2011).

Colorado allows some produced water disposal from coalbed methane production, but not from fracking sites, a spokeswoman for the state Department of Public Health and Environments said in an email.

EPA's Region 6, which handles permitting for most oil- and gas-producing states, has issued only about a dozen NPDES permits in the last year, a spokeswoman for the regional office in Dallas said in an email.

In New Mexico, the state Department of Energy, Minerals and Natural Resources has been working on a white paper exploring produced water issues. In Texas, the state Railroad Commission has asked EPA acting Administrator Andrew Wheeler for assistance getting permitting authority for oil and gas wastewater.

In Oklahoma, the Department of Environmental Quality plans to send an application to EPA by the end of the month, asking for permitting authority over oil field-produced water, Chard said. So far, no companies have applied for permission to use produced water outside the oil field, she said.

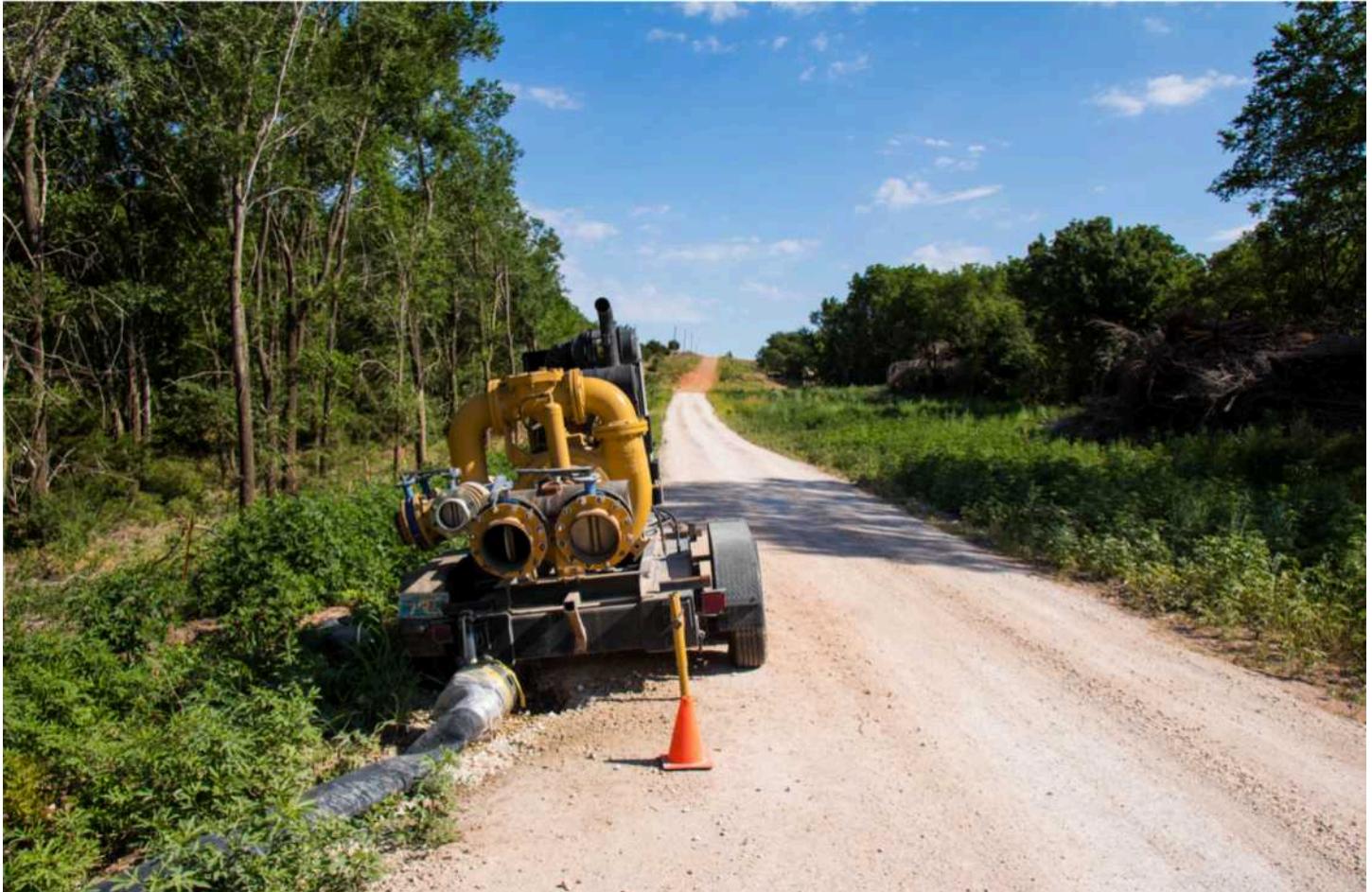
Once the state has permitting authority, though, the cleaned-up wastewater could be used for a variety of purposes, including agriculture, industrial or municipal use.

Municipal sewage in the United States is often more contaminated than oil field waste, but it's treated and returned to rivers and lakes under EPA guidelines, where it's often consumed by the next town or city downstream. Some communities, particularly in drought-stricken Western states, have even experimented with “toilet to tap” systems that route treated water directly from sewer plants into the municipal water system (Climatewire, July 11, 2014).

“Unless you live on the North Pole, you're downstream of somebody and are likely drinking or using reused water,” Chard said.

State Supreme Court sides with industry in fight over oil-field water regulation

Joe Wertz, StateImpact Oklahoma, November 15, 2018



The Oklahoma Supreme Court on Tuesday sided with the energy industry, ruling against officials in Kingfisher County who blocked companies from using temporary lines to transport produced, treated or recycled water in one of the state's hottest oil fields.

Last spring, Kingfisher County Commissioners stopped issuing permits for temporary pipes placed in easements alongside county roads to pump water to and from drilling and oil-field sites, citing liability concerns and environmental hazards posed by leaks.

Oil companies said the ban was expensive and unnecessary and could worsen truck traffic and force drillers to use fresh water instead of recycled oil-field water for hydraulic fracturing.

The Oklahoma Oil and Gas Association filed a lawsuit in August, arguing the ban was unreasonable and challenged the commissioners' authority to regulate the water lines.

The chief legal counsel for the Oklahoma Corporation Commission, the state's oil and gas regulator, agreed with

that argument in a legal opinion and cited a 2015 law that crimped local governments' ability to prohibit oil-field operations.

Oklahoma's high court agreed. In a 6-3 ruling and order, justices voided Kingfisher County's water line ban and said the Corporation Commission has "exclusive authority" to regulate the transportation and storage of oil-field water.

The oil and gas association — which recently merged with the Oklahoma Independent Petroleum Association — said the decision was an important clarification for oil and gas companies that would help ensure "much-needed certainty and uniformity" across the state.

"A patchwork of local ordinances and regulations creates unnecessary confusion, thwarts innovative solutions, and threatens environmental protections and public health," OI-PA-OKOGA spokesperson Cody Bannister said in a statement. "Using temporary water lines is an industry-standard practice that has numerous environmental benefits, including reducing truck traffic and supporting water recycling efforts."

Oil association report points to hundreds of economically damaged wells

Adam Wilmoth, The Oklahoman, September 19, 2017

At least 450 older vertical wells in Kingfisher County alone have been damaged economically because of bigger horizontal wells in the area, according to an interim report by vertical producers.

The Oklahoma Energy Producers Alliance released the interim study last week, saying it indicates that the older wells have experienced widespread well bashing and that damage has cost producers and royalty owners throughout the state.

“I believe nearly every vertical well in Kingfisher County will be negatively impacted by horizontal frack jobs at some point,” OEPA founder Mike Cantrell said. “We’re just trying to get people to get fair value for their property up front before the damage is done.”

The study shows that 80 percent of the affected vertical wells are outside the well unit boundaries, meaning royalty owners from the damaged wells do not benefit from the new horizontal wells.

Horizontal well operators, however, say the number of effected wells appears to be overstated and that royalty owners, producers and state and local coffers benefit from the much more prolific horizontal wells.

“The question the study does not answer is how many wells have had resolution,” said Chad Warmington, president of the Oklahoma Oil and Gas Association. “My companies say there obviously is well-to-well interference, but most of those are handled company to company. The affected wells are either bought out or fixed.”

In some cases, horizontal well operators try to address potential damage to vertical wells before operations begin, but vertical operators are unwilling to negotiate, said A.J. Ferate, vice president of regulatory affairs at the Oklahoma Independent Petroleum Association.

“Particularly in Kingfisher County, larger companies drilling horizontal wells are offering ahead of time that if they bash a well, they’ll give concessions or pay damages or give them a part of the well,” he said. “Many times they try to buy the well ahead of time, but in many instances they have been told ‘no.’”

Oklahoma is dotted with thousands of vertical wells, many

of which are older wells considered to be marginal or stripper wells because they produce only a few barrels of oil equivalent per day. Modern techniques including horizontal drilling and hydraulic fracturing have allowed operators to drill new wells in the state’s oldest oil basins, restarting interest in the areas with wells that initially produce hundreds or thousands equivalent barrels of oil and natural gas per day.

Hydraulic fracturing — or fracking — involves pumping large amounts of water and sand into the horizontal well to shatter the dense rock, allowing oil and natural gas to flow more easily to the wellhead. When a horizontal well is fracked near an existing vertical well, the process can send water and sand into the older wells, causing them to produce more water and less oil and natural gas.

In some cases, pressure from the fracking operation can cause physical damage to the pipe or other parts of the vertical well, causing spills or other environmental problems.

“We have a well-established vertical world, and we have a new horizontal world. The issue is how can these two worlds live together,” Oklahoma Corporation Commission spokesman Matt Skinner said. “Wells are obviously being damaged. We know this is happening. It is a problem that needs to be addressed, and to address it we need more data.”

The commission hopes to use the data to determine whether new rules or processes should be put in place, Skinner said.

“We’re not at a stage to say we need new rules or here are the new rules, but certainly this issue could be part of that process,” he said.

The Corporation Commission is responsible for approving planned wells and spacing units for the wells before they are drilled. If the wells experience economic damage but not environmental damage, the vertical well operators can seek recovery through district court.

A federal jury last month awarded H&S Equipment Inc. and Mark Holloway Inc. \$220,000 in damages for vertical wells that were affected by horizontal wells drilled by Felix Energy LLC and later sold to Devon Energy Corp.

Oil, gas rights balanced against local ones in committee debate Tuesday

Jack Money, The Oklahoman, April 10, 2019

A proposed law that could allow mineral rights owners to sue municipalities or other local jurisdictions because of overly restrictive oil and gas laws, rules or regulations survived a committee hearing Tuesday, barely.

House Bill 2150, co-authored by Oklahoma Sen. Mark Allen, R-Spiro, and Rep. John Pfeiffer, R-Orlando, received a due pass recommendation by a 7-to-5 vote by members of the Senate Judiciary Committee, but only after the measure's enacting clause was removed.

The measure, committee members learned Tuesday, also is being discussed by a working group involving the Oklahoma Independent Petroleum Association-Oklahoma Oil and Gas Association and the Oklahoma Municipal League.

The OIPA-OKOGA supports the bill, while the league supports city officials who are alarmed by its language and seek to prevent its passage.

It wasn't clear Tuesday whether the Association of County Commissioners of Oklahoma, which represents county commissioners at the Capitol, is involved in the working group.

A lobbyist representing the association didn't reply Tuesday to an emailed request for comment. But based upon an emailed statement from OIPA-OKOGA's president, it appears counties are lobbying against it.

"The Oklahoma Municipal League has reached out to us about working with our local community leaders on common-sense solutions to these important issues," Chad Warmington wrote Tuesday.

He described the discussions as "a welcome change from the hostile approach that county representatives — who continue to misrepresent what is contained in this bill — have taken towards the oil and natural gas industry."

OIPA-OKOGA, Warmington has said, believes mineral rights owners should be able to seek financial compensation from local governments where over-restrictive rules prevent drilling and production of their reserves.

The bill's language states an ordinance, rule or regulation could constitute a taking under Article 2 of Oklahoma's constitution and relevant statutes if it were to substantially impact minerals' values by interfering with the use of or access to minerals by substantially increasing oil and gas operational costs.

If made law, the language would add to existing statute that already bars municipalities, counties and other local jurisdictions from adopting ordinances, rules or regulations that exceed the Oklahoma Corporation Commission's authority to regulate the oil and gas industry.

Local officials counterargue state law allows municipalities and other local governmental entities to adopt laws, rules and regulations that protect the health, welfare and safety of their residents.

They add that surface owners in Oklahoma are entitled to as much legal protection as mineral rights owners.

On Tuesday, Allen said the Legislature needs to protect all property owners in Oklahoma, "both mineral and surface owners."

Committee Chairman Julie Daniels, R-Bartlesville, observed balancing industry and local concerns are a growing, problematic issue that involves both the oil and gas and agriculture industries. Daniels urged committee members to support the bill.

However, two Republicans on the committee, Sen. Lonnie Paxton, R-Tuttle, and Sen. Darcy Jech, R-Kingfisher, joined its three Democrats in voting against the measure.

Paxton said he knows the industry has benefited residents through jobs and royalties, but said he also understands concerns about potential impacts the industry can have on local communities.

"This bill right here may be taking a step too far," he said.

On Tuesday, Mike Fina, executive director of the Oklahoma Municipal League, said initial discussions within the working group have been productive and that more are planned.

Fina said municipal league members have a better understanding of industry representatives' concerns about a mosaic patchwork of setback and noise rules they face as they work among various communities.

Industry representatives, meanwhile, are learning from municipal officials about increasing pressures they face from residents who are concerned about what is happening where they live and work.

"One thing that really was eye opening to everyone was that all of us — both city officials and industry representatives — are getting the same calls, and that it makes sense for us to sit down and try to address these issues," Fina said.

Fina described HB 2150 as addressing an outlying issue among many that have arisen between local communities and the oil and gas industry in recent years.

"We would like to see this bill not make it into law because it is such a liability concern for municipalities," Fina said.

"But I think if we can address these other issues that are probably more important to the industry, I think we will probably see HB 2150 go away."

State Oil and Gas Severance Taxes

Anne Kolesnikoff and Cassarah Brown, National Conference of State Legislatures, September 6, 2018

Taxes on Oil and Gas Production

Technological developments have increased access to oil and natural gas reserves across the country.

Over the past several years, many states have considered measures to benefit from these newly accessible resources and to ensure that communities are reimbursed for the impact that oil and natural gas development may have on infrastructure.

As a primary approach, states have imposed taxes and fees on the extraction, production and sale of natural gas and oil. These “severance” taxes—taxes applied to materials severed from the ground—tax the extraction or production of oil, gas and other natural resources.

Thirty-four states currently produce natural gas. In 2017, the five states that produced the most natural gas in the United States included Texas, Pennsylvania, Oklahoma, Louisiana and Wyoming. Pennsylvania is the largest U.S. natural gas producer that does not impose a severance tax—though the state does levy a per well impact fee. In April 2018, of the 31 crude oil-producing U.S. states, the five highest producing states included Texas, North Dakota, New Mexico, Oklahoma and Alaska. In total, 34 states have enacted fees or taxes on oil and gas production.

Ways to Tax Oil and Gas Production

States differ in how to impose taxes on oil and gas, generally taxing a fraction of the market value, the volume produced or some combination thereof. Most states have enacted tax incentives, credits and exemptions to encourage or discourage production from certain well types. Many states impose oil and gas conservation fees, levies or assessments in addition to or instead of a traditional production or severance tax. These fees and assessments also tax the volume or value of the oil and gas produced.

Value Taxes on Oil and Gas Production

States most often tax the value of produced oil and gas. These taxes are applied at the point of production, before accounting for transportation and distribution costs. Value taxes can be difficult to implement because states must closely monitor gas and oil sales to determine the current market value. Further, because prices are prone to fluctuation, value taxes can make state revenue predictions difficult. Texas and Wyoming tax the assessed oil and gas value with reduced rates and exemptions to incentivize production from certain well types.

Two states—Colorado and Idaho—tax the gross income from produced oil and gas, rather than calculate the monthly market value. While Idaho has a flat rate, Colorado uses a tiered system.

Taxing the Volume of Oil and Gas Produced

Several states tax the volume of oil or gas produced, most often per barrel of oil or per 1,000 cubic feet of natural gas. While simple to implement, these taxes do not reflect price fluctuations. Gas and oil conservation fees and assessments commonly tax the volume produced with a relatively low flat rate, often adjusted

annually. For example, Arkansas places a value tax on gas and oil through its severance tax in addition to a relatively modest fee per volume of oil and gas produced as an oil and gas assessment. States often design volume taxes to be easily adjusted, thereby adapting to the changing market value of gas and oil.

Value-Volume Taxes on Oil and Gas Production

Many states with severance taxes incorporate both the volume of oil and gas produced and the oil and gas market value or apply separate taxes to the volume and value. For example, Montana adjusts its tax rate on production value based on the volume of oil or gas a well produces, in addition to the age and classification of the well. Other states, such as Oklahoma, adjust their tax rates on gross production value based on the current value of gas. Such approaches aim to increase a state’s severance tax income when the oil and gas industries are thriving and reduce state pressure when the industry lags.

Controversy Surrounding Oil and Gas Severance Taxes

It is difficult to directly compare states’ severance tax revenue potential because approaches vary. For example, West Virginia applies a 5 percent flat tax on gross oil and gas production and provides exemptions for low-producing oil and gas wells. On the other hand, many states, including Mississippi, apply tax exemptions and incentives to high-cost gas wells, inactive wells and discovery wells to help encourage production. States may also provide tax credits to offset local taxes on oil and gas. Additionally, since methods to determine marketable value may vary per state, tax rates on the market value of oil and gas are difficult to compare.

Pennsylvania and Wyoming offer interesting examples of the controversy surrounding severance tax rates and their enactment.

Pennsylvania: Impact Fee versus Severance Tax

Pennsylvania is the largest U.S. natural gas producer that does not impose a severance tax. Instead, it levies an impact fee on every producing gas and oil well in the state, regardless of the volume produced. Studies by the Pennsylvania Budget and Policy Center estimate that while the state’s impact fee will continue to generate about \$173-\$227 million per year, a severance tax on production value would bring in \$1.7 billion over five years. Governor Tom Wolf’s proposal would leave the impact fee in place, and bring the state’s effective tax rate to 4 percent, on par with other natural gas-producing states. However, severance tax opponents argue that a tax would deter gas production and that estimates of “missed” revenue do not account for tax exemptions and reductions that would reduce revenue from the proposed severance tax.

Wyoming: Uncertainty Over Impacts of Proposed Severance Tax Cut

Proposed legislation in Wyoming attempts to balance revenue generation and private investment from oil and gas companies.

Senate File 98 would cut the state's severance tax from 6 percent to 3 percent for wells in their third and fourth years of oil or gas production. While lawmakers hope to incentivize new drilling, a study commissioned by the Wyoming State Legislature in 2000 suggests increased production would not make up for the loss of revenue from lowering taxes. Faced with a budget deficit of more than \$800 million over the next two years, some lawmakers are not willing to risk the loss of revenue from a finite resource.

Distribution of Tax Revenues from Taxes and Fees on Oil and Gas Production

Natural gas fracking rig. Severance and production taxes produce a relatively small portion of most states' revenue. However, in 2016, Alaska and North Dakota's severance taxes made up 37.5 percent and 41.8 percent of their total tax collections, respectively. States distribute revenues in various ways, but typically, most of the collected taxes are deposited into the general fund. For example, Alaska deposits all funds generated from its Oil and Gas Production Tax into the state's general revenue fund.

States also use the revenue to fund conservation or environmental cleanup projects and distribute portions of the collected taxes to local governments. Additionally, some states reserve a portion of the collected taxes for permanent funds, whose earned interest can help balance state budgets. Many states appropriate revenue from these taxes to two or more of these areas. For example, Colorado deposits its Severance Tax on oil and gas into three major funds: the first \$1.5 million into its Innovative Energy Fund, then the remaining funds are split, half to the state severance tax trust fund and the other half to the local government severance tax fund. Alternatively, North Carolina uses the revenue from its Oil and Gas Severance Tax to fund the natural gas and oil reclamation regulatory program, to meet its environmental and resource management needs and to reclaim land affected by exploration for, drilling for and production of natural gas and oil.

Severance Taxes by State

Texas

Tax Type: Gas and Oil Production Tax

Tax Description:

- 7.5 percent tax of gas and liquid hydrocarbons market value
- 4.6 percent tax of oil market value or 4.6 cents for each barrel of 42 standard gallons of oil produced in this state, whichever rate results in the greater amount of tax
- 4.6 percent tax of gas condensate market value for gas condensate
- Incentives and exemptions for inactive wells, marginal wells and high cost gas wells

Revenue Allocation: 0.5 percent of revenues used for enforcement of production tax and tax provisions

- Remaining revenues: 25 percent deposited in the Foundation School Fund and 75 percent deposited in the General Revenue Fund.



Tax Type: Oil and Gas Field Clean-Up Regulatory Fee

Tax Description: \$0.006625 per barrel of crude oil and \$0.000667 per MCF of gas

Revenue Allocation: Revenues deposited in the Oil and Gas Regulation and Cleanup Account; revenue in account may not exceed \$20 million or fall below \$10 million; fund used to plug abandoned or orphan wells.

Oklahoma

Tax Type: Gross Production Severance Tax

Tax Description: Tax on gross production and based on monthly average crude oil and gas prices:

- 7 percent for gross value of oil and gas production
- 2 percent levy on oil and gas wells drilled after July 2015 for 36 months; then increased to 7 percent

Exceptions:

- Incremental production from secondary and tertiary enhanced recovery projects
- Horizontally drilled wells
- Reestablished production from inactive wells
- Incremental production from production enhancement projects
- Production from deep wells
- Production from new discovery wells
- Production from wells drilled based on 3-D seismic surveys

Revenue Allocation: Revenues distributed to: General Revenue Fund, County Highway Fund, and revenue distribution to these funds varies based oil or gas tax rates.



Tax Type: Additional Excise Tax on Petroleum and Gas

Tax Description: .085 percent of the gross value on each barrel of petroleum oil (0.085 of 1 percent); 0.095 percent of the gross value of all-natural gas and/or casinghead gas (0.095 of 1 percent).

Revenue Allocation:

Revenues from oil:

- 82.634 percent deposited to the General Revenue Fund
- 10.526 percent deposited to Corporation Commission Plugging Fund
- 6.84 percent deposited to the Interstate Oil Compact Fund of Oklahoma

Revenues from gas:

- 82.6045 percent deposited to the General Revenue Fund
- 10.5555 percent deposited to the Corporation Commission Plugging Fund
- 6.84 percent deposited to the Interstate Oil Compact Fund of Oklahoma

Tax Type: Oil and Gas Production Fee

Tax Description: \$0.0035 per barrel of petroleum liquid produced

- \$0.00015 per MCF of natural gas produced
- Exception: oil and gas exempt from oil and gas production tax

Revenue Allocation: 3 percent of revenues deposited in the Oklahoma Tax Commission Revolving Fund and the remaining revenues, after July 1, 2013, deposited in the Sustaining Oklahoma's Energy Resources Revolving Fund.

North Dakota

Tax Type: Oil and Gas Gross Production Tax

Tax Description:

- \$.0705 per MCF of gas (changes annually on July 1)
- Gross production tax rate on oil is 5 percent of the gross value

Revenue Allocation:

- 30 percent of revenues deposited in the state Legacy Fund.
- Remainder distributed, via formula, to Oil and Gas Impact Fund and political subdivisions within state, including state general fund.



Tax Type: Oil Extraction Tax

Tax Description:

- 5 percent of gross oil value.
- Reduced to 2 percent for qualified production from wells outside the Bakken and Three Forks formations.
- If the trigger price of \$90 is exceeded for three consecutive months the oil extraction tax rate increases to 6 percent and will revert to 5 percent after the trigger price is below \$90 for three consecutive months.
- Stripper wells exempt.

Revenue Allocation: 30 percent of revenue credited to Legacy Fund. Of the remaining revenues: 20 percent credited to Resource Trust Fund, 10 percent credited to Common Schools Trust, 10 percent credited to Foundation Aid Stabilization, and 60 percent credited to state (distributed via formula).

Louisiana

Tax Type: Natural Resources Severance and Processing Tax

Tax Description:

Gas severance tax rate adjusted annually and never to be less than 7 cents per 1,000 cubic feet:

- Full Rate (July 1, 2018 to June 30, 2019): \$0.122
- Low-producing oil-well gas: \$0.013
- Low-producing gas-well gas: \$0.013
- Produced water-full rate (July 1, 2012 to June 30, 2013): \$0.118
- Produced water-incapable oil-well gas: \$0.024
- Produced water-incapable gas-well gas: \$0.0104 well.

Oil (percent of value):

- Full rate oil/condensate: 12.5 percent
- Low-producing oil rate: 6.25 percent
- Stripper oil rate: 3.125 percent
- Reclaimed oil: 3.125 percent
- Produced water-full rate: 10 percent
- Produced water-incapable oil rate: 5 percent
- Produced water-stripper oil rate: 2.5 percent

Severance taxes on new discovery oil and natural gas wells suspended 24 months or until payout of well.

Revenue Allocation: 20 percent severance tax revenues, up to \$500,000, allocated to producing parish. Remaining funds, up to base level determined by revenue estimates, allocated to Bond Security and Redemption Fund.

Revenues exceeding base level: 50 percent allocated to Louisiana Investment Fund for Enhancement and 50 percent to state general fund.

Tax Type: Oil Field Restoration Fee

Tax Description: \$0.015 for every barrel of oil and condensate produced and \$0.003 for every MCF of gas produced.

Revenue Allocation: Revenues deposited in oilfield site restoration fund.

Tax Type: Oil Field Restoration Fee

Tax Description: \$0.015 for every barrel of oil and condensate produced and \$0.003 for every MCF of gas produced.

Revenue Allocation: Revenues deposited in oilfield site restoration fund.



New Mexico

Tax Type: Oil and Gas Severance Tax

Tax Description:

- 3.75 percent of taxable value of oil or gas severed and sold
- 1.875 percent of taxable value for enhanced recovery project oil and gas
- 2.45 percent of taxable value for well workover projects in excess of production projection
- 1.85 percent or 2.8125 percent of taxable value for stripper wells

Revenue Allocation: Revenues deposited in the severance tax bonding fund and remaining revenues deposited in the severance tax permanent fund.

Tax Type: Oil and Gas Conservation Tax

Tax Description: \$0.19 percent of taxable value of sold oil or gas.

Revenue Allocation: Revenues deposited in the Oil and Gas Reclamation Fund and the state general fund.

Tax Type: Oil and Gas Emergency School Tax

Tax Description:

Oil:

- 3.15 percent of taxable value
- 1.58 percent for stripper wells producing less than or equal to \$15 per barrel
- 2.36 percent for stripper wells producing oil greater than \$15 but less than \$18 per barrel

Gas:

- 4 percent of taxable value
- 2 percent for stripper well with annual value less than \$1.15 per MCF
- 3 percent for stripper wells with annual value greater than \$1.15 but less than \$1.35 per MCF.

Revenue Allocation: Revenues distributed to the state general fund.

Tax Type: Oil and Gas Ad Valorem Production Tax

Tax Description: Rate based on assessed value of property.

Revenue Allocation: Revenues deposited in the oil and gas production fund.

Tax Type: Natural Gas Processor's Tax

Tax Description:

- 0.0065 per mmbtu of natural gas multiplied by adjustment factor
- Adjustment factor equal to the annual taxable value per MCF of natural gas divided by \$1.33

Revenue Allocation: Revenues distributed to state general fund.



Arkansas

Tax Type: Severance Tax

Tax Description: Tax on market value of natural gas produced:

- 1.5 percent for new discovery gas, 24 months from date of first production
- 1.5 percent for high-cost gas, 36 months from date of first production, 12-month extension possible
- 1.25 percent for marginal gas
- 5 percent on natural gas not defined as new discovery or marginal gas
- 5 percent on high-cost gas following cost recovery period

Revenue Allocation: 5 percent of revenues deposited into state general fund; 95 percent of revenues deposited as special revenues distributed according to Arkansas Highway Distribution Law.

Tax Type: Oil Excise Tax

Tax Description: Tax on market value at time of severance: 4 percent of the market value when production averages 10 barrels or less per well per day; 5 percent of the market value when production averages more than 10 barrels per well per day.

Additional taxes on oil include: 0.005 (5 mills) per barrel of oil produced in Arkansas; 2 cents per barrel of oil produced in Arkansas

Revenue Allocation: 3 percent of revenues deposited into General Revenue Fund Account; Of remaining 97 percent: 75 percent to State Treasury Fund, 25 percent to County Aid Fund.

Tax Type: Oil and Gas Assessment

Tax Description: Up to 50 mills per barrel of crude oil or petroleum used or marketed, Up to 10 mills per MCF of natural gas produced and saved each month.

Revenue Allocation: Revenues credited to pay for costs associated with oil and gas conservation administration.



Kansas

Tax Type: Mineral Severance Tax

Tax Description: \$1 per ton of coal, 8 percent tax on gross value of oil or gas.

Exception: Gas wells with gross value less than or equal to \$87 per day; Low-producing oil wells

Revenue Allocation: Money for refunds distributed into mineral production tax refund fund. Of remaining revenues: 7 percent deposited in the special county mineral production tax fund.

For oil and gas for any county which had \$100,000 or more in receipts: 20 percent to the mineral production education fund. The remainder credited to the state general fund.

Tax Type: Oil and Gas Conservation Fee

Tax Description: Oil: 91 mills per barrel, Gas: 12.9 mills per MCF.

Revenue Allocation: Revenues deposited in the Conservation Fee Fund.



To compare state oil and gas severance taxes for all states:
<http://www.ncsl.org/research/energy/oil-and-gas-severance-taxes.aspx> view

Legislation creating task force on drilling regulations advances

Daisy Creager, *The Journal Record*, April 4, 2019



A Helmerich & Payne drilling rig off state Highway 9 east of Chickasha. (Journal Record file photo)

A bill creating a task force to evaluate the impacts of new drilling on existing wells, a topic that has horizontal and vertical drillers at odds, is moving to the Oklahoma Senate Appropriations Committee after winning unanimous approval from the Senate Energy Committee on Thursday.

House Bill 2111, authored by state Rep. Terry O'Donnell, R-Catoosa, would create the nine-member Oklahoma Oil and Natural Gas Regulatory Modernization Task Force.

The task force would recommend changes to regulations after it reviews existing procedure for resolving well communication disputes, looks at alternatives used by other states and identifies resources the Oklahoma Corporation Commission needs to enforce orders.

Senate author Sen. Mark Allen said he thinks the bill will help the industry.

“Hopefully we can get those groups together and get a task force to work with them and get them on the same playing field and see where each other’s problems are without having to go through the Corporation Commission,” Allen said.

Oklahoma Energy Producers Alliance President Mike Cantrell supports the legislation, saying reform is needed for the regulation of horizontal wells.

“(Horizontal drillers) get the permit to drill the well without ad-

ressing what damage might occur in the fracking process after they drill the well,” Cantrell said. “The problem we’re having is (vertical drillers) have hundreds of wells destroyed by these horizontal frack jobs.

“We would like to have that addressed on the front end of the process where they would have to take measures not to damage the existing vertical wells as they do their horizontal frack jobs. ... My take is they just want to keep doing what they’re doing.”

Chad Warmington, president of the Oklahoma Independent Petroleum Association – Oklahoma Oil and Gas Association, also supports the legislation.

“OIPA-OKOGA and its members are supportive of any efforts that assist in modernizing Oklahoma’s oil and natural gas regulations in order to effectively and efficiently utilize new and advancing drilling techniques,” Warmington said in a statement.

The task force would be made up of two people from the House, two from the Senate, one from the Corporation Commission, the governor or a designee from his office and two members from oil and gas trade associations – one appointed by the Senate and one appointed by the House.

The Oklahoma secretary of energy and environment would serve as the chairperson. The task force would have until Sept. 1, 2020 to deliver a final report on its findings.

Oklahoma Laws and Incentives

U.S. Department of Energy, Alternative Fuels Data Center

Listed below are the summaries of all current Oklahoma laws, incentives, regulations, funding opportunities, and other initiatives related to alternative fuels and vehicles, advanced technologies, or air quality. You will view summaries of:

- **State Incentives (9)**
- **Utility/Private Incentives (3)**
- **Laws and Regulations (15)**

State Incentives

Electric Vehicle Supply Equipment (EVSE) Grant Program

The Oklahoma Department of Environmental Quality's (DEQ) ChargeOK program offers grants for public EVSE. Eligible projects include direct current (DC) fast chargers located along designated plug-in electric vehicle (PEV) transportation corridors and DC fast chargers or Level 2 EVSE located at destination locations or community charging hubs. DEQ will award competitive grants for up to 80% of eligible project costs. The program is funded by Oklahoma's portion of the Volkswagen Environmental Mitigation Trust. For more information, including the program requirements, a map of designated transportation corridors, and the application period, see DEQ's ChargeOK website.

Alternative Fuel School Bus and Electric Vehicle Supply Equipment (EVSE) Rebate Program

The Oklahoma Department of Environmental Quality (DEQ) is accepting applications for projects that repower or replace an actively used, engine model year 2009 or older, diesel school bus with an alternative fuel. Eligible alternative fuels and technologies include all-electric, electric hybrid, propane, and natural gas. Government-owned vehicles may be reimbursed up to 50% of the project cost and non-government owned vehicles may be reimbursed from 25% to 50% of the project cost, depending on the project. Charging infrastructure for electric buses is eligible for funding, but is subject to a per-charger maximum and the project cap. The program is funded by Oklahoma's portion of the Volkswagen (VW) Environmental Mitigation Trust. For more information, including per-vehicle caps on project reimbursements and application deadlines, see the DEQ VW Settlement website.

Natural Gas Vehicle and Idle Reduction Weight Exemption

A vehicle powered in whole or part by compressed or liquefied natural gas may exceed the state's gross and axle weight limits by up to 2,000 pounds, equal to the difference between the weight of the vehicle with the natural gas tank and fueling system and the weight of a comparable diesel tank and fueling system. The exemption is allowed on all state roads and interstate highways, as defined in Title 23 of the Code of Federal Regulations section 127(s).

Any vehicle equipped with idle reduction technology may

exceed the state's gross vehicle weight limits by up to 400 pounds to compensate for the additional weight of the idle reduction technology. The additional weight may not exceed the actual certified weight of the idle reduction unit. Upon request, vehicle operators must provide proof or certification of the weight of the idle reduction technology and proof that the idle reduction technology is fully functional. (Reference Oklahoma Statutes 47-14-109 and 47-14-109.3)

Alternative Fuel Vehicle (AFV) Tax Credit

For tax years beginning before January 1, 2020, a one-time income tax credit is available for 45% of the incremental cost of purchasing a new original equipment manufacturer AFV or converting a vehicle to operate on an alternative fuel. The state also provides a tax credit in the amount of 10% of the total vehicle cost, up to \$1,500, if the incremental cost of a new AFV cannot be determined or when an AFV is resold, as long as a tax credit has not been previously taken on the vehicle. Equipment used for conversions must be new; must not have been previously used to modify or retrofit any vehicle; must meet applicable federal and state safety standards; and must be installed by a state certified alternative fuels equipment technician. The alternative fuels eligible for the credit are natural gas and propane. Tax credits may be carried forward for up to five years. (Reference Oklahoma Statutes 68-2357.22)

Alternative Fueling Infrastructure Tax Credit

For tax years beginning before January 1, 2020, a tax credit is available for up to 75% of the cost of installing commercial alternative fueling infrastructure. Eligible alternative fuels include natural gas, propane, and electricity. The infrastructure must be new and must not have been previously installed or used to fuel alternative fuel vehicles. A tax credit is also available for up to 50% of the cost of installing a residential compressed natural gas fueling system, up to \$2,500. The tax credit may be carried forward for up to five years. (Reference Oklahoma Statutes 68-2357.22)

Ethanol Fuel Retailer Tax Credit

Retailers that sell fuel blends of gasoline containing up to 15% ethanol by volume (E15) are eligible for a motor fuel tax credit of \$0.016 per gallon of ethanol blended into gasoline and sold in Oklahoma, as long as the retailer provides a price reduction to the purchaser of the ethanol fuel in the same amount. This incentive is effective unless the federal government mandates the use of reformulated fuel in an area within Oklahoma that is in nonattainment with the National Ambient Air Quality Standards. (Reference Oklahoma Statutes 68-500.10-1)

Ethanol Sales Tax Exemption

The portion of ethanol (ethyl alcohol) sold and blended with motor fuel is exempt from sales tax. (Reference Okla-

homa Statutes 68-500.10-1 and 68-1359)

Biofuels Tax Exemption

Biodiesel or other biofuels produced by an individual from feedstocks grown on the individual's property and used in the individual's own vehicle are exempt from the state motor fuel excise tax. (Reference Oklahoma Statutes 68-500.4 and 68-500.10)

Biofuels Construction and Permitting Assistance

The Oklahoma Department of Environmental Quality (DEQ) provides technical and regulatory assistance to small businesses that need permits to construct and operate biodiesel and ethanol production facilities. For more information, see the DEQ Small Business Assistance Program website.

Utility/Private Incentives

Natural Gas Vehicle Loans - Communication Federal Credit Union (CFCU)

CFCU offers loans to individuals and businesses that purchase new or converted compressed natural gas (CNG) vehicles. Conversion systems must be certified by the U.S. Environmental Protection Agency and installed by an insured and state-licensed facility. New vehicle loans are available at amounts up to the manufacturer's suggested retail price plus the cost of the conversion. Pre-owned or CFCU member-owned vehicles with a CNG fuel system or conversion installation are eligible for loans at up to 115% of the National Automobile Dealers Association suggested retail value. All financing is at CFCU standard auto loan rates. CFCU also offers loans for the cost of home fueling appliances. For more information, see the CFCU CNG Loans website.

Natural Gas Vehicle (NGV) and Infrastructure Rebate - Oklahoma Natural Gas

Oklahoma Natural Gas (ONG) offers rebates for NGVs purchased or converted after June 20, 2016, in the amount of \$2,000 for a dedicated or bi-fuel NGV. ONG also offers \$3,000 toward the cost of a compressed natural gas home fueling station. Rebates are available on a first come, first served basis and are limited to three rebates per applicant, per calendar year. For more information, see the ONG CNG Rebate Program website.

Alternative Fuel Vehicle (AFV) and Infrastructure Grants for Public Fleets

Under the Creating Long-term Energy Alternatives Now by Advancing Improvements Regionally (CLEAN AIR) Grants program, the Association of Central Oklahoma Governments (ACOG) issues requests for proposals (RFPs) for alternative fuel and advanced technology vehicle projects in the Oklahoma City Area Regional Transportation Study (OCARTS) area. Projects must provide a reduction in vehicle equipment emissions and cannot increase the number of vehicles in applicant fleets. Eligible projects may also include AFV fueling station or charging infrastructure. Eligible applicants include OCARTS-member governments, certain public trusts and public authorities providing essen-

tial services to OCARTS-member governments, member entity public transit fleets, and to public school fleets whose district boundaries are contained partially or wholly within the OCARTS area. There are currently no available RFPs (verified August 2018). For more information, including open solicitations, see the ACOG CLEAN AIR Grants for Public Fleets website.

Laws and Regulations

Autonomous Vehicles Council

By executive order, the governor established the Aerospace and Autonomous Systems Council (Council). The Council will review all aspects of the development of autonomous systems and related technologies, including research and development, education, economic development, job creation, and capital investment. The Council will also provide recommendations to the Governor and will submit and periodically review strategic plans. (Reference Executive Order 2011-19, 2017)

Compressed Natural Gas (CNG) Vehicle Loan Program Development

The Oklahoma Cooperative Circuit Engineering Districts Board must develop and adopt rules and processes for a no-interest loan program to allow qualified county governments to purchase or convert CNG vehicles. Counties that borrow funds must sell to a nongovernmental entity or properly dispose of a comparable number of conventional vehicles. Loan terms will be up to five years. (Reference Oklahoma Statutes 69-687.3C)

Natural Gas Measurement

The Oklahoma Department of Labor (DOL) must standardize compressed natural gas (CNG) and liquefied natural gas (LNG) measurements for retail motor vehicle fuel, unless the National Conference on Weights and Measures has established equivalent measures. Until the DOL standardizes measurements, a gasoline gallon equivalent is equal to 5.66 pounds (lbs.) of CNG and a diesel gallon equivalent is equal to 6.06 lbs. of LNG. (Reference Oklahoma Statutes 83-119)

Compressed Natural Gas (CNG) Fueling Infrastructure Inspection

The Oklahoma Department of Labor may access and inspect any equipment, practices, or methods used in association with public CNG fueling infrastructure. (Reference Oklahoma Statutes 40-142.2)

Access to State Alternative Fueling Stations

The Oklahoma Office of Management and Enterprise Services (OMES) Fleet Management Division may construct, install, acquire, operate, and provide alternative fueling infrastructure for use by state agencies and local government and for use by the public in areas of the state where public access to alternative fuel infrastructure is not readily available. OMES must discontinue public access to their fueling stations if a privately owned alternative fueling station opens within a five-mile radius. Alternative fuels

include natural gas, propane, ethanol, methanol, biodiesel, electricity, and hydrogen. (Reference Oklahoma Statutes 74-78 and 74-130.2)

Compressed Natural Gas (CNG) Fueling Infrastructure Development

The Oklahoma Legislature intends to increase the amount of CNG fueling infrastructure in the state, with the overall goal of having one public fueling station every 50 miles by 2025. The Oklahoma Office of Management and Enterprise Services Fleet Management Division may partner with private entities to build CNG fueling infrastructure. (Reference Oklahoma Statutes 74-78f)

Low- and Medium-Speed Vehicle Access to Roadways

A low-speed electric vehicle (EV) is any four-wheeled EV powered by an electric motor that draws current from rechargeable storage batteries or other sources of electric current and whose top speed is greater than 20 miles per hour (mph) but not greater than 25 mph. Low-speed EVs may not operate on streets or highways with posted speed limits greater than 35 mph but may cross a street or highway with a posted speed limit greater than 35 mph.

A medium-speed EV is defined as any self-propelled, electrically powered four-wheeled motor vehicle, whose top speed is greater than 30 miles per hour (mph) but not greater than 35 mph. Medium-speed EVs must be registered according to the Oklahoma Vehicle License and Registration Act. Medium-speed EVs may operate on roadways with a posted speed limit of up to 45 mph but are not permitted to travel on any highway in the state that is a part of the National System of Interstate and Defense Highways. Low- and medium-speed EVs must meet the safety standards specified in Title 49 of the Code of Federal Regulations, section 571.500. (Reference Oklahoma Statutes 47-11-805.1, 47-1102, and 47-1151.4)

Public Utility Definition

An entity that is not a regulated utility that provides retail plug-in electric vehicle (PEV) charging services is not defined as a public utility and may sell electricity if it is used for the purpose of fueling a PEV. (Reference Oklahoma Corporation Commission RM 201800010 and Oklahoma Administrative Code 165:35-13-1)

Ethanol Labeling Requirement

Motor fuel containing more than 1% ethanol or methanol may not be sold or offered for sale from a motor fuel dispenser unless the individual selling or offering the fuel for sale prominently displays a label on the pump stating the fuel “Contains Ethanol” or “Contains Methanol,” as applicable. The retailer must display the label in a clear, conspicuous, and prominent way on the same side of the motor fuel pump where the price is shown. If a motor fuel pump dispenses fuel that contains at least 10% ethanol (E10) or 5% methanol, the label must also state the percentage of ethanol or methanol, respectively, by volume. In addition, the person selling motor fuel or offering it for

sale must provide the following information to the fuel user if requested: 1) the percentage of ethanol contained in the motor fuel being sold; 2) the percentage of methanol contained in the motor fuel being sold; and 3) if the motor fuel contains methanol, the types and percentages of associated co-solvents in the motor fuel being sold. (Reference Oklahoma Statutes 52-347)

Biodiesel Definition and Specifications

Biodiesel is defined as a fuel that is comprised only of mono-alkyl esters of long chain fatty acids, is produced from vegetable oils or animal fats, and meets ASTM specification D6751. A biodiesel blend is a blend of biodiesel meeting ASTM specification D6751 and petroleum-based diesel fuel. (Reference Oklahoma Statutes 52-325)

Alternative Fuel Vehicle (AFV) Acquisition Requirements

All school and government fleets may convert their vehicles to operate on alternative fuels, and all school districts should consider purchasing only vehicles able to operate on alternative fuels. Alternative fuels include natural gas and liquid fuels produced from natural gas, propane, ethanol, methanol, electricity, biodiesel, coal-derived liquid fuels, hydrogen, and fuels derived from biological materials. School and government vehicles capable of operating on an alternative fuel must use the fuel whenever a fueling station is located within a five-mile radius of the respective school district or government department and the price of the alternative fuel is cost competitive with the displaced conventional fuel. If school and government vehicles must be fueled outside the five-mile radius and no fueling station is reasonably available, the school and government vehicles are exempt from this requirement. (Reference Oklahoma Statutes 74-130.3)

Alternative Fuel Vehicle (AFV) Tax and Fee

Compressed natural gas (CNG) used in motor vehicles is subject to a state motor fuel tax of \$0.05 per gasoline gallon equivalent (GGE) until January 1, 2020. Beginning January 1, 2020, the tax rate increases to match the rate imposed on diesel fuel. Liquefied natural gas (LNG) is also subject to a state motor fuel tax rate of \$0.05 per diesel gallon equivalent (DGE) until January 1, 2020, after which the tax rate increases to match the rate imposed on diesel fuel.

In lieu of the motor fuel tax, some AFV owners are subject to a motor vehicle fee. An annual flat fee applies to passenger automobiles, pickup trucks, vans and heavy-duty vehicles using propane, natural gas, methanol, or blends of 85% methanol and 15% gasoline (M85). Propane and natural gas vehicles with a payload capacity of less than 2,000 pounds (lbs.) are taxed at a rate of \$50 per vehicle per year. Methanol and M85 vehicles with a payload capacity of less than 2,000 lbs. are taxed at a rate of \$100 per vehicle per year. Propane, methanol, and M85 vehicles with a payload capacity greater than 2,000 lbs. are taxed at a rate of \$150 per vehicle per year. If the owner acquires the vehicle or converts it to run on the alternative fuel after July 1 of the tax year, the flat fee is half of the above mentioned amount.

AFVs must display a decal that the Oklahoma Tax Commission issues on an annual basis. (Reference Oklahoma Statutes 68-500.4 and 68-723)

Alternative Fuel Technician Training

The Alternative Fuels Technician Certification Act (Act) regulates the training, testing, and certification of technicians and trainees who install, modify, repair, or renovate equipment used in alternative fueling infrastructure and in the conversion of any engine to operate on an alternative fuel. Alternative fuels include propane, natural gas, methanol, ethanol, electricity, coal-derived liquid fuels, hydrogen, biodiesel, and fuels derived from biological materials. This includes original equipment manufacturer engines dedicated to operate on an alternative fuel. Plug-in electric vehicles (PEVs), PEV charging infrastructure, and PEV technicians must also comply with the rules and regulations of this Act. (Reference Oklahoma Statutes 40-142.3)

Committee of Alternative Fuels Technician Examiners

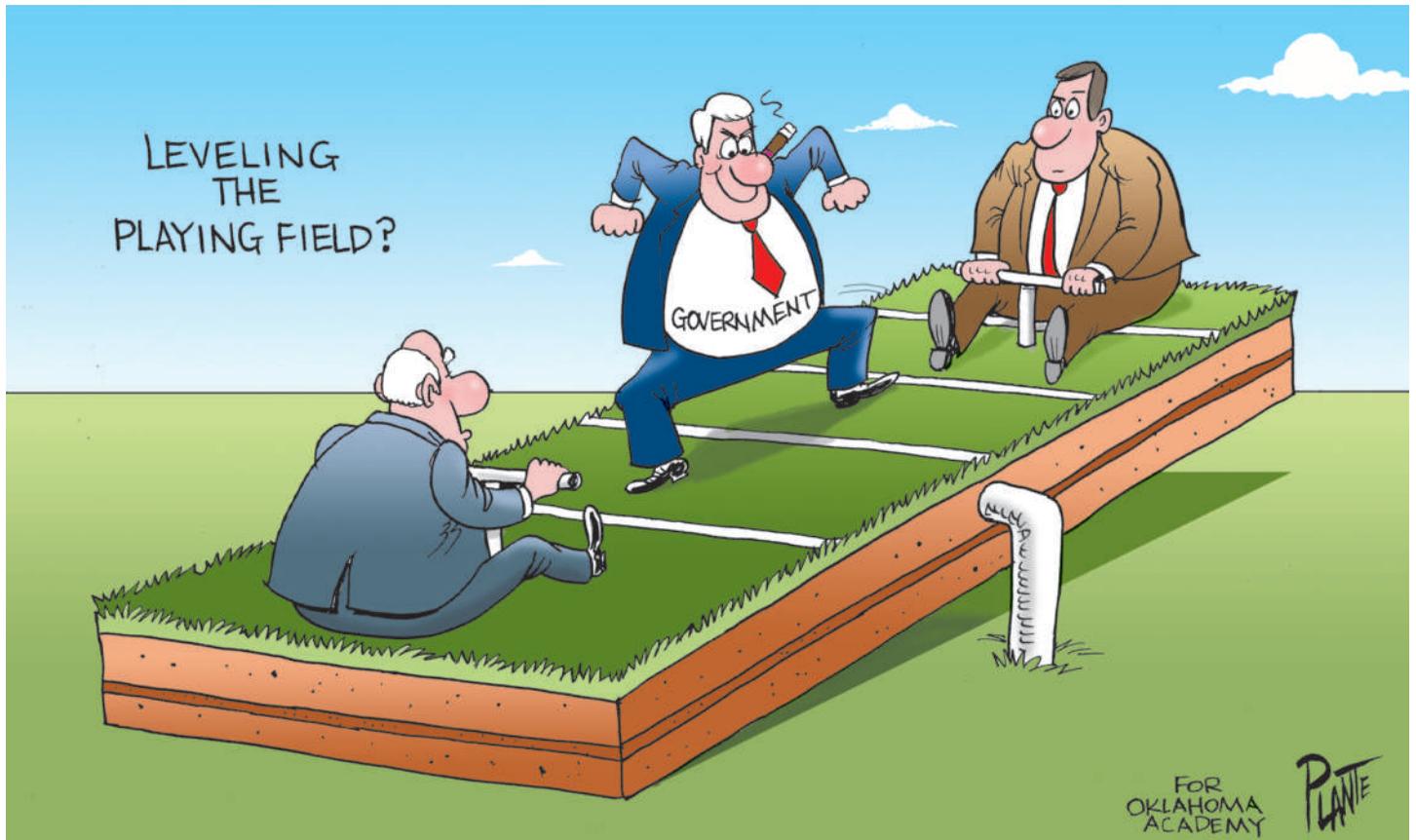
The Committee of Alternative Fuels Technician Examiners (Committee) was established to assist the Commissioner of Labor on matters relating to the formulation of rules and standards to comply with the Alternative Fuels Tech-

nician Certification Act. The Committee consists of eight members, including experts in the natural gas, propane, and electric vehicle industries. (Reference Oklahoma Statutes 40-142.6)

Alternative Fuels Technician Certificates

The Department of Labor (DOL) will issue a certificate to any person who has successfully passed the appropriate alternative fuels equipment, alternative fuels compression, or electric vehicle technician examination as provided in the Alternative Fuels Technician Certification Act. A certification fee applies. For companies, partnerships, or corporations involved in the business of installing, servicing, repairing, modifying, or renovating equipment used in converting or modifying engines or fueling equipment to be used with alternative fuels, DOL will issue a separate certificate.

DOL can issue an alternative fuels trainee certificate to any person who submits a trainee application within 15 business days of being hired by a licensed alternative fuels conversion or fueling station installation company. (Reference Oklahoma Statutes 40-142.8)



Building the Wind Turbines Was Easy. The Hard Part Was Plugging Them In

Russell Gold, Wall Street Journal, June 22, 2019

Adapted from “SUPERPOWER: One Man’s Quest to Transform American Energy” by Wall Street Journal reporter Russell Gold, to be published by Simon & Schuster, Inc., on June 25.

When Michael Skelly first visited the Oklahoma panhandle in 2009, he gazed at a giant grid with squares of corn and grassland. There were few houses, one every mile or so. Half had been abandoned decades ago by homesteaders who gave up to the elements. This pancake-flat landscape, he thought, held the key to overturning one of the greatest misconceptions of the climate-change crisis.

For years, the wind and the sun were widely dismissed as niche sources of power that could never fill America’s vast need for energy. But now the cost of solar and wind power had fallen so much that the U.S. could substantially reduce harmful emissions while also lowering the price of electricity. Put it all on a big enough grid, one that could use the ample sunshine from the desert Southwest to keep Atlanta’s office towers cool, or the persistent wind in the Great Plains to run Midwestern factories, and you’d address the often-repeated critique of renewable energy: The sun isn’t always shining and the wind isn’t always blowing. On a big enough grid, that’s not an issue. There is wind somewhere and the clouds don’t cover the entire U.S.

In Oklahoma, Skelly knew the wind rarely stopped blowing. A midcentury travelogue joked that homes had a “crowbar hole... designed to check on the weather. You shove a crowbar through the hole: if it bends, the wind velocity outside is normal; if the bar breaks off, ‘it is better to stay in the house.’”

You could build renewable energy here, he thought, on a scale that could change the country and maybe even the planet.

There was a snag and it was a big one. We have 21st-century technology to produce the power, but we still have a 20th-century power grid that can’t move it from the windy and sunny parts of the country to the urban markets. The American power grid isn’t set up for it. It’s old-fashioned and parochial when it needs to be continental and forward-looking. It’s like the nation’s roads before President Dwight D. Eisenhower championed the construction of the Interstate Highway System seven decades ago.

Like Eisenhower, Skelly had a plan: He wanted to begin building a new power grid that could carry inexpensive renewable electricity from places such as the Oklahoma panhandle to the east and west. An electricity superhighway that would save customers money while reducing pollution and carbon emissions. An interstate system for electrons.

Skelly had a history of getting things done. When he was in the Peace Corps in Costa Rica in the mid-1980s, he helped set up a microcredit program to let fishermen develop new markets for their catch. One lesson Skelly took from the project was the importance and influence of money. After getting a degree from Harvard Business School, he returned to Costa Rica in 1992, this time to build a tram to take tourists into the rain-forest canopy. He had never built anything before.

When he needed a heavy-lift helicopter to move the towers for the rain-forest tram, Skelly flew to neighboring Nicaragua and looked up a friend from Harvard, a former Sandinista guerrilla with connections to the head of the country’s air force, Col. Manuel Salvatierra. Skelly parked himself in Salvatierra’s office for a week until he had a deal to rent a military helicopter. It delivered the towers into the rain forest and the tram got built.

RENEWABLES ON THE GRID

In 2000, Skelly moved to Houston for his first job in the wind industry, developing wind farms for what became Zilkha Renewable Energy. The industry was at the tail end of a lengthy metamorphosis. It went through decades of debacles—wind turbines that broke down constantly and solar panels that produced ridiculously expensive electrons. But wind turbines had grown larger and more durable—and their costs were falling. The solar industry had begun an era of globalized production that was driving down costs. Renewable energy was not just for dreamers who wore sandals. It was starting to attract Wall Street capital and be taken seriously.

At the same time, the operators of the nation’s regional grids were moving cautiously. They worried that a sudden drop in wind could destabilize the grid. Slowly, they grew comfortable adding more renewable energy. In 2003, there were 1.2 gigawatts of wind power on the Texas power grid, offering roughly the equivalent amount of power as one of the two units at the South Texas Project, a nuclear plant near the Gulf of Mexico.

“I remember folks saying, at that point in time, that we would have to do some things radically different if we got about 15 gigawatts,” said Dan Woodfin, the grid’s senior director of system operations. But Texas reached 15 gigawatts, or 15,000 megawatts, in 2015, and the sky didn’t fall. There are now more than 22,000 megawatts of wind and nearly 2,000 megawatts of solar on the Texas grid—and the number keeps growing.

Other grid operators had similar experiences. Nick Brown, president of the Southwest Power Pool, the grid operator

for several Great Plains states, testified before Congress a couple of years ago that his organization was handling 17,000 megawatts of wind without any issues. “I will tell you as an engineer, with training in operations and planning, if you had asked me 10 years ago if we would have been able to reliably accommodate even half of that, I would have said no. Period. End of discussion,” he said.

In the early 2000s, as chief development officer for Zilkha Renewable, Skelly helped plan and build wind farms from New York to Washington state. Zilkha Renewable grew quickly. In 2005, it was bought by Goldman Sachs, which sold it a couple of years later to Energias de Portugal SA for \$2.15 billion, a handsome profit.

It was becoming clear that there was no shortage of wind, and that it was the grid that was the barrier to the dream of alternative energy. There was plenty of wind in the Great Plains and solar in the southwestern U.S., but that’s not where demand for power was located. That power needed to be moved from one part of the country to another. For Skelly, the next adventure was tackling the grid itself.

He essentially wanted to build several long extension cords. One end would be plugged into the Oklahoma panhandle; the other end would reach east until it crossed the Mississippi River. As his plan took shape, the price of wind and solar generation kept falling to the point where it cost less than power generated by conventional coal or natural gas.

Academics were starting to ask what would happen if the U.S. added lots of low-cost renewable energy and managed to move it around. One 2016 study by the National Oceanic and Atmospheric Administration’s research laboratory concluded that by 2030, the U.S. could cut its carbon-dioxide emissions by 80%, using only existing technologies. And the cost of power wouldn’t rise. In fact, it would be cheaper. That scenario didn’t rely on some hoped-for storage breakthrough, just the construction of a network of transmission lines similar to Skelly’s plans.

A different group of researchers, at the National Renewable Energy Laboratory, examined whether it was even possible to run the U.S. on 30% renewable energy. (In 2016, wind and solar generated about 8% of electricity; now it’s about 10.5%.) They built the largest and most sophisticated model of the U.S. electricity system on a supercomputer called Peregrine to find out. Their answer? It was both doable and wouldn’t raise power prices or destabilize the grid. But to get the biggest carbon reduction and lowest generating cost, they, too, found that the U.S. needed to build a new overlay of transmission lines—a system of moving large amounts of power from one point of the existing grid to another.

“We have put to bed the ‘Is this possible?’ question,” said Aaron Bloom, who led the NREL researchers. Thirty percent was doable, they concluded. “The question is 50% and beyond.”

Skelly figured that if he could build an Oklahoma-to-Tennessee line, the proof of concept would unlock more private investment. He co-founded Clean Line Energy Partners, secured institutional funding and set out to realize his vision.

CHICKENS AND EGGS

He soon discovered hidden booby traps. One had been set all the way back in 1935 by a company then called Arkansas Power & Light. Back then, it found inexpensive sources of power—waste steam from a lumber mill, for instance, or a seam of coal—and constructed transmission lines to spread the electricity to nearby cities. As it expanded, Arkansas Power agreed to electrify the state’s farming communities in exchange for a state-regulated monopoly franchise. Once secure, the company pushed for rules to ensure no one else could follow.

Skelly wanted to build a transmission line across Arkansas, but the rules required Clean Line to be a utility. However, to be a utility, it needed to own or operate power equipment. It was a Catch-22 of Arkansas Power’s devising. The state had successfully dug a moat around the utility, and hadn’t built a drawbridge. It was a “chicken-and-egg paradox,” in the words of a state regulator, one that would haunt Skelly and his colleagues for years.

Then there was the land issue. In a few places, Clean Line might need the federal government to use eminent domain to be able to build the transmission line. Some Arkansans weren’t happy with that. Julie Morton, a former television weather reporter, wasn’t interested in Skelly’s arguments about national grids, reduced carbon emissions and low power prices. “Arkies,” she said, “we’re as poor as dirt, but we have land, and that is our core. When you start messing with that, you are messing with our heart and soul.” She didn’t want Skelly and Clean Line acquiring any right-of-way easements.

What started as an idea, with Skelly and a couple of others hunched over a kitchen table, soon grew into a company with dozens of employees. Skelly told them never to refer to the company as a startup. They would encounter powerful utilities and politicians in coming years, he said, and as Clean Line employees they needed to take themselves seriously.

The company made good progress. Clean Line gathered state approvals and prepared to file for a federal blessing. Fifteen wind developers expressed interest in building in the Oklahoma panhandle to deliver power on the proposed extension cord. Skelly approached the Tennessee Valley Authority, a federal power agency. In 2009, he told them he could deliver electricity at \$70 a megawatt-hour. By 2014, wind technology had improved so quickly that he was talking to the TVA about \$40. His offer price would soon be significantly cut again, to below what the TVA paid for coal power.

Skelly was regularly visiting TVA's headquarters and received a warm reception from the TVA head. Negotiations seemed to be going well. But the TVA was getting a decidedly different message from Tennessee Sen. Lamar Alexander, a Republican who had a longstanding dislike for wind turbines. He had bought a vacation property on Nantucket Island, off the Massachusetts coast, in 2001. The week he closed on the property, news broke about Cape Wind, a plan to build 170 wind turbines in the middle of Nantucket Sound. A year later, after being elected to the U.S. Senate, he introduced a bill that would make life difficult for off-shore wind developers. Over the next few years, he kept up his campaign against them. "The windmills we are talking about today are not our grandmother's windmills," he warned. Sen. Alexander would make sure that Skelly and Clean Line didn't have it easy.

But as the months passed, Skelly and Clean Line made huge progress. The audacious plan to build the largest renewable-energy project in North America, and deliver it power-hungry customers in the southeast, was coming together.

THE WEEK FROM HELL

Then, in February 2015, Arkansas's two Republican senators mounted an attack, initiating what came to be known around the Clean Line offices as "the week from hell."

Sens. John Boozman and Tom Cotton introduced a bill designed to make it impossible for Skelly to build a single transmission line. The senators said that while decisions of eminent domain were sometimes unavoidable when building power lines, they should be in the hands of local officials, not Washington bureaucrats. Sen. Boozman said he was hearing from constituents opposed to the line and wanted to give state officials a veto over it. "We felt like it was important that they had a say in it," he said.

Skelly was trying to connect different grids and share power in a way that created stability and enabled clean, inexpensive power to flow across state lines. But while he was envisioning an interstate, the senators wanted to allow every state to put up roadblocks. Their legislation would require the federal government to get approval from the governor or public-service commission of each affected state before it could use eminent domain to build a transmission line with a private company.

A few days later, the Arkansas senators' proposed bill scared off a needed Clean Line investor. A couple of managers at New York private fund Global Infrastructure Partners called Skelly. "They said to put the pencils down. We are done. This isn't going to work out," Skelly said. "Investors hate regulatory risk. And we served up a plateful that week."

Back in 1954, when President Eisenhower laid out his interstate plan in Detroit's Cadillac Square, he took off his

hat and waved it. "We are pushing ahead with a great road program," he told the crowd, "a road program that will take this nation out of its antiquated shackles of secondary roads all over this country and give us the types of highways that we need." Within a few years, cars and trucks zipped without stop from state to state.

For Michael Skelly, it wouldn't quite turn out that way. He wasn't the president; he just had a big, bold idea. It was the type of infrastructure project that the U.S. struggles with, even when privately financed. Along the way, he found that the obstacles to a cleaner, cheaper electricity future have more to do with politics than technological limits.

With three senators speaking out against it, the project had a whiff that repelled investors. Another setback came in Missouri, where regulators blocked needed approvals to proceed with a separate transmission line there. But then a major victory in Washington: The Energy Department decided to participate in the project after years of deliberation.

Skelly expected to come to terms with landowners for at least 95% of the parcels. Eminent domain would be required for the rest. If he had been building a natural-gas pipeline, he would have finished the process in a matter of months.

He still needed the TVA to buy a portion of his wind power. Clean Line offered a 20-year deal at record-low prices. Bill Johnson, then the TVA's president, didn't show the deal to his board and said TVA's analysis showed that Clean Line didn't save the utility any money over the proposed contract. He declined to make the analysis available.

In the end, tantalizingly close to being built, Skelly's project stalled. In late 2017, Clean Line agreed to sell the Oklahoma portion of its project to Florida utility and power developer NextEra Energy. Other buyers snapped up other projects, which look likely to be built. The company Skelly had helped build would be stripped for parts like a car in a junkyard.

His vision of a supergrid of direct-current power lines zipping cheap energy around had faltered. Someone else would have to carry that project over the finish line.

In the months after the company folded, Skelly talked to various people about what he would do next. "I am feeling a little heartbroken," he said.

— "*Superpower: One Man's Quest to Transform American Energy*" is based on more than 100 interviews and thousands of pages of documents.

New rule requiring wind facility owners to pay development, annual operational fees takes effect Aug. 1.

Jack Money, The Oklahoman, June 29, 2019

A new rule takes effect Aug. 1 that will provide the Oklahoma Corporation Commission with additional dollars to help regulate the development of wind energy resources in the state.

The rule requires owners of wind energy facilities to pay the agency \$2,000 annually per facility to help compensate for its oversight responsibilities. With 58 operational wind farms that are not owned by a state-regulated utility, the fee initially is expected to generate \$116,000 annually.

The rule also requires developers of proposed wind energy facilities to pay the agency \$5,000 whenever they submit notices of their plans to build a new project.

Brandy Wreath, director of the commission's Public Utility Division, has said it costs his staff about \$300,000 annually to regulate the industry. And while the amount the fee will generate won't totally offset that cost, Wreath said he expects it will help significantly.

That is because the division's most labor-intensive oversight of facilities is needed at the front end of proposed developments, when regulators must be sure the projects meet prescribed setback and military air space requirements, Wreath said.

"That is the majority of the work," he said. "While there is a lot of desk time, we also meet with affected land owners to talk about siting issues and easements, or meet with a city council or school board to discuss compliance issues.

"We also are gearing up to more closely monitor wind farm construction issues," he said, noting the law approved this year sets fines for prematurely starting construction before appropriate federal clearances for projects are obtained.

"What we are hoping is it will help us have the tools in our chest that will enable us to respond quickly whenever an issue arises," Wreath said.

As adopted, the rule requires the annual fee to be paid on each project by March 1, concurrently with when project owners provide the commission with operational data related to each project's nameplated capacity and production.

Gov. Kevin Stitt approved changes to the commission's Rules of Practice, which include the fees, earlier this year. Owners of individual turbines that generate power consumed by a home or business aren't required to pay the annual fee.



A rule that takes effect Aug. 1 will require owners of wind facilities like the Frontier Wind project seen here to pay a \$2,000 annual fee to regulators to help offset oversight costs. [OKLAHOMAN ARCHIVES]

It also won't have to be paid by Oklahoma-regulated utilities that own wind projects in the state, given they already pay fees to the division as part of their annual utility assessments.

Oklahoma is the third-top producer of wind energy in the country.

The Advanced Power Alliance reported earlier this year that wind developers in Oklahoma have invested \$20 billion and paid out \$51 million annually in land leases to property owners across the state, just the past decade.

The alliance also published data showing that wind generates 36% of the electricity created in Oklahoma to supply energy to the Southwest Power Pool and that 97% of that is consumed by Oklahomans.

‘Growing pains’: Wind industry has different views on tax proposals

Tres Savage, NonDoc, April 18, 2018

While many in the Oklahoma Legislature seem to have an appetite for pulling state revenue from the wind industry, two separate proposals are receiving separate reactions among wind companies. The result is a difference of opinion within an industry often viewed as monolithic.

“In a time when the wind industry needs to be sticking together, I see some splintering going on within the industry,” said Sen. Casey Murdock (R-Felt), a lawmaker with numerous wind farms and further proposed development in his northwest Oklahoma district. “That disappoints me because they need to be sticking together.”

If the Legislature is adamant about drawing dollars from the wind industry, companies with established projects currently receiving state tax credits have said they would prefer a new “gross production tax” on future wind farms’ electricity production.

Conversely, some companies planning future projects say a new production tax would disrupt their business models, but limiting payouts for previously authorized tax credits would not affect future development.

“Wind as an industry in Oklahoma has been getting a lot of spotlight put on it, but in reality it’s still a new industry in Oklahoma,” Murdock said Wednesday. “But probably in the process of the industry growing in Oklahoma, they are having some growing pains as far as the industry as one (group). They’re starting to sprout and have different business interests growing from the main tree of wind.”

Tax credit refundability vs. gross production tax

The House has a bill on its floor agenda this week that would eliminate the refundability of state tax credits for wind companies. Those credits have been sunsetted already, meaning new wind developments do not qualify for them. But hundreds of millions of dollars remain to be paid out over the next decade, and some lawmakers want to eliminate their refundability altogether.

Mark Yates, Oklahoma director of the Wind Coalition, said that would be a bad idea for multiple reasons.

“I have no doubt that there will be lawsuits challenged against the state of Oklahoma (if tax credit refundability is eliminated),” Yates said Tuesday at the Capitol. “These companies have already started assembling teams ready to

litigate this particular issue because we will have projects go into default because of this.”

SB 888 by Sen. Josh Brecheen (R-Coalgate) and Rep. Jeff Coody (R-Grandfield) is the bill on the House calendar that concerns Yates. Amended in a House committee to place a hard cap on wind-energy tax credits, SB 888 would eliminate their refundability beginning Jan. 1, 2019. It would only need 51 votes to pass the House.

“We’ve told lawmakers, look, any retroactive treatment is a non-starter with us,” said Yates, whose organization represents some of the world’s largest energy companies, as well as wind developers. “We are willing to continue dialogues about the future tax structure.”

The “future tax structure” Yates referenced involves an alternative proposal that would add a new gross production tax on the electricity generated by new wind energy projects. Such a measure would need 76 votes to pass the House, something Senate Majority Floor Leader Greg Treat (R-OKC) said he believes is unlikely.

“We’ll see if they have the votes over there (in the House) for a GPT,” Treat said. “A soft cap would be much more likely to pass both chambers.”

But Cliff Branan, a former state senator who serves as executive director of the Windfall Coalition, said the state should simply find some way to get the wind industry to have “skin in the game.”

“Those are both good options as lawmakers look for ways to solve Oklahoma’s cash problems,” Branan said of the credits-vs-GPT debate. “It is time for wind producers to contribute to our state’s coffers like other energy sources.”

Murdock, however, said the industry already contributes a lot at local levels. He opposes capping wind tax credits and creating a new GPT.

“I think both are problematic. I want to see the growth of wind in this state. I think the caps are devastating to existing projects,” he said. “I think because they sell the energy where it’s a 20-year contract, these tax credits are figured in with their financing and with their bid price on what they bid electricity into the grid. By capping them, I think it messes with their financing, and I don’t think that’s fair to them when they were counting on this payment.”

“Then you switch over to GPT, I think that hurts the developers, and I most definitely want to see more wind developed in this state. So you put GPT on, and I think that hurts future development because we’re in competition with other states.”

‘Different taxes would have different impacts’

While Branan may not care where lawmakers slice in search of a pound of breezy flesh from wind companies, individuals within the industry do.

“Based on the taxes that have been proposed, different taxes would have different impacts,” said Ron Flax-Davidson, chairman and CEO of PNE Wind USA, the American division of PNE Wind Group, a German energy company.

Flax-Davidson said PNE is in the middle of financing discussions on a wind farm project in Kay County, though he declined to provide a specific location for the development. Since Oklahoma ended its tax credit program for new wind development, PNE would not be affected by the proposed caps on existing wind credits. But Flax-Davidson said a new GPT on wind energy would derail his company’s Oklahoma project if it were not grandfathered in with a start date of at least Jan. 1, 2021.

“A new wind tax of gross production would not harm wind farms that are currently operating, but it would affect new projects like ours,” he said. “The question then is, can anybody afford to pay that tax, and will there be any other wind farms that are built? And that I can’t answer.”

Flax-Davidson said PNE is not a member of Yates’ Wind Coalition, which does represent many of the existing wind operators in Oklahoma. While Yates said the Wind Coalition would prefer to see a new GPT instead of a tax-credit cap, he argued that a GPT would also be an impediment.

“Here we go with the generation tax in Oklahoma, when you don’t see it in Kansas, you don’t see it in Texas. In fact, you only see it in Wyoming,” Yates said. “So now we are going to artificially inflate the price of Oklahoma wind. So in the [Southern Power Pool], all that’s going to do is dispatch Kansas and Texas wind first. So really it’s a lose-lose for Oklahoma in the sense that it [would make] our wind generation prices go up, and it’s ultimately, eventually going to be passed onto consumers in electricity cost.”

Branan disagreed.

“Since Oklahoma has established itself as a wind produc-

er, it is time for the industry to pay its share of taxes in our state,” the Windfall Coalition director said. “If future projects can’t sustain themselves without continued subsidies, what is the point of having them here, especially when so much Oklahoma wind power is bound for customers in other states?”

But Yates is quick to note that Oklahoma’s “subsidies” for any new project have been eliminated in recent years. Now, he is trying to protect the refundable payments promised by the state for past projects, which would be eliminated under SB 888 and capped at \$35 million per year in HB 3710.

“Our industry has been very unified in its voice that retroactivity is detrimental to our industry and the state of Oklahoma,” Yates said. “I would say that on the cap issue — the retroactivity treatment of the wind industry — all of our companies understand the importance of the state of Oklahoma honoring its word.”

But Branan questioned Yates’ claim that existing projects would “default” on their loans.

“So far, we only have the word of wind lobbyists that capping tax credits would affect the viability of wind projects in Oklahoma. These projects are still eligible for generous federal subsidies,” Branan said. “Other industries have seen their tax incentives reduced or eliminated over time, including repeated cuts to credits available to oil and natural gas companies.”

Yates noted that the bluster between the two energy industries has been witnessed by lawmakers.

“I think there’s no doubt that we have legislators in this building who have been told (...) if we’re going to increase gross production tax on oil and gas, there’s got to be a hit on wind. And I’ve had many legislators say they’ve been threatened with that,” Yates said. “At the end of the day, yes, there are some oil and gas interests that have been attacking all session long. That hasn’t changed. That’s nothing new.”

Potential amendments to SB 888

Rep. David Perryman (D-Chickasha) has filed two amendments on SB 888: One that would dedicate savings from the bill to the Education Reform Revolving Fund, and a second that gutted the entire bill and replaced it with language creating a production tax on new wind energy developments in 2019 and beyond.

Officials consider standardizing method for taxing wind farms

Daisy Creager, *The Journal Record*, May 3, 2019

Wind power advocates are working to standardize the method of assessing property tax valuation for wind farms following a series of lawsuits involving wind farm owners protesting tax values assigned by county assessors.

The phasing out of a five-year property tax exemption has reassigned responsibility of assessing value from the Oklahoma Tax Commission to county assessors, leading to tax protests and lawsuits from wind power producers that disagree with higher assessments by counties.

State Rep. Kevin West, R-Moore, said he filed a bill to standardize the valuation process for the current legislative session, but in an effort to begin conversations about the issue he did not move the legislation forward. Advanced Power Alliance Vice President Mark Yates contacted West shortly after the bill was filed and a working group is being formed to discuss the issue.

“We’re just now really starting to try and put the pieces together to come up with some meetings over the interim so all parties involved will have a say and we can come up with something that everyone agrees on,” West said. “This is something that’s very much needed to get all parties at the table.”

Total Assessment Solutions Corp. Oil and Gas Appraisal Manager Jerry Wisdom has consulted with several counties, appraising the value of several Oklahoma wind farms. He said value differences between the state and firms like TAS stem from different assessments of equipment depreciation, whether assets can be considered intangible and the cost of turbines, which has fallen in recent years.

“There’s 26 different counties that have facilities and you’re going to have 26 different opinions of value,” Wisdom said. “It’s not an attack on the industry, it’s just an overall valuation theory that they want to make sure they’re doing right by the county’s valuation and it’s fair and equitable between the whole industry itself.”

Tax protests have been filed in Comanche, Noble and Dewey counties, among others. Blue Canyon Windpower LLC and Blue Canyon Windpower V LLC recently reached a settlement with Comanche County Assessor Grant Edwards, resolving tax litigation protesting assessments between 2015 and 2018.

During the lawsuit, more than \$3.28 million of disputed taxes were held in escrow. In the settlement, more than \$1.2 million in disputed taxes were released to the county and school districts, with the rest being refunded to the companies.



Cows graze on a farm as wind turbines operate in the background in western Kingfisher County. (Journal Record file photo)

Attorney David Elder, who represented Blue Canyon Wind Power LLC, said the company also has pending property tax lawsuits in Grady and Kiowa counties.

In Dewey County, Taloga Wind LLC has two pending tax protests, contending the county assessor’s \$177 million valuation in 2017 and \$181 million valuation in 2018 should both be \$60 million or less. The company is awaiting the results of an informal hearing regarding the county assessor’s 2019 valuation, and may protest it depending on the results.

Taloga Superintendent Darci Stephenson said the protests were expected, but the protested amount being held in escrow means it is not going to schools.

“It has just removed that portion of money from our budget, so we’ve had to be careful in budgeting and planning for the future,” Stephenson said.

Yates said the working group will include industry representatives, local officials, school superintendents and lawmakers. Yates said the varying county assessments have created uncertainty for the producers, the counties and the school districts.

“The school districts are bonding on these projects,” Yates said.

Noble County Assessor Mandy Snyder supports the idea of the working group. Thunder Ranch Wind Project’s lawsuit against Noble County was recently settled, she said.

“Any time you can get both the taxpayer and the assessor in the room to come to the correct conclusion for everyone is a big deal,” Snyder said. “I sure don’t go to work in the morning looking for my next lawsuit.”

Can we find an equitable wind tax?

Michael Madden, WyoFile, February 19, 2019



The pursuit of a sensible public policy for wind power in Wyoming has become an unsettled, decade-long saga. Most other states in the region have already figured out how to appropriately regulate and tax wind resources, but it seems Wyoming inherently deals with a more complex set of circumstances.

We can trace this, in large part, to the perceived conflict between wind and the state's primary breadwinner — the mineral industry. Coal, oil and natural gas together have combined as the basic economic engines and financiers of public services in Wyoming for generations. Anything interfering with that pecking order is naturally going to receive a lot of complicating attention.

The nationwide expansion of wind power has been seen as a threat to coal. Other market dynamics like the growth of natural gas use by electric utilities are at least as responsible for pressures in the coal industry, but the connection between growth in wind generation and the contraction of coal is foremost in many Wyoming minds.

Another factor that makes the wind debate different in Wyoming is the lack of economic and fiscal diversification compared to other states. The mineral industry accounts for about 70 percent of state and local government revenue. More diversified states with a growing wind generation industry do not contend with the notion that growth of one industry means contraction in another.

Wyoming's fraught relationship with wind is reflected in the pattern of wind legislation going back to 2009. There have been dozens of bills proposed in the last decade — most have simply blown away, but some have reemerged in

successive sessions and succeeded.

The first attempt to generate revenue from wind power — House Bill 275 – Wind turbines-royalty fee in 2009 — called for a 3 percent tax on the value of electricity generated from wind. The bill failed, partially because of the complex interface between the tax rate with the federal production tax credit.

In the same session, House Bill 215 – Tax exemption for renewable resources [Enrolled Act No. 70] repealed the sales and use tax exemption for wind power equipment and materials. This repeal was in part deemed necessary because counties needed revenue to pay for roads and other infrastructure during construction of wind farms. The characteristic two-year payment lag of ad valorem taxes prevented that revenue source from being practical for this purpose.

Finally, in 2009, a task force on wind was formed via a footnote in the budget bill. This task force was charged with looking at wind taxation policies and appropriate regulatory structures.

Wind legislation reached its high point in 2010 with regulatory standards and the first wind energy production tax. The new regulations required that wind farm developments be reviewed by the Industrial Siting Council.

The wind energy production tax was enacted after much debate. Initially drafted as \$3 per megawatt hour with the proceeds going to the state General Fund, the tax was premised on a consultant's finding that the superior quality of wind in Wyoming could sustain it. Quite simply put, since

the Wyoming wind blows so dang much, it is economically possible to assess a generation tax.

Ultimately lawmakers lowered the rate to \$1 per megawatt hour and apportioned 40 percent of the revenue to the General Fund and 60 percent to the counties containing the wind facility. The tax is effective upon the third year of facility operation.

A few bills dealing with wind tax revenue have been drafted since, but all have failed. The tax and revenue distribution system created in 2010 is the same one in force today.

The Legislature also in 2010 halted wind developers invoking eminent domain to place windmills and extended the work of the wind energy task force, asking them to focus on eminent domain, wind rights and ownership and entitlements of compensation to landowners.

Then, for about five years, wind received little legislative attention. With the state's fiscal picture looking stable it wasn't on top of many minds.

But with mineral prices falling in 2016 the Joint Revenue Committee was assigned the topic of finding a new revenue source for school construction. New coal lease income — the previous source of school building money — was drying up. Suddenly raising the wind tax started getting a lot more attention as an alternative.

Significantly, this was the first year we utilized actual committee research to determine what a fair and equitable wind tax rate would be. The research demonstrated that the effective megawatt hour taxes that the state received from electricity produced from coal and natural gas ranged between \$3 and \$5 per megawatt hour.

We got to those figures by looking at the revenue the state was receiving from coal and gas and how much of those fuels respectively were required to produce a megawatt hour of electricity. New wind tax proposals since have been based on equity with the rates for oil and gas generated electricity. That way the state is not picking favorites.

Heated debate ensued. Predictable opposition to a rate hike came from the wind industry. Land owners, fearing that a higher state tax would increase the difficulty of negotiating land leases with operators, were also opposed as were environmentalists and the Wyoming Business Council. As the interim between the 2016 and 2017 sessions came to a close every wind tax bill died in committee.

Even though no committee legislation was forthcoming in 2017, Rep. Scott Clem (R-Gillette) filed a bill calling for

a \$5 per megawatt hour tax. It failed in the committee on a split vote. A similar bill calling for a \$4 dollar tax was drafted in 2018, but also failed.

Interest in equitable wind taxation expanded significantly this session. Three individual bills were filed calling for a tax of \$4, \$5 and another that would have phased in a tax starting at \$0.50 and rising to \$5 in the fifth year of operation of a wind facility. Surprisingly, House leadership did not refer any of these bills for committee action much to the frustration of sponsors and cosponsors.

There's no telling what's next for wind taxation. However, it is clear when looking at the number of sponsors and cosponsors of wind tax bills, more and more legislators are willing to consider wind as a significant revenue generator for the state. Polls, too, suggest a growing public appetite for wind taxes in Wyoming's fiscal structure. And the continued decline of coal revenue will virtually ensure that there will be future discussions of wind as a meaningful revenue contributor.

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Aside from the equity argument described above, those who favor a wind tax point to the fact that the energy sprawl associated with wind turbines upon the Wyoming landscape will have far reaching impacts within other economic sectors. These impacts should therefore be mitigated. Moreover, wind turbines are growing in size and thereby will have increased impacts on the aesthetic character of the state. Another argument that more and more citizens point to is that nearly all generation taxes are paid by non-Wyoming residents who prefer power from renewable sources.

Opponents in future discussions will suggest that any additional taxes on wind power will stifle growth and development of future wind projects. Another argument is that renewable energy sources such as wind should be encouraged and therefore not taxed in the interest of long-term environmental benefits.

The most recent development surrounding the future of wind taxes involves a grassroots plan, led in part by Sen. Cale Case (R-Lander) and former Carbon County Rep. Jeb Steward of Encampment. They will seek a ballot initiative calling for additional wind taxes.

The fact that meaningful debate on this subject was curbed by legislative leadership during the present session will likely lead to an increased interest among members of the public. Time, alone, will tell whether this approach will be successful.

New Fees on Hybrid and Electric Vehicles

Kristy Hartman and Kevin Pula, National Conference of State Legislatures, March 21, 2019

Almost 200,000 plug-in electric vehicles were sold in 2017—more than any other year in the U.S. electric vehicle market. This comes as several major automakers, including General Motors, Ford, Volvo and Volkswagen, made announcements expanding the development and production of plug-in and all-electric cars.

Current electric vehicle sales only represent about 1 percent of all light-duty car sales in the United States, but as sales continue to climb, there are concerns this may lower gasoline tax revenues. The repairs and improvements to the nation's highways have traditionally been funded primarily through federal and state taxes collected at the pump. Electric vehicles pay the same registration fees imposed on traditional vehicles and some transportation-related taxes, but electric vehicles don't require gasoline to operate, so they don't contribute to the upkeep of highways through a gas tax.

Many states face declining gas tax revenue—not only because of electric vehicles—forcing state policymakers to consider other ways to pay for the nation's transportation infrastructure. In 2017, state legislators considered more measures implementing new electric vehicle fees than any other action related to electric vehicles. As of October 2018, 21 states have enacted legislation requiring a special registration fee for select hybrid and plug-in electric vehicles, although Oklahoma's legislation was subsequently struck down by the state Supreme Court, bringing the total number of states implementing fees to 20. These fees come in addition to standard motor vehicle registration fees.

State legislation related to electric vehicle fees has increased in recent years, with Utah and Mississippi becoming the most recent states to pass measures. Nine states enacted new fees in 2017—California, Indiana, Minnesota, Oklahoma, Oregon, South Carolina, Tennessee, West Virginia and Wisconsin. Many of these fees are included in larger transportation funding packages, coming alongside increases in gas taxes, vehicle registration fees or other transportation-related revenues.

Oklahoma passed H.B. 1449 in 2017, but the state Supreme Court struck it down, concluding that the measure was a tax instead of a fee, and that it did not meet the constitutional requirements for passage of revenue bills. In a 6-3 ruling, the court determined the measure was unconstitutional because it failed to receive three-fourths of the legislative vote and it passed less than five days before the end of the legislative session, both of which are constitutional requirements for revenue-raising bills in the state.

Ten other states enacted fees in previous legislative sessions—Colorado, Georgia, Idaho, Michigan, Missouri, Nebraska, North Carolina, Virginia, Washington and Wyoming. The fees range from \$200 for a plug-in electric vehicle in Georgia and West Virginia to \$50 in Colorado and Wyoming. Some states also impose a fee for plug-in hybrid vehicles that operate on a combination of electricity and gas-

oline, as well as hybrid electric vehicles that aren't recharged using electricity. The fee for plug-in hybrid vehicles is \$47.50 in Michigan and \$100 in West Virginia. Indiana includes plug-in hybrid vehicles and hybrid electric vehicles in its \$50 annual fee. South Carolina is the only state without an annual fee, and instead requires a payment of \$120 for all-electric cars and \$60 for plug-in hybrid vehicles, once every two years.

In at least four states—California, Indiana, Mississippi and Utah—these special fees are structured to grow over time. Either tied to the consumer price index or another inflation-related metric, these states are striving to avoid the declining purchasing power of gas taxes due to years of fixed-rate structures.

States have yet to realize significant revenue collections from these special fees since the market share for hybrid and electric vehicles is still so small. Proponents support the fees to bring equity among drivers, attempting to get all drivers to pay for the use of roadways. If forecasted sales of hybrid and electric vehicles continue, states could see future revenue streams grow because of electric vehicle adoption and these new registration fees.

In addition to new fees, 34 states provide incentives for certain hybrid and plug-in electric vehicles, including purchase rebates, tax credits, HOV-lane access and free parking. Please see NCSL's publication *State Efforts to Promote Hybrid and Electric Vehicles* for more information.

Hybrid and Electric Vehicle Categories

Hybrid and electric vehicles generally fall into the following categories:

- **Plug-in electric vehicles (PEV).** This is a general term for any car that runs at least partially on battery power and is charged using electricity.
- **Battery electric vehicles (BEV).** BEVs, such as the Nissan Leaf, run entirely on an electric motor and rechargeable battery. This is also referred to as an all-electric vehicle.
- **Plug-in hybrid electric vehicles (PHEV).** PHEVs, such as the Chevrolet Volt, combine two propulsion modes in one vehicle. They have an electric motor and rechargeable battery, but can switch to gasoline once the battery power is depleted.
- **Hybrid Electric vehicles (HEV).** HEVs, such as the Toyota Prius, use a gasoline engine with an electric motor. Although these vehicles have an electric motor and battery, they don't plug in to be recharged.

View the full NCSL report at <http://www.ncsl.org/research/energy/new-fees-on-hybrid-and-electric-vehicles.aspx>

An Overview by the Oklahoma Association of Electric Cooperatives

Sid Sperry, Oklahoma Association of Electric Cooperatives, August 2019

Oklahoma's electric cooperatives serve more than 525,000 Oklahomans and another 123,500 consumer-members in five (5) surrounding states, including Arkansas, Colorado, Kansas, New Mexico and Texas. Collectively, these electric cooperatives own, operate and maintain nearly 123,000 miles of distribution and high-voltage electric transmission powerline located in all 77 counties of the state. Cooperative service areas include approximately ninety-three percent (93%) of the state's land mass.

Electric cooperatives are firmly committed to delivering power that is safe, reliable, environmentally responsible, and financially affordable. In addition, Oklahoma's electric cooperatives are:

- Private, non-profit, independent electric utility businesses;
- Established to provide "at-cost" electric service;
- Owned by the consumers they serve;
- Governed by a board of directors elected from and by the membership of the cooperative;
- Providers of education, training and information to their members, their employees, and their directors;
- Concerned about and actively engaged in the sustainable development of the communities they are a part of, and serve;
- Capable of providing returns of capital to their contributing members (patronage capital credits/refunds).

The Oklahoma Association of Electric Cooperatives (OAEC) is a trade association established to support the interests of member-owned electric cooperatives. Formed in 1942, OAEC aims to unify and empower Oklahoma's electric cooperatives through legislative representation, regulatory oversight, training and education services, safety programs, communications support, and advocacy.

Currently, OAEC is comprised of twenty-seven (27) retail electric cooperative distribution systems (25 based in Oklahoma, and 2 Arkansas based-systems with a portion of their membership in Oklahoma) and three (3) wholesale electric generation and transmission cooperatives (G&Ts), two in Oklahoma and one in Texas. OAEC is headquartered in Oklahoma City.

Position Statements:

- The electric utility industry as a whole is experiencing transformation in fuel types and resources, demand-side technology, and distributed generation; throughout this transformation process, legislators and regulators should rely on industry expertise to ensure that reliability and affordability are maintained.
- The electric utility industry is extremely complex and capital intensive; duplication of infrastructure facilities (i.e., poles & wires) is unnecessary, wasteful, and ultimately, needlessly expensive to Oklahoma consumers.
- Rate design and rate making should continue to be based on actual cost of service; levels of subsidization, fuel resource incentives and distributed generation incentives (solar, for example) should be addressed in state or federal tax codes instead of legislative means.
- New distributive resources contribute to reductions in kilowatt hour energy sales, while at the same time placing a capital burden on electric utilities to "stand-by" for service at times when those distributive resources (wind and solar, primarily) are largely unavailable. If not managed properly, this can drive up costs for every class of consumer, i.e., residential, commercial, industrial.
- The deployment of electric vehicles (EVs) – again, if not properly managed – could overwhelm current electric distribution systems and infrastructure. Education, rate programs, and improved infrastructure will be necessary in order to utilize the current electric supply systems during low usage or "off-peak" time periods to avoid capital additions that are expensive and could increase costs as a result.

Additional Considerations:

- One of the most difficult problems facing the electric industry today is the lack of a clear, concise and long-term direction in energy and environmental policy development from state and federal government perspectives. The electric business is typically built on 10 to 15-year plans. Since the enterprise is extremely capital intensive, key decisions often take a great deal of time to formulate and construction/implementation can sometimes take 4 or 5 years to complete. In simplistic terms, the electric industry operating systems of

today were conceived, planned, constructed and implemented at least 5 to 10 years ago. Even such things as Regional Transmission Access, Regional Markets, and Regional Reliability Organizations have all been in existence for at least the last 10 years. State and federal policy makers and regulatory authorities fostering a system that allows long-term planning for the electric utility industry is critical.

- The Federal Energy Regulatory Commission (FERC), through Regional Transmission Organizations (RTOs), implemented long-term, all-inclusive planning processes many years ago, and most all electric utilities are or have been involved in those plans. Unfortunately, changes in political administrations or regulatory councils often bring about philosophical differences that can create new, unvetted environmental policies, fuel use policies, renewables policies, and endangered species policies. The lack of clear, long-term planning and direction for the industry as a whole can cause electric utilities to make short-term, “do-no-harm” decisions that instead create tendencies that erode the environment, reduce reliability, and increase costs to end-use consumers.

Summations:

- Generally speaking, Oklahoma’s electric utility industry is in an exceptionally well-positioned place for at least the next 5 to 10 years in terms of low-cost, reliable, environmentally friendly service.

Oklahoma’s electric cooperatives are also well-positioned for future growth, with one key restriction:

expansion of electric cooperative service is extremely limited in high-growth metropolitan and urban areas because of antiquated constitutional provisions and court decisions from almost a century ago. Further, cooperatives’ growth in rural areas is greatly compromised due to exceptions in the Retail Electric Supplier Certified Territory Act, where other utility types (investor-owned utilities or “IOUs”) can expand into unincorporated rural areas, often enabling the “cherry-picking” of large, high load factor loads.

This combination of laws does not allow for a true “level playing field” between the different utility types today, and places electric cooperatives at a significant disadvantage.

- Additionally, the traditional Oklahoma philosophy of “it has to be fossil fuel based because it helps the oil and gas industry,” or, conversely, more recent philosophy espousing “it has to be renewable energy because it is clean” needs to change. Simply put, there is room for BOTH types of fuel resources because in fact they are BOTH good for the state of Oklahoma, and for the people who live and work here.
- Lastly, Oklahoma’s electric cooperatives look forward to a continued emphasis on cost-based electric utility services without the subsidization of one class of consumer over another. A fair and equitable approach is needed for the benefit of all consumers in Oklahoma, and for the good of all electric utility types, be they electric cooperatives, investor-owned utilities, or municipal utilities.

Benefits of Large-Scale Renewables and Resource Diversity

Public Service Company of Oklahoma

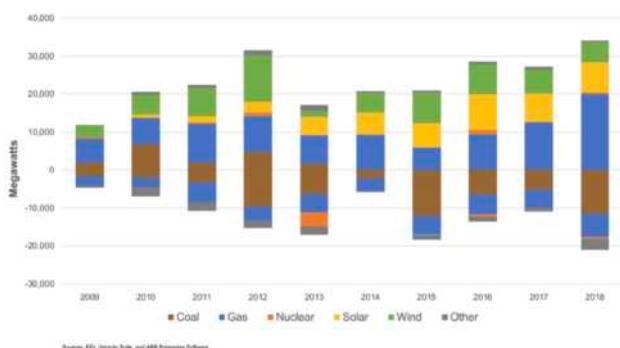
Public Service Company of Oklahoma, August 2019

The Changing Energy Industry

Renewable energy continues to grow as the electric industry evolves to meet customer expectations for clean energy. Electricity production from large-scale, non-hydro renewable resources (wind, solar, biomass, and geothermal) almost doubled between 2005 and 2010, and doubled again between 2010 and 2016. Today, large-scale non-hydro renewable resources are producing almost 12% of the nation's electricity, up from 2.2% in 2005. Distributed generation (such as rooftop solar and small wind installations) currently provides 0.7% of the country's power.

Over the last five years, more than half of the United States' new electricity generation capacity has been wind and solar. To maintain reliability and achieve appropriate greenhouse gas reductions, an all-of-the-above approach to electric generation is needed. This includes replacing declining quantities of coal with natural gas, nuclear, large-scale renewables, distributed generation, and energy storage.

Capacity Additions And Retirements



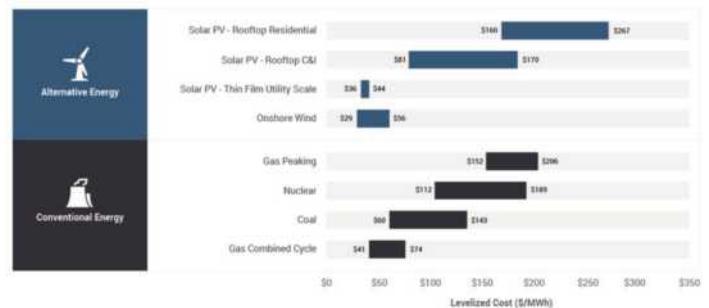
Public Service Company of Oklahoma uses a diverse mix of resources to provide reliable, affordable electricity to customers while transitioning to a cleaner generation portfolio. PSO's strategy includes adding new renewable and natural gas generation, building a smarter energy system, and providing customers with new energy technologies. Large-scale renewables are monitored and dispatched as part of the broader energy system allowing for continued grid reliability. Natural gas generation provides capacity customers can count on around the clock regardless of the weather. These diverse energy resources help PSO deliver reliable electricity at some of the lowest prices in the nation.

Large-Scale Renewables Add Diversity and Deliver Benefits as Coal Generation Declines

Large-scale renewables provide many benefits to the modern grid. Placing renewable resources on the grid strategically can mitigate

or delay congestion issues created when too much generation tries to flow through the same transmission or distribution circuits. Likewise, large-scale renewables can provide ancillary services to the grid. These essential reliability services are necessary to support the transmission of capacity and energy from resources to customers while maintaining reliable operation of the transmission system.

The cost of large-scale renewables is lower on a per-megawatt basis than distributed generation resources. Because it can be factored into the overall fuel mix as needed by the local utility or by the regional system operator, its efficiency is maximized. Lazard's latest annual Levelized Cost of Energy Analysis (LCOE 12.0) shows a continued decline in the cost of generating electricity from alternative energy technologies, especially large-scale solar and wind. In some scenarios, alternative energy costs have decreased to the point that they are now at or below the marginal cost of conventional generation.



Oklahoma's Economy Benefits from Clean Energy

Oklahoma has a strong tradition as a leader in the national energy economy and, by working together, Oklahomans can maintain that advantage. Low-cost, clean energy is a priority for residential and business customers. In 2018, more than 90% of energy serving PSO customers came from natural gas and renewable resources. By developing Oklahoma's abundant clean energy resources, we position our state for long-term economic success.

Large-scale wind development is good for the state and local economy. It adds to the tax base and attracts new employers, developing much-needed revenue streams for schools and local government, especially in rural areas. Lease payments and salaries for construction and long-term jobs are often reinvested into the community, revitalizing rural areas.

Investments in the technology-driven, digital economy are not going away; in fact, they continue to grow year after year. Large companies, including those in technology, assess the long-term carbon footprint of each capital investment they make, a decision driven by both economic competitiveness and environmental stewardship. Oklahoma can position itself to attract other companies to invest in the state's economy by supporting large scale renewable and natural gas generation investments.

An Energizing Future Lies Ahead

OG&E, August 2019

The utility industry is running headlong into the future, and we're excited by the opportunities that lie ahead. We're also mindful that there will be challenges. That's why we as utilities and stakeholders must remain nimble, change-ready and inextricably connected as we navigate through these opportune times.

At OG&E, we've been here before:

As the first here in Oklahoma to install utility scale wind and solar farms.

As one of the first in the country to deploy smart technology systemwide.

As only the second in the country to build a facility featuring seven, quick-start combustion turbines, similar to jet aircraft engines, capable of firing and putting energy on the grid in under 10- minutes.

Along with these advances, we've invested more than \$5 billion in environmental upgrades, upgrading our many of our gas-fired plants and building new high-voltage transmission lines – all while keeping our customer rates essentially flat.

Today's electric utilities have, and will continue to enable downstream technology and transactions, support critical grid infrastructure and ensure customer equity. This evolving world will require out-of-the-box thinking and leave binary decision-making behind.

In short, it will be a game-changer.

With advancements in technology and increasing customer expectations it is imperative that policies and regulations are clear, consistent and constructive. These things should not define what or how a Company should do this thing, or that. Rather, they should hold the Company accountable, asking are they doing the right things in terms of affordability, reliability, customer service and stewardship? This is how we measure ourselves.

- Our rates are THE lowest among the country's investor-owned utilities – some 29% below the national average.
- We continue to rank in the top echelon under the JD Power Customer Satisfaction rankings and still improving.
- We are the best in storm recovery and still improving reliability every year.
- We've done these things while reducing sulphur dioxide, nitrogen oxide and carbon dioxide by 86%, 74% and 40% respectively. These numbers are unmatched in our industry.

Our employees are entrusted to make this all possible. They are our most trusted and necessary partners. Without them, it won't happen. Like most things in our industry, this too will be a challenge. Utility workforces are aging. Large percentages of employees are retirement eligible, requiring that we compete for top talent as years of knowledge, skills and abilities leave the company.

It is truly a watershed moment for the industry.

A Deeper Dive Into an Electric Future

OG&E, August 2019

In July 2018, the National Association of Regulatory Utility Commissioners (NARUC) Board of Directors adopted a resolution to “encourage regulators and industry to consider sensible programs aimed at accelerating investments in electric system infrastructure to help modernize and protect the nation’s electric grid.” In passing the resolution, NARUC recognized that “utilities across the nation are finding it necessary to make investments in their transmission and distribution systems to accommodate the rapid pace of technological developments and meet increasing customer demands for an electric systems that operates in a smart, secure, reliable resilient and efficient manner.” They also acknowledged that the nation’s electric grid is subject to a greater risk of both physical and cybersecurity threats and concluded that “the upgrade and modernization of the electric system infrastructure on an accelerated basis can mitigate this risk by enhancing the security, safety, reliability, and resilience of the electric grid.”

This upgrading and modernizing of the electric grid is commonly referred to throughout the electric industry as Grid Modernization. Most Grid Modernization plans include three categories--structural integrity, functional integrity, and technology. In combination, these categories of investment are intended to address both current and future customer needs through an enhanced grid.

Structural integrity includes making sure that poles, conductor, lightning protection, and underground cables are robust and able to withstand the strains of more frequent and increasingly severe weather events. These types of assets typically provide service for many decades and stretch over thousands of miles. Often times, the failure of these assets is visible and tangible to customers and typically gain attention during severe weather events. While maintaining this type of asset is nothing new, Grid Modernization involves a more focused assessment of conditions with upgrading and replacement where need is indicated. By utilizing knowledge gains through analyzing the data being

captured, utilities can upgrade and proactively replace these assets prior to failure. This type of replacement can reduce operational costs and reduce the duration and frequency of customer outages.

Functional integrity includes ensuring that equipment such as breakers, relays, and transformers are operating at the highest levels of performance and reliability. Although this type of equipment has existed for years, the capability of these devices has significantly improved. For example, an electro-mechanical relay installed 50 years ago had no communication or remote operation capability, but today’s relay can have both which allows an operator to know the status of the system and make configuration changes remotely from a control center, thus reducing outage times. Finally, the technology component of Grid Modernization enables additional improvements in reliability and operations by increasing visibility to the devices in the field allowing automation to optimize and restore the system faster and safer. Further, as the number of customer-owned distributed energy resources (DER) increases, so does two-way power flow—making visibility of the system paramount to ensure safe and efficient operation of the grid.

To accelerate Grid Modernization investment, it is critical for utilities to begin working with regulators, customers, and other stakeholders to realize the benefits of Grid Modernization and to explore cost recovery solutions that address the challenges of attracting the capital necessary to finance grid modernization investment. The most significant barrier of traditional ratemaking policies is “regulatory lag.” The NARUC Board of Directors recognized this need when it included in its resolution a recommendation that state regulatory commissions explore alternative rate recovery mechanisms to accelerate Grid Modernization efforts. Now is the time to advance the conversation around Grid Modernization so that Oklahomans can benefit from a safer, stronger and more resilient grid.

How Electricity Is Delivered To Consumers

U.S. Energy Information Administration, August 31, 2018

Electricity is delivered to consumers through a complex network

SPP

Electricity is generated at power plants and moves through a complex system, sometimes called the grid, of electricity substations, transformers, and power lines that connect electricity producers and consumers. Most local grids are interconnected for reliability and commercial purposes, forming larger, more dependable networks that enhance the coordination and planning of electricity supply.

In the United States, the entire electricity grid consists of hundreds of thousands of miles of high-voltage power lines and millions of miles of low-voltage power lines with distribution transformers that connect thousands of power plants to hundreds of millions of electricity customers all across the country.

The stability of the electricity grid requires the electricity supply to constantly meet electricity demand, which in turn requires coordination of numerous entities that operate different components of the grid. The U.S. electricity grid consists of three large interconnected systems that operate to ensure its stability and reliability. To ensure coordination of electric system operations, the North American Electric Reliability Corporation developed and enforces mandatory grid reliability standards that the Federal Energy Regulatory Commission (FERC) approved.

Electricity comes from various sources and types of providers

The origin of the electricity that consumers purchase varies. Some electric utilities generate all the electricity they sell using just the power plants they own. Other utilities purchase electricity directly from other utilities, power marketers, and independent power producers or from a wholesale market organized by a regional transmission reliability organization.

The retail structure of the electricity industry varies from region to region. The company selling you power may be a not-for-profit municipal electric utility; an electric cooperative owned by its members; a private, for-profit electric utility owned by stockholders (often called an investor-owned utility); or in some states, you may purchase electricity through a power marketer. A few federally owned power authorities—including the Bonneville Power Administration and the Tennessee Valley Authority, among others—also generate, buy, sell, and distribute power. Local electric utilities operate the distribution system that connects consumers with the grid regardless of the source of the electricity.

The process of delivering electricity

The electricity that power plants generate is delivered to customers over transmission and distribution power lines. High-voltage transmission lines, such as those that hang between tall metal towers, carry electricity over long distances to where consumers need it. Higher voltage electricity is more efficient and less expensive for long-distance electricity transmission. Lower voltage electricity is safer for use in homes and businesses. Transformers at substations increase (step up) or reduce (step down) voltages to adjust to the different stages of the journey from the power plant on long-distance transmission lines to distribution lines that carry electricity to homes and businesses.

Evolution of the electric power grid

At the beginning of the 20th century, more than 4,000 individual electric utilities operated in isolation from each other. As the demand for electricity grew, especially after World War II, utilities began to connect their transmission systems. These connections allowed utilities to share the economic benefits of building large and often jointly-owned electric generating units to serve their combined electricity demand at the lowest possible cost. Interconnection also reduced the amount of extra generating capacity that each utility had to hold to ensure reliable service during times of peak demand. Over time, three large, interconnected systems evolved in the United States.

U.S. electrical systems are now interconnected

Local electricity grids are interconnected to form larger networks for reliability and commercial purposes. At the highest level, the U.S. power system in the Lower 48 states is made up of three main interconnections, which operate largely independently from each other with limited transfers of electricity between them.

- The Eastern Interconnection encompasses the area east of the Rocky Mountains and a portion of the Texas panhandle.
- The Western Interconnection encompasses the area from the Rockies to the west.
- The Electric Reliability Council of Texas (ERCOT) covers most of Texas.

The Eastern and Western Interconnections in the United States are also linked with the Canadian power grid. The network structure of the interconnections helps maintain the reliability of the grid by providing multiple routes for power to flow and allowing generators to supply electricity to many load centers. This redundancy helps prevent transmission line or power plant failures from causing interruptions in service to retail customers.

Balancing authorities manage grid operations

The three interconnections describe the large-scale physical structure of the grid. The regional operation of the electric system is managed by entities called balancing authorities, which ensure that electricity supply constantly matches power demand. Most of the balancing authorities are electric utilities that have taken on the balancing responsibilities for a specific part of the power system. All of the regional transmission organizations in the United States also function as balancing authorities. ERCOT is unique in that the balancing authority, interconnection, and the regional transmission organization are all the same entity and physical system.

A balancing authority ensures that electricity demand and supply are finely balanced to maintain the safe and reliable operation of the power system. If demand and supply fall out of balance, local or even widespread blackouts can result. Balancing authorities maintain appropriate operating conditions for the electric system by ensuring that a sufficient supply of electricity is available to serve expected demand, which includes managing transfers of electricity with other balancing authorities.

Electric reliability organizations set standards for grid operations

Electric utilities are responsible for maintaining the safety of their systems and planning for the future power needs of their customers. Initially, voluntary standards were developed by the electric power industry to ensure coordination of linked interconnection operations. Today, mandatory reliability standards for planning and operating power systems and for addressing security concerns at critical electrical infrastructure are in place. The North American Electric Reliability Corporation and its member organizations developed and enforce these standards, which FERC approved. In Canada, Canadian regulators fill this role.

Challenges facing the power grid

Construction of electricity infrastructure in the United States began in the early 1900s and investment was driven by new transmission technologies, central station generating plants, and growing electricity demand, especially after World War II. Now, some of the older, existing transmission and distribution lines have reached the end of their useful lives and must be replaced or upgraded. New power lines are also needed to maintain the electrical system's overall reliability and to provide links to new renewable energy generation resources, such as wind and solar power, which are often located far from where electricity demand is concentrated.

Several challenges exist for improving the infrastructure of the grid:

- Siting new transmission lines (getting approval of new routes and obtaining rights to the necessary land)

- Determining an equitable approach for recovering the construction costs of a new transmission line built in one state when the line provides benefits to consumers in other states
- Addressing the uncertainty in federal regulations regarding who is responsible for paying for new transmission lines, which affects the private sector's ability to raise money to build transmission lines
- Expanding the network of long-distance transmission lines to renewable energy generation sites where high-quality wind and solar resources are located, which are often far from where electricity demand is concentrated
- Protecting the grid from physical and cyber attacks

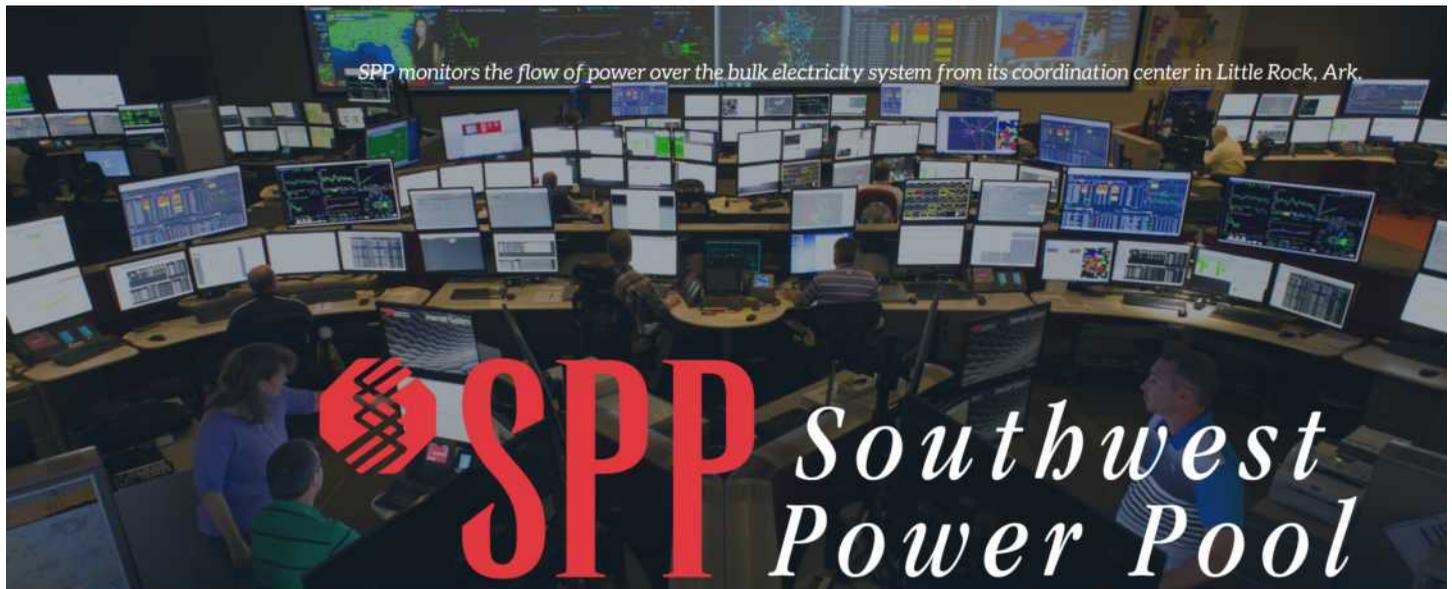
The smart grid

The smart grid incorporates digital technology and advanced instrumentation into the traditional electrical system, which allows utilities and customers to receive information from and communicate with the grid. A smarter grid makes the electrical system more reliable and efficient by helping utilities reduce electricity losses and to detect and fix problems more quickly. The smart grid can help consumers intelligently manage energy use, especially at times when demand reaches significantly high levels or when a reduced energy demand is needed to support system reliability.

Smart devices in homes, offices, and factories can inform consumers and their energy management systems of times when an appliance is using relatively higher-priced electricity. These alerts help consumers, or their intelligent systems, to optimally adjust settings that, when supported by demand reduction incentives or time-of-use electricity rates, can lower their energy bills. Smart devices on transmission and distribution lines and at substations allow a utility to more efficiently manage voltage levels and more easily find out where an outage or other problem is on the system. Smart grids can sometimes remotely correct problems in the electrical distribution system by digitally sending instructions to equipment that can adjust the conditions of the system.

Southwest Power Pool

SPP Information Brochure



Our lives depend on electricity, but most of us have no idea how many people, machines and complex processes work together around the clock, every day of the year to ensure the reliable supply of cost-effective power.

Southwest Power Pool (SPP) helps its members work together to keep the lights on today and in the future for millions of Americans, and we've been doing so for more than 75 years.

SPP is a regional transmission organization (RTO) that manages the bulk electric grid, operates a wholesale electric market and plans transmission on behalf of a diverse group of utilities and transmission companies. Like air-traffic controllers – who don't own the planes they direct, the skies they monitor or the airports that serve as travel hubs – SPP doesn't own power plants or transmission lines, but we direct the bulk power grid in our region to make certain electricity gets from where it's made to where it's needed.

To accomplish our mission, our Little Rock, Arkansas-based staff of real-time system operators, engineers and planners, software developers, security experts and support staff collaborate with stakeholders to ensure electric reliability through a unique, relationship-based approach to doing business that has stood the test of time.

TO KEEP THE LIGHTS ON TODAY AND IN THE FUTURE, SOUTHWEST POWER POOL PARTNERS WITH MEMBER COMPANIES IN **14 STATES** TO MANAGE THE **POWER GRID**, FACILITATE THE WHOLESALE PURCHASE AND SALE OF **ELECTRICITY** AND PLAN UPGRADES TO A NETWORK OF **66,892 MILES OF TRANSMISSION LINES**

SPP AT-A- GLANCE

FOUNDED
Dec. 16, 1941

HEADQUARTERS
Little Rock, Ark.

CLASSIFICATION
Federal Energy Regulatory
Commission-designated
RTO and 501(c)(6) nonprofit
corporation

VALUE
SPP's services provide
members \$1.7 billion in
net benefits annually at a
benefit-to-cost ratio of
11-to-1.

SERVICE TERRITORY
546,000 square miles

**MILES OF
TRANSMISSION**
66,892

POPULATION SERVED
17.5 million

GENERATING PLANTS
818 (RTO); 757 (Markets)

SUBSTATIONS
5,054

WHAT WE DO

FACILITATION

SPP is first and foremost a facilitator of consensus among our diverse stakeholder group. Our member-driven approach to business means each of our member companies, regardless of designation or size, has equal opportunity to participate in the decision-making process. We act in the best interest of our entire region, not of any single entity or group of like-minded companies.

RELIABILITY COORDINATION

SPP manages the power grid 24x7, coordinating the reliable and cost-effective delivery of electricity instantaneously from where it's generated to where it's needed. We ensure the grid's safety and maintain its reliability during weather events, when power plants and transmission lines go out of service and in other changing conditions. We work to ensure the lights come on every time a switch is flipped throughout our 500,000-plus square mile footprint.

SPP MONITORS
THE POWER GRID
24X7, WORKING SO
THE LIGHTS COME
ON EVERY TIME A
SWITCH IS FLIPPED
THROUGHOUT OUR
**500,000+ SQUARE
MILE FOOTPRINT**

MARKETS ADMINISTRATION

We operate a wholesale electricity market that delivers the most reliable and economical power available at any given time, facilitating the sale and purchase of electricity across our footprint. Our Integrated Marketplace provides approximately \$570 million in savings annually to market participants.

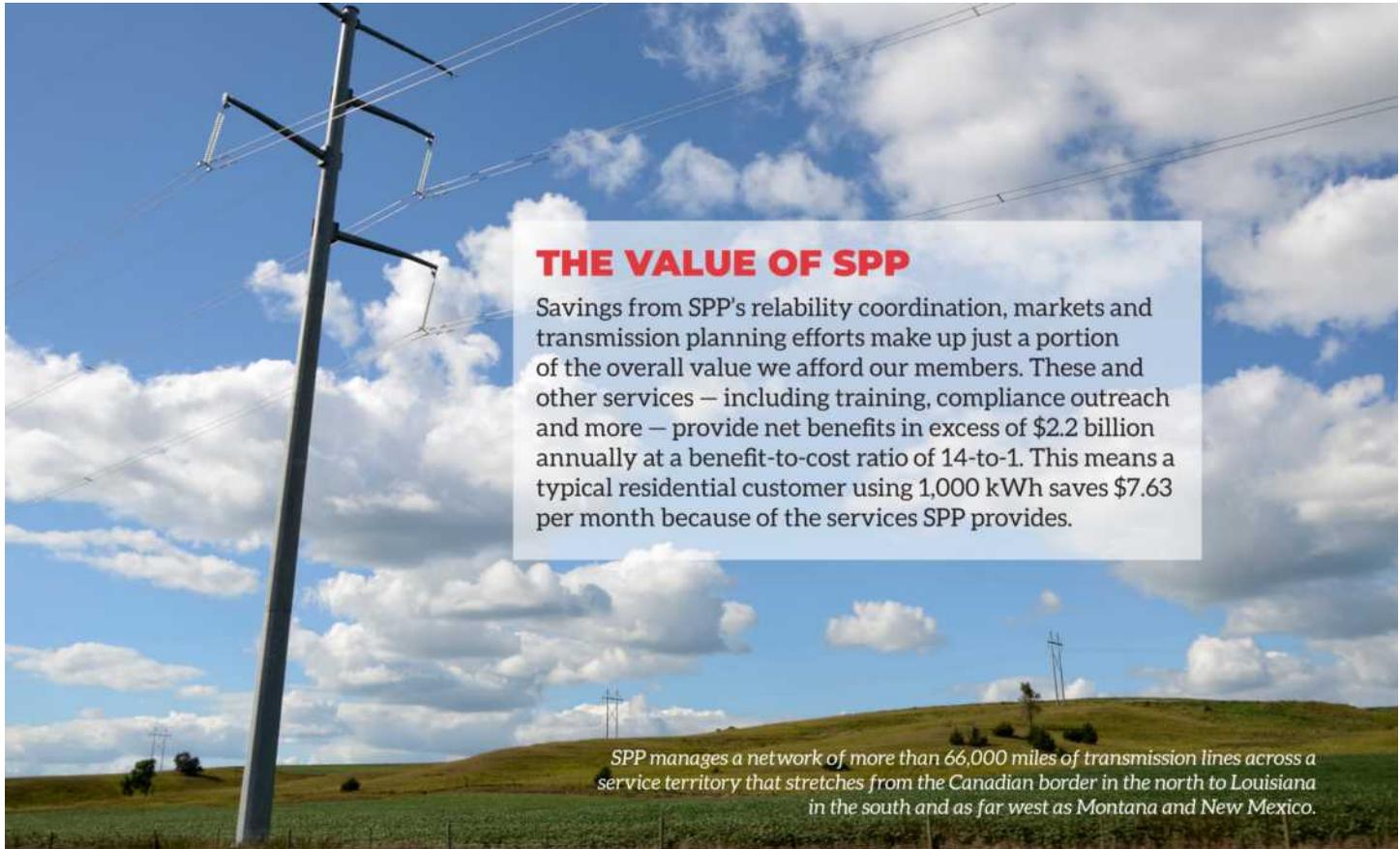
OUR INTEGRATED
MARKETPLACE
PROVIDES
PARTICIPANTS
APPROX.
**\$570M
IN SAVINGS
ANNUALLY**

TRANSMISSION PLANNING

SPP works with our members to plan tomorrow's power grid, assessing needs and solutions to be certain the lights stay on for many years to come. We do so holistically, and thanks to our member-driven stakeholder process and economies of scale afforded by the size and geographic diversity of our footprint,

TRANSMISSION
INVESTMENTS IN
THE SPP REGION
HAD, ON AVERAGE,
**A BENEFIT-TO-COST
RATIO OF
3.5-to-1**

we're able to optimize transmission build-out. That means transmission in the SPP region is only built when and where it's needed, is built to reliable standards and is certain to provide value. A recent study conducted by SPP and validated by the Brattle Group showed that transmission investments in the SPP region had, on average, a benefit-to-cost ratio of 3.5-to-1.



THE VALUE OF SPP

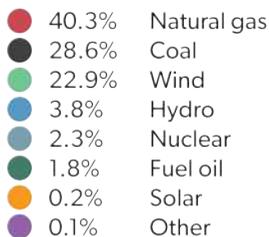
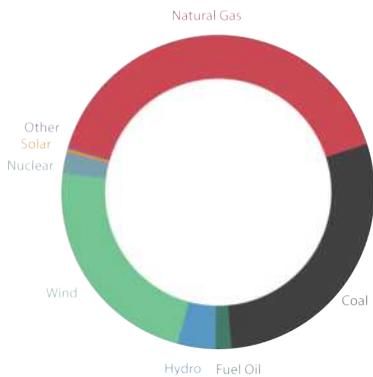
Savings from SPP's reliability coordination, markets and transmission planning efforts make up just a portion of the overall value we afford our members. These and other services – including training, compliance outreach and more – provide net benefits in excess of \$2.2 billion annually at a benefit-to-cost ratio of 14-to-1. This means a typical residential customer using 1,000 kWh saves \$7.63 per month because of the services SPP provides.

SPP manages a network of more than 66,000 miles of transmission lines across a service territory that stretches from the Canadian border in the north to Louisiana in the south and as far west as Montana and New Mexico.

Generating capacity by fuel type:

90 GW total

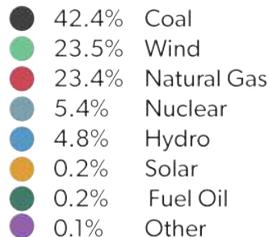
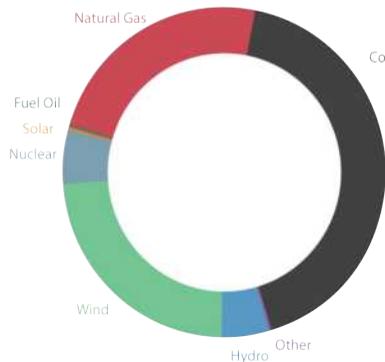
Generating capacity as of Jan. 1, 2019 is based on nameplate capacity of all resources in the SPP region.



Energy production by fuel type:

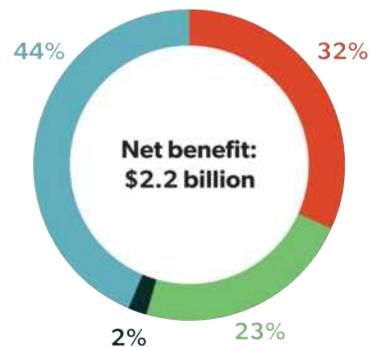
275,887 GWh total

These figures represent the total amount of energy produced in the SPP region in 2018, categorized by fuel source.



SPP PROVIDES ITS MEMBERS \$2.2 B OF NET BENEFITS ANNUALLY

THROUGH SAVINGS, EFFICIENCIES AND ECONOMIES OF SCALE.

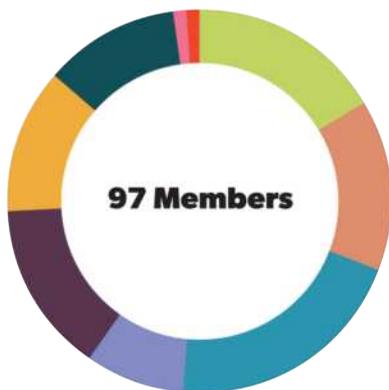


* Numbers are rounded.

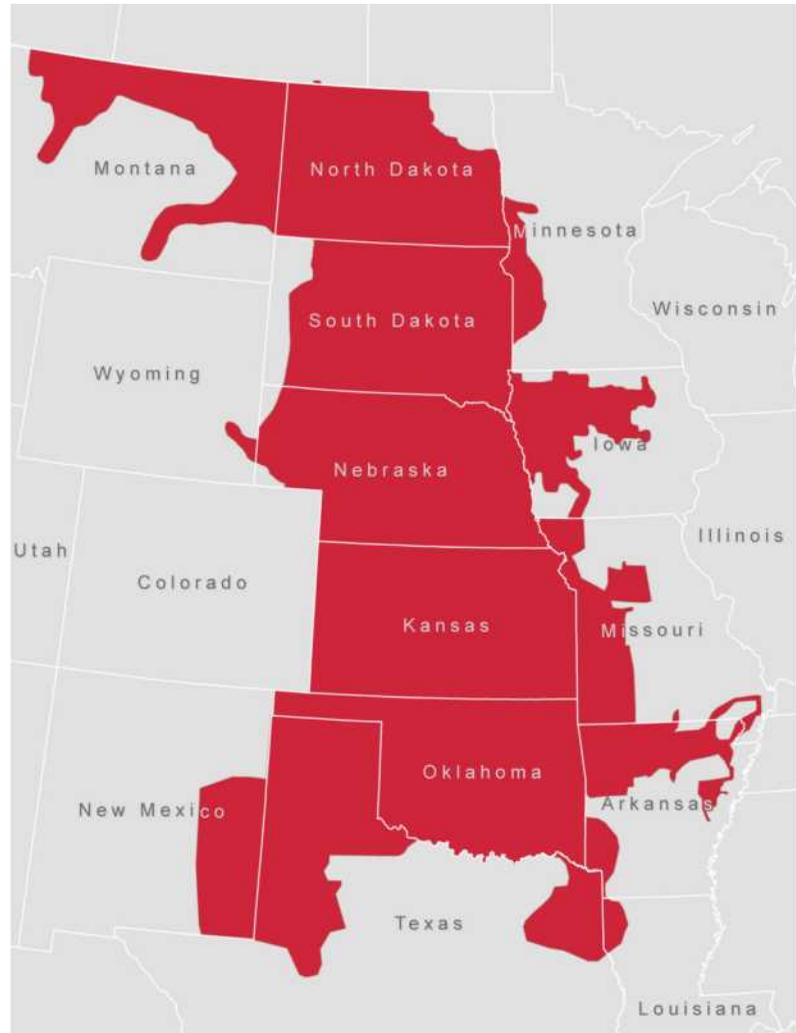
OUR MEMBERS

Our members include investor-owned utilities, marketers, electric cooperatives, municipals, companies that own transmission, public power and state and federal agencies. Members own the transmission lines and generation equipment fueled from a diverse portfolio of sources.

Members drive the strategic direction of SPP through participation in numerous working groups and committees.



- 16 Investor-Owned Utilities
- 14 Municipal Systems
- 20 Generation and Transmission Cooperatives
- 8 State Agencies
- 15 Independent Power Producers
- 12 Power Marketers
- 10 Independent Transmission Companies
- 1 Federal Agency
- 1 Large Retail Customers



THE SPP REGION

SPP's 546,000 square mile service territory covers all or part of 14 states and represents a population of approximately 17.5 million people.



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The GRDA Generation Story: Using Oklahoma resources to power Oklahoma

Dan Sullivan, CEO, Grand River Dam Authority, August 24, 2019

The Grand River Dam Authority's story of renewable energy and efficient operations, driven by Oklahoma resources, is nearly 80 years in the making. It began in the fall of 1940, in the rugged, rural northeast corner of the state, where GRDA had just completed the mile-long Pensacola Dam, across the Grand River Valley. It continues today, with GRDA's ultra-efficient Unit 3 combined cycle gas generator, fueled by Oklahoma natural gas.

Not only was Pensacola Dam Oklahoma's first hydroelectric facility, but it was also a key component in the effort to bring electricity to all areas of the state. By harnessing the natural resources of the Grand River to convert the power of falling water into megawatts, GRDA helped boost rural electrification in the latter days of the Great Depression, at a time when many viewed electricity as a luxury. In the decade following the dam's completion, the presence of reliable, renewable "hydropower" in Northeast Oklahoma would light up more than homes, as more and more business and industrial development moved into the region, fueling an economic development engine that is still running strong today. Pensacola, along with Robert S. Kerr Dam (completed in 1964) and the Salina Pumped Storage Project (1968) still help to fuel that engine today.

However, there came a time when electricity demands would outpace hydroelectricity capacity. In response, GRDA entered the thermal-generation field in the early 1980s with the completion of its two-unit coal-fired complex. Fueled by coal from Wyoming's Powder River Basin, the units combined for a capacity of 1,010 megawatts and served to transform GRDA from a small producer of hydropower to a major energy supplier across the region. The addition of thermal-generation to the generation portfolio allowed GRDA to meet the ever-growing energy demands of its customers, including several Oklahoma communities that, by 1982, had already been GRDA customers for over 30 years.

From the very beginning, this coal generation was defined by abundant, low-cost, electricity. Efficient power plant operations and a commitment to proper maintenance resulted in decades of high-reliability from the coal-burning units, which served as the base load generators to meet customer demands. At the same time, GRDA continued to give the same kind of attention to its hydroelectric assets. A major, multi-million dollar upgrade to Pensacola Dam's six turbine-generators in the late 1990s/early 2000s brought greater efficiencies and increased output to this renewable power supply. In the decade that followed, GRDA also upgraded the four turbine-generators at Robert S. Kerr Dam to achieve similar efficiency and capacity increase. With these hydro assets now set to produce renewable power for many years to come, GRDA's focus began to shift

to a long-term generation plan that would slowly move it away from coal and towards renewables and more efficient Oklahoma natural gas. The utility's first step into the gas generation field came in the fall of 2008 when it purchased a 36 percent interest in the Redbud Plant (Luther, Oklahoma). Redbud added nearly 450 megawatts to the GRDA portfolio while also enhancing both diversity and reliability. GRDA now had three generation sources: coal, renewable hydro, and gas.

However, wind generation was already present in Oklahoma and GRDA's move towards expanding its renewable energy sources was already approaching. It arrived in 2011 when GRDA signed a deal with its customer, Google, to provide wind generation to the Google Data Center located in the MidAmerica Industrial Park. Under the terms of that agreement, GRDA began purchasing renewable energy from the Canadian Hills Wind Farm, near El Reno, Oklahoma, to help meet the energy needs of the Google Data Center. In the years that followed, GRDA would enter into more power purchase agreements with Oklahoma wind farms. Today, GRDA's total wind power capacity stands at 385 megawatts.

At the same time wind was being added to the portfolio, GRDA was focused on its thermal-generation future and a plan that would upgrade some existing coal generation and replace the rest with highly-efficient gas generation. In 2015, GRDA completed an \$80 million environmental upgrade project to bring its Unit 2 coal generator into compliance with new Clean Air Act regulations. When it went online in the early 1980s, the unit was the only coal generator in Oklahoma to be equipped with a scrubber to help clean emissions. However, all emissions equipment was upgraded or enhanced to meet the new standards and allow for generation into the future. That work was completed well ahead of the Environmental Protection Agency (EPA) deadline.

Also in 2015, GRDA broke ground on its new Unit 3 combined cycle gas plant. The decision to build this facility came after much research and meetings with customers and other stakeholders. With the full support of that group, GRDA's board voted to purchase the first M501J advanced class gas turbine to ever be deployed in the Western Hemisphere. Built by Mitsubishi Hitachi Power Systems (MHPS), the turbine is paired with a MHPS steam turbine to provide 495 MW of electricity in the combined cycle process, all fueled by Oklahoma natural gas. More importantly, it took GRDA generation to new efficiency levels. In fact, at the time of its dedication (October 2017), the unit was rated as the most efficient 60 hertz power plant in the world.

Unfortunately, between Unit 3's 2015 groundbreaking and 2017 dedication, the recently-upgraded Unit 2 suffered a catastrophic fire on July 1, 2016. Although none of the newly-installed emissions upgrades were affected, the turbine-generator and other components did suffer extensive damage. Repairs were soon underway but the work would last through much of 2017, while the new Unit 3 was also being constructed just next door. Initially, GRDA had planned to retire the first coal burner, Unit 1, in April of 2017, and replace its output with the upgraded Unit 2 and new Unit 3. However, the fire caused a shift in the timeline. GRDA asked for, and received, an extension from the United States Department of Energy to continue Unit 1 operations until one of the other units could be brought online. On August 14, 2019, the GRDA Board of Directors voted to begin the process to fully decommission Unit 1. Today, Units 3 and 2, respectively, produce most of the abundant, reliable electricity needed to meet customer demands.

However, a visit to the powerhouse of either Pensacola Dam or Robert S. Kerr Dam would quickly reveal that GRDA has never strayed from its renewable power roots. GRDA is still very much in the business of harnessing the waters of the Grand River – an Oklahoma natural resource -- to produce power for its home state.

Combine that hydroelectricity with renewable wind energy and ultra-efficient gas generation – both also powered by Oklahoma natural resources – and the result is a very exciting, efficient, energetic future for GRDA in Oklahoma. It all goes back to the GRDA “5E’s of Excellence” Mission: We deliver affordable, reliable ELECTRICITY, with a focus on EFFICIENCY and a commitment to ENVIRONMENTAL STEWARDSHIP. We are dedicated to ECONOMIC DEVELOPMENT, providing resources and supporting economic growth. Our EMPLOYEES are our greatest asset in meeting our mission to be an Oklahoma Agency of Excellence.



Building Awareness, Developing Policies, Inspiring Oklahomans to Move Ideas Into Action!

TOWN HALL CONFERENCES

Topics covered at the Town Hall Conference from 2001 - 2019

2001- Competing in an Innovative World

Town Hall Chair: Cliff Hudson, SONIC, America's Drive-In

2002- Oklahoma's Health

Town Hall Chair: Cliff Hudson, SONIC, America's Drive-In

2003- Oklahoma Resources: Energy and Water

Town Hall Co-Chairs: John Feaver, University of Science and Arts of Oklahoma; Howard Barnett, TSF Capital LLC; and Larry Nichols, Devon Energy Corp.

2004- Oklahoma's Environment: Pursuing A Responsible Balance

Town Hall Chair: William R. McKamey, AEP Public Service Company of Oklahoma

2005- Drugs: Legal, Illegal... Otherwise

Town Hall Chair: Howard Barnett, TSF Capital LLC

2006- Strategies for Oklahoma's Future

Town Hall Co-Chairs: John Feaver, University of Science and Arts of Oklahoma; and Larry Rice, Tulsa University

2007- Building Alliances: Tribal Governments, State & Local Governments And Private Sectors

Town Hall Chair: Douglas Branch, Phillips McFall

2008- Oklahoma's Criminal Justice System: Can We Be Just As Tough But Twice As Smart?

Town Hall Chair: Steve Turnbo, Schnake Turnbo Frank PR

2009- Getting Ready For Work: Education Systems And Future Workforce

Town Hall Chair: Howard Barnett, OSU- Tulsa

2010 May- Oklahoma Water- A Special Town Hall on Oklahoma's 50 Year Water Plan

Town Hall Chair: John Feaver, University of Science and Arts of Oklahoma

2010 November- MUNI.OK.GOV- Addressing Municipal Governance

Town Hall Chair: Tom McKeon, Tulsa Community College

2011- Developing the Oklahoma Economy

Town Hall Chair: Susan Winchester, The Winchester Group

2012- It's 2032- Where in the World is Oklahoma?

Town Hall Chair: Steve Kreidler, University of Central Oklahoma

2013- Moving Oklahoma: Improving Our Transportation Infrastructure

Town Hall Chair: Darryl Schmidt, BancFirst

2014- We Can Do Better: Improving the Health of the Oklahoma People

Town Hall Co-Chairs: Kay Goebel, PhD, Psychologist; Gerry Clancy, MD, OU-Tulsa; and Steve Prescott, MD, Oklahoma Medical Research Foundation

2015- Oklahoma Priorities: The Government & Taxes We Want

Town Hall Co-Chairs: Howard Barnett, OSU- Tulsa; and Dan Boren, Chickasaw Nation Department of Commerce

2017- Oklahoma Votes: Improving the Election Process, Voter Access & Informed Voter Engagement

Town Hall Co-Chairs: Dan Boren, Chickasaw Nation Department of Commerce; and John Harper, AEP Public Service Company of Oklahoma

2018- Aligning Oklahoma's Tax Code to Our 21st Century Economy

Town Hall Co-Chairs: Darryl Schmidt, BancFirst; and Dan Boren, Chickasaw Nation Department of Commerce

2019- OKLAHOMA ENERGY: Optimizing Our Resources for the Future

Town Hall Co-Chairs: C. Michael Ming, retired VP Baker Hughes, a GE company, and Stuart Solomon, retired President & COO of Public Service Company of Oklahoma

A complete Library of Town Hall Resource Documents, Findings & Recommendation Reports can be found at www.okacademy.org



Building Awareness, Developing Policies, Inspiring Oklahomans to Move Ideas Into Action!

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