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REDUCING EMISSIONS WHILE DRIVING ECONOMIC GROWTH: INDUSTRY-LED INITIATIVES

HEARING

BEFORE THE

SUBCOMMITTEE ON CLEAN AIR AND NUCLEAR SAFETY

OF THE

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

UNITED STATES SENATE

ONE HUNDRED SIXTEENTH CONGRESS

FIRST SESSION

OCTOBER 17, 2019

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ONE HUNDRED SIXTEENTH CONGRESS

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REDUCING EMISSIONS WHILE DRIVING ECONOMIC GROWTH: INDUSTRY-LED INITIATIVES

THURSDAY, OCTOBER 17, 2019

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
SUBCOMMITTEE ON CLEAN AIR AND NUCLEAR SAFETY,
Washington, DC.

The Committee met, pursuant to notice, at 10:03 a.m. in room 406, Dirksen Senate Office Building, Hon. Mike Braun (Chairman of the Subcommittee) presiding.

Present: Senators Braun, Whitehouse, Barrasso, Capito, Ernst, and Carper.

OPENING STATEMENT OF HON. MIKE BRAUN, U.S. SENATOR FROM THE STATE OF INDIANA

Senator BRAUN. Good morning. I call this hearing to order.

Thanks to everyone for being here today.

We are meeting today to begin the important work of examining our changing climate and its effects on producers of American goods, services, and agriculture. Today, we will hear testimony from experts on the innovative private sector led initiatives in the U.S. that reduce air emissions while promoting economic growth. We will begin with opening statements and then hear from our panel of witnesses.

I will start here. During the month of August, I traveled around the Hoosier State on my Summer Solutions tour. In the first little over 9 weeks, I did visit all 92 counties and got a real good reading of where Hoosiers are on issues related to climate. Nearly every stop, we discussed the importance of sustainability and the need to protect our environment.

As I have learned through visiting with Hoosiers over the past 2 years, I have concluded the American people are paying attention to these important conversations. You wouldn't know it by watching the news, but we have all been thinking about and investing in this problem for a long time. Everyone, that is maybe except Washington, who has been too polarized for too long to deal with much of anything, particularly our changing climate.

Instead, American innovators and capital have been leading the way, our manufacturing, agriculture, and generation sectors have seen significant improvements from the voluntary adoption of new, lower carbon corporate practices.

According to the Energy Information Administration, U.S. energy related CO_2 emissions decreased nine-tenths of a percent in 2017 alone. The American economy has been so impressive at reducing emissions that, in 2018, BP noted in its statistical review of world energy that the U.S. was the world leader for reducing carbon emissions, prompting the American Enterprise Institute to note that for the ninth time in this century, the U.S. has had the largest decline in emissions in the world. And we still need to do better.

In fact, in 2017, the U.S. Energy Information Administration found U.S. emissions from energy sources hit their lowest level in 25 years, while during those same 25 years, U.S. GDP more than doubled, and real median household income rose by nearly 20 percent.

And yet, innovation continues. In September, Duke Energy, a company which serves 7.2 million customers, announced an ambitious new initiative, which would bring its carbon emissions to net zero by 2050.

The world's largest retailer, Amazon, has announced its plan to achieve net zero by 2040.

Last year, in an Indiana subsidiary of Nicor, a natural gas utility that serves almost 4 million customers, announced a Your Energy, Your Future plan. Under this initiative, Nicor plans to cut 90 percent of its greenhouse gas emissions.

What is perhaps most impressive about changes made by industry is that we have been able to accomplish significant emissions reduction while not sacrificing the country's overall economic competitiveness. But we must constantly remain vigilant of the balance.

There is a real risk that in attempting to curb emissions, American families, workers, and businesses will be hit with rising prices, fees, and utility bills. It is our duty to balance these two interests. Rather than dictate choices, we should allow for the market to drive new ways to produce and consume energy and goods more efficiently.

However, our national debate is deviated from this balance, instead focusing on policies which would, without question, severely limit consumer choice in many areas, from the type of energy you should use to the kind of car or appliance you should buy, to how much meat you should eat. In the case of the Green New Deal, a complete central planning reorganization of our economy, I believe the effect would be significant, and not in the right direction.

It is one thing when you make these decisions for yourself. It is another one when Washington forces its decisions upon you.

Economic competitiveness would be the real cost of these proposals, when ironically, if we really are going to solve our environmental problems, we will need innovators to produce the technologies to get us there, the hallmark of what has built this country. This is why today's focus on private sector investment has been so critical, what has been driving these decisions and what the results have been.

I look forward to each of your testimonies as we continue to consider these questions. And I draw the parallel of being on the HELP Committee, where we are taking on the health care industry, who I have solely blamed for the pickle we are in with high

health care costs, and have asked them to get with it, start fixing yourselves. When 80 Senators weigh in, you should be getting the message.

I have been impressed, in the energy sector, in what we are going to talk about today, the interest within the industry of being responsible in trying to help protect the environment.

Now I would like to recognize Ranking Member Senator Whitehouse for his opening statement.

Senator.

OPENING STATEMENT OF HON. SHELDON WHITEHOUSE, U.S. SENATOR FROM THE STATE OF RHODE ISLAND

Senator WHITEHOUSE. Let me start by thanking Senator Braun for holding this. He is a terrific colleague to work with on these issues. I think there is a real chance for progress in the weeks and months ahead.

I will start my remarks by looking backward to 1986, when a similar subcommittee of this Committee had 3 days of hearings on climate change. After these hearings, six members of this Committee, three Republicans and three Democrats, wrote to the executive director of the now defunct Office of Technology Assessment, and asked for a study of policy options to reduce carbon pollution. They all wrote together that they were deeply troubled by climate change and its implications for the human and natural worlds. Deeply troubled, and implications for the human and natural worlds being quotes from their letter, 33 years ago.

In the intervening decades, carbon pollution and global temperature increase and warming and acidification of the oceans and the experience of climate related events like wildfires have all accelerated. The disastrous effects of climate change are now plain for anyone who is looking to see. Yet Congress has undertaken no serious legislation to address our climate crisis.

Why is that? Because hundreds of millions of dollars are spent by the fossil fuel industry to block climate action. Much of this is spent through trade associations and front groups that are controlled by the fossil fuel industry.

Two of these trade associations are present here today. The watchdog group, Influence Map, identified the U.S. Chamber as one of the two most obstructionist groups on climate policy. API is not far behind.

There are signs of change at the Chamber, and at the National Association of Manufacturers, the two tied for worst climate obstructers in America. And even at API. I want to express my appreciation to the Chamber for inviting me, of all people, to speak to a Chamber gathering in New York City during Climate Week, which I hope is a sign of good progress to be made in the future.

I appreciate very much also that the Chairman and my colleague from West Virginia are working with me to provide Federal dollars for developing new technologies to reduce industrial emissions. Our industrial emissions bill is a good one. The Chamber and NAM are supporting it.

But what companies are doing voluntarily to reduce their emissions won't come close to the reductions that we need. A 2018 study by America's Pledge totaled up the voluntary pledges from compa-

nies and State and local government emissions reduction commitments and found that they would only result in a 17 percent decline in carbon emissions by 2025, which is well short of even the rather weak kneed Paris Agreement pledge of 28 percent. We actually need far larger reductions if we are to hold warming to 1.5 degrees Celsius and avoid the very worst of consequences.

Innovation is a beautiful thing. America specializes in it, but it doesn't happen in a vacuum. Without Federal policies such as a price on carbon, there is little incentive for businesses to innovate. We have seen this principle proven out over and over, whether for criteria air pollutants under the Clean Air Act, or CFCs under the Montreal Protocol. Federal and international policies provided the framework for businesses to rely on and develop new technologies that reduced those emissions.

Investors also recognize this. More than 200 major investors with $6.5 trillion in assets under management recently wrote to almost 50 blue chip companies that, "Corporate commitments to embrace energy efficiency and set greenhouse gas reduction goals are necessary and welcomed, but to facilitate the deployment of capital at a necessary pace and scale, a strong public policy framework is needed."

More than 500 investors with over $35 trillion in assets under management recently called on policymakers to put a meaningful price on carbon emissions. The reason for this is, of course, the well documented warnings which I have forwarded to every single one of my Senate colleagues of a carbon asset bubble crash and a coastal property values crash. Progress on climate is increasingly seen as essential to successful business models in the banking, investment, and agricultural sectors.

To get that progress done, corporate America must ensure that the trade associations to which they belong are not major climate obstructionists. And I hope the Chamber and API are getting the message.

If one message can come out of this hearing, it is that it is well past time for corporate America to break the fossil fuel industry's stranglehold on these trade associations, and instead, demand the climate action that is needed to protect our economy and their own business models.

Thank you very much, Mr. Chairman.

Senator BRAUN. Thank you, Senator.

I am pleased that we have a great panel here today. Our witnesses come from a wide variety of backgrounds, and I am looking forward to the different perspectives that will facilitate our discussion today.

Our first witness today is Todd Wilkinson, who is co-owner and operator of a commercial cow-calf operation in South Dakota. He is also co-owner of Redstone Feeders, a family owned cattle feeding and finishing operation, and a founding member and current vice president of the South Dakota Cattlemen's Foundation.

Mr. Wilkinson is here today in his capacity as policy division vice chairman of the National Cattlemen's Beef Association. Mr. Wilkinson has practiced law for more than 35 years, specializing in estate planning and agricultural law. He is a graduate of

Augustana College and the University of South Dakota Law School.

Our next witness is Frank Macchiarola, the vice president of downstream and industry operations at the American Petroleum Institute, API. He joined API in January 2016, where he leads association efforts on fuels, refining, marketing, and downstream safety, security, and technology. Prior to joining API, Mr. Macchiarola served as executive VP of government affairs at America's Natural Gas Alliance. From 2004 to 2013, he worked here in several senior staff positions in the U.S. Senate, including staff director and counsel to the U.S. Senate Committee on Energy and Natural Resources, and minority staff director of the U.S. Senate Committee on HELP.

Mr. Macchiarola earned his BA from the College of Holy Cross, and his J.D. from New York University School of Law.

Next in line will be Marty Durbin. Mr. Durbin is the president of the Global Energy Institute at the U.S. Chamber of Commerce. Previously, Mr. Durbin was the executive VP and chief strategy officer at the American Petroleum Institute, and the VP of Federal relations at the American Chemistry Council.

Earlier in his career, he served as a staffer for Senator Alan Dixon, and for Congressman Rick Boucher. Mr. Durbin received his bachelor's in government and politics from the University of Maryland–College Park.

Fourth will be Dr. Andrea Dutton. She is an associate professor at the University of Wisconsin–Madison where her research focuses on various impacts of climate change, in particular its impact on sea levels. Previously, she spent 8 years as an assistant professor in the University of Florida's Department of Geological Sciences.

Prior to her professorship at the University of Florida, Dr. Dutton was a research fellow at the Australian National University, where she worked to understand historical warming periods. Dr. Dutton holds a bachelor's degree in music from Amherst College, in addition to a master's and Ph.D. both in geology from the University of Michigan. She completed her post-doctoral work at the Australian National University.

Final witness today is John Wilson, the VP and director of corporate engagement for Calvert Research and Management. His firm specializes in responsible and sustainable investing across global capital markets. Mr. Wilson leads the design and execution of Calvert's corporate engagement and shareholder activism strategy.

He began his career in the investment management industry in 1997. Before joining Calvert Research, he was the head of governance and research at Cornerstone Capital Group. He also served as the director of corporate governance at TIAA-CREF and was the director of socially responsible investing at Christian Brothers Investment Services.

John earned a B.A. in English from Georgetown University, an MBA in finance from Columbia University, and an MIA in economic and political development from Columbia University School of International and Public Affairs.

I want to remind the witnesses that your full written testimony will be made part of the official hearing record. Please keep your

statements to 5 minutes, so that we may have plenty of time for questions.

We look forward to hearing your testimony, beginning with Mr. Wilkinson.

Please proceed.

STATEMENT OF TODD WILKINSON, POLICY DIVISION VICE CHAIRMAN, NATIONAL CATTLEMEN'S BEEF ASSOCIATION

Mr. WILKINSON. Good morning, and thank you, Chairman Braun and Ranking Member Whitehouse.

My name is Todd Wilkinson. I am an owner of a cow-calf operation with my son and a part owner of a commercial feed yard with my brothers near to Smith, South Dakota. I am proud today to testify on behalf of the American cattle producers.

The United States has one of the lowest beef greenhouse gas emission intensities, 10 to 50 times lower than other countries around the world. That statistic is not accidental. American cattle producers work hard to implement new technologies and practices that reduce our environmental impact while simultaneously increasing our efficiency.

Farmers and ranchers face increasing pressure from consumers to be socially responsible while managing existing environmental responsibility and attempting to remain economically viable. According to the U.S. Environmental Protection Agency, direct emissions from cattle represent just 2 percent of all greenhouse gas emissions in this country.

Climate change policies that unfairly target cattle producers fail to recognize the positive role of cattle. Rather than waiting for Congress to adopt misguided policies that threaten the viability of this key industry in the climate fight, we hope to shift the conversation to continue to be the innovators.

Cattle graze on over 660 million acres in the United States. That is nearly a third of our Nation's continental land mass. This acreage not only feeds cattle, but also sequester carbon. The ruminant grazing enhances sequestration. Emissions from cattle are a part of the natural cycle of the methane.

Cattle consume grasses and then emit methane through belches as a part of the ruminant digestive process. In just 10 years, more than 90 percent of that methane oxidizes in the atmosphere and converts to CO_2. The CO_2 is then absorbed by grasses. Those grasses are eaten by cattle, and the process goes on and on.

Methane has no long term impact on the climate when the emissions and the oxidation are in balance. While cattle are a nominal contributor to America's overall greenhouse gas emissions, our industry works to further increase our efficiency every day by implementing grazing management systems.

Our operation developed a grazing management system through USDA's Natural Resource and Conservation Service, which guides our implementation of a rotational grazing system. Rotational grazing creates an opportunity for cattle to intensely graze pastures, thereby compounding carbon sequestration while naturally decreasing weed and invasive species growth.

If producers have learned anything, it is that there is no one size fits all, no silver bullet solution. Cattle producers across the Nation

effectively implement voluntary conservation practices with technical assistance from USDA and land grant universities. The benefit of technical assistance is its personalized approach. Local NRCS employees work with agricultural producers to implement a suite of conservation practices best suited to fit each individual need.

Voluntary conservation practices supported by research and implemented by producers with technical assistance are the keys to increasing efficiency and resilience. The American cattle herd provides an incredible environmental benefit through unmatched ability to upcycle byproducts. Upcycling being defined as a concept of using discarded materials to create a higher value product.

In addition to the cattle's ability to turn grass into a nutrient dense protein, cattle also upcycle other byproducts when they move from pasture to the feed yard. Ninety percent of the cattle feed yard diet is human inedible. At Redstone Feeders, we feed a byproduct of an ethanol called distiller's grain. By feeding distiller's grain to cattle, not only do we provide the animals with an essential set of nutrients, but simultaneously reduce the greenhouse gas emissions.

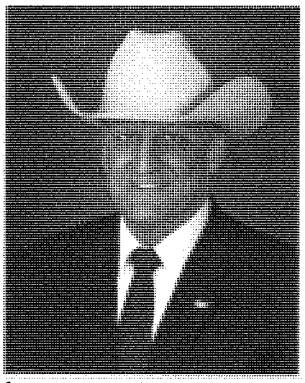
Distiller's grain is just one example. There are many byproducts that are fed to cattle to enhance their diet in a safe and efficient manner, including potato peelings, bakery trimmings, even byproducts of chocolate.

NCBA was a founding member of the U.S. Roundtable for Sustainable Beef. The roundtable is a multi-stakeholder organization which aims to demonstrate and improve beef sustainability. The roundtable began with a discussion on how we, as members of the beef value chain, can directly and measurably impact sustainability. This approach is unique from previous sustainability efforts, because it is anchored by the institutional knowledge of America's cattle producers.

Farmers and ranchers are America's original conservationists. We provide a safe and affordable beef supply, and we work hard every day to ensure that we can pass our operations on to the next generation.

Thank you, and I look forward to your questions.

[The prepared statement of Mr. Wilkinson follows:]



Todd Wilkinson

National Cattlemen's Beef Association
2019 Policy Division Vice Chairman

Todd Wilkinson is a co-owner and operator of a commercial cow-calf operation with his son, Nick Wilkinson in De Smet, S.D. He is also a co-owner of Redstone Feeders, a family owned cattle feeding and finishing operation.

In addition, Wilkinson has practiced law for more than 35 years, specializing in estate planning and agricultural law. He is a graduate of Augustana College and USD School of Law. His firm, Wilkinson & Schumacher, is sought after by landowners (cow-calf, stocker and feeder segments) across the state when they are facing legal challenges.

Over the years, Wilkinson has been heavily involved in local, state and national leadership roles. During his time on the South Dakota Cattlemen's Association Board he had many roles including president in 2015-2016. Wilkinson has also served on numerous NCBA committees as well as the Environmental Working Group, Traceability Working Group and Cattle Marketing Working Group. Wilkinson served as NCBA Region VII Policy Vice President for two years.

Wilkinson is a founding member and current Vice President of the South Dakota Cattlemens Foundation.

He is married to Jean and they have three children and seven grandchildren.

Testimony

on behalf of the

National Cattlemen's Beef Association

with regard to

"Reducing Emissions While Driving Economic Growth: Industry-led Initiatives"

submitted to the

United States Senate
Committee on Environment and Public Works
Subcommittee on Clean Air and Nuclear Safety

Mike Braun, Chairman

submitted by

Todd Wilkinson
Co-Owner
Redstone Feeders, LLC
Co-Owner
Wilkinson Livestock LLC
Policy Division Vice Chairman
National Cattlemen's Beef Association

October 17, 2019
Washington, D.C.

Good morning, Chairman Braun and Ranking Member Whitehouse. My name is Todd Wilkinson. I am involved in a cow/calf operation with my son and am part-owner of a commercial feedyard with my brothers in De Smet, South Dakota. Redstone Feeders finishes cattle after their time on pasture. Over the years, every step in the beef supply chain has taken steps, with the help of valuable research, to intentionally increase efficiency while simultaneously reducing our environmental footprint. Thank you for the opportunity to testify before the subcommittee today.

Farmers and ranchers face increasing pressure from consumers to be socially responsible, while balancing existing needs to remain environmentally conscious and economically viable. According to the U.S. Environmental Protection Agency, direct emissions from beef cattle represent just two percent of our country's greenhouse gas emissions. The United States has some of the lowest greenhouse gas emissions from the cattle industry – 10 to 50 times lower than cattle sectors from other countries around the world. Our low emissions are not accidental– America's cattle producers work hard to implement new technologies and practices that reduce our environmental impact, while simultaneously increasing efficiency. But this evolution and innovation only comes with freedom to research, experiment, and implement. Climate policies that *unfairly* target cattle producers fail to recognize the positive role of cattle and beef in a healthy, sustainable food system. Rather than adopting misguided policies that threaten the viability of farmers and ranchers, we want to shift the conversation. American beef production and consumption is a climate change solution.

Cattle graze on over 660 million acres in United States – nearly one third of our nation's continental land mass. This acreage not only feeds cattle but also naturally sequesters carbon, a benefit compounded by ruminant grazing. Grazing builds deep root systems in prairie grasses, which improve soil health. Healthy soils retain more water, sequester more carbon, and increase the resiliency of our ranches.

Methane emissions from cattle are part of the natural methane cycle. Cattle consume grasses and then emit methane, through belches, as part of the ruminant digestive process. Within 10 years, more than 90% of that methane combines with oxygen in the atmosphere and converts to CO_2. The CO_2 is then absorbed by grasses via photosynthesis, those grasses are eaten by cattle, and the process starts over. Methane has no long-term impact on the climate when emissions and oxidation are in balance. And this balance has been maintained for centuries: the buffalo population that roamed prior to the European settlement is estimated to be near equal to today's cattle population. The U.S. cattle population has not contributed to a significant increase in methane emissions and, according to the USDA's Agricultural Research Service, is not a significant contributor to climate change.

While cattle are an incremental contributor to America's overall greenhouse gas emissions, our industry works to become more efficient every day, partly through managed grazing systems. My operation developed a grazing management plan with the Department of Agriculture's Natural Resource Conservation Service (NRCS) which guides our implementation of a rotational grazing system. Rotational grazing creates the opportunity for cattle to intensely graze pastures, thereby

compounding carbon sequestration benefits. Additionally, systematic grazing allows producers to naturally decrease weed and invasive species growth. The grazing management plan is just one example of the many conservation tools that cattle producers have at their disposal.

Over generations, if cattle producers have learned anything, it's that there is no "silver bullet" solution – no one size fits all approach. Grazing management plans provide an excellent example. While increased soil health is a top priority for every cattle producer, so is the protection of wildlife habitat. In many areas today, ranches are the last natural area, protecting wildlife from being completely squeezed out by urban encroachment. A variety of wildlife species, from large ungulates to small pollinators, benefit from the open spaces uniquely provided by working ranches. Preserving large, unbroken landscapes is critical to habitat conservation and the ultimate success of local wildlife. When ranchers are regulated out of business, these vast lands are often divided and sold in small parcels, greatly impeding species' migratory habits. Wildlife depend on the work that we do to maintain water sources, foster robust forage production, and keep landscapes intact. Cattle producers consider every potential factor (animal welfare, carbon sequestration, wildlife benefits, water quality, etc.) when making any decision on their operation. A grazing management plan does not directly translate to "intensive rotational grazing," but instead means that every producer should implement a suite of practices that best fits the needs of their operation, their cattle, and their environment.

Beyond improving the land, cattle ranchers utilize various technologies to increase cattle efficiency, thereby improving our carbon footprint. Through genetic testing, we determine which of our bulls has superior traits to enhance meat quality, feed efficiency, and growth—in addition to mothering ability, docility, fertility and calving ease. Efficiency traits directly affect beef sustainability; an animal that reaches harvest faster and produces a high-quality meat product will have a lower overall environmental impact. The first predictors of a cow's breeding potential in the 1980s were simple: the weights of each animal were taken and used them to predict their mature size and the mature size of their calves. Today, producers can take a DNA sample to predict genetic calving capability. Currently, we see micro-level improvement, but over the years, increased herd efficiency will lead to macro-level progress.

The American cattle herd is unmatched in its ability to upcycle waste and byproducts. "Upcycling" is the concept of using discarded materials to create a higher value product. In addition to cattle's ability to turn inedible grass into a nutrient dense protein product, cattle also upcycle other byproducts when they move from the pasture to the feedyard. Ninety percent of what cattle consume during their time at the feedyard is human-inedible. At Redstone Feeders, cattle upcycle a by-product of ethanol production called distillers grain. Previously, this product was discarded at a landfill, but beef nutrition researchers found that it could be fed in measured quantities to cattle, providing a new source of protein. Beef nutritionists began helping producers formulate rations to use this new resource instead of discarding it as waste. Distillers grain provides protein to cattle, uses the corn by-product to efficiently feed animals, thereby preventing the creation of additional greenhouse gases. Distillers grain is just one example. There are many by-products that are fed to cattle to enhance their diet in a safe and efficient manner, including potato peelings,

bakery trimmings, and even by-products of chocolate. Do you remember the news story about the truck load of discarded Skittles candy that was taken to a dairy farm to be used as feed? Some people questioned why we would feed candy to cows, but a cow's rumen is filled with specialized bacteria that needs a variety of sugar to live and be able to digest the grass and plant material she eats. Skittles can be good for cows when fed in a balanced diet, and better still those discarded candy pieces didn't end up in the trash! According to the USDA's Office of the Chief Economist, food waste is the single largest component going into municipal landfills, driving landfills to their position as the third largest source of methane emissions. Cattle's ability to upcycle byproducts significantly reduces our landfill and food waste emissions.

Ranchers continually work to improve the health and well-being of their animals, implementing new technology whenever possible. Antibiotics are an important technology used to maintain cattle health, allowing animals to utilize feed and water resources efficiently. A sick animal takes longer to gain weight and reproduce, creating a larger net environmental footprint. Additionally, the addition of FDA-approved growth promotants to an animal's diet improve overall environmental impact, both directly and indirectly. Ionophores are feed additives which improve feed efficiency and reduce methane emissions by improving rumen bacterial fermentation. Used effectively, growth promotants assist in not only further reducing the cattle industry's carbon footprint, but also water, fertilizer, and feed use. These technological enhancements are vital to increasing efficiency and therefore environmental impact of the nation's cowherd. This technology allows us to produce the same amount of beef today that we were producing in the 1970's with 33 percent fewer animals.

In an effort to assist producers in taking incremental steps toward increasing their economic viability and decreasing their environmental footprint, NCBA was a founding member of the U.S Roundtable for Sustainable Beef (USRSB). USRSB is a multi-stakeholder organization which aims to demonstrate and improve beef sustainability. The USRSB is the product of previous failed attempts to define "sustainability" in the beef industry, the result of which were ineffective, top-down approaches that left cattle producers disinterested and disenfranchised. USRSB changed this. It began from a discussion on how we, as members of the beef value chain, can directly and measurably impact sustainability. The Roundtable brought together a broad swath of stakeholders-cattle ranchers and feedyards who comprise the majority of the membership; retailers like McDonald's, Arby's, Wendy's; beef packers and processors; and environmental non-governmental organizations and universities. USRSB is unique from previous beef sustainability efforts because it is anchored by the institutional knowledge of America's cattle producers. USRSB recently released its Framework for Beef Sustainability and is encouraging operations all along the beef value chain to measure their individual impact of key areas in sustainability: Water Resources, Land Resources, Air & Greenhouse Gas Emissions, Efficiency & Yield, Animal Health & Wellbeing, and Employee Safety & Wellbeing.

Cattle producers lead the conversation when it comes to environmental sustainability – USRSB is just one example. The USRSB Framework allows our industry to highlight not only our advances in recent generations, but also opportunities for improvement. It demonstrates our commitment to

doing right by the land, responsibly raising animals, caring for the people who raise beef, and making money to support our families and the next generation of beef producers.

Cattle producers across the nation continuously work to improve our operations with technical assistance from USDA and land grant universities. USDA-NRCS not only provides technical assistance to farmers and ranchers who wish to implement conservation practices, but cost-share funding through its Environmental Quality Incentives Program (EQIP) and Conservation Stewardship Program (CSP). The benefit of technical assistance is its personalized approach: local NRCS employees work with agricultural producers to implement a suite of conservation practices best suited to fit the individual needs of each operation. Many of the solutions supported by NRCS' Conservation Technical Assistance are the product of land grant university research and extension. Cover Crop research is a perfect example. While cover crops have been used by generations to limit soil erosion and increase carbon sequestration, these benefits grow exponentially when producers utilize seeds that are the most compatible with their soil type and regional climate. Soil type varies significantly across the United States, but also across individual states, or even on one farm. Thanks to advances in cover crop research, producers are able to achieve the greatest benefit from their conservation practices. Voluntary conservation practices, supported by research and implemented by producers with technical assistance, are the key to increasing efficiency and resilience.

The U.S. cattle industry is proud of its history as stewards of our nation's natural resources. The industry takes very seriously its obligation to protect the environment while providing the nation with a safe and affordable beef supply. Cattle producers are America's original conservationists, and we work hard every day to ensure that we can pass our operations on to the next generation. My family, and the entire American cattle producing community, is committed to remaining environmentally, economically, and socially sustainable for generations to come.

Senate Committee on Environment and Public Works
Subcommittee on Clean Air and Nuclear Safety
Hearing entitled, *"Reducing Emissions while Driving Economic Growth: Industry-led Initiatives"*
October 17, 2019
Questions for the Record for Mr. Wilkinson

Senator Braun:

Mr. Wilkinson, earlier this year, the Senate Agriculture Committee held a hearing on Climate Change and Agriculture. During that hearing, witnesses testified about the incredible level of efficiency achieved by American ranchers.

For example, an American dairy cow can produce about 23,000 pounds of milk each year. In Mexico, it takes up to five cows to produce that same amount of milk, and in India, it takes up to 20.

On the crop side, not only are our farms more efficient, but they are aided by advances in biotechnology which allow farmers to reduce their use of pesticides and water, while at the same time increasing yields per acre of field.

1. *Since the United States cannot make a significant impact on global temperatures alone, this is an international issue. If the world is truly serious about the climate, they should prefer American agriculture. Do you agree?*

In an effort to remain economically viable while considering environmental and social concerns, agricultural producers in the United States have significantly evolved their production practices to sustainably meet growing food demand. United States food production, and specifically beef production, is more efficient than any other country in the world. Our efficiencies are primarily due to our producers' ability to implement emerging technologies combined with North America's preferable landscape.

Farmers and ranchers in the United States utilize technological advances to increase efficiency and reduce overall environmental footprint. Cattle herd genetics is a primary example. When breeding, ranchers consider the efficiency with which animals convert forage to muscle, in addition to docility, mothering ability, and calving ease. Passing along traits that encourage efficiency improves a rancher's long-term sustainability. Efficient cattle consume less forage and produce less waste in order to achieve necessary weight gain. These benefits are compounded by improved feeding practices. FDA-approved growth promotants increase efficiency, thereby reducing enteric fermentation emissions, water use, and waste output. Ionophores are feed additives that improve feed efficiency while reducing methane emissions by improving rumen bacterial fermentation. Improved herd genetics and feed efficiency allow America's cattle industry to produce the same amount of beef as in 1977 with 33% fewer cattle. These technological advances are made possible by important research at both the federal and state levels.

While technological advances continue to improve herd efficiency, America's natural landscape give our cattle producers an unprecedented advantage. A significant portion of global cattle production emissions are the product of deforestation activities. Global entities should distinguish U.S. cattle production from other countries around the world, because our producers do not deforest in order to create grazing acreage. The United States has natural prairies and rangeland, allowing ranchers to raise cattle without removing forests. America's natural landscape, combined with efforts by producers to further increase production efficiency, makes U.S. beef production preferable to other countries around the world.

2. *If the federal government took a too heavy-handed approach at trying to force farmers to cut emissions faster than the market would permit, do you think we would see U.S. producers being replaced in the market by less efficient foreign imports?*

Americans eat the same amount of beef today as in 1909, keeping domestic demand relatively steady. However, demand continues to increase among developing countries. As nations become wealthier, they turn to higher quality protein options. Worldwide beef demand is not likely to slow or reverse in the coming generations. While the United States raises just over nine percent of the world's cattle population, we produce twenty percent of the world's beef supply. In considering ways to increase climate resiliency, Congress should be mindful of American cattle producers' contribution to the world food supply. Regulatory efforts that stifle beef production in the United States do not reduce global beef demand. Should Congress limit the ability of America's cattle raisers to produce beef, demand will be met by other countries using less sustainable practices. As the population grows and more countries gain access to beef, American cattle producers are in the best possible position to meet this demand in a sustainable manner.

Senator BRAUN. Thank you.
Mr. Macchiarola.

STATEMENT OF FRANK MACCHIAROLA, VICE PRESIDENT OF DOWNSTREAM AND INDUSTRY OPERATIONS, AMERICAN PETROLEUM INSTITUTE

Mr. MACCHIAROLA. Thank you, Chairman Braun, Ranking Member Whitehouse, and Senator Capito. Thank you for the opportunity to testify this morning.

The subject of today's hearing raises important policy questions affecting our Nation's economic strength, energy security, and environmental stewardship. How we address these topics will have meaningful implications for our Nation's future and our standing globally.

Over the past decade, the United States has experienced a dramatic transformation in our energy landscape. Ten years ago, energy analysts and policymakers spoke in terms of energy scarcity with the expectation that we would predominantly be importing natural gas from the Middle East, Russia, and West Africa to meet our growing energy demand. On the petroleum side, a similar picture was emerging, with projections of flat domestic production and growing dependence on foreign sources of oil.

As a result of oil and natural gas industry innovation, and the advancement of engineering technologies, such as hydraulic fracturing and horizontal drilling, we speak today in terms of energy abundance, and our Nation's energy future is bright. Domestic oil production has risen from 5 million barrels per day in 2009 to now more than 12 million barrels per day today. On the natural gas side, U.S. production of natural gas has increased by more than 50 percent over the last decade, with natural gas deliveries to electric power consumers doubling since 2004.

American oil and gas development and production from unconventional shale resources has fundamentally changed the energy landscape while creating economic growth and significant employment opportunities across the country. And congressional leadership to end the crude oil export ban has favorably reshaped our Nation's energy security posture.

The U.S. is poised to remain the world's leading producer of oil and natural gas, which will continue to help strengthen our economy and national security for years to come. Challenges remain, however. And the oil and natural gas industry is committed to meeting these head on. One such challenge includes addressing the risks associated with global climate change through collaborative efforts of private industry, Government, and the public.

The oil and natural gas industry is focused on solutions to help reduce greenhouse gas emissions, while ensuring access to affordable and reliable energy that helps enhance our standard of living around the world. At the same time, the U.S. has become the leading producer of natural gas, CO_2 emissions here at home have declined to their lowest levels in a generation. From 2005 to 2017, the U.S. economy grew by 20 percent, while CO_2 emissions fell by 14 percent overall.

In addition to reductions in emissions of CO_2, the growth of natural gas in power generation over the last several years has led to

significant reductions in nitrogen oxide, sulfur dioxide, and particulate matter emissions, contributing to cleaner air for all Americans.

Importantly, while we have experienced a dramatic increase in U.S. production of natural gas, emissions of methane from our industry have decreased over the past 20 years. The story here is the same. We have accomplished positive environmental outcomes by advancing technologies that ensure we are capturing both VOCs and methane.

Our industry has been at the forefront of innovation, developing technologies to reduce emissions from hydraulic fracturing completions, storage tanks, pneumatic controllers, and leaks. We have worked directly with the EPA since the early days of the Obama administration in 2010 to ensure that EPA's regulations incorporate these and other effective emissions reductions requirements. And we continue to support these regulatory requirements.

Our industry has also established the Environmental Partnership, a program for continuous improvement in environmental performance with an initial focus on VOC and methane emission reductions. There are currently 67 companies participating in the program, including 18 of the 20 top natural gas producers. Companies in the partnership agree to implement emission reduction programs for leaks, pneumatic controllers, and for liquids unloading operations.

On the downstream side of our industry, more than 98 percent of vehicles on the road use our fuels to conduct commerce, commute to work, go on vacation, and visit loved ones. Today this is done with cleaner fuels that allow automobile manufacturers to build engines that reduce emissions. This progress has helped drive significant reductions of major air pollutants, even as vehicle miles traveled have tripled.

A strong natural gas sector and a strong oil sector is essential to our Nation. Our industry supports 10.3 million jobs in nearly 8 percent of the U.S. economy. More importantly, the men and women who work in our industry are committed to providing reliable and affordable energy, and to protecting the environment. After all, they live in the communities in which they work. Through a balanced approach that promotes innovation and smart regulation, we can provide affordable, abundant energy that Americans rely upon. And we can do it with an emphasis on environmental protection and stewardship.

Thank you, and I look forward to your questions.

[The prepared statement of Mr. Macchiarola follows:]

Frank Macchiarola
Vice President, Downstream and Industry Operations, American Petroleum Institute (API)

Frank J. Macchiarola is the vice president of Downstream and Industry Operations at the American Petroleum Institute (API). Mr. Macchiarola joined API in January 2016, where he leads association efforts on fuels, refining, marketing and downstream safety, security and technology.

Prior to joining API, Mr. Macchiarola served as Executive Vice President of Government Affairs at America's Natural Gas Alliance (ANGA).

From 2004 to 2013, Mr. Macchiarola served in several senior staff positions in the United States Senate including Staff Director, Minority Staff Director, and Counsel to the U.S. Senate Committee on Energy and Natural Resources, and Minority Staff Director of the U.S. Senate Committee on Health, Education, Labor, and Pensions.

Mr. Macchiarola was previously a partner in the policy resolution group at Bracewell & Giuliani LLP and he began his career as an associate in the litigation group of a New York City law firm.

Mr. Macchiarola earned his B.A. from the College of the Holy Cross and his J.D. from New York University School of Law.

Frank Macchiarola
Vice President, Downstream and Industry Operations
American Petroleum Institute
The Senate Committee on Environment and Public Works,
Subcommittee on Clean Air and Nuclear Safety
October 17, 2019

The 600 member companies of API represent all facets of America's oil and natural gas industry. Our industry supports 10.3 million American jobs and 7.6 percent of gross domestic product. We also provide most of the energy America needs to power our economy and support our way of life.

Innovation is the lifeblood of our industry. We have successfully developed and advanced technologies to safely and responsibly explore for and produce the oil, natural gas, and natural gas liquids that are vital to every aspect of our economy. This includes the application of emissions reduction technologies to capture both volatile organic compounds (VOCs)and methane. The refining side of our industry likewise continues to invest in emissions reduction technologies. U.S. refiners are producing cleaner gasoline and diesel fuels which, coupled with advanced vehicle technologies, means today's new cars, SUVs and pickup trucks are about 99 percent cleaner for common pollutants than vehicles in 1970. Cleaner fuels played a significant role in a 73 percent reduction of the six Clean Air Act Criteria Air Pollutants between 1970 and 2017 – even as vehicle miles traveled increased 189 percent. Furthermore, the development of ever cleaner fuels is exemplified in our industry's investment in the supply of very low sulfur fuel oil for the marine shipping industry and our support for International Maritime Organization (IMO) 2020 to drive down emissions of sulfur oxides. Because of American ingenuity and engineering prowess, the U.S. is not only firmly established as a global energy superpower, but also as a driver of technologies, best practices and products designed to elevate environmental performance.

Thanks to American technology and innovation, we have witnessed a dramatic transformation of the energy landscape over the past 10 years, both here in the US and globally. Looking back

10 years ago, we spoke in terms of energy scarcity and the expectation was that we would be importing billions of dollars of natural gas from places like the Middle East, Russia and West Africa. The outlook was the same on the petroleum side, with the U.S. expected to see onshore oil production declining or flattening with limited upside potential expected in the deeper waters of the Gulf of Mexico, and a continued and significant dependence on imports expected for years to come.

Fortunately, because of innovation and the advancement of the engineering technologies of hydraulic fracturing and horizontal drilling, we have experienced an energy resurgence and the U.S. is now the world's largest producer of both oil and natural gas. Clearly, we now speak in terms of energy abundance. This has brought with it tremendous benefits for everyday Americans, as we as a nation rely on oil and natural gas in everything that we do – from getting to work and getting our kids to school, to heating and cooling our homes, to using our stovetop to put dinner on the table.

As both the U.S. and global economies grow, the U.S. – with its abundant supplies – now provides economic and energy stability to domestic and global markets through continued and expanded production of oil and natural gas. But our leadership does not stop there. We are also leaders in environmental performance.

As early as 1999, the Department of Energy (DOE) recognized the environmental benefits provided by hydraulic fracturing. In its report titled *Environmental Benefits of Advanced Oil and Gas Exploration and Production Technology,* hydraulic fracturing was identified as an advanced completion and stimulation technology. DOE recognized environmental benefits from the technology to include: increased recovery, lower waste volumes, fewer wells drilled (more resource contacted and ability to drill multiple wells from a single well pad), protection of ground water resources, and less surface disturbance. A June 2016 report from the Western Energy Alliance and the Petroleum Association of Wyoming, titled *Gaining Ground,* shows how technological advances in drilling techniques and operations have dramatically lowered surface

disturbance, which reduces impacts on wildlife and minimizes habitat fragmentation. Today, operators are able to do ever more with less, minimizing their environmental footprint and protecting the surrounding environment.

Our industry is also leading the way in successfully tackling emissions and the story here is the same: we have accomplished this by advancing the technologies to ensure that we are capturing VOCs and methane, which is the primary component of natural gas. We have demonstrated that the solution to addressing methane emissions is through the development and application of technologies through innovation. While oil production has more than doubled since 2005 and natural gas production has increased by nearly 70 percent over the same time period, our industry has developed and implemented technologies and best practices to help drive our emission rates down significantly. Furthermore, from 2000-2016, the U.S. oil and natural gas industry has invested more than $108 billion in low and zero greenhouse gas emission technologies including renewable energy sources, advanced technology vehicles, fugitive gas reduction technologies, combined heat and power, carbon capture and storage, and basic and applied research. Our country has seen its carbon dioxide emissions drop to the lowest levels in 25 years, and this is directly attributable to industry leadership and the increased use of clean-burning, abundant, affordable natural gas in power generation.

Our industry uses a collaborative approach to advancing solutions to any issue that may arise, whether it be an issue related to production, safety, habitat conservation, air, water or waste. The establishment and growth of The Environmental Partnership ("The Partnership") is a tremendous example of our industry working together in a process of learning, collaborating and taking action, and this important program has helped to drive strong environmental performance for the broader industry.

The Partnership is a new coalition of oil and natural gas production companies, which came together recognizing that more could be accomplished through a collective effort, with the

participating companies actively committing to continuously improve the industry's environmental performance. The program started with 26 participants at the end of 2017 and has significantly grown to 67 members strong, representing every major onshore production basin in the U.S. The program includes the largest U.S. energy producers as well as the smallest energy producers among its participants. Participants include 18 of the top 20 natural gas producers in the country, and 32 of the top 40. This is quite impressive considering The Partnership has only been around for a short time, and this demonstrates industry's continued commitment to emissions reduction.

The program is built upon three key principles: taking action, learning about best practices and technologies, and fostering collaboration. The Partnership's initial focus is to further reduce the industry's air emissions. That means further reducing methane, a greenhouse gas, and volatile organic compounds which can lead to the formation of ground level ozone.
To accomplish this, The Partnership developed three separate Environmental Performance Programs that participating companies are implementing to further reduce emissions from operations. Companies are using advanced monitoring technologies to find and repair leaking equipment, replacing or modifying higher-emitting process control equipment, and implementing best practices to minimize emissions associated with the removal of liquids from natural gas wells as they age.

In July, The Partnership released its first Annual Report to track and share program participants progress, as well as highlight our performance programs, and the learning and collaboration fostered by The Partnership. One of the most important aspects of The Partnership has been the three performance programs that participants are implementing, focused on making improvements regarding the three primary sources of industry methane emissions. According to EPA data, the three primary sources of industry methane emissions are equipment leaks, pneumatic control devices and leaks that may occur when excess liquids are unloaded from a natural gas well.

Participants in The Partnership's Leak Detection and Repair Program reported a leak occurrence rate of just 0.16 percent, or 1.6 components for every 1,000, and that figure comes from more than 156,000 surveys across more than 78,000 production sites. This is an important signal that ongoing industry efforts to identify and fix emissions sources are working.

Other data is also encouraging. In 2018, The Partnership companies replaced, retrofitted or removed from service more than 3,000 high-bleed pneumatic controllers, which leak small amounts of natural gas as part of their normal operations. This is on top of the 28,000 pneumatic controllers that were already replaced by participating companies prior to 2018. Today, 38 companies in The Partnership report that they have completely removed these controllers from their operations.

In addition, participants in The Partnership reported monitoring more than 132,000 manual liquids unloading events in 2018. This type of monitoring makes a big impact in ensuring that natural gas and its components like methane are not unnecessarily released into the atmosphere.

We know these actions are making a difference. EPA estimates have shown that finding and fixing leaks can lead to a 40% emissions reduction. Replacing high-bleed pneumatic controllers with an alternative device can lead to a 60% reduction in emissions, and likely much greater. In fact, between 2011-2017, producers of oil and natural gas reduced methane emission rates by nearly 60% across four large natural gas producing regions (Anadarko, Appalachian, Eagle Ford and Permian), even as output increased significantly.

Equally as important as its performance programs, however, are The Partnership's efforts to foster greater learning and collaborating within the industry. The Partnership held workshops in the Permian and in Oklahoma City this year. In 2018, The Partnership conducted workshops in Pennsylvania, Texas and Colorado. All of these workshops provided the industry with the opportunity to take a closer look at the latest technologies and best practices being used to

detect leaks. These workshops were open to any oil or natural gas producer and included lengthy question-and-answer periods where company representatives freely shared knowledge gained from their experiences in the field.

The Environmental Partnership and its companies also benefited from collaboration with METEC, a research and testing facility located at Colorado State University. The Partnership provided a grant and helped to facilitate research that METEC was undertaking into optical gas imaging cameras, and also organized a tour for companies of the METEC site.

Critical to the progress The Partnership has made is its model for information sharing and collaboration on technologies and techniques to reduce methane emissions. The feedback on the experience of our participants is telling. For example, we've heard from smaller operators that otherwise wouldn't have access to the kind of resources or information on cutting edge technology to reduce their environmental impact.

When one smaller company became involved with The Partnership, they were still finalizing their emissions detection and repair program. Through The Partnership, they were able to learn from and collaborate with larger and various other companies who already had successful programs in place. Being able to see the depth and details of those programs helped springboard their own, enabling the company to operate their facilities at a higher level. These opportunities to learn, collaborate and take action in order to responsibly develop our nation's essential oil and natural gas resources are at the foundation of The Partnership's mission.

Our industry's innovation has also played a constructive role in the development of the regulatory framework for addressing emissions. API's working relationship with EPA is a constructive one that has enabled industry to share information about rapidly changing technologies while hosting site visits so that EPA staff can best understand emissions sources and how to control them. The U.S. energy revolution is a technology revolution, with extensive innovations for addressing emissions that include reduced emission completions, low-emission

valves and leak detection through sophisticated optical gas imaging cameras. Our industry has been using many of these technologies for years. EPA's own regulations now incorporate many of these innovations and API supports having these regulatory emission control requirements in place.

API and the oil and gas industry have also been at the forefront of developing guidance documents for estimating greenhouse gas emissions from operations and for sustainability reporting. In 2001, API was among the first organizations in the world to release guidance for estimating GHG emissions from oil and natural gas operations, a tool that is vital for understanding emissions so that we can take steps to manage and reduce them. Soon after issuing that important guidance, API released its SANGEA software platform for estimating and reporting greenhouse gas emissions, an important tool that's relied upon around the world for calculating and compiling GHG emissions and energy usage data from exploration and production, gas processing, refining and marketing, petrochemicals, transportation, electricity consumption, manufacturing, coal mining, and other activities. On top of that, API has collaborated with IPIECA and the International Oil & Gas Producers Association, two global industry organizations, in the publishing of *Oil and Gas Industry Guidance on Voluntary Sustainability Reporting*, a critical tool that guides the industry in its reporting of GHG emissions.

In addition, through its Global Industry Services Division, API drives safety, environmental protection, and sustainability across the oil and gas industry by setting world-class standards and best practices, and administering certification, training, events, publications, and safety programs for global industry operations. API was formed in 1919 as a standards-setting organization and is the global leader in convening subject matter experts to establish, maintain, and distribute consensus standards for the oil and gas industry. Environmental and operational safety is at the core of the energy development that's critical to America's economy and energy security – something that can be seen in the more than 700 standards API developed in its first 100 years, including the 100-plus exploration and production standards created or

strengthened since 2010. API standards have been cited 750 times in U.S. EPA, OSHA, Coast Guard, FTC, PHMSA, and BSSE regulations. API standards have been referenced about 225 times by regulatory bodies.

The commitment and progress of the U.S. oil and natural gas industry to safe and responsible operations positions our country very well for continued production of the oil and natural gas Americans need here at home. As recent events in Saudi Arabia demonstrate, U.S. energy production strengthens our energy and national security and helps put downward pressure on prices, while also providing many thousands of new jobs for Americans and billions of dollars in additional revenue for our government. According to the Energy Information Administration (EIA), we produced an average of 5 million barrels of oil a day in 2008, and we are now producing over 12 million barrels per day. Simultaneously, we have reduced the amount of oil that we import. But we can and should do more.

As we have seen throughout this current energy resurgence, increased production of U.S. oil and natural gas drives many benefits for the country, including billions of dollars in capital investments, creation of thousands upon thousands of well-paying jobs, continued improvement in our balance of trade, and increased energy security for the U.S. and our allies abroad. U.S. production has reached a point where it provides an effective buffer against unplanned supply disruptions in the global crude oil market. The recent attack on the Saudi oil processing facility immediately took more than 5 million barrels of oil off the global market, yet the global market exhibited newfound resilience that is directly attributable to the U.S. oil boom.

Market disruptions are not new. According to the Energy Information Administration (EIA), market disruptions reached 3.6 million barrels per day in May 2016, and more recently reached 3.3 million barrels a day in February and July of this year. U.S. production growth has made all the difference in mitigating against these disruptions, helping to offset the loss from unplanned

production outages around the world and put downward pressure on prices to the great benefit of American consumers and businesses.

Fundamentals of economics are quite evident in oil and natural gas markets, with growing U.S. supplies putting downward pressure on the price of oil and natural gas. The Henry Hub price of natural gas has remained at $6.00 per mmBtu or less since December 2008, with most months since then with an average price in the $2 to $4 range. Abundant supplies of natural gas in the U.S. and the ability of U.S. producers to efficiently produce these resources has led the EIA and other analysts to predict that natural gas prices will remain relatively low for many years. Between 2007 and 2017, household energy spending fell 10.5 percent, even while expenditures for health care, education and food increased significantly.

Similarly, the price of crude oil has declined significantly. The spot price for West Texas Intermediate crude oil averaged $95 per barrel in January 2014. By December 2014 it was down to $59, and in January 2016 it was at $32. According to EIA, in 2017 drivers saved an average of $220 per capita in fuel costs compared with 2007. Even with the recent events in the Middle East, the price of West Texas Intermediate has recently remained near $60 per barrel. Affordable energy helps drive the economy, and affordability comes with increased access to U.S. oil and natural gas supplies.

The U.S. energy boom has also been a catalyst to resurgent manufacturing and petrochemical sectors, which rely on low cost energy to fuel operations and on natural gas and natural gas liquids as feedstocks for production. For example, the American Chemistry Council (ACC) identified 334 chemical industry investment projects valued at $204 billion that have been announced as of May 2019. According to ACC, during peak investment years, these projects could support 431,000 jobs and $292 billion in new economic output by 2025.

To maintain these benefits, we must plan for the future, and the most sensible approach is to pursue safe and responsible energy development here at home. Given expected global

economic and population growth, more total energy will be needed both in the U.S. and globally. The EIA forecasts that U.S. energy demand will grow by 9 percent between 2017 and 2050, with more than two-thirds of the energy demand expected to be met by oil and natural gas, as is the case today.

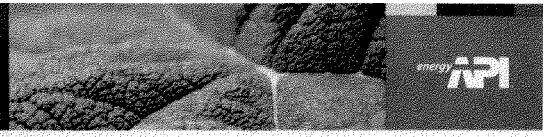
Globally, the change in energy demand is much greater and, when it comes to liquid petroleum products, the U.S. competes on a global basis for these resources. Recent forecasts by the International Energy Agency (IEA) estimate that the global economy from 2017 to 2040 will require an expansion of over 11 million barrels per day in global oil supplies. The growth in demand for natural gas worldwide is expected to be even larger, increasing by 44 percent from 2017 to 2040. Despite significant growth of renewable energy and improvements in energy efficiency, in 2040 more than half the world's energy demand is projected to be met by oil and natural gas, as is the case today.

In the U.S., we have a tremendous resource base with which to meet our growing energy needs. Based upon conservative estimates, we have enough oil and natural gas resources to fuel more than 200 million cars for 50 years and heat 70 million households for more than four centuries. And there is very likely much more oil and natural gas than previously known in areas where the industry has been unable to explore, and new technologies allow us to access resources previously thought unreachable. The Bureau of Ocean Energy Management estimates that there is more than 50,000 Tcf of gas hydrates in-place in the lower 48 states. That's more than 1,500 years of consumption.

Technological innovations and industry leadership have propelled the oil and natural gas industry forward. Additionally, the oil and natural gas industry remains committed to smart regulatory structures that promote safety, environmental protection, and responsible operations and also provide the flexibility to incentivize innovation and enhance the deployment of new technologies.

In his book "The Quest", the Pulitzer-prize winning historian Daniel Yergin points out that "[p]olicies related to access to energy and its production can have major impact on the timeliness of investment and the availability of supply – and thus on energy security." Seventy-eight percent of U.S. voters support increased domestic oil and natural gas production. We know that Americans also expect that we produce our energy with safeguards for our workers, communities and the environment. With the right policies and right leadership, through innovation and the deployment of advanced technologies, we can produce American oil and gas resources in a safe and environmentally responsible way, securing our own energy supplies, advancing our mutual environmental objectives, and bolstering America's economic and energy security. The success of The Environmental Partnership is proof positive of this.

API STANDARDS DRIVE ENVIRONMENTAL PROTECTION ACROSS THE OIL AND GAS INDUSTRY



Through the Global Industry Services Division, API drives safety, environmental protection, and sustainability across the oil and gas industry by setting world-class standards and best practices, and administering certification, training, events, publications, and safety programs for global industry operations.

API was formed in 1919 as a standards-setting organization and is the global leader in convening subject matter experts to establish, maintain, and distribute consensus standards for the oil and gas industry.

Environmental and operational safety is at the core of the energy development that's critical to America's economy and energy security – something that can be seen in the more than 700 standards API developed in its first 100 years, including 330 exploration and production standards created or strengthened since 2010.

- API standards have been cited 750 times in U.S. EPA, OSHA, Coast Guard, FTC, PHMSA, and BSSE regulations
- API standards have also been referenced about 225 times by regulatory bodies in China, UAE, Russia, Mexico, Brazil, India, U.K. and Canada

API ENVIRONMENTAL STANDARDS*

PUB. TYPE	#	TITLE
RP	49	Recommended Practice for Drilling and Well Servicing Operations Involving Hydrogen Sulfide
RP	50	Natural Gas Processing Plant Practices for Protection of the Environment
RP	51	Onshore Oil and Gas Production Practices for Protection of the Environment
RP	51R	Environmental Protection for Onshore Oil and Gas Production Operations and Leases
RP	52	Land Drilling Practices for Protection of the Environment
RP	75	Recommended Practice for Development of a Safety and Environmental Management Program for Offshore Operations and Facilities
Bull	75L	Guidance Document for the Development of a Safety and Environmental Management System for Onshore Oil and Natural Gas Production Operations and Associated Activities
RP	96	Deepwater Well Design and Construction
RP	99	Flash Fire Risk Assessment for the Upstream Oil and Gas Industry
RP	100-1	Hydraulic Fracturing—Well Integrity and Fracture Containment
RP	100-2	Managing Environmental Aspects Associated with Exploration and Production Operations Including Hydraulic Fracturing
Bull	100-3	Community Engagement Guidelines
Std	536	Post-Combustion NOx Control for Equipment in General Refinery and Petrochemical Services
API	555	Process Analyzers
RP	1007	Loading and Unloading of MC 306/DOT 406 Cargo Tank Motor Vehicles
RP	1169	Recommended Practice for Basic Inspection Requirements—New Pipeline Construction

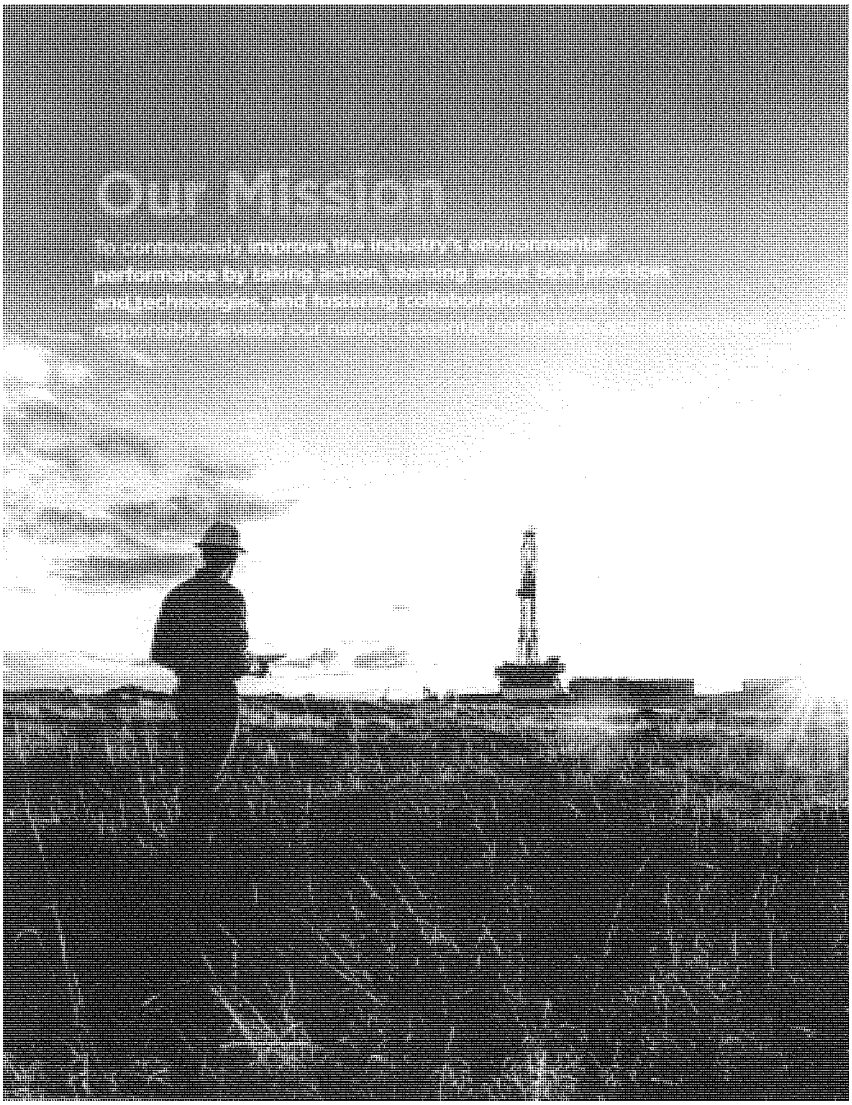
PUB. TYPE	#	TITLE
RP	1604	Closure of Underground Petroleum Storage Tanks
RP	1615	Installation of Underground Petroleum Storage Systems
Std	1631	Interior Lining and Periodic Inspection of Underground Storage Tanks
Std	2610	Design, Construction, Operation, Maintenance, and Inspection of Terminal and Tank Facilities
Publ	9100	Model Environmental, Health and Safety (EHS) Management System and Guidance Document
Publ	9100A	Model Environmental, Health and Safety (EHS) Management System
Publ	9100B	Guidance Document for Model EHS Management System
Publ	4703	Water Management and Stewardship in Midstream, Downstream, and Delivery Operations in the Oil and Gas Industry
Publ	4700	Primer for Evaluating Ecological Risk at Petroleum Release Sites
Publ	4639	Estimation of Fugitive Emissions from Petroleum Refinery Process Drains
Publ	4640	Petroleum in the Freshwater Environment: An Annotated Bibliography, 1946–1993
Publ	4641	Summary of Produced Water Toxicity Identification Evaluation Research
Publ	331	Environmental Performance Indicators: Methods for Measuring Pollution Prevention
Publ	340	Liquid Release Prevention and Detection Measures for Aboveground Storage Facilities
Publ	312	Responding to Environmental Challenge: The Petroleum Industry and Pollution Prevention
DR	141	Global Emissions of Carbon Dioxide from Petroleum Sources

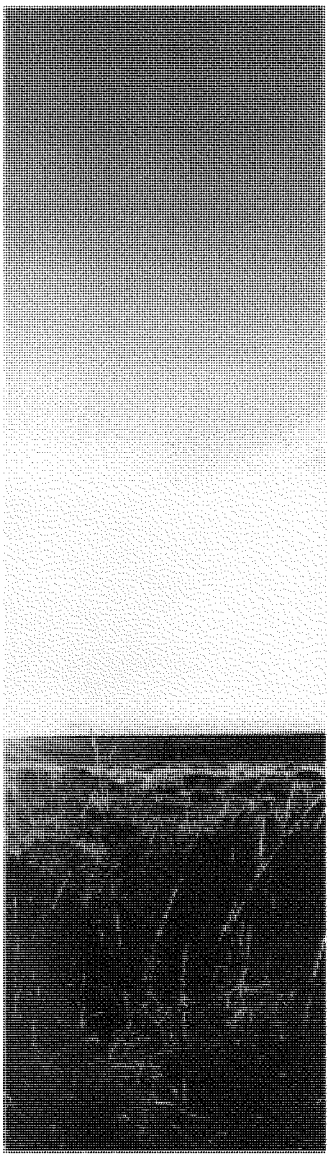
*This list highlights some of the API standards that are focused on environmental performance and best practices, but is not a comprehensive list.

ANNUAL REPORT 2019

Improving the Natural Gas and Oil Industry's Environmental Performance

THE ENVIRONMENTAL PARTNERSHIP


OUR MISSION
To continuously improve the industry's environmental
performance by fostering partnerships among local, global,
and technological and learning collaboration to serve the
regulatory, scientific and industry communities.



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Anadarko Petroleum Corporation

Joint Message from the Program Director and Chair

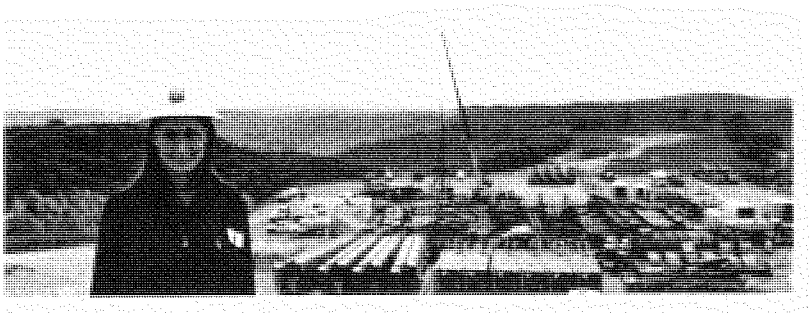
IMPROVING THE NATURAL GAS AND OIL INDUSTRY'S ENVIRONMENTAL PERFORMANCE

As the natural gas and oil industry supplies the energy needed to power America's modern economy, its continued commitment to advance environmental solutions has never been stronger. That's the context for The Environmental Partnership (The Partnership), a new coalition of natural gas and oil companies that have committed to continuously improve the industry's environmental performance.

The Partnership came together recognizing that more could be accomplished through a collective effort. The program is built upon three key principles: *taking action, learning about best practices and technologies, and fostering collaboration.* The Partnership is now comprised of **65** members representing every major onshore production basin in the U.S.

The Partnership's initial focus is to further reduce the industry's air emissions. That means continuing to reduce methane, a greenhouse gas, and volatile organic compounds (VOCs), which can lead to the formation of ground-level ozone.

To accomplish this, The Partnership developed three separate Environmental Performance Programs that participating companies are implementing to further reduce methane and VOC emissions from operations. Companies are using advanced monitoring technologies to find and repair leaking equipment, replace or modify higher-emitting process control equipment, and implement best practices to minimize emissions associated with the removal of liquids from natural gas wells as they age.



To underscore The Partnership's commitment, our participants agreed to track their progress and report annually. This report is the first time we are publicly sharing these results.

Equally as important as The Partnership's performance programs are the learning and collaborating that has been fostered. The Partnership provides a forum for competitors to become learning partners, where natural gas and oil operators large and small can share their experiences and knowledge with one another.

Additionally, collaborating with others outside the natural gas and oil industry—including regulators, researchers, and equipment manufacturers—will help build upon the natural gas and oil industry's collective understanding.

Finally, none of this is possible without the dedication of the women and men of the participating companies, and we are grateful for the enthusiasm and leadership they continue to bring to the program. While there is much more work to be done, The Partnership is a solid foundation based on effective actions upon which we will continue to build in the years to come.

We're committed to accelerating the program's progress and meeting the challenge of continually improving the industry's environmental performance.

Sincerely,

Matthew Todd
Program Director
The Environmental Partnership

Vanessa Ryan, Chevron
Program Chair
The Environmental Partnership

Message from Mike Sommers

PRESIDENT AND CEO, AMERICAN PETROLEUM INSTITUTE

The U.S. energy revolution is changing our world for the better.

Today, the U.S. leads the world in producing natural gas and oil, while simultaneously reducing methane emissions relative to production in basins across the U.S. In the Permian basin, energy production grew 100 percent from 2011–2017, while methane emissions relative to production fell nearly 40 percent. In the Eagle Ford basin, production grew 130 percent over the same time period, and methane emissions relative to production fell nearly 70 percent.

We're proud of the work of The Environmental Partnership, an industry-led initiative launched in 2017 that is leading the way to further reduce methane emissions from energy operations. **With 65 members to date, The Partnership serves as a model for industry leadership on shared environmental goals and creating pathways for new technologies** and techniques—like optical gas imaging cameras, drones and other devices—to drive down emissions, while providing the energy vital to every American family and business.

Our shared challenges are great, but so too is the commitment of the industry—through efforts like The Environmental Partnership—to build on emissions reductions achieved and pave the way for continuous improvement. Answering the dual challenge of powering innovation while meeting the world's growing energy needs and continuously improving America's environmental performance has never been more important, and we're committed to leading the way and doing our part.

Sincerely,

Mike Sommers
President and CEO
American Petroleum Institute

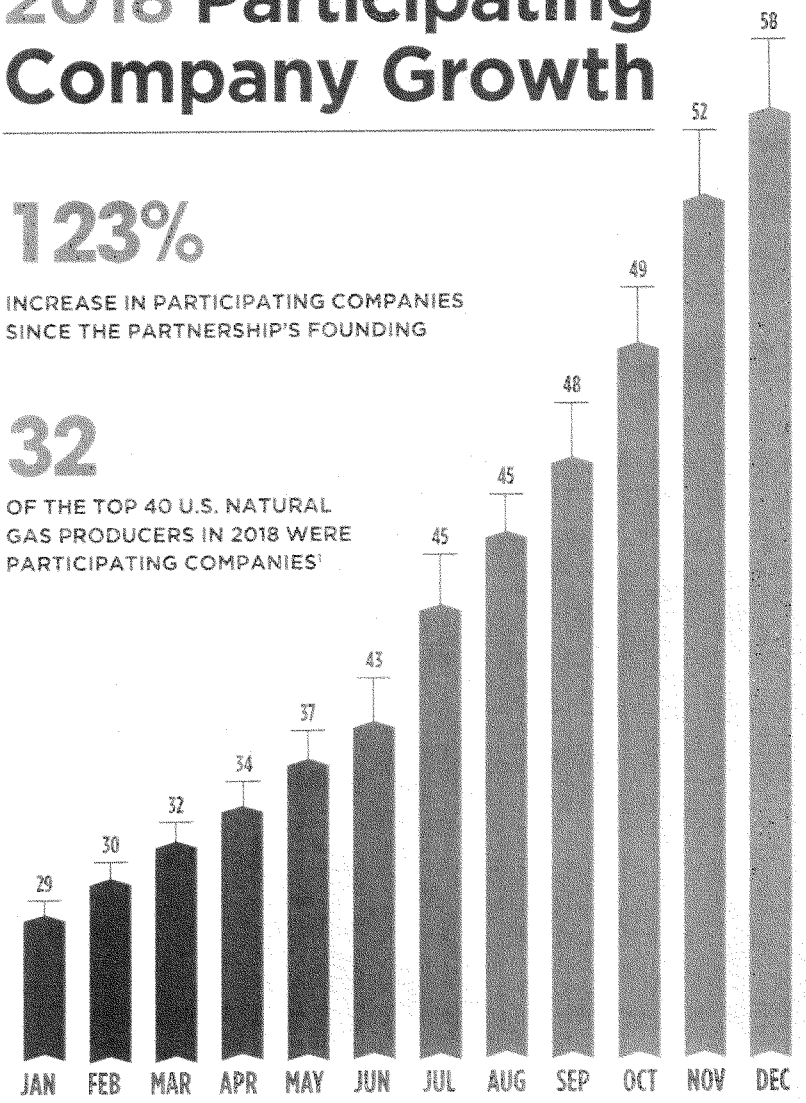
2018 Participating Company Growth

123%

INCREASE IN PARTICIPATING COMPANIES SINCE THE PARTNERSHIP'S FOUNDING

32

OF THE TOP 40 U.S. NATURAL GAS PRODUCERS IN 2018 WERE PARTICIPATING COMPANIES[1]

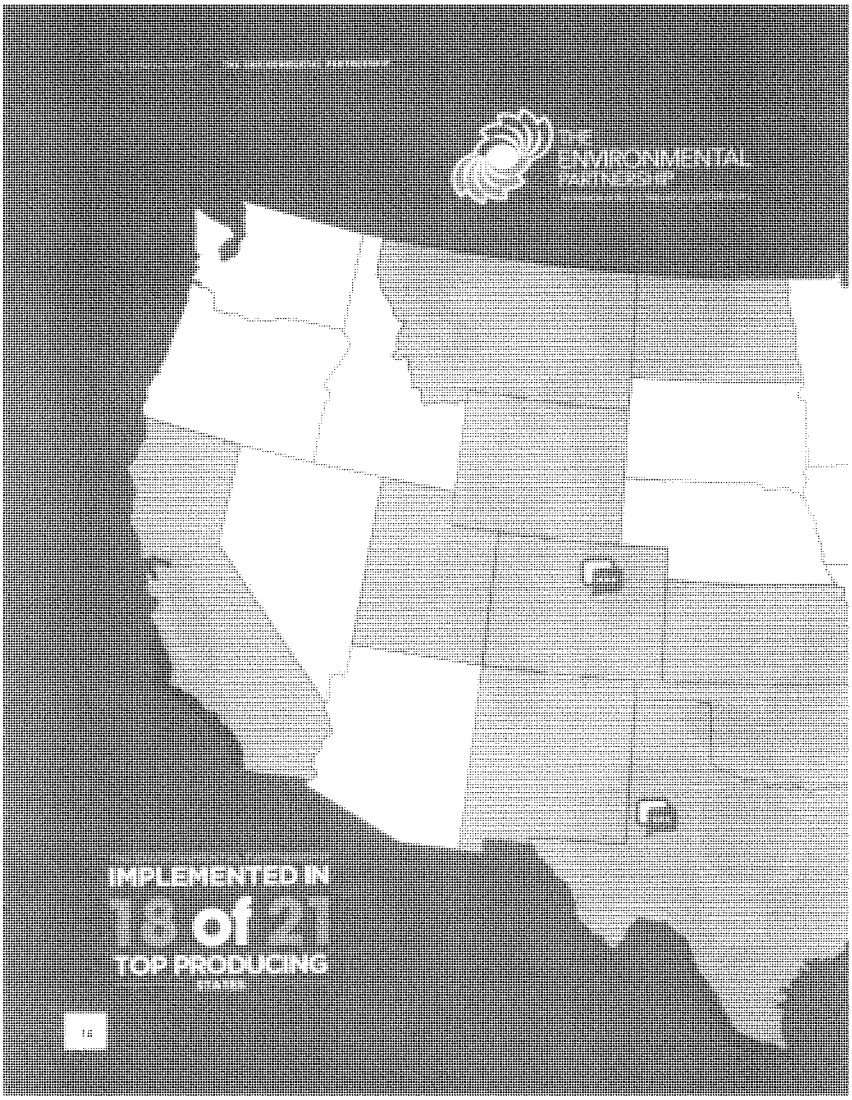


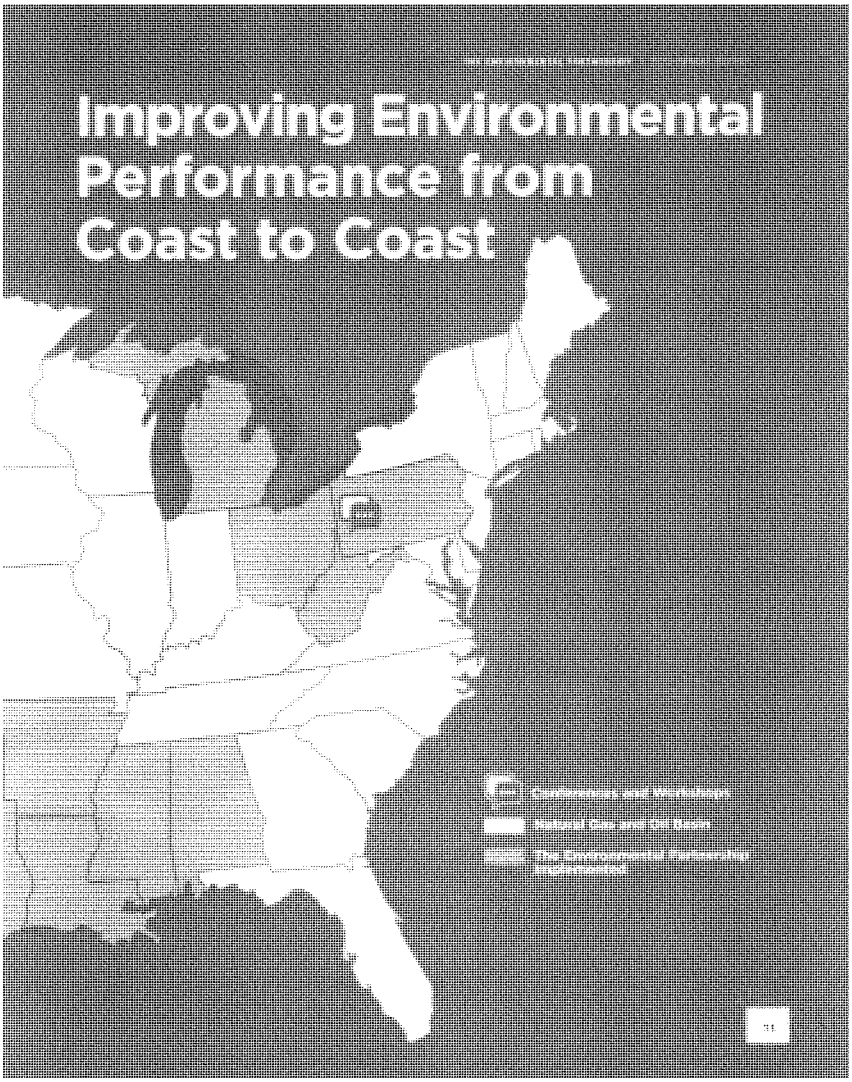
[1] http://www.mass.org/wp-content/uploads/2019/04/Equity-Q-2018-production.pdf

2018 Membership

AERA
ALTA
Anadarko
Antero
CALIFORNIA RESOURCES CORPORATION
CALLON PETROLEUM
CHESAPEAKE ENERGY
Chevron
Denbury
devon
encana
EQT Where meets innovation.
FELIX ENERGY
Gulfport ENERGY
HESS
HighPoint RESOURCES
MURPHY EXPLORATION & PRODUCTION CO.
NEWFIELD
noble energy
OASIS PETROLEUM
PENNENERGY RESOURCES
PIONEER
QEP ENERGY
RANGE RESOURCES
SENECA RESOURCES
Sequitur ENERGY RESOURCES
SM ENERGY
Western Gas Partners, LP
WHITING
WPXENERGY.

Apache
BHP
bp
Cabot Oil & Gas Corporation
CIMAREX
ConocoPhillips
CROWNQUEST
eog resources
equinor
EXTRACTION
Oil & Gas
ExxonMobil
JKLM ENERGY LLC
LIME ROCK RESOURCES
Marathon Oil
Corporation
hunt
OIL COMPANY
OXY
Occidental
PDC ENERGY
PENNSYLVANIA GENERAL ENERGY
PGE
RED BLUFF
RESOURCES
REPSOL
Riviera
Resources
SABLE
PERMIAN RESOURCES
swn
Southwestern Energy
SURGE
Energy
TOTAL
TRINITY
OPERATING
XTO
ENERGY


THE ENVIRONMENTAL DIMENSION
IMPLEMENTED IN
18 of 21
TOP PRODUCING
STATES

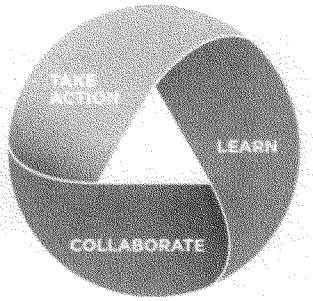

Improving Environmental Performance from Coast to Coast
Commission on Northern
Pacific Coast Land Use Planning
The Cascadia Project
Cascadia Project
11

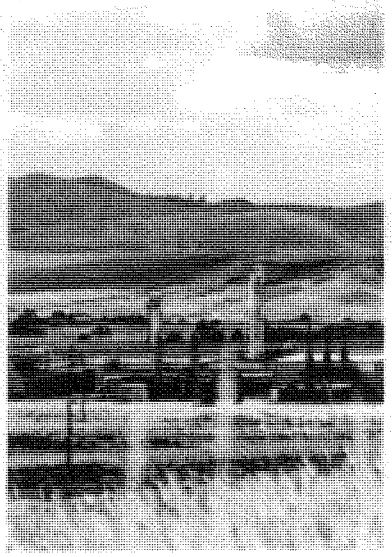
Program Summary

TARGETING EMISSIONS THROUGH COLLABORATION, PROVEN METHODS, AND ADVANCED TECHNOLOGY

MISSION

To continuously **improve the industry's environmental performance by taking action, learning about best practices and technologies, and fostering collaboration** in order to responsibly develop our nation's essential natural gas and oil resources.





PRINCIPLES

Learn
Participants have committed to continuous learning about the latest industry innovations and best practices that can further reduce their environmental footprint while safely and responsibly growing energy production.

Collaborate
Participants have committed to collaborate with one another and with academics, researchers, and regulators, on the best strategies, tools, and tactics to improve environmental performance.

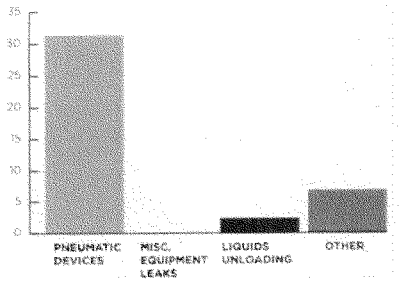
Take Action
Participants have committed to taking action to improve their environmental performance. This is being accomplished through The Partnership's three environmental performance programs, which companies can implement and phase into their operations.

Background

The U.S. natural gas and oil industry is committed to the protection of human health, safety, and the environment. Even as the U.S. is leading the world in natural gas and oil production, methane emissions have fallen, thanks to industry leadership and investment in new technologies.

Seeking to build on this success, a group of 26 natural gas and oil production companies formed The Partnership in December 2017. These companies committed to continuously improving their environmental performance.

EPA's GHGRP 2017 CH_4 Emissions (MMT CO_2E*)



*MMT CH_4 to MMT CO_2E using IPCC-AR5 GWP of 28
Source: *U.S. EPA Greenhouse Gas Reporting Program. Accessed April 29, 2019*

The Partnership is focused on reducing emissions from natural gas and oil production and is designed to evolve and advance, using innovations, science, and data to identify new initiatives to help the industry further reduce its environmental footprint, while safely and responsibly growing energy production.

Our Environmental Performance Programs

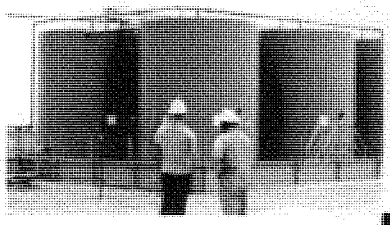
The Partnership developed three separate Environmental Performance Programs for participating companies to phase into their operations starting January 1, 2018.

These programs were selected based on EPA emissions data (see page 34) and are designed to further reduce emissions using proven, cost-effective controls targeting three of the most significant sources of emissions.

They consist of the following:

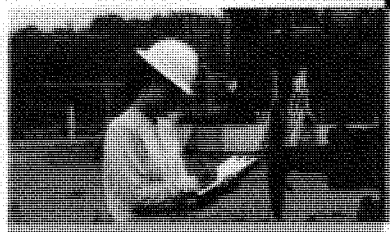
- **Leak Detection and Repair:** *Participants committed to leak monitoring, followed by timely repair, at select sites using detection methods and technologies such as portable analyzers or optical gas imaging cameras.*
- **Focus on High-Bleed Pneumatic Controllers:** *Participants committed to replace, remove, or retrofit high-bleed pneumatic controllers with intermittent, low-, or zero-emitting devices.*
- **Improving the Manual Liquids Unloading Process:** *Participants committed to implement an industry best practice that minimizes emissions associated with the removal of liquids that, as a well ages, can build up and restrict natural gas flow.*

2018 Environmental Performance Highlights



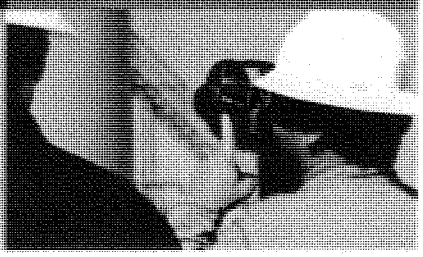
0.16%
LEAK OCCURENCE RATE

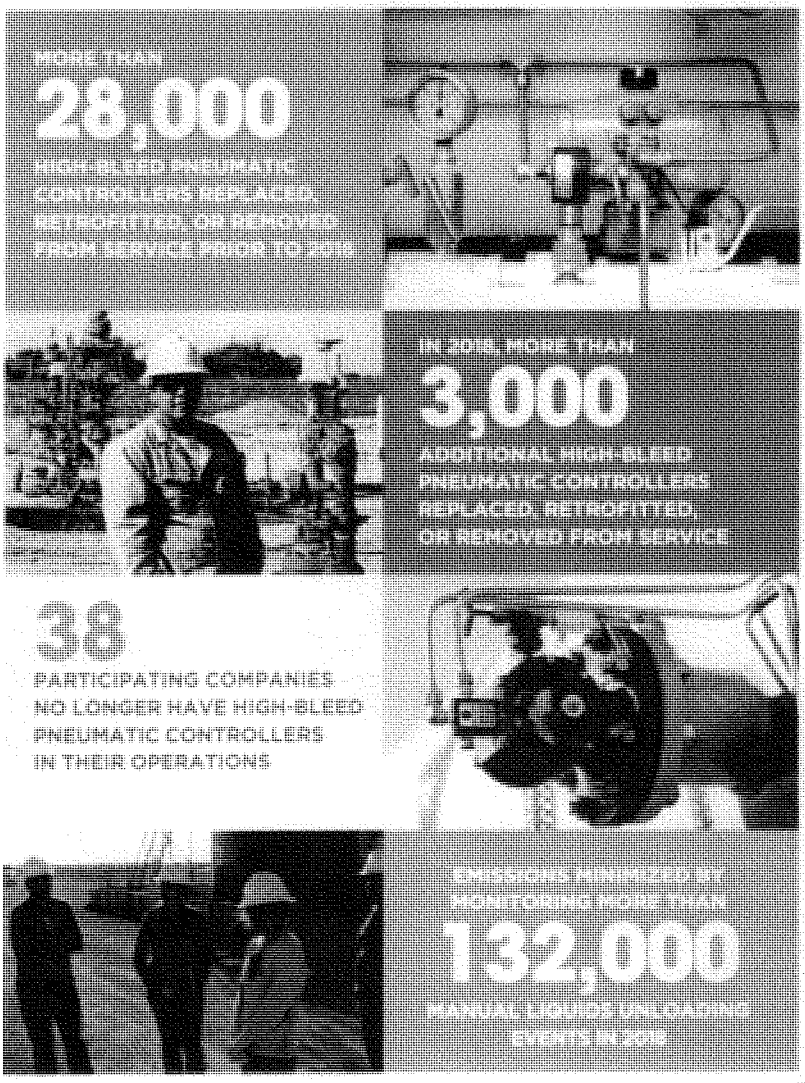
MORE THAN
78,000
SITES SURVEYED



MORE THAN
156,000
SURVEYS CONDUCTED

MORE THAN
56 MILLION
COMPONENTS INSPECTED




MORE THAN
28,000
HIGH-BLEED PNEUMATIC CONTROLLERS REPLACED, RETROFITTED, OR REMOVED FROM SERVICE PRIOR TO 2016
IN 2016, MORE THAN
3,000
ADDITIONAL HIGH-BLEED PNEUMATIC CONTROLLERS REPLACED, RETROFITTED, OR REMOVED FROM SERVICE
38
PARTICIPATING COMPANIES NO LONGER HAVE HIGH-BLEED PNEUMATIC CONTROLLERS IN THEIR OPERATIONS
ENERGYNE MINIMIZED BY MONITORING MORE THAN
132,000
MANUAL LIQUIDS UNLOADING EVENTS IN 2016

Learning Together

ACHIEVING ENVIRONMENTAL PROGRESS

Participants in the program are committed to continually learning about the latest innovations and best practices that can further reduce their company's environmental footprint while safely and responsibly growing energy production.

The Partnership's workshops are one of the primary ways we help our participants learn more about opportunities to reduce emissions. In 2018, The Partnership hosted two workshops located near major natural gas and oil basins to allow production and facility workers to attend. The workshops were open to all upstream natural gas and oil producers, regardless of whether they were active participants in the program.

These workshops were a great success, with participants learning about a variety of topics. Workers from both small and large producers attended the workshops, where they heard directly from industry and technological experts. They also had the opportunity to explore some of the latest emissions-detection technologies and ask questions of the presenters.

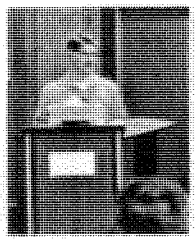
These interactions enable sharing new ideas and creating new networks, and are an important foundation for 2019 and beyond.

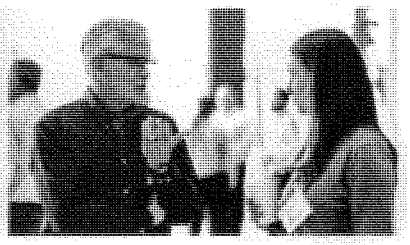
THE ENVIRONMENTAL PARTNERSHIP'S PERMIAN SPRING WORKSHOP 2018

The first spring workshop focused on reducing emissions and included a session on the foundations of implementing an effective leak-detection and repair program. This included how, through the use of readily-available software, leak surveys and results could be tracked in a company's database to ensure timely repair.

There was also a presentation on current and pending environmental regulations, and a discussion on how one company changed its approach to site designs in an effort to further reduce emissions.

This inaugural workshop included over 100 participants from more than 30 companies with operations in both New Mexico and Texas. These large and small operators focused discussions on reducing emissions in the Permian basin, one of the United States' most important regions for natural gas and oil production.





"The staff of University Lands is encouraging all oil and gas operators to consider joining The Environmental Partnership. The opportunity to participate and be recognized as a member **of this important program provides oil and gas producers with a way to collectively demonstrate the environmental stewardship that is being achieved by our industry."**

RICHARD BRANTLEY
Sr. VP Operations with University Lands

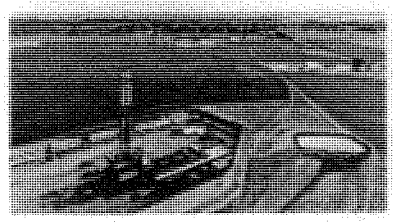
"At Encana, sustainability is exemplified in our efforts towards innovative and efficient business practices. The Environmental Partnership provides a forum for collaborating with industry partners on the use of technologies and best management practices to reduce emissions without dictating solutions. Encana's participation in **The Environmental Partnership demonstrates our commitment to reducing VOC emissions through innovation and deployment of efficient, sustainable business practices."**

MICHAEL MCALLISTER
Executive Vice President & Chief Operating Officer
Encana Services Company Ltd.

"Lime Rock strives to become an industry leader in reducing emissions. Our participation in **The Environmental Partnership allows us to collaborate with other experts in the field to assure that our programs provide the best opportunity to achieve this goal."**

C. TIM MILLER
President and COO
Lime Rock Resources

THE ENVIRONMENTAL PARTNERSHIP'S APPALACHIAN SUMMER WORKSHOP 2018



Presentations and discussions focused on program priorities and regulatory realities, including:

REGULATORY REVIEW

Summary of regulatory developments likely to impact natural gas and oil producers. One company gave a presentation on its **experience acquiring new facilities and the steps it took to ensure compliance with federal and state regulations including permitting systems and inspections. The company also discussed its firsthand experience with EPA's self-audit program and how companies can work more effectively with the EPA.**

PRO-ACTIVE LEAK DETECTION

Focused on the **importance of having robust, proactive Leak Detection and Repair (LDAR) programs. This included a hands-on look at technologies such as optical gas imaging (OGI) cameras that can be deployed for leak detection.**

PNEUMATIC CONTROLLERS

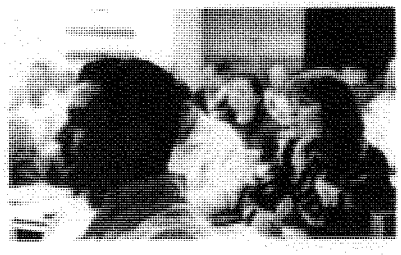
Presenters gave an overview of the **multiple types of pneumatic controllers and potential alternatives, such as instrument air compressors that use air**—rather than natural gas—to operate controllers. The presenters also discussed the considerations and costs that should be accounted for when replacing pneumatic controllers.

LIQUIDS UNLOADING

Discussion centered on several **techniques that can be employed to help minimize the environmental impacts associated with the liquids unloading process**.

CONNECTING EXPERTS

The workshop concluded with a networking lunch, where attendees had the opportunity to collaborate with one another on **ways to further reduce emissions and lessen our environmental footprint**.



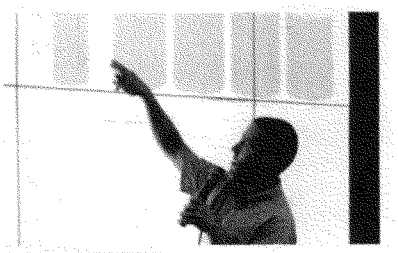
The Partnership's second workshop was held on July 26, 2018, in Canonsburg, Pennsylvania, located just outside of Pittsburgh. This region is home to the Appalachian basin, a fast-growing source of natural gas.

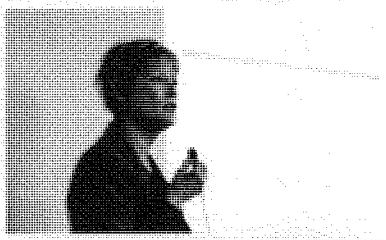
THE ENVIRONMENTAL PARTNERSHIP ANNUAL MEETING 2018

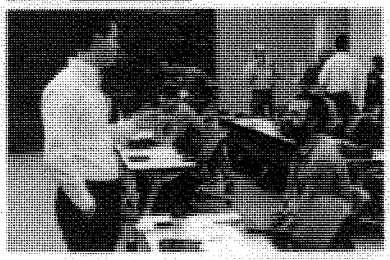
CONNECTING EXPERTS WITH OPERATORS

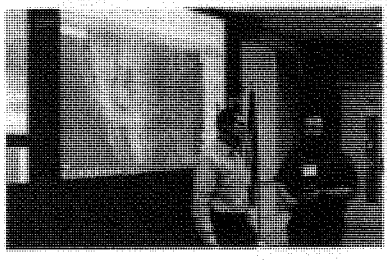
The first annual meeting focused on the science of pneumatic controllers, the regulations affecting them, and alternative power sources. During a panel discussion consisting of five natural gas and oil producers with smaller operations, producers expressed the benefits of their participation in The Partnership. Several panelists noted that **The Partnership provided them with access to experts and knowledge-sharing near major basins, which allowed nearby production and facility workers to attend.**

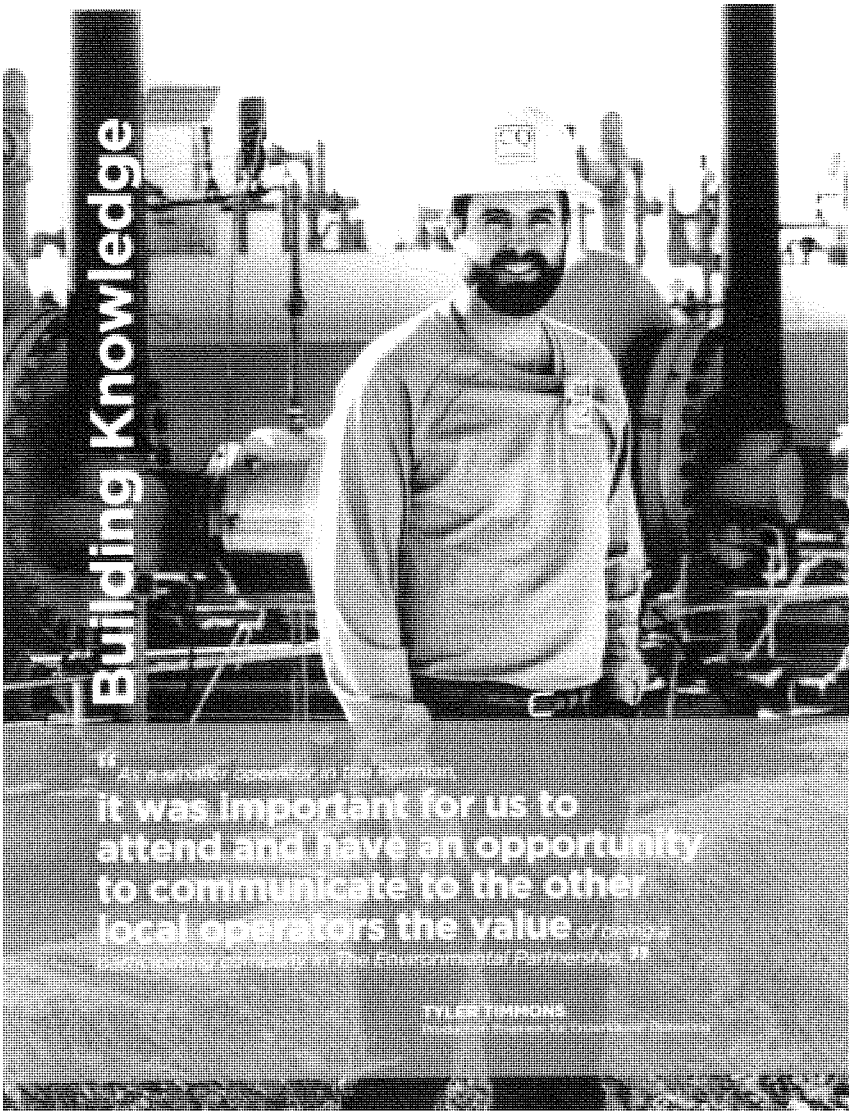
In the afternoon, the annual meeting included five presentations on pneumatic controllers, which sparked a lot of discussions among the participants.










Building Knowledge
"It was important for us to attend and have an opportunity to communicate to the other local operators the value of having a safety culture in the Petrochemical Contractors."
TYLER TWINONE
Industrial Hygienist, Petrochemical Contractors

CROWN/GIBBS FINDS VALUE IN THE ENVIRONMENTAL PARTNERSHIP'S FOCUS ON LEAK DETECTION AND REPAIR PROGRAMS

Crown/Gibbs Contracting is a leader in the installation and maintenance of underground utilities in the Southeast. Its customers include municipalities, utilities, and private companies.

The company's most recent work includes installation of gas distribution lines for the Georgia Natural Gas Expansion Project, and the Georgia Natural Gas Expansion Project, Phase II.

Crown/Gibbs's most recent environmental performance improvement initiatives include the Georgia Natural Gas Expansion Project, Phase II, and the Georgia Natural Gas Expansion Project, Phase III

Collaborating to Improve Performance

The Partnership works to bring together members of the U.S. natural gas and oil industry—as well as academics, researchers, and regulators—to collaborate on ways to improve environmental performance while responsibly developing our nation's natural gas and oil resources. Through The Partnership, we can share strategies, information, and technologies that have been most effective in reducing emissions.

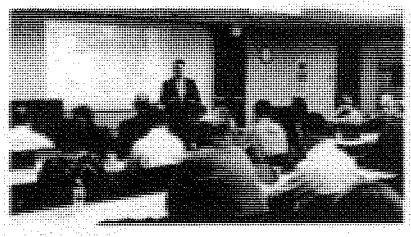
In 2018, The Partnership collaborated with outside groups in a number of ways. Our annual conference brought together industry and outside groups for thoughtful conversations about ways to work together. The Partnership also worked closely with the Methane Emissions Technology Evaluation Center (METEC) site at Colorado State University, assisting with its study of methane-detection technology.

THE ENVIRONMENTAL PARTNERSHIP'S FIRST ANNUAL CONFERENCE

PRODUCERS WITH MANUFACTURERS, RESEARCHERS, AND REGULATORS

The conference focused on pneumatic controllers and brought together producers, manufacturers, researchers, and regulators to discuss this technology and how it might be improved.

The conference included an overview of methane emissions in the industry, and noted that **pneumatic controllers are the industry's largest source of methane emissions. Building off of that context, there was information shared on industry studies and the challenges and successes with pneumatic controllers.**



An EPA official gave a presentation on the agency's efforts to study emissions from pneumatic controllers. This included an overview of federal and state regulations on pneumatic controllers, and a look at existing studies on this technology. In addition, the Colorado Department of Public Health and Environment presented an overview of a planned pneumatic controller study that the agency is undertaking.

Attendees were then treated to a panel discussion that included pneumatic controller manufacturers. **The manufacturers discussed new technologies that can help reduce methaneemissions. Many of these new controllers are powered by electricity, instrument air or mechanical devices.** They also discussed common malfunctions and how they can be fixed or prevented.

A final presentation was given by the METEC at Colorado State University. This included a look at the facility's ongoing research of methane-detection technologies and the progress they have made.

The Partnership's first annual conference was held on October 10, 2018, in Denver, Colorado.

METEC SITE PROVIDES IMPORTANT TOOLS FOR PARTNERSHIP COLLABORATION

The METEC site at Colorado State University is an **innovative facility designed to help evaluate new technologies to detect and quantify methane emissions at natural gas and oil production sites.** The facility is constructed so that researchers can precisely control field conditions, giving them the ability to more accurately test detection equipment. **At METEC, natural gas can be released at a known rate and then detection equipment is tested to determine if it is correctly identifying the leak source.**

A variety of methane-sensing methods are tested at METEC, including cameras, sensors, drones, helicopters, airplanes, and satellites. This testing gives natural gas and oil producers information about new leak-detection technologies and the knowledge of how to best utilize them.

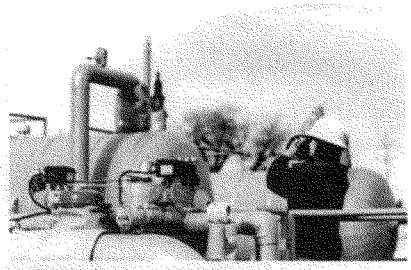
THE ENVIRONMENTAL PARTNERSHIP ASSISTS WITH OPTICAL GAS IMAGING CAMERA STUDY

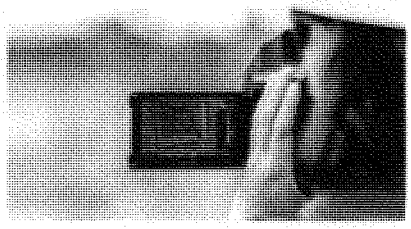
In 2018, The Partnership collaborated with METEC on a study to help optimize the use of optical gas imaging (OGI) cameras. OGI cameras use highly sensitive thermal-imaging technology to detect fugitive emissions of natural gas.

The portable nature of these cameras make them ideal for use at natural gas production sites. Having access to more data about the cameras' capabilities helps researchers to better develop protocols for their optimal use.

To help complete this data and enhance the use of these cameras, **The Partnership supported additional field testing by METEC on OGI cameras. METEC was able to operate additional testing days where OGI camera operators were able to bring their cameras to the site for testing and data collection. Many participants in The Partnership were able to take advantage of this opportunity, test their equipment, and share their valuable data during this window. That data is now being analyzed so that natural gas producers can better employ this important technology.**

PARTNERSHIP PARTICIPANTS VISIT METEC SITE FOR HANDS-ON DEMONSTRATIONS





Public/private collaboration is critical in ensuring that all sectors are working together toward the common goal of an even cleaner environment.

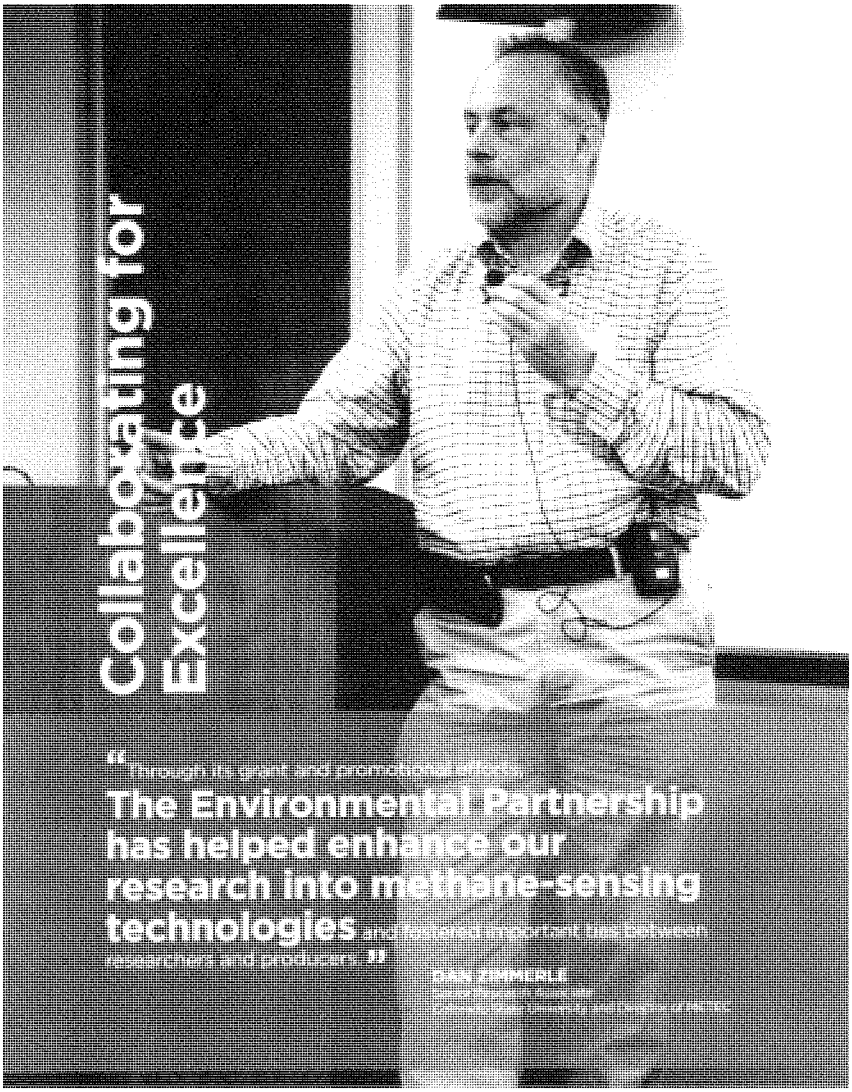
Through site visits, **The Partnership and METEC are bringing together academia, researchers, and industry experts to share information and improve data and technology.** METEC itself is a collaborative project supported by the Advanced Research Projects Agency-Energy (ARPA-E), a government agency that promotes and funds the research and development of advanced energy technology.

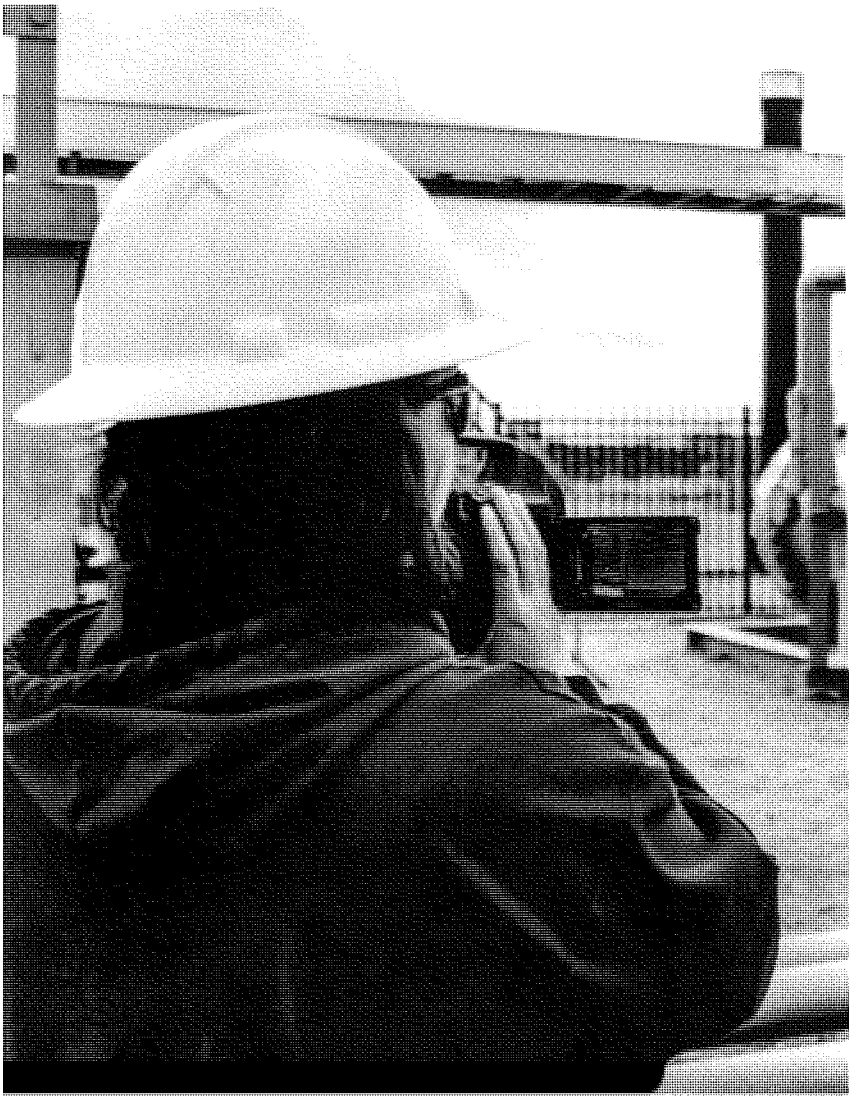
"We recognize the challenge of providing the energy the world needs while reducing emissions.
The Environmental Partnership aligns with our own longstanding commitment to reduce emissions while meeting global energy demand."

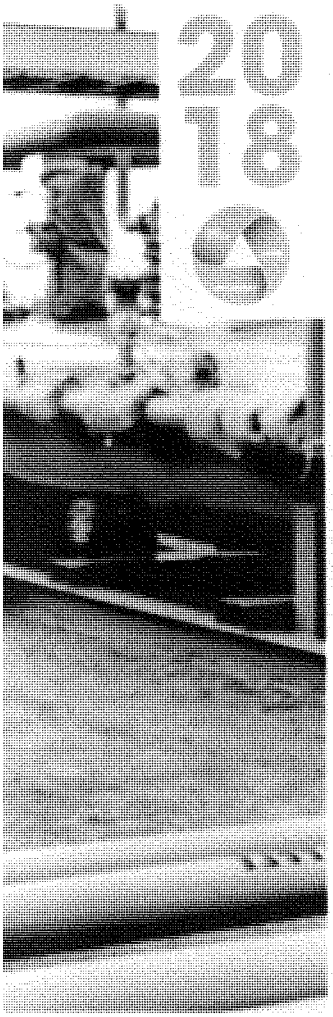
STAALE GJERVIK
Senior VP Unconventional, ExxonMobil and President, XTO Energy

"Participation in The Environmental Partnership demonstrates our **commitment to further reduce our overall methane profile.**
The Environmental Partnership's programs will play a complementary role to our ongoing work in reducing emissions, providing a platform for collaboration with other participants, other experts and share best practices while we learn from one another."

THOMAS E. JORDEN
President and CEO
Cimarex


Collaborating for Excellence
“Through its good and innovative offices,
The Environmental Partnership has helped enhance our research into methane-sensing technologies and facilitated a much-needed bridge between researchers and producers.”
DAN FORNALE





Taking Action

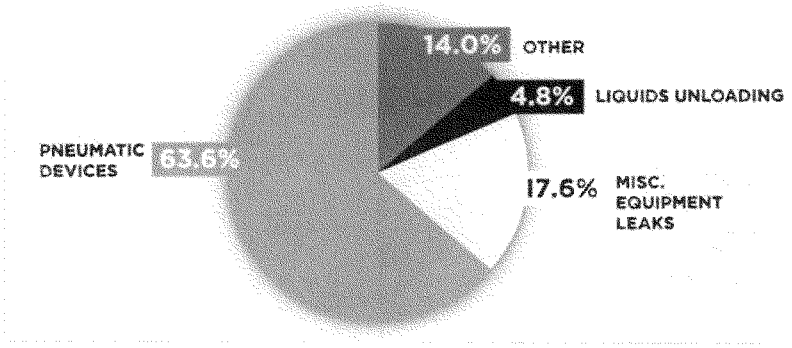
PARTICIPANTS ARE IMPLEMENTING PROGRAMS THAT ACHIEVE SIGNIFICANT EMISSIONS REDUCTIONS IN THESE AREAS.

Our participants are committed to taking real and concrete steps to help further reduce our industry's environmental footprint.

The Partnership's initial focus is on reducing emissions of methane and volatile organic compounds (VOCs). Methane is the second-most abundant greenhouse gas, emitted both in nature and via human activity. **Because methane is the primary constituent of natural gas, minimizing its release is important to industry from an environmental and business standpoint.** VOCs are naturally occurring compounds containing carbon that can be emitted along with methane during natural gas production. This is an important target for emissions reductions because they are a precursor to ground-level ozone formation and smog.

The Partnership studied available data and research about the source of industry emissions, including the EPA's Greenhouse Gas Reporting Program (GHGRP). According to GHGRP, the three primary sources of industry methane emissions are pneumatic devices, equipment leaks, and leaks made during the liquids unloading process.

U.S. EPA GREENHOUSE GAS REPORTING PROGRAM



EPA's GHGRP 2017 CH_4 Emissions MMT CO_2E (total%)
Source: *U.S. EPA, Greenhouse Gas Reporting Program. Accessed April 29, 2019*

Based on the highest sources of methane emissions in EPA's analysis (above), The Partnership created three performance programs—one for each emissions source. These performance programs are designed to help producers better locate the source of these emissions and then take corrective measures to stop or reduce them. Participants have the option of participating in one or more of these programs and have committed to reporting annually on their progress. Participation in these programs began on January 1, 2018.

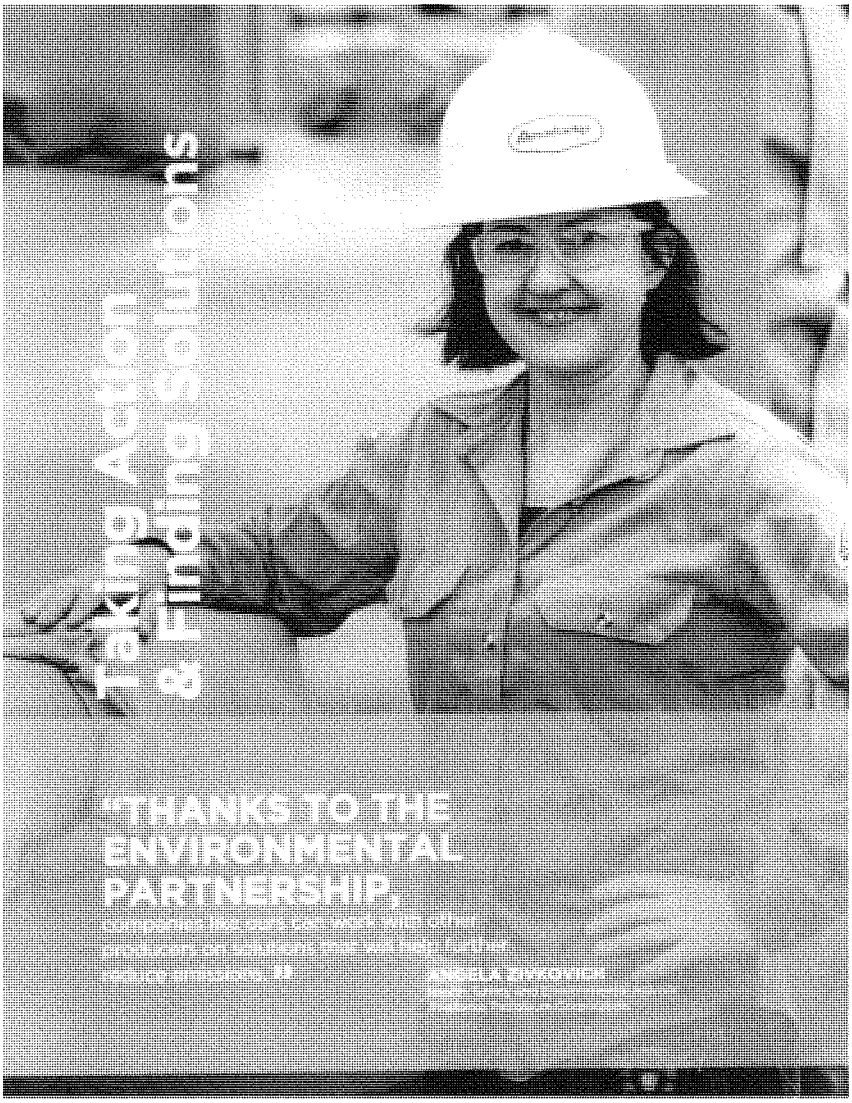
These performance programs are one of the most critical components of The Partnership. **Through these programs, we are making real progress in reducing emissions and helping to ensure we are responsible stewards of our environment.**

"Occidental employs cutting-edge technologies and processes to contribute to the decline in methane emissions and to achieve exemplary safety and environmental performance. Our participation in The Environmental Partnership is an extension of Occidental's continuing commitment to conducting its business in a manner that protects the health and safety of people and the environment at its facilities and in the communities where we operate. The learnings from The Partnership workshops has been valuable to Occidental."

VICKI HOLLUB
President & CEO
Occidental Petroleum Corporation

"Shell is a proud member of The Environmental Partnership in part because it provides a smart strategic framework with **measurable and sustainable programs. It's a unique platform that showcases industry efforts to do more to reduce methane emissions.** We are excited by the continued growth of this important voluntary effort."

GRETCHEN WATKINS
President
Shell Oil Company


Taking Action
& Finding solutions
"THANKS TO THE
ENVIRONMENTAL
PARTNERSHIP,
AREEA DIXONIA

TAXIDIC ACTION PRINCIPLE

1 LEAK-DETECTION AND REPAIR PROGRAM

Under The Partnership's leak-detection program, participants will utilize the latest technology and increase their efforts to detect and capture fugitive emissions at their facilities. Natural gas production and transportation involves miles of pipelines and a significant number of valves, flanges, and connections. The industry is already investing heavily into maintaining this vital infrastructure, but the use of enhanced technologies will make it possible to further locate and repair leaks that could be emitting methane and VOCs into the atmosphere.

Participants will implement initial monitoring at selected sites using instrument methods and technologies such as portable analyzers or optical gas imaging (OGI) cameras to detect fugitive methane emissions.

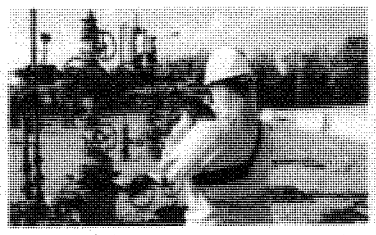
Program Specifics

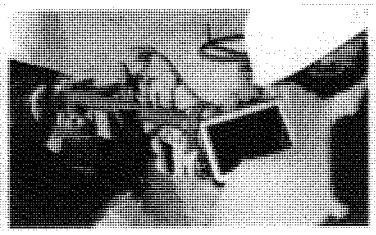
EMISSIONS SOURCE:
Company plan will outline criteria for site selection *(e.g. percent production, number of sites, etc.)*.

METHOD:
OGI camera, portable analyzer, or other instrument/technology.

TIMELINE:
Phased in, initiated within 18 months with all participating sites covered within a maximum five-year period.

REPAIR PERIOD:
Completed within 60 days unless delay of repair is required to wait until the next scheduled shutdown or pending part availability.





Leak Detection Program

THE ENVIRONMENTAL PARTNERSHIP

0.16%
LEAK OCCURENCE RATE

MORE THAN
78,000
SURVEYS CONDUCTED

MORE THAN
56 MILLION
COMPONENTS INSPECTED

MORE THAN
156,000
SITES SURVEYED

2 PNEUMATIC CONTROLLER PROGRAM

Pneumatic controllers, frequently used at remote or automated industry facilities, utilize gas pressure to operate mechanical devices. Even through normal operations, these controllers can release small amounts of methane and VOCs into the atmosphere. Pneumatic controllers are used widely in the industry and thus comprise a major source of emissions.

IN 2018, MORE THAN

3,000

ADDITIONAL HIGH-BLEED PNEUMATIC CONTROLLERS REPLACED, RETROFITTED, OR REMOVED FROM SERVICE

38

PARTICIPATING COMPANIES NO LONGER HAVE HIGH-BLEED PNEUMATIC CONTROLLERS IN THEIR OPERATIONS

MORE THAN

28,000

HIGH-BLEED PNEUMATIC CONTROLLERS REPLACED, RETROFITTED, OR REMOVED FROM SERVICE PRIOR TO 2018

Program Specifics

EMISSIONS SOURCE:
Existing onshore gas-powered, continuous, high-bleed pneumatic controllers located at upstream onshore production and gathering facilities as well as natural gas processing plants.

METHOD:
These controllers will be replaced, removed or retrofitted with one of the following technologies:

- *Continuous-low-bleed controller*
- *Intermittent-vent controller*
- *Electrically operated controller and valve actuator or mechanical controller*
- *Convert to compressed air to replace natural gas as the motive gas*
- *Remove from service where feasible with no replacement*

Exceptions will be granted if a pneumatic controller cannot be replaced due to safety or operational reasons.

TIMELINE:
Commitment to meet 100% replacement goal within five years.

3 MANUAL LIQUIDS UNLOADING PROGRAM

Over time, liquid can accumulate inside natural gas wells and impede the flow of gas. These liquids must then be removed or "unloaded" so that gas production is not inhibited. During manual liquids unloading, the flow of natural gas from the well is diverted to an atmospheric vent. This can cause the wellbore pressure to change, allowing liquids to rise to the surface without the assistance of automated equipment. Without careful monitoring, this process can allow some methane and VOCs to be released into the atmosphere.

Program Specifics

EMISSIONS SOURCE:
Existing onshore gas well sites that conduct manual liquids unloading operations.

METHOD:
Operators will monitor the manual unloading process and close all wellhead vents to the atmosphere. This method does not apply to the following operations: swabbing, plunger lifts, or episodes where remaining on site might be considered a safety hazard.

EMISSIONS MINIMIZED BY MONITORING MORE THAN

132,000

MANUAL LIQUIDS UNLOADING EVENTS IN 2016

Acknowledgement

We would like to thank all of the dedicated individuals that contribute to The Environmental Partnership, and look forward to the future as we continue to welcome new companies, including:

AMERICAN PETROLEUM PARTNERS

ASCENT RESOURCES

Continental RESOURCES

equitrans Midstream

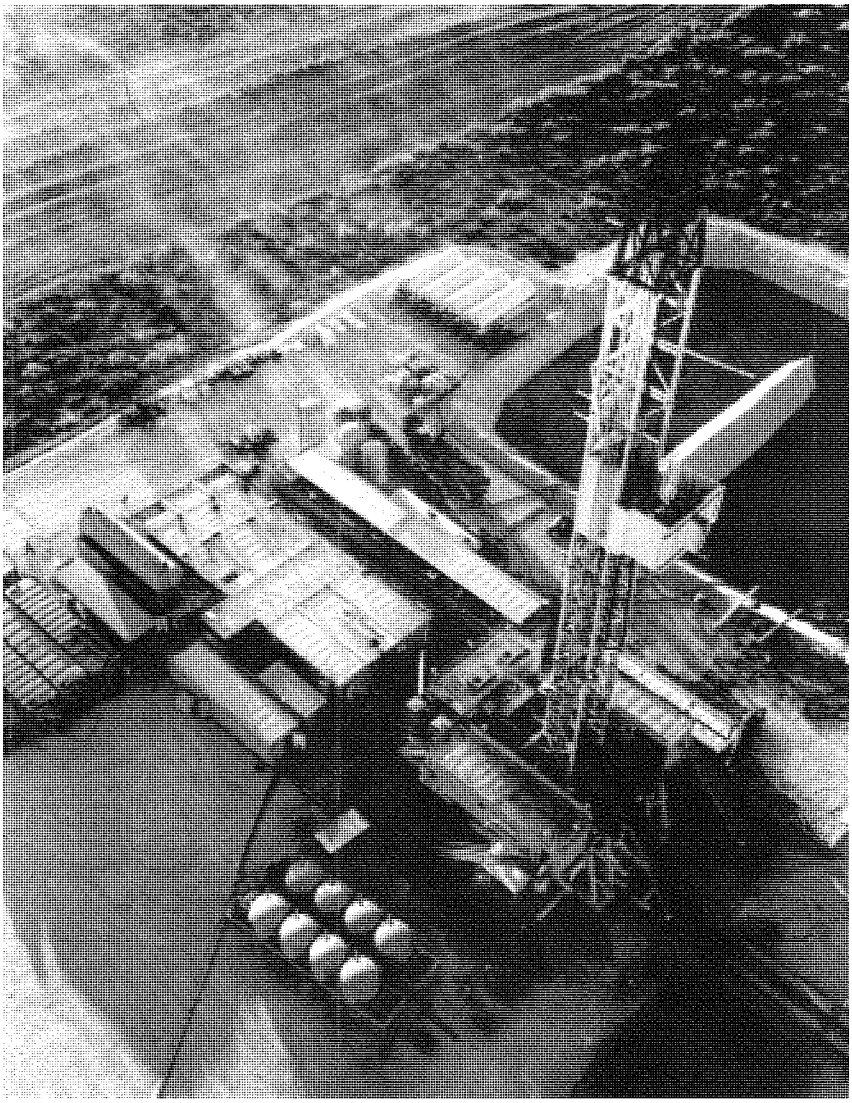
FIELDWOOD ENERGY

FLYWHEEL ENERGY

HEX

SDR Summit Discovery Resources LLC

WARWICK GROUP



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Senate Committee on Environment and Public Works
Subcommittee on Clean Air and Nuclear Safety
Hearing entitled, *"Reducing Emissions while Driving Economic Growth: Industry-led Initiatives"*
October 17, 2019
Questions for the Record for Mr. Macchiarola

Senator Braun:

The electric sector has reduced carbon emissions by 27% below 2005 levels as of 2018 and many power companies have set aggressive goals to reduce their carbon emissions even more in the future.

Duke Energy has 840,000 customers in Indiana and operates the largest electric grid in the country spanning the Midwest and Southeast. As I noted in my opening statement, last month, Duke Energy announced a voluntary commitment to accelerate their carbon-reduction goals to cut CO_2 emissions by half or more by 2030 and strive to attain net-zero emissions by 2050.

1. What market factors are driving these decisions?

Sustained low prices are primarily responsible for the increase in natural gas consumption for electric power. Higher production levels at lower prices in tight oil plays in the Permian Basin have contributed to the Henry Hub spot price falling from $8.69 per Million Btu (MMBtu) in 2005 to $3.15/MMBtu in 2018. Last month, the price fell to $2.47/MMBtu. Thanks to the growing use of natural gas in power generation, the U.S. has increased its reliability and resilience while leading the world in the reduction of CO_2 emissions since 2000. According to the Energy Information Administration (EIA), U.S. energy-related CO_2 emissions have decreased in 7 of the past 10 years – and should be 14 percent lower in 2019 than they were in 2005. This market-driven transition strengthens American energy security, provides reliable energy to consumers, and meets the objective of reducing emissions.

2. If Congress today were to set a hard target of eliminating CO_2 emissions within ten years, would such a goal be realistically achievable?

Any proposal to eliminate CO_2 emissions within ten years – which would fundamentally reorder the American energy system and significantly disrupt our standard of living – should first be measured by its impacts on American consumers, the economy and the country's opportunity for future prosperity. Transportation, housing, workspaces, communications and modern necessities are all powered or supported by oil and natural gas. Further, the increased use of natural gas is the primary reason that U.S. CO_2 emissions have fallen to their lowest levels in a generation. Restricting the development of this domestically supplied source of abundant and ever-cleaner energy would be counterproductive to reducing emissions while simultaneously advancing human and economic development as well as energy and national security.

   a. What would such a policy have on the nation's economic trajectory? Especially in the manufacturing sector?

Modeling a proposal that transforms the domestic energy system in that timeframe presents a unique set of challenges. However, here's what we do know: energy from abundant U.S. oil and natural gas drives economic growth and opportunity, technical innovation, helps Americans generate wealth and empowers solutions to daily and long-term challenges, while making America stronger and more secure.

The growth of domestic production has essentially insulated American families and manufacturers from global supply disruptions that would have once put severe pressure on the economy. In 2011, the U.S. surpassed Russia to become the world's largest producer of natural gas. Last year, the U.S. surpassed Saudi Arabia to become the world's largest producer of oil. Historically, oil and natural gas prices have been subject to volatility for discrete periods of time. And, before the U.S. energy revolution, these prices moved together. Today, oil and natural gas prices have largely moved independently, and prices and price volatility have essentially been reduced by half over the past five years.

Having lower and steadier domestic oil and natural gas prices has advantaged our domestic manufacturing sector and lowered energy expenditures for American families. Between 2010 and 2017, EIA data indicate that American households spent nearly $210 billion less on all forms of energy. And, data through 2017 from the Bureau of Labor Statistics show that total household energy spending decreased by 6.3 percent since 2010, while spending for food, education and healthcare increased 26.1 percent, 38.8 percent and 56.1 percent, respectively. Reduced energy costs are critical to enabling American families to save or reallocate their hard-earned income to purchases or investments beyond the energy sector.

Finally, the oil and natural gas industry supports 10.3 million well-paying jobs, creating STEM-related opportunities for veterans, women and minorities, and contributing $1.3 trillion to the U.S. economy. A proposal to eliminate the jobs that power nearly 8 percent of the U.S. economy would have untold impacts on the manufacturing sector and the domestic job market, overwhelming job replacement program capacity and putting further strain on economic safety nets for the energy workforce.

b. What effect would such a policy have on the global temperature?

The reality is that energy is bought and sold in a global marketplace, where demand for our products will continue to rise. According to the EIA, the world's population is expected to increase 25 percent by 2050, to 9.5 billion from 7.6 billion in 2019. The 7.6 billion people today strive for increasing standards of living that are fundamentally enabled by energy. And, as the world's population grows, the welfare of billions hangs in the balance.

Since 1970, global demand for oil, natural gas, and coal has grown with GDP to provide the energy that is essential to human and economic development. This trend is expected to continue. For example, the International Energy Agency (IEA) projects that fossil fuels will provide as much as 78 percent of global energy needs by 2040. The question remains where this energy will come from.

U.S. natural gas is produced in among the most highly regulated countries in the world. And, by IEA estimates, U.S. production produces among the lowest CO_2 emissions in the world. Consequently, when the U.S. produces and exports energy, it results in lower global emissions when compared to natural gas production elsewhere and can also prevent the burning of coal and biomass in emerging economies. This a win for the environment, the U.S. economy and human and economic development.

Rising global coal consumption has largely offset attempts to reduce CO_2 emissions. Global demand for coal has grown at nearly half the rate of global real GDP, despite efforts by advanced economies to switch to alternative sources of energy. Decreasing demand for coal in the U.S. and Europe has lowered prices, stimulating demand in emerging economies with growing energy needs. Between 2006 and July 2019, nearly 1,100 gigawatts of new coal-fired electricity generation was added globally, effectively negating reductions in CO_2 emissions from other geographies and sectors.

Rather than seeking to reduce or eliminate domestic energy production – which stands to increase global temperatures – U.S. policies should instead be aimed at increasing the global use of liquefied natural gas (LNG). U.S. LNG exports currently reach 34 countries across 5 continents. Further expanding these exports can lead to additional emissions reductions when they supplant the burning of coal in electricity generation while also supporting economic progress.

In Congress, we often hear about the importance of innovation that is "exportable," meaning that the U.S. can share the technologies we develop in order to help improve environmental outcomes in the rest of the world.

3. Can you briefly outline innovations that the American industries have made that have resulted in exportable technologies?

API was formed in 1919 as a standards-setting organization, and this year we celebrated our 100-year anniversary. In its first century, API developed more than 700 standards to enhance operational safety, environmental protection, efficiency and sustainability across the oil and natural gas industry. These standards have been cited more than 750 times in U.S. EPA, OSHA, Coast Guard, FTC, PHMSA, and BSEE regulations and referenced approximately 225 times by regulatory bodies in China, the U.A.E., Russia, Mexico, Brazil, India, the U.K. and Canada. While API represents the U.S. oil and natural gas industry, we export best practices for safety and environmental protection around the world.

Further, domestic industry investment in innovation – such as the combination of hydraulic fracturing, advanced seismic imaging and horizontal drilling – has spurred an energy revolution with global potential. U.S. natural gas is produced in among the most highly regulated countries in the world. And, by IEA estimate, U.S. production produces among the lowest CO_2 emissions in the world. Consequently, when the U.S. exports American energy, it results in lower global emissions when compared to natural gas production elsewhere and can also prevent the burning of coal and biomass in emerging economies. This is a win for the environment, the U.S. economy, and human and economic development.

Beyond the contribution of increased natural gas production and use to reduce GHG emissions, the U.S. oil and natural gas industry is also taking exportable action to reduce methane emissions. While natural gas production increased more than 50 percent between 1990 and 2017, methane emissions from natural gas systems decreased 14 percent over the same period. Between 2011 and 2019, energy companies reduced emission rates by nearly 60 percent across four of America's large natural gas producing regions – Anadarko, Appalachian, Eagle Ford and Permian – even as output increased significantly.

These outcomes are no accident. Informed by U.S. EPA's greenhouse gas emissions inventory and reporting data, in 2017, the U.S. oil and natural gas industry established The Environmental Partnership (TEP) to target the three largest sources of emissions. In just over a year, TEP has grown from 26 to 69 participating companies, and includes both our country's largest and our country's smallest natural gas producers. Participants include 18 of the top 20 producers in the country, and 32 of the top 40. Efforts are ongoing to recruit additional members.

The program is built on three key principles: taking action, learning about best practices and technologies, and fostering collaboration. With the aim of reducing the industry's methane emissions, TEP developed three Environmental Performance Programs to: 1) find a repair leaking equipment, 2) replace or modify higher-emitting process control equipment, and 3) implement best practices to minimize emissions associated with the removal of liquids from natural gas wells as they age.

These actions are making a meaningful difference and reporting from TEP companies shows that their efforts are achieving significant environmental results. EPA estimates that finding and fixing leaks can lead to a 40 percent emissions reduction. Replacing high-bleed pneumatic controllers with intermittent-, low-, or zero-emitting devices can conservatively lead to a 60 percent reduction in emissions and likely much greater. While TEP member companies all operate in the U.S., many of them have implemented these environmental best practices at their operations around the world.

Finally, API has been at the forefront of developing guidance for estimating GHG emissions from operations and for sustainability reporting. In 2001, API was among the first organizations in the world to release guidance for estimating GHG emissions from operations, a tool that is vital to understanding and reducing emissions. Following the publication of this guidance, API released its SANGEA software platform for estimating and reporting GHG emissions. API has collaborated with IPIECA and the International Oil & Gas Producers Association, two global industry organizations, to publish *Oil and Gas Industry Guidance on Voluntary Sustainability Reporting*, a critical tool that guides industry in its reporting of GHG emissions.

These innovations, centered on our industry's commitment to setting and meeting world-class best practices, have the potential to be adapted globally to increase operational safety, environmental protection, efficiency and sustainability.

Senator Whitehouse:

4. How much money did ExxonMobil, BP, and Shell give to API in 2018?

API does not disclose information proprietary to our organization, such as annual dues payments.

5. How much money did Marathon Petroleum give to API in 2018?

API does not disclose information proprietary to our organization, such as annual dues payments.

6. What conversations did API have with ExxonMobil, BP, and/or Shell with respect to the Trump administration's August 2019 proposal to scrap methane regulations?

ExxonMobil, BP, and Shell – along with the balance of our more than 600 member companies – participate in internal deliberations on API's policy positions and strategies for achieving public policy goals. These discussions are designed to allow for an open dialogue and therefore remain confidential to the organization. Given the breadth of our diverse membership and the range of policy issues that we face, it is not without precedent that our member companies are not in unanimous agreement on every issue under consideration.

Individual member companies have expressed a range of public views on EPA's 2016 New Source Performance Standards, which were considered in the formation of API's current position. While API filed comments on the Trump Administration's proposed methane rule, several API member companies filed comments separately, reflecting their views.

a. For each of these three companies, did they register their objection to this proposal with API?

API does not disclose information proprietary to our organization, such as internal deliberations related to the development of policy positions.

b. For each of these three companies, did they inform API that they opposed API's decision to support this proposal?

API does not disclose information proprietary to our organization, such as internal deliberations related to the development of policy positions.

c. For each of these three companies, did they inform API that they opposed API's decision to support this proposal?

API does not disclose information proprietary to our organization, such as internal deliberations related to the development of policy positions.

d. For each of these three companies, did they inform API that they opposed API's decision to support this proposal?

API does not disclose information proprietary to our organization, such as internal deliberations related to the development of policy positions.

e. Please provide all documents since November 8, 2016 relating to communications between API, ExxonMobil, BP, Shell, and/or Marathon Petroleum regarding the regulation of methane from oil & gas facilities.

API does not disclose information proprietary to our organization, such as internal communications related to the development of policy positions.

7. What conversations has API had with ExxonMobil, BP, and/or Shell with respect to carbon pricing?

   a. For each of these three companies, did they inform API that they support carbon pricing?

API does not disclose information proprietary to our organization, such as internal deliberations related to the development of policy positions.

   b. Which carbon pricing proposals, either made by legislators or outside groups, did these three companies indicate to API that they support?

API does not disclose information proprietary to our organization, such as internal deliberations related to the development of policy positions.

   c. Which carbon pricing proposals, either made by legislators or outside groups, did these three companies indicate to API that they oppose?

API does not disclose information proprietary to our organization, such as internal deliberations related to the development of policy positions.

   d. Please provide all documents since November 8, 2016 relating to communications between API, ExxonMobil, BP, Shell, and/or Marathon Petroleum regarding the carbon pricing.

API does not disclose information proprietary to our organization, such as internal communications related to the development of policy positions.

8. You indicated that API makes decisions based on consensus. If three of API's largest members, in this case ExxonMobil, BP, and Shell, opposed the Trump administration's August 2019 proposal to scrap methane regulations for oil and gas facilities, how is API's support for this proposal consistent with consensus-based decision making?

API supports the cost-effective regulation of new and modified sources within EPA's New Source Performance Standards (NSPS OOOO and OOOOa) to reduce VOC emissions, which has the co-benefit of reducing methane emissions. This position is representative of a consensus, rather than a unanimous, position and reflects the careful consideration of a broad range of member views.

Under the Clean Air Act, EPA is obligated to make a "significant contribution" finding before expanding the source category to include additional industrial sectors and regulating additional pollutants. The transmission and storage segment and methane were improperly added because EPA failed to make a significant contribution finding. Our members broadly agree that EPA must do a significant contribution finding to justify the regulation of a new pollutant or the expansion of a source category.

9. You indicated that API remained neutral on the Trump administration's proposal to freeze greenhouse gas emission and fuel economy standards for cars and light trucks despite pressure from some of its members to support this proposal.

    a. Which API members pressured API to support this proposal?

API does not disclose information proprietary to our organization, such as internal deliberations related to the development of policy positions.

    b. If API remained neutral on this issue because of a split in its membership, why did API not remain similarly neutral on methane regulations as a result of a split in its membership?

API does not disclose information proprietary to our organization, such as strategies for achieving public policy goals. This position is representative of a consensus, rather than a unanimous, position and reflects the careful consideration of a broad range of member views. API's public comments, submitted in October 2018, reflect the views of the association and are attached for your review.

Senator BRAUN. Thank you.
Mr. Durbin.

STATEMENT OF MARTIN DURBIN, PRESIDENT, GLOBAL ENERGY INSTITUTE, U.S. CHAMBER OF COMMERCE

Mr. DURBIN. Chairman Braun, Senator Whitehouse, thank you. Thanks for the opportunity to testify today.

Let me start by saying the Chamber believes the climate is changing, and that humans are contributing to these changes. Inaction on climate is not an option, and there is much common ground on which all sides of this discussion should come together to address climate change with policies that are practical, flexible, and durable. We also believe in a policy approach that considers costs, benefits, and the competitiveness of the U.S. economy.

In order to tackle the global climate challenge, we must commercialize and deploy clean energy technologies. It will be largely up to the business communities to develop, finance, build, and operate the solutions needed to power economic growth worldwide, mitigate greenhouse gas emissions, and build resilient, lower carbon infrastructure. In short, we will need more energy with fewer emissions. The good news is, we are up to the challenge.

Thousands of companies have already taken voluntary steps to reduce emissions and have pledged further reductions. Sustainability plans are now the norm for major corporations. Our Global Energy Institute has launched an Energy Innovates initiative to showcase the innovators, projects, and technologies that are shaping America's future energy landscape.

The specific examples are included in my written testimony, but we have highlighted technologies such as battery storage, advanced nuclear, power plants that utilize CO_2 itself as an energy source, and energy efficient, smart neighborhoods. All of these technologies will be needed.

Such technologies are being developed and deployed first in the United States, but ultimately, are an opportunity for the U.S. to become the world's leading exporter of clean energy technology. This will not only be a business opportunity and an economic boon, but also a way for the U.S. to take a leadership role in reducing global emissions and to improve the quality of life in developing countries that lack access to the basics, like electricity and refrigeration.

These global realities illustrate the paramount importance of technological breakthroughs that will enable financially constrained developing countries to adopt the technologies necessary to slow and ultimately reverse emissions growth. The good news is that numerous technologies hold great promise to do just that, and that is why the Chamber has made the development and acceleration of these alternatives a top priority.

All told, the private sector was responsible for more than $45 billion of energy related research and development in 2017. But we can't do it alone. There remains an important role for the Federal Government to play in technology development, including through the Department of Energy's National Laboratory System.

However, statistics show that U.S. investment in R&D is only average compared to other developed nations. The Chamber has long

supported increasing R&D budgets with programs like ARPA-E, a great example of what can be accomplished.

We agree more must be done to meet the challenge of climate change. The Chamber has established a task force on climate actions, which will help us gain a better understanding of the range of mechanisms, innovations, and internal processes that our members are employing to address climate change. This dialogue will make us smarter about how existing policies and future proposals affect our broad membership. What we learn will help inform our approach to legislation and other policy proposals to address this important issue for our members, the Nation, and the world.

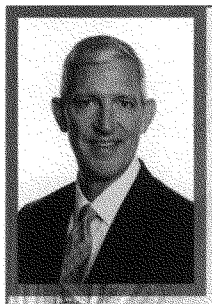
That said, we believe there are concrete actions Congress can take now which would help accelerate the innovation agenda necessary to address this challenge. We recently led a letter with 27 organizations from across the political spectrum, calling on Senate leadership to schedule floor time for a series of legislative proposals which would reduce emissions. My written testimony highlights the specific bipartisan legislation the Chamber supports, many of which were introduced or are co-sponsored by members of this Committee.

As we said in that letter, more needs to be done. But there is no reason to delay passage of initiatives we know would help us reduce emissions right now. Doing so would send a signal that Congress is serious about this issue.

American businesses have a long history of rising to the world's challenges. Companies and entrepreneurs are bringing innovation, technology, and ingenuity to the climate change challenge. We believe combating climate change and growing the economy can and should go hand in hand. Our members are already hard at work in bringing solutions to the table.

Thank you for the opportunity to testify. I look forward to your questions.

[The prepared statement of Mr. Durbin follows:]



Martin Durbin

President, Global Energy Institute, U.S. Chamber of Commerce

Martin (Marty) Durbin is president of the U.S. Chamber of Commerce's Global Energy Institute (GEI). Durbin leads GEI's efforts to build support for meaningful energy action through policy development, education, and advocacy, making it a go-to voice for commonsense energy solutions.

Previously, Durbin was the executive vice president and chief strategy officer at the American Petroleum Institute (API), where he integrated API's broad advocacy capabilities in pursuit of the organization's and the industry's public policy priorities. He returned to API after serving for nearly three years as president and CEO of America's Natural Gas Alliance (ANGA), representing North America's leading independent natural gas exploration and production companies. There he oversaw ANGA's market expansion efforts with industry, government, and consumer stakeholders. At the end of 2015, he guided ANGA's ultimate combination into API to better achieve the mission of both organizations.

Before joining ANGA, Durbin served as executive vice president of Government Affairs at API. Subsequently, Durbin served as vice president of Federal Relations at the American Chemistry Council (ACC). Prior to the merger of the ACC and the American Plastics Council (APC) in 2002, Durbin directed Federal and International Affairs for APC, serving as a liaison to sister organizations in Canada, Europe, Japan, Mexico, and South America. Earlier in his career he served as a legislative assistant for Sen. Alan J. Dixon (D-IL) and for Rep. Rick Boucher (D-VA).

Durbin serves as chairman of the Board for A Wider Circle, a grassroots nonprofit organization dedicated to ending poverty for one individual and one family after another. He received a B.A. in government and politics from the University of Maryland, College Park. He is married and has three children.

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The mission of the U.S. Chamber of Commerce's Global Energy Institute is to unify policymakers, regulators, business leaders, and the American public behind a common sense energy strategy to help keep America secure, prosperous, and clean. Through policy development, education, and advocacy, the Institute is building support for meaningful action at the local, state, national, and international levels.

The U.S. Chamber of Commerce is the world's largest business federation representing the interests of more than 3 million businesses of all sizes, sectors, and regions, as well as state and local chambers and industry associations.

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Statement of the U.S. Chamber of Commerce

"Reducing Emissions while Driving Economic Growth: Industry-led Initiatives"

Marty Durbin
President
Global Energy Institute

Senate Subcommittee on Clean Air and Nuclear Safety

October 17, 2019

1615 H Street NW | Washington, DC | 20062

My name is Marty Durbin and I am the President of the Global Energy Institute, an affiliate of the U.S. Chamber of Commerce ("Chamber"). Thank you for the opportunity to testify today on industry-led initiatives to reduce emissions while driving economic growth.

Introduction

The climate is changing and humans are contributing to these changes. Inaction on climate is not an option. We believe there is much common ground on which all sides of this discussion should come together to address climate change with policies that are practical, flexible, predictable, and durable. We also believe in a policy approach that considers costs, benefits, and the competitiveness of the U.S. economy.

It will be largely up to the business community to develop, finance, build, and operate the solutions needed to power economic growth worldwide, mitigate greenhouse gas emissions, and build resilient, lower-carbon infrastructure. Thousands of businesses already are taking action in their own operations and along their value chains by investing in technology solutions and enhancing their efficiency.

Advanced technologies and innovation offer the best solution for managing climate risks and reducing greenhouse gas (GHG) emissions. Breakthroughs in commercially-viable technologies are necessary to enable significant cuts in GHG emissions while maintaining economic growth. The U.S. should maintain a leadership role in technologies, such as advanced nuclear, energy efficient systems and building materials, large-scale renewables, energy storage, high-efficiency low-emission power plants, and carbon capture and storage/utilization by supporting a broad-based public- and private-sector technology portfolio.

Business is Taking Action to Address Climate Change

The American business community is developing technologies to address the challenge of climate change. They are doing so to meet the expectations of their customers and value chains, shareholders and the public. They are also doing so because they care about the environment and the communities in which they live and operate, and to compete and lead in evolving and emerging markets. We believe that our free enterprise system is best equipped to address this challenge because it drives ingenuity and investment. The public agrees. In fact, a poll conducted by the Global Energy Institute earlier this year found that 79% of voters believe that investments in innovation and technology are the best way to address climate change.[1]

Thousands of companies have already taken voluntary steps to reduce emissions and have pledged further reductions. Sustainability plans are now the norm for major corporations. For example:

- DuPont is making contributions to a low carbon economy by: reducing energy intensity in the transportation sector by providing materials that enable automotive light weighting and electrification and enabling more energy efficient building through sustainable

[1] Available at: https://www.globalenergyinstitute.org/global-energy-institute-unveils-american-energy-cleaner-stronger-agenda.

insulation and building systems, and other measures.

- Salesforce delivers a Carbon Neutral Cloud to all its customers and is more than halfway to the company's goal of reaching 100% renewable energy by 2022. Last month they announced Salesforce Sustainability Cloud, a carbon accounting product designed to help customers easily generate trusted investor-grade environmental data to inform their climate action programs.

- UPS' alternative fuel and advanced technology vehicles now exceed 10,000 vehicles globally. Using renewable fuels, UPS trucks are achieving up to a 90 percent reduction in lifecycle greenhouse gas emissions when compared to conventional diesel trucks. In May 2019, UPS announced the largest purchase of renewable natural gas in history.

In addition, last year the Global Energy Institute launched our "*EnergyInnovates*" initiative to showcase the innovators, projects and technologies that are shaping America's future energy landscape. These include:

- North America's largest lithium ion battery storage facility in Escondido, CA, built and operated by San Diego Gas and Electric, a Sempra Energy utility. Battery storage is a key grid resource that will maximize the potential and availability of intermittent renewable resources

- Small modular nuclear reactors by NuScale, whose simplified design allows for safe, scaleable, cost-efficient emissions-free applications around the globe.

- A revolutionary zero-emissions power plant developed by NetPower, which will capture carbon dioxide emissions before compressing and recirculating gas into its system—creating value for CO2 and incentive for ensuring that it isn't released into the atmosphere.

- A "smart neighborhood" developed by Alabama Power which features high-performance, energy efficient construction and systems and a dedicated micro-grid featuring solar, battery storage and natural gas power. This project is a prime example of public-private partnership, in this case between Southern Company, DOE's Oak Ridge National Laboratory, Signature Homes, and others.

These projects represent just a fraction of the innovation that is happening across America every day. Such technologies are being developed and deployed first in the United States, but ultimately are an opportunity for the U.S. to become the world's leading exporter of clean energy technology. This will not only be a business opportunity and an economic boon, but also a way for the U.S. to take a leadership role in reducing global emissions and to improve the quality of life in developing countries that lack access to basics like electricity and refrigeration.

The importance of fostering U.S. leadership to address climate change through commercialization and global deployment of clean energy technologies cannot be overstated. Recently released projections by the Energy Information Administration forecast that, while emissions from developed nations are expected to begin declining, developing countries'

emissions will increase by more than 8.4 billion metric tons of carbon dioxide (CO_2),—from 22.8 billion metric tons in 2018 to 31.2 billion metric tons in 2050, a 37 percent increase.[2] (For perspective, total U.S. economy-wide CO_2 emissions were 5.2 billion metric tons in 2018.)

These global realities illustrate the paramount importance of technological breakthroughs that will enable financially constrained developing countries to adopt alternate technologies necessary to slow, and ultimately reverse, emissions growth. The good news is that numerous technologies hold great promise to do just that, and that is why the Chamber has made the development and acceleration of these alternatives a top priority.

Federal R&D Investment is Critical Component of Energy Innovation

For the innovation agenda to succeed, business and government must work together. The American business community leads the world in investment in emerging energy technologies. Based on data from the National Science Foundation (NSF), we estimate that the private sector was responsible for about $45 billion in direct investment for energy related R&D in 2017. A recent report from NSF's National Science Board found roughly 19% of the world's total R&D funding is performed by U.S. businesses. This type of investment has and will result in breakthroughs that are needed to develop technologies that can be deployed worldwide.

Significant federal government resources have been invested to develop carbon reduction technologies. The Department of Energy national laboratory system is a unique asset capable of developing pre-commercialization technologies that can then pair with the private sector to be brought to market. The Chamber is a strong supporter of government research and development including programs such as ARPA-E, and has regularly called for increased funding for this and other programs.

Data from the International Energy Agency suggest that while the United States government spends far more on energy R&D that any other Organization for Economic Co-operation and Development (OECD) country (Figure 1), its spending as a share of GDP is only about average.

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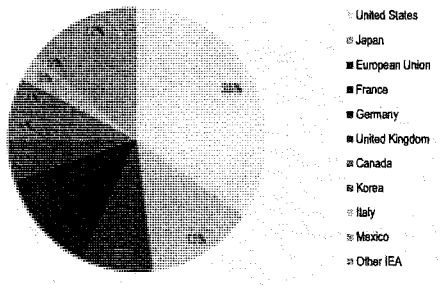
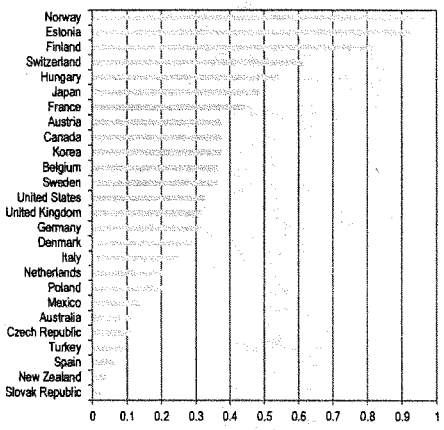
[2] U.S. Energy Information Administration, *International Energy Outlook*, September 2019. Available at https://www.eia.gov/outlooks/ieo

Figure 1. Public energy RD&D budgets by country for IEA members and the European Union



Source: International Energy Agency, *Energy Technology RD&D Budgets, 2019.*

Figure 2: Total public energy RD&D budgets per thousand units of GDP by country for 2017



Source: International Energy Agency, *Energy Technology RD&D Budgets, 2019.*

The Chamber has long supported increasing federal R&D budgets. In addition to improving energy security, advanced new technologies can reduce the costs of meeting environmental requirements and thus expand the range of economically and politically acceptable policy options. Innovation is not a luxury; it is a fundamental need. The U.S. should maintain its leadership role in advanced energy technologies.

An Energy Innovation Agenda

We recognize that more must be done to meet the challenge of climate challenge. Policymakers will continue to play a critical role. The Chamber has established a Task Force on Climate Actions, which will help us gain a better understanding of the range of mechanisms, innovations, and internal processes that our members are employing to address climate change. This task

force will give us a dedicated venue to engage with our broad membership, and make us smarter about the impact of both existing policies and future proposals. What we learn will help inform our approach to legislation and other policy proposals to address this important issue for our members, the nation, and the world.

That said, we believe that there are concrete actions that Congress can take now which would make significant strides toward addressing this challenge. We recently led an effort with 27 organizations from across the political spectrum calling on Senate leadership to schedule floor time for a series of legislative proposals which would reduce emissions. These include:

- **S. 383, the Utilizing Significant Emissions with Innovative Technologies (USE IT) Act**, which would advance CO2 utilization and direct air capture research, permitting and development.

- **S. 903, the Nuclear Energy Leadership Act (NELA)**, which would bolster America's leadership in nuclear energy by facilitating the development of next-generation nuclear energy resources.

- **S. 1201, the Enhancing Fossil Fuel Energy Carbon Technology (EFFECT) Act of 2019**, which would authorize DOE to support the development of technologies that improve the efficiency, effectiveness, costs, and environmental performance of coal and natural gas use.

- **S. 1602, the Better Energy Storage Technology (BEST) Act**, which would increase R&D in battery storage technologies to strengthen the electric grid amid the integration of renewables.

- **S. 1685, the Launching Energy Advancement and Development through Innovations for Natural Gas (LEADING) Act of 2019**, which would accelerate DOE's research and development of commercially-viable carbon capture technologies for natural gas-fired electric generation facilities.

- **S. 2137, the Energy Savings and Industrial Competitiveness Act**, which would improve the energy efficiency of buildings, industries and manufacturers, and the federal government, delivering energy security and environmental benefits.

- **S. 2300, the Clean Industrial Technology Act**, which would establish an emissions-reduction technology program to reduce industrial sector greenhouse gas emissions.

Each of these bills enjoys bipartisan support, including from many members of this Subcommittee. The Chamber is working to ensure adoption of these bills and to build support inside and outside the Beltway for these efforts.

American businesses have a long history of rising to the world's challenges. Companies and entrepreneurs will bring innovation, technology and ingenuity to the climate change challenge. We believe that combatting climate change and continuing economic growth can and should go hand in hand, and our members are already hard at work in bringing solutions to the table.

Senate Committee on Environment and Public Works
Subcommittee on Clean Air and Nuclear Safety
Hearing entitled, *"Reducing Emissions while Driving Economic Growth: Industry-led Initiatives"*
October 17, 2019
Questions for the Record for Mr. Durbin

Senator Mike Braun (R-IN):

The electric sector has reduced carbon emissions by 27% below 2005 levels as of 2018 and many power companies have set aggressive goals to reduce their carbon emissions even more in the future.

Duke Energy has 840,000 customers in Indiana and operates the largest electric grid in the country spanning the Midwest and Southeast. As I noted in my opening statement, last month, Duke Energy announced a voluntary commitment to accelerate their carbon-reduction goals to cut CO2 emissions by half or more by 2030 and strive to attain net-zero emissions by 2050.

1. *What market factors are driving these decisions?*

2. *How should we support such voluntary reductions so that we can continue to make emissions improvements while at the same time protecting the pockets of American consumers?*

3. *Given the investor pressures we are seeing today, could industry move faster without negatively impacting economic growth?*

The significant recent progress related to power sector carbon emissions reductions are primarily being enabled by marked advances in technology and innovation. In particular, abundant and affordable natural gas and declining costs for renewables and energy efficiency technologies, along with maximizing the output of existing nuclear units, are allowing companies to expand generation from lower-carbon energy sources and accelerate emissions reduction commitments.

Importantly, bold future goals such as mid-century net-zero emissions commitments will also hinge on breakthrough technological advances. As Duke CEO Lynn Good has stated, "Getting to net-zero carbon emissions, while ensuring energy remains reliable and affordable, will require new technologies. That's the very reason we need to act now. We must continue leveraging today's technologies while sustaining investment in innovation for this vision to become reality." This is precisely why the Chamber has made passage of and funding for comprehensive climate and energy innovation legislation a top priority.

Senator Sheldon Whitehouse (D-RI):

4. *I asked you about the Chamber's policies committees. It would appear from the Chamber's website that in order to sit on one of these policy committees, a company must be either an "elite" or "C100" level member.*

    a. *Is this in fact the case?*

This question seeks information clearly protected by the fundamental right of freedom of association guaranteed to the Chamber and its members, as to all in the United States of America, by the First Amendment to the Constitution. Therefore, on behalf of itself and its members, the Chamber respectfully declines to provide information in response to this question.

    b. *Must a company pay extra in order to be an "elite" or "C100" member?*

Please refer to the answer provided to question 4(a).

    c. *What is the minimum amount a company must pay in order to be an "elite" member?*

Please refer to the answer provided to question 4(a).

    d. *What is the minimum amount a company must pay in order to be a "C100" member?*

Please refer to the answer provided to question 4(a).

    e. *If minimum monetary thresholds depend upon a company's size, please provide the minimum monetary thresholds for each level of membership for all sizes of companies.*

Please refer to the answer provided to question 4(a).

5. *Please describe the purpose of these policy committees and the activities and responsibilities of the companies that are members of these committees. Please also describe how the work of these policy committees informs the Chamber's priorities.*

The purpose and activities of the Chamber's policy committees is described on our website at: https://www.uschamber.com/about/policy-committees-special-subcommittees-councils-and-task-forces

6. *You mentioned that the Chamber has both an energy & agriculture and an environment policy committee. Which companies currently sit on these policy committees?*

Please refer to the answer provided to question 4(a).

7. *How much did each of the companies on the energy & agriculture policy committee pay the Chamber and its affiliates in 2018?*

Please refer to the answer provided to question 4(a).

8. *How much did each of the companies on the environment policy committee pay the Chamber and its affiliates in 2018?*

Please refer to the answer provided to question 4(a).

9. *How much in total did fossil fuel industry companies, electric utilities, and railroads pay the Chamber and its affiliates in 2018?*

Please refer to the answer provided to question 4(a).

10. *Do the Chamber and its affiliates take money from non-corporate sources of funding such as political advocacy groups associated with the Koch brothers?*

Please refer to the answer provided to question 4(a).

a. *Please itemize all donations from non-corporate sources of funding since 2010.*

Please refer to the answer provided to question 4(a).

11. *How much did Marathon Petroleum give to the Chamber and its affiliates in 2018?*

Please refer to the answer provided to question 4(a).

12. *How much did ExxonMobil give to the Chamber and its affiliates in 2018?*

Please refer to the answer provided to question 4(a).

13. *Which member companies did the Chamber consult about its decision to sue EPA to block the Clean Power Plan?*

Please refer to the answer provided to question 4(a).

14. *Which member companies did the Chamber consult about its decision to intervene in litigation to support the Trump Administration's so-called ACE rule to replace the Clean Power Plan?*

Please refer to the answer provided to question 4(a).

15. *Which member companies did the Chamber consult about its decision to fund a since-debunked study critical of the Paris Agreement?*

Please refer to the answer provided to question 4(a).

NOTE: For further information regarding this study, please visit https://www.globalenergyinstitute.org/setting-record-straight-nera-report

16. *Which member companies did the Chamber consult about its decision to send a letter to senators urging them to oppose a resolution disapproving the so-called ACE rule and informing them that their vote might be scored by the Chamber in its annual scorecard?*

Please refer to the answer provided to question 4(a).

17. *How does the Chamber's support for the so-called ACE rule, a rule which EPA admits would do little if anything to reduce carbon pollution compared to a business as usual scenario, square with the Chamber's position that "inaction is not an option" on climate change?*

The ACE rule establishes emissions guidelines for states to use when developing plans to limit carbon dioxide emission from coal-fired power plants within their borders. The rule calls on affected power plants to undertake a broad range of technologies and techniques to reduce the carbon intensity of electric generation. EPA projects that implementation of this rule would reduce CO_2 emissions from coal-fired power plants by 11 million short tons in 2030, which, along with industry trends, would ultimately lead to CO_2 emissions from those plants of as much as 35 percent below 2005 levels by 2030. (See summary of final ACE rule, available at https://www.epa.gov/newsreleases/epa-finalizes-affordable-clean-energy-rule-ensuring-reliable-diversified-energy)

While more is being done to reduce CO_2 emissions, one important aspect of the ACE rule is that it accomplishes emissions reductions in a manner that is consistent with the language of the Clean Air Act. Section 111(d)(1) of the Clean Air Act, the authority under which the ACE rule rests, requires that the emissions guidelines set by EPA and the performance standards established by states must be based on measures that can be achieved on the premises of a facility subject to the regulation. The ACE rule does this, and thus represents an important step toward achievable progress within EPA's existing statutory authority.

Senator BRAUN. Thank you.
Dr. Dutton.

STATEMENT OF ANDREA DUTTON, VISITING ASSOCIATE PROFESSOR, DEPARTMENT OF GEOSCIENCE, UNIVERSITY OF WISCONSIN–MADISON, GAINESVILLE, FLORIDA

Ms. DUTTON. Thank you, Chairman Braun, and Ranking Member Whitehouse, for inviting me to speak today.

I am a geochemist and field geologist who conducts research on past climate and sea level change. The main focus of my research is the behavior of sea level and polar ice sheets during past warm periods to better inform us about future sea level rise.

My research accomplishments have been widely recognized, for example, as a Fellow of the Geological Society of America, as a Fulbright Scholar, and as a newly minted MacArthur Fellow.

I am here today to offer my expert opinion as a geologist and climate scientist on the scale of the challenge that we face from industrial greenhouse gas emissions and resulting human caused global warming.

The devastating impacts of climate change will vary by region. Some will contend with worsened wildfires, while others will grapple with intensified inland flooding or rainfall, inundation from sea level rise, or more intense and slower moving hurricanes.

This list may evoke personal memories of extreme weather events from the past few years. That is because climate change is already here, and it is going to get worse before it can get better.

All regions of the U.S. will experience higher temperatures. Consider Florida, where I have lived for the past 9 years. In 2000, Miami had 24 days with a heat index at or above 105 degrees Fahrenheit, the official danger level according to the National Weather Service. By 2030, Miami is projected to experience 126 danger days a year, that is about 1 in 3 days, where crippling heat will make it dangerous for people to be outdoors.

Are voluntary reductions in industrial emissions enough to avoid such futures? The answer is no. They don't even come close. Voluntary reductions are but proverbial drops in the bucket.

Because of decades of relative inaction, the scale of the problem has grown, and the time to act is rapidly shrinking. Policy solutions must therefore be bold, moving us rapidly toward net zero emissions, with the aid of stringent and integrated policy interventions, including putting a price on carbon.

Reductions do not happen in a vacuum, though. They are driven by policy, which in turn drives innovation to meet new targets.

As a geologist, with the perspective that deep time brings to this issue, I offer these four critical insights. No. 1, we are conducting an uncontrolled and unprecedented experiment here on planet Earth. Our extensive knowledge of past climate change reveals that there is no other event in Earth history that approaches the combined rate and magnitude of change that we are causing, aside from cataclysmic events such as the massive asteroid impact that marked the end of the Cretaceous. While Earth survived that impact, the dinosaurs did not, nor did about 75 percent of all marine species. Climate change is not so much about saving our planet,

then, as it is about maintaining thriving ecosystems that support human civilization.

No. 2, while there are natural, stabilizing processes that draw down carbon dioxide levels in the atmosphere, they are too slow, by several orders of magnitude, to keep up with the rate at which we are pumping them into the atmosphere. It would take many thousands of years to draw down the carbon dioxide that we have already emitted.

No. 3, our actions today will impact the climate for millennia to come, a lesson drawn from studies of geological changes. The U.S. leads the world in cumulative carbon emissions. The faster we slash these emissions, the less dangerous the outcomes. Committing to additional fossil fuel infrastructure, conversely, locks in more dangerous impacts.

No. 4, finally, the geologic record tells us that we can expect big impacts from what sound like small perturbations. We are already witnessing the effects of climate change at just over 1 degree Celsius, and every fraction of a degree matters. For comparison, Earth was no more than 4 degrees Celsius colder at the peak of the last ice age, when ice sheets more than a mile thick covered parts of North America and mammoths and mastodons roamed through present day Florida.

My own research tells us that increasing Earth's temperature by as little as 1 degree Celsius could commit us to at least 6 meters—that is 20 feet or more—of sea level rise. If we don't enact policies to reduce greenhouse gas emissions as the best available science dictates, we are committing to a very expensive and dangerous future.

Talking to Floridians on the front lines of sea level rise, I know that they are deeply concerned about climate change and want to know what is being done. During the recent global climate strike led by our youth, millions took to the streets telling us in no uncertain terms that it is up to us to act now or we take their future from them. As a mother, as a scientist, and as a citizen of the United States, I hear their call. And I hope that you will too.

Thank you.

[The prepared statement of Ms. Dutton follows:]

Andrea Dutton, Ph.D.
Visiting Associate Professor, Geological Sciences Department
University of Wisconsin-Madison

Dr. Andrea Dutton is a geologist and climate scientist who conducts research on past climate and sea-level change. She is currently a faculty member in the Department of Geoscience, University of Wisconsin-Madison and was previously and Associate Professor at the University of Florida. Dr. Dutton is a Fellow of the Geological Society of America, a Fulbright Scholar, and a MacArthur Fellow.

Written testimony of

Dr. Andrea Dutton
Visiting Associate Professor, Department of Geoscience
University of Wisconsin-Madison, Madison, WI

Before the

U.S. Senate Environment and Public Works Subcommittee on Clean Air and Nuclear Safety
Hearing on "Reducing Emissions While Driving Economic Growth: Industry-led Initiatives"

October 17, 2019

Thank you, Chairman Braun, Ranking Member Whitehouse, and committee members for inviting me to speak today.

As of August, I am a faculty member at the University of Wisconsin-Madison in the Department of Geoscience. Prior to that, I was an Associate Professor at the University of Florida.

I am a geochemist and field geologist who conducts research on past climate and sea-level change. The main focus of my research is the behavior of sea level and polar ice sheets during past warm periods to better inform us about future sea-level rise. My research accomplishments have been widely recognized, for example as a Fellow of the Geological Society of America, as a Fulbright Scholar, and as a newly-minted MacArthur Fellow.

I am here today to offer you my expert opinion as a geologist and climate scientist on the scale of the challenge we face from industrial greenhouse gas emissions and resulting human-caused global warming.

The devastating impacts of climate change will vary by region: some will contend with worsened wildfires, while others will grapple with intensified inland flooding or rainfall, inundation from sea-level rise, or more intense, slower-moving hurricanes[1]. This list may evoke ***personal*** memories of extreme weather events from the past few years. That is because climate change is already here and it is going to get worse before it can get better[2].

All regions of the U.S. will experience higher temperatures. Consider Florida, where I have lived for the past 9 years. Florida is home to 10 of the 25 hottest cities in the U.S. Miami is the hottest. In 2000, Miami had 24 days with a heat index at or above 105 °F, the official danger level according to the National Weather Service[3]. By 2030, Miami is projected to experience 126 danger days a year—about 1 in 3 days—where crippling heat will make it dangerous for people to be outdoors[4].

Are voluntary reductions in industrial emissions enough to avoid such futures?

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[1] 4th National Climate Assessment, Vols. I & II, United States Global Change Research Program (USGCRP). https://www.globalchange.gov/nca4

[2] IPCC, 2018: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)].

[3] Hot temperatures combined with high humidity create dangerous conditions for humans. When the heat index exceeds 104°F, the National Weather Service defines it as a dangerous day. The heat index is a combination of heat and humidity, sometimes referred to as the "feels like" temperature. Under such conditions, sunstroke and heat exhaustion are likely, and physical activity or being outside for long periods is risky, and can lead to heat stroke. Dangerous heat days pose the greatest risk to the young and the elderly, and to those who don't have easy access to air conditioning.

[4] Analysis by Climate Central (https://www.climatecentral.org/news/sizzling-summers-20515#dangerdays). Projections of the days each year above a threshold temperature are made assuming current emissions trends continue and are based on a downscaled and bias-corrected ensemble of climate models known as CMIP5 (the same models used in the IPCC).

The answer is ***NO***. They don't even come close. Voluntary reductions are but proverbial drops in the bucket. Because of decades of relative inaction, the scale of the problem has grown and time to act is rapidly shrinking (Figs. 1, 2.). Policy solutions must therefore be bold, moving us rapidly towards net-zero emissions with the aid of stringent and integrated policy interventions including putting a price on carbon[5-6]. Reductions don't happen in a vacuum. They are driven by policy, which in turn drives innovation to meet new targets.

The scientific consensus tells us that we are on a tight timeline: by the year 2030, a little over 10 years from now, we must reach net-zero emissions to keep global climate at or below 1.5 °C[7].

The United States has a pivotal role in determining our future climate. Although China's emissions have been growing and now exceed those of the U.S., the U.S. has contributed the most in terms of total (cumulative) carbon dioxide emissions and our emissions of carbon dioxide per person dwarf those of China by more than 2:1 (Figs. 3, 4). Experience shows us that the introduction of policy can be extremely effective, and drive rapid changes in emissions that can translate to recovery from environmental degradation. An example of this is the implementation of the Montreal Protocol, which was designed to phase out the production of multiple substances that contribute to ozone depletion. Measurements reveal that the Antarctic ozone hole is slowly healing, providing evidence that the Montreal Protocol is working[8].

As a geologist, with the perspective that **deep time** brings to this issue, I offer **these four critical insights**:

(1) We are conducting an uncontrolled and unprecedented experiment here on planet Earth. Our extensive knowledge of past climate change reveals that there is **no other event in Earth history** that approaches the combined rate and magnitude of change that ***we*** are causing, aside from cataclysmic events such as the massive asteroid impact that marked the end of the Cretaceous. While Earth survived, the dinosaurs did not, nor did about 75% of all marine species[9]. Climate change is not about saving our planet, it is about maintaining thriving ecosystems that support human civilization.

(2) **While there are natural, stabilizing processes that draw down carbon dioxide levels in the atmosphere, they are too slow—by *several orders of magnitude*—to keep up with the rate at which we are pumping carbon dioxide into the atmosphere[10].** It would take many thousands of years to draw down the carbon dioxide that we have already emitted.

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[5] IPCC, 2018: Global Warming of 1.5°C.

[6] International Monetary Fund (IMF) (2019) *Fiscal Monitor: How to Mitigate Climate Change*, Washington, D.C., October.

[7] Ibid.

[8] Strahan, S.E. and Douglass, A.R. (2018) Decline in Antarctic Ozone Depletion and Lower Stratospheric Chlorine Determined From Aura Microwave Limb Sounder Observations, *Geophysical Research Letters*, 45, 382-390.

[9] Jablonski, D. (1995) Extinctions in the fossil record, *in* Extinction Rates (eds. Lawton, J. H. & May, R. M.), 25–44, Oxford University Press, Oxford.

[10] Archer, D., Eby, M., Brovkin, V., Ridgewell, A., Cao, L., Mikolajewicz, U., Caldeira, K., Matsumoto, K., Munhoven, G., Montenegro, A., Tokos, K. (2009) Atmospheric lifetime of fossil fuel carbon dioxide, Annual Review of Earth and Planetary Science, 37, 117-134.

(3) **Our actions today will impact the climate for millennia**, a lesson drawn from studies of geological changes[11]. The U.S. leads the world in cumulative carbon emissions[12]. The faster we slash emissions, the less dangerous the outcomes. Committing to additional fossil fuel infrastructure, conversely, locks in more dangerous impacts.

(4) **Finally, the geologic record tells us that we can expect big impacts from what sound like small perturbations.** We are already witnessing the effects of climate change at just over 1 °C and every fraction of a degree matters. For comparison, Earth was no more than *four* degrees °C (7 °F) colder during the peak of the last ice age, when ice sheets more than a mile thick covered parts of North America and mammoths and mastodons roamed present day Florida[13]. My own research tells us that increasing Earth's temperature by as little as 1 °C could commit us to at least 6 meters—that's 20 feet—or more sea-level rise[14].

If we don't enact policies to reduce greenhouse gas emissions as the best available science dictates, we are committing to a very expensive and dangerous future. Talking to Floridians on the front lines of sea-level rise, I know they are deeply concerned about climate change[15] and want to know what's being done.

During the recent global climate strike led by our youth, millions took to the streets telling us—in no uncertain terms—that it is up to us to act now or we take their future from them. As a mother, as a scientist, and as a citizen of the United States, I hear their call. I hope that you will too.

Thank you.

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[11] Clark, P.U., Shakun, J.D., Marcott, S.A., Mix, A.C., Eby, M., Kulp, S., Levermann, A., Milne, G.A., Pfister, P.L., Santer, B.D., Schrag, D.P., Solomon, S., Stocker, T.F., Strauss, B.H., Weaver, A.J., Winkelmann, R., Archer, D., Bard, E., Goldner, A., Lambeck, K., Pierrehumbert, R.T., Plattner, G-K. (2016) Consequences of twenty-first-century policy for multi-millennial climate and sea-level change, *Nature Climate Change*, 6, 360-369.

[12] Le Quéré, C., et al. (2018) Global Carbon Budget, *Earth System Science Data*, 10, 1-54.

[13] Shakun, J.D., Clark, P.U, He, F., Marcott, S.A., Mix, A.C., Liu, Z., Otto-Bliesner, B., Schmittner, A., Bard, E. (2012) Global warming preceded by increasing carbon dioxide concentrations during the last deglaciation, *Nature*, 484, 49–54.

[14] Dutton, A., Carlson, A.E., Long, A.J., Milne, G.A., Clark, P.U., DeConto, R., Horton, B.P., Rahmstorf, S., Raymo, M.E. (2015) Sea-level rise due to polar ice-sheet mass loss during past warm periods, *Science*, 349, aaa4019.

[15] https://climatecommunication.yale.edu/news-events/ahead-of-the-first-democratic-presidential-primary-debate-new-poll-shows-florida-voters-support-climate-action/ See linked pdf on polling data: "Florida Voters Support Climate Action."

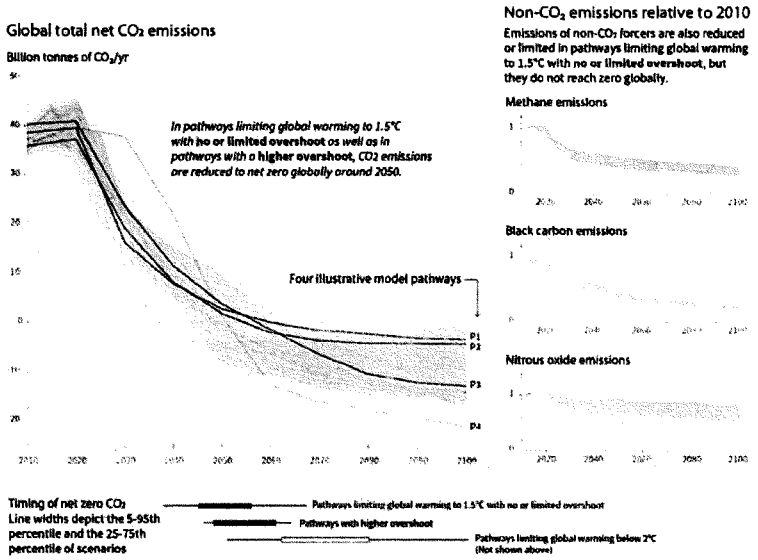

Figure 1. Global emissions pathways from the IPCC SR 1.5 (2018). Note the sharp reduction in CO_2 emissions required to limit global warming to 1.5 °C. Figure reproduced from Fig. SPM.3a in the IPCC Special Report on the impacts of global warming of 1.5 °C.

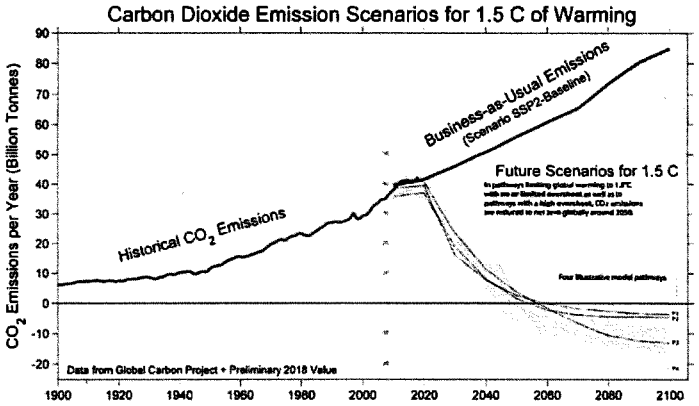

Figure 2. Historical context of emissions (from the Global Carbon Project) superimposed upon the main panel of Fig. 1 (above). The data for the SSP2 scenario comes from the International Institute for Applied Systems Analysis (IIASA) database of scenarios for the Coupled Model Intercomparison Project (CMIP6). Figure by Robert Rohde.

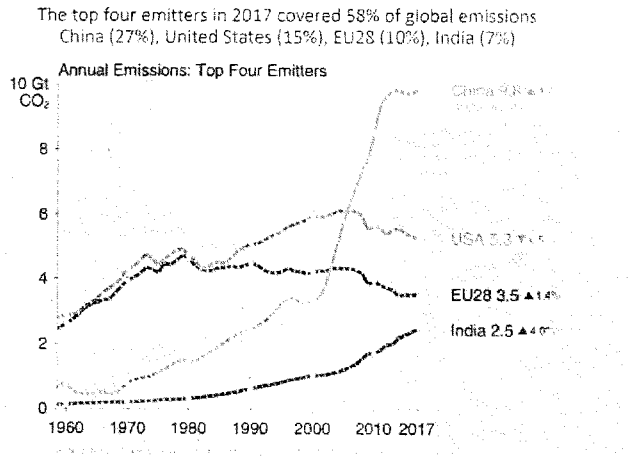

Figure 3. The top four emitters in 2017 comprise 58% of global carbon dioxide emissions. Source: Carbon Dioxide Information Analysis Center (CDIAC); Le Quéré et al, 2018 (see footnote #10); Global Carbon Budget 2018. Figure from the Global Carbon Project: Global Carbon Budget 2018.

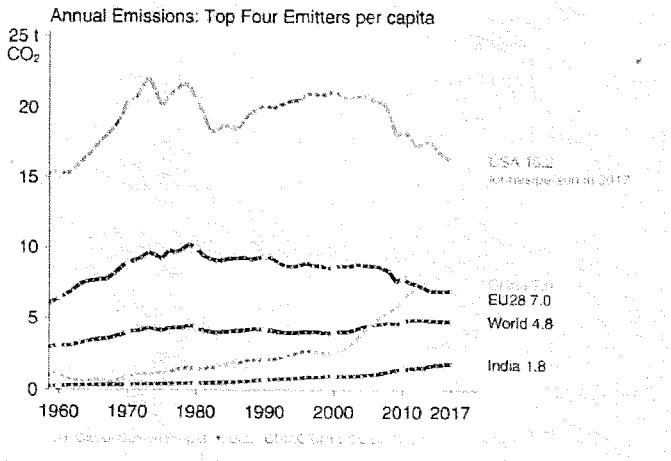

Figure 4. The top four emitters per capita of carbon dioxide emissions. Source: Carbon Dioxide Information Analysis Center (CDIAC); Le Quéré et al, 2018 (see footnote #10); Global Carbon Budget 2018. Figure from the Global Carbon Project: Global Carbon Budget 2018.

Senator BRAUN. Thank you.
Mr. Wilson.

STATEMENT OF JOHN WILSON, VICE PRESIDENT AND DIRECTOR OF CORPORATE ENGAGEMENT, CALVERT RESEARCH AND MANAGEMENT

Mr. WILSON. Chairman Braun, Ranking Member Whitehouse, thank you for your invitation to speak before you today.

My name is John Wilson, and I am Vice President and Director of Corporate Engagement for Calvert Research and Management. Our firm sponsors one of the largest and most diversified families of responsibly invested mutual funds. We seek to generate favorable investment returns by allocating capital consistent with financially material environmental, social, and governance issues and through structured engagement with our portfolio companies.

Climate change is an urgent issue for us as fiduciaries because investment returns depend on a robust and growing economy. The U.S. Government's Fourth National Climate Assessment makes clear that unchecked climate change could reduce economic activity in several U.S. sectors by hundreds of billions of dollars by the end of the century. We believe our investment portfolios will be exposed to these risks within the coming decades, well within a typical investment time horizon.

As one element of our overall investment analysis, we evaluate the exposure of companies we invest in to the risk of climate change. This assessment is consistent with well grounded empirical evidence. A recent meta-analysis of 32 studies found a negative correlation between corporate carbon emissions and financial performance.

Many mainstream investors and companies now support action on climate change. Three hundred and sixty investors with $36 trillion under management have committed to engage the top greenhouse gas emitting companies in dialogue about how they can drive a transformation toward a clean energy economy and achieve the goals of the Paris Agreement.

On the corporate side, nearly 7,000 companies worldwide now report on greenhouse gas emissions and mitigation strategies to the Carbon Disclosure Project, the most comprehensive database of this information in the world. According to CDP, the 215 largest global companies alone report over $1 trillion of capital at risk from climate impacts, many of which may be felt in the next 5 years.

Among the many industries making commitments to transform their business models, at least 17 U.S. utilities have pledged to cut emissions by at least 80 percent by 2050, to the Chairman's earlier point. And all major automotive companies are investing heavily in low or no carbon transportation alternatives, and committing to expand their line up of electric powered vehicles.

Despite the efforts being made on all sides, consensus is emerging among both investment professionals and corporate executives that voluntary efforts will not be enough. Business incentives are misaligned because those responsible for the emission of greenhouse gases do not bear the costs of climate related harms such as extreme weather events, drought, or sea level rise. Instead, those costs are borne by the entire market.

For this reason, a coalition of 515 institutional investors with $35 trillion under management urged world governments to enact enabling policy to meet the goals of the Paris Agreement, in part by helping to accelerate sound business investments in climate mitigation. A clear policy signal, such as a carbon price, would allow investors to better quantify the economic implications of climate change on investment decisions.

For companies, it would help to overcome the pressures of short-termism, which sometimes hampers long term innovation. We observe, for example, that a mix of subsidies and requirements has helped to incentivize research and development that has rapidly reduced the cost of wind and solar energy over the last several years.

Both corporations and investors can and should make important contributions to the public dialogue about climate change policy. We are concerned, however, that some companies have failed to align their public policy engagements with their long term business strategies to invest in climate solutions. In response, 200 investors with $6.5 trillion under management forwarded a letter to company CEOs calling on them to harmonize their lobbying activities with the goals of the Paris Agreement.

This letter asks companies to develop governance procedures to ensure consistency between long term business strategy and public policy engagement, including both direct engagement as well as lobbying by intermediaries, such as trade associations and social welfare organizations.

We are pleased that some of these third parties have recently expressed support for action on climate change, and encourage them to back up their words with substantive action consistent with the scale of the economic challenge that we face.

Most concerning to us as investors is the lack of U.S. leadership in climate policy. Rather than supporting investors' and companies' efforts to make economically rational long term investment decisions, the Federal Government is moving in the opposite direction, first by initiating steps to withdraw from the Paris Agreement, and most recently by seeking to block States' efforts to address the issue.

A failure of the U.S. to address climate change could impact U.S. competitiveness relative to countries that are supporting the next generation of technology and solutions. Investors and companies across the globe are collaborating with the public sector to address the risks that greenhouse gases pose to portfolios and long term business investment. The absence of U.S. Government leadership from this partnership ensures that these technologies and solutions will arise elsewhere.

We urge the Committee to support legislation that will allow us to rapidly scale investments in climate change mitigation, and I would like to thank the Committee for allowing me the opportunity to share my perspectives on these important topics.

Thank you.

[The prepared statement of Mr. Wilson follows:]

John Wilson
Vice President, Director of Corporate Engagement, Calvert Research and Management

John Wilson is a vice president and director of corporate engagement for Calvert Research and Management, a wholly owned subsidiary of Eaton Vance Management that specializes in responsible and sustainable investing across global capital markets. He leads the design and execution of Calvert's corporate engagement and shareholder activism strategy. John is responsible for overseeing Calvert's systematic, top-down monitoring and bottom-up research approaches to identify issuers where dialogue in critical environmental, social and governance (ESG) topics could help improve long-term corporate value and/or environmental or societal outcomes. He manages a team of engagement specialists who monitor issues for engagement opportunities, develop the business case for change in conjunction with Calvert's ESG research analysts, participate in investor coalitions and manage Calvert's custom proxy voting guidelines. He joined Calvert Research and Management in 2019.

John began his career in the investment management industry in 1997. Before joining Calvert Research and Management, he was a head of governance and research at Cornerstone Capital Group. Prior experience includes serving as director of corporate governance at TIAA-CREF and as director of socially responsible investing at Christian Brothers Investment Services. Inc.

John earned a B.A. in English from Georgetown University, an MBA in finance from Columbia University Business School and an MIA in economic and political development from Columbia University School of International and Public Affairs.

Testimony of
John K.S. Wilson
Vice President, Director of Corporate Engagement
Calvert Research and Management

The Senate Committee on Environment and Public Works Subcommittee on Clean Air and Nuclear Safety

"Reducing Emissions While Driving Economic Growth: Industry-led Initiatives."

October 17, 2019
9:30 AM

Chairman Braun, Ranking Member Whitehouse, and Members of the Committee, thank you for the invitation to testify before you today. My name is John Wilson and I am Vice President, Director of Corporate Engagement at Calvert Research and Management, an investment management firm based in Washington, DC that invests across global capital markets. Calvert is a subsidiary of Eaton Vance Management, a leading global asset manager based in Boston.

Our firm sponsors one of the largest and most diversified families of responsibly invested mutual funds, encompassing active and passively managed equity, fixed income, alternative and multi-asset strategies. As of September 30, 2019 across our portfolios, we held more than 5800 securities from over 5000 issuers in developed and emerging markets. We seek to generate favorable investment returns for our clients by allocating capital consistent with financially material environmental, social and governance issues and through structured engagement with portfolio companies.

Climate change is an urgent issue for us as fiduciaries because investment returns generally depend on a robust and growing economy. The U.S. Government's Fourth National Climate Assessment makes clear that unchecked climate change could reduce economic activity in each of several U.S. sectors by hundreds of billions of dollars by the end of the century.[1] In emerging markets, a lack of resources available for adaptation to changes in the physical environment may exacerbate the risk of economic disruption from civil conflict and mass migration in addition to the costs associated with physical changes to the natural environment. We believe our investment portfolios will be exposed to these risks within the coming decades – well within a typical investment time horizon.

Our approach to managing exposure to the risks of climate change includes an evaluation of the climate policies and performance of the companies we invest in as one element of our overall investment analysis. This assessment is well-grounded in the empirical evidence. A recent meta-analysis of 32 studies found negative correlation between carbon emissions and financial performance[2]. This stands to reason – in many industries where these issues are material, lower greenhouse gas emissions correlate with more efficient operations, forward thinking product strategy, and better engagement of employees, many of whom care deeply about this issue.

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[1] https://nca2018.globalchange.gov/
[2] https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3225953

Calvert first identified climate change as a financially material investment risk as early as the 1990s, when the scientific consensus on climate change was taking shape. We began to engage with corporations with the express objective of improving enterprise value through better management of climate-related risks. At that time, only a few investors had identified climate change as a major concern, and many companies were expressing reluctance to accept the reality of human-caused climate change.

Today, support for action on climate has become a mainstream position for investors and companies. 360 investors with $36 trillion under management have joined the *Climate Action 100+*, a five year initiative to engage the top greenhouse gas emitting companies in dialogue about how they can drive a transformation toward a clean-energy economy and achieve the goals of the Paris Agreement.

Increasing numbers of investors are seeking opportunities to invest directly in climate solutions, such as through a mechanism called "green bonds," or fixed income securities that allow investment into projects with positive environmental benefits. The green bond market has grown from $37 billion in issuances in 2014 to $168 billion in 2018, a sign of rapidly growing investor interest in this area.[3]

On the corporate side, nearly 7000 companies world-wide now report on carbon emissions and mitigation strategies to the Carbon Disclosure Project (CDP), the most comprehensive database of this information in the world.[4] According to CDP, the 215 largest global companies alone report over $1 trillion of capital at risk from climate impacts, many of which may be realized in the next five years.[5]

A newer reporting standard that emphasizes forward looking strategic reporting, promulgated by the *Task Force on Climate-related Financial Disclosures,* now has over 700 supporters with assets of $118 trillion under management, including private sector, public sector, and central bank supporters.

645 global companies have joined *The Science Based Targets Initiative*, a joint program of CDP and the United Nations Global Compact, and have agreed to set goals for reducing greenhouse gas emissions. Some examples of industries making commitments to major transformations of their business models include: At least 17 U.S. utilities have pledged to cut emissions by 80% or to provide 100% carbon-free energy by 2050; all major automotive companies are investing heavily in low-or no-carbon transportation and committing to expand their lineup of electric powered vehicles; and technology companies are dramatically reducing greenhouse gas emissions, primarily by powering their data centers with renewable energy.

Despite the efforts being made on all sides, we find a clear consensus among both investment professionals and corporate executives that voluntary efforts will not be enough.

At the moment, business incentives are misaligned because those responsible for the emission of greenhouse gases do not bear the costs of climate-related harms such as extreme weather events, drought, and sea level rise. Instead, these costs are borne by us all.

For this reason, many investors support policies such as a carbon tax to better align the real costs of climate change with those parties responsible for the emission of greenhouse gases. A coalition of 515

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[3] https://www.climatebonds.net/market/explaining-green-bonds
[4] https://www.cdp.net/en/research/global-reports/global-climate-change-report-2018
[5] https://www.cdp.net/en/articles/media/worlds-biggest-companies-face-1-trillion-in-climate-change-risks

institutional investors with $35 trillion under management have promulgated a *The Global Investor Statement on Climate Change* urging world governments to enact enabling policy to meet the goals of the Paris Agreement, in part by helping to accelerate sound business investments into the energy transition. [6]

A clear policy signal would allow investors to better quantify the economic implications of climate change on investments and more efficiently allocate capital to investments suitable for the low-carbon economy. For companies, policy clarity would help to overcome the pressures of short-termism that sometimes hamper long-term innovations. We observe, for example, that a mix of subsidies and requirements has helped to incentivize the research and development that has rapidly brought the price of wind and solar energy down, and improved access to clean and renewable sources of energy.

Both corporations and investors can make important contributions to the public dialogue about climate change policy. We are concerned that some companies have failed to align their public policy engagements with their long-term business strategies to invest in climate solutions. In response, Calvert and 200 other investors with $6.5 trillion under management forwarded a letter to company CEOs calling on them to harmonize their lobbying activities with the goals of the Paris Agreement.

The letter asks companies to develop governance procedures to ensure consistency between long-term business strategy and public policy engagement, including both direct engagement as well as lobbying by intermediaries such as trade associations and social welfare organizations. We are pleased that some of these third parties have recently expressed increased support for action on climate change. Yet, we are concerned that continued resistance to progress may undermine their own members' investments in climate solutions and destroy shareholder value in the long run.

Even more concerning than the inconsistency in industry positioning, though, is the lack of leadership in U.S. climate policy. Rather than supporting investors and companies' efforts to make economically rational long-term investment decisions, the federal government is moving in the opposite direction – first by initiating steps to withdraw from the Paris Agreement, and more recently by seeking to block states' efforts to address the issue.

A failure of the U.S. to address climate issues could impact U.S. competitiveness with countries that are supporting research, development and dissemination of the next generation of technologies and solutions. Investors and companies across the globe are collaborating with the public sector to address the risk that carbon poses to portfolios and long term business investment. The absence of the U.S. government leadership from this partnership ensures that these technologies and solutions will arise elsewhere.

We urge this Committee to support legislation that will allow key economic actors to rapidly scale existing efforts to address the significant risks posed by climate change.

I would like to again thank the Committee for allowing me the opportunity to share my perspectives on these important topics. My sincere hope is that this forum provides an opportunity for constructive dialogue on how to ensure that the capital markets have the best information and incentives to manage the uncertainties related to climate change. Inaction threatens not only to hinder portfolio returns but also to undermine economic growth and broad prosperity.

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[6] http://theinvestoragenda.org/wp-content/uploads/2019/09/190916-GISGCC-for-UNCAS.pdf

The Senate Committee on Environment and Public Works Subcommittee on Clean Air and Nuclear Safety
"Reducing Emissions While Driving Economic Growth: Industry-led Initiatives"
October 17, 2019

Responses to Questions for the Record from Chairman Braun

1. ***Mr. Wilson, you note in your testimony that your firm first included climate as a material investment risk in the 1990s. In your view, is your model of pressuring companies to pursue sustainable policies through capital markets an efficient way to ensure that companies are making the best investments with available capital?***

Calvert Research and Management ('Calvert") engages in dialogue with companies on material environmental, social and governance issues that have the potential to affect the financial performance of the company to better support long-term value creation for our investors. We prioritize those companies where we are concerned that environmental, social and governance ("ESG") underperformance could be creating a long term risk to shareholder value.

We strive to establish respectful and productive relationships with companies to resolve conflicts and promote best practices. Shareholders can be particularly credible because they bring an independent and objective perspective to ESG dialogue, while their interests are aligned with those of companies. In our experience, collaborations with shareholders to develop sustainability policies can often lead to companies adopting a longer term approach to strategic planning, operations, and human capital management that addresses key sustainability concerns.

Research shows that companies that incorporate financially material stakeholder concerns into strategic planning are likely to outperform companies that ignore these considerations over the full business cycle.[1] Nevertheless, market pressures to produce short term results often induce corporations to ignore these longer term concerns in their business planning, creating risk for value destruction and lost potential opportunities for growth.

An example of academic research demonstrating the benefits of shareholder engagement on climate change is *Shareholder Activism and Firms' Voluntary Disclosure of Climate Change Risk* by Caroline Flammer, Michael W. Toffel and Kala Viswanathan, Harvard Business School Working paper 20-049, October 2019.

[1] Khan, Mozaffar N., George Serafeim, and Aaron Yoon. "Corporate Sustainability: First Evidence on Materiality." Harvard Business School Working Paper, No. 15-073, March 2015 Available at: http://nrs.harvard.edu/urn-3:HUL.InstRepos:14369106 ; Clark, Gordon L., Feiner, Andreas and Viehs, Michael, "From the Stockholder to the Stakeholder: How Sustainability Can Drive Financial Outperformance" (March 5, 2015). Available at SSRN: https://ssrn.com/abstract=2508281 or http://dx.doi.org/10.2139/ssrn.2508281

2. ***Over the past couple of years, we have seen a change in the way that companies have approached the issue of environmental protection. What are the reasons underlying this shift in corporate strategy?***

There has been a growing understanding among the public, investors and corporate managers of the ways in which corporate inattention to ESG issues can harm companies and the wider economy. Companies do not operate in isolation but exist within a multifaceted economic system that is exposed to, and influenced by, an evolving set of environmental and social risks that impact a firm's chance of success. Numerous academic studies have shown that companies better prepared to anticipate and manage these risks are also better prepared to drive shareholder value and stronger financial performance. A recent meta-study that aggregated the results of 2,200 studies on the topic concluded that the vast majority found positive correlations between corporate financial performance and ESG considerations that are financially material to that business.[2] Associated financial benefits included lower costs of capital, improved operating performance, and stronger free cash flow.

Over the last several years leading companies have developed successful models to add value through management of sustainability issues. Previously, many companies assumed that sustainability policies would impose additional costs to companies unconnected to financial results. However, as some companies demonstrated the value of these policies, others followed suit. For example, as companies have experienced the cost benefits of increasing efficiency in the use of natural resources, other companies developed systems to allow them to track and manage these resources as well. Eventually, these practices become part of standard operating procedures for all companies.

Finally, the increasing adoption of ESG policies by the financial industry and large asset owners such as pension plans creates an incentive for companies to enact environmental policies as a means of improving their access to capital. Dialogue between shareholders and companies has helped to raise awareness among corporate managers about the expectations of investors and the wider public about the appropriate management of these issues.

3. ***As your organization evaluates environmental policies, how do you consider the impacts those policies may have on competition and industry consolidation?***

As a manager of investment portfolios, Calvert has an interest in maintaining a competitive marketplace. We believe that greater attention to financially material ESG issues may help to improve the quality of competition in the marketplace.

The demand among workers, consumers and investors for greater corporate sustainability may drive innovation, as companies seek to respond to evolving societal expectations. In such an environment, responsiveness to social and environmental issues that are core to company strategy can be a competitive advantage for new entrants, or more adaptable industry players, against incumbents who may be slower to react to societal trends. For example, consumer demand for healthy and sustainable foods has created opportunities for new companies to capture this market, while some longstanding incumbents may struggle to adapt product lines, supply chains, and brands not well adapted to sustainability concerns.

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[2] Gunnar Friede & Timo Busch., "ESG and Financial Performance: Aggregated evidence from more than 2000 empirical studies," 2015. Available at: https://www.tandfonline.com/doi/full/10.1080/20430795.2015.1118917

Senator BRAUN. Thank you.

I am going to start with the questions, and I would like to address the first one to Dr. Dutton.

I really do believe that the dynamic we are facing is significant. I think—Senator Whitehouse and I have talked about modeling that is out there, that is going to give believability to where you don't—it is going to be hard for any of us to react to something where the world is going to end in 12 to 15 years. We are already beyond the point of redemption, I am going to guess, if that happens.

I think to make this sellable to the American public—we all know that sea levels will rise over time. I think you referred to 6 meters, over what period of time? When do you expect that?

Ms. DUTTON. Great question. So my research, a lot of it has focused on looking at past warm periods, trying to understand how much the ice sheets melted and then how quickly that happened, which is what you are asking there.

Senator BRAUN. Yes.

Ms. DUTTON. So that 6 meters, or 20 feet, will not happen in your lifetime or mine. But the problem is, we don't know the full answer to that question yet. And that is in part because we have never been around to witness dynamic retreat of Greenland and Antarctica of the type that is starting to happen now. So we don't know all of the physics involved in that ice sheet retreat. And that is the largest uncertainty when we look at sea level projections into the future.

However, having said that, we are certain that sea level is rising. So that uncertainty about exactly how quick shouldn't really be the focus of the issue. Yesterday in the Miami Herald, they reported that the northern part of Key Largo has now been underwater, a neighborhood, for more than 40 days in a row. And they are in about a foot of water.

Right now, tides up and down the U.S. east coast from New York to Miami are running about a foot to a foot and a half higher than predicted. It is not just because of sea level rise, but additional impacts of swell, and when you get intense rainfall, there is no place for it to go.

So these effects will in fact happen sooner than most people think they will.

Senator BRAUN. What would be the next two or three biggest general impacts? We all know sea level, because we hear that all the time. Can you graphically give us what you think the next two or three biggest differences would be in terms of how it is going to impact everyday life?

Ms. DUTTON. Right. Well, there are a myriad of ways. As you know, there is a domino effect as well.

But one thing I have been focusing on recently when I give public talks is just the heat, which came up in my testimony today. So if you have experienced heat of 105 degrees, it is crippling. Even though I work most of the day indoors, and I go outside just to walk to my car, it feels miserable, right? You can't do much outside then.

So heat, there is a limit of the heat that we can tolerate as humans and still perform as we expect to. So heat is a big one.

Another one is the wildfires that we are now seeing play out across the western U.S. The area of those wildfires is growing, and a lot of it is attributable to climate change.

And hurricanes are more intense; slower moving hurricanes are going to be big contenders.

Part of the reasons I highlight these wildfires and hurricanes, they require huge responses in terms of Federal disaster management. And the rapid intensification that we have seen in some of these hurricanes, which is a trend that should increase with increasing temperatures, makes it very difficult from an emergency response perspective.

Senator BRAUN. One final question on the subject of what might happen. Does climate change in any fashion have an effect that would not be catastrophic? In other words, in places where, just to get it out there, I would like to hear, or is it just universally going to be destructive and bad?

Ms. DUTTON. So you may argue that some people, it might benefit them. So maybe you can grow apples farther north or something like that. The problem is, the rate at which the temperatures are changing and these zones are migrating northward are too fast for us to keep up in terms of infrastructure.

We have developed and built things based on the climate of that region. To expect farmers to say, oh, well, instead of planting this, now I am just going to completely change and do something different, we just can't adapt that quickly. And that rate of change is really the biggest challenge.

Senator BRAUN. Thank you.

I am going to go to Senator Whitehouse here in a moment.

But I think the thing I grapple with mostly is how we marshal the resources, especially in the context of a place that is not functioning here well currently, with trillion-dollar deficits, when you look at what the cost would be. So there is going to be a lot of practicality that is going to have to be applied, in how you start the correction.

That is why I think that the more accurately we can have models that we can trust would be kind of the selling tool to take this in a broader way, not only here, but to convince industry and emitters across the board that it is happening, and to make it realistic on the other side of how we marshal the resources to combat it.

Senator Whitehouse.

Senator WHITEHOUSE. Thank you very much, Chairman, and thank you again for this hearing.

Let me start by asking Mr. Durbin and Mr. Macchiarola whether your trade associations ordinarily develop policy positions based on the consensus position of your member companies.

Mr. DURBIN. Yes, we strive for consensus with the members to reach a policy position.

Senator WHITEHOUSE. Mr. Macchiarola.

Mr. MACCHIAROLA. Yes, Senator, policy establishment at API is largely based on the consensus based approach, as well as principle based approach, reflecting the views of the broad membership of the association.

Senator WHITEHOUSE. So, Mr. Durbin, let me follow up a little bit more in detail about the Chamber.

As I understand it, the Chamber has several dozen policy committees. And your member companies can pay extra to sit on those policy committees, is that correct?

Mr. DURBIN. Well, the policy committees, there are various affiliates, including the Global Energy Institute that I lead, where members can pay to be a part of that group. But the broad policies of the U.S. Chamber are set by the board of directors of the broad U.S. Chamber.

Senator WHITEHOUSE. Is there a policy committee on environment and energy?

Mr. DURBIN. There are two separate committees that are open to the broad membership; again, every member, one on energy and agriculture, the other on environment and air. Just had a call with them yesterday. Yes, those committees do exist.

Senator WHITEHOUSE. If there is a call that goes out to the members of those committees, do you contact every single member of the Chamber? Or is there some way in which companies have identified their interest in that committee, and you have a list?

Mr. DURBIN. Exactly. They opt in.

Senator WHITEHOUSE. And do they compensate the Chamber in any way for the right to opt in?

Mr. DURBIN. Not beyond their membership.

Senator WHITEHOUSE. It is a function of their regular dues?

Mr. DURBIN. Indeed.

Senator WHITEHOUSE. Can you tell me which companies—this probably should be a question for the record—the two committees that you mentioned, can you tell me which companies sit on them?

Mr. DURBIN. Certainly, I will take that as a question for the record.

Senator WHITEHOUSE. Great. I don't expect you to have that off the top of your head.

Do you know how much the companies on those two policy committees contributed to the Chamber, let's say, in 2018, to the Chamber and its affiliates?

Mr. DURBIN. I don't. I can look into that, and not every company pays the same amount.

Senator WHITEHOUSE. We will make that a question for the record then, also.

Do you know how much in total fossil fuel industry companies and allied organizations contributed to the Chamber in 2018?

Mr. DURBIN. Again, I will get back to you on that.

Senator WHITEHOUSE. OK, we will make that a question for the record, too.

Do you know if the Chamber and its affiliates take money from non-corporate sources of funding, such as political advocacy groups?

Mr. DURBIN. Not to my knowledge. And I promise I won't play this line too frequently today, but yesterday was—now there are 6 weeks. So I would be happy to get back to you, like so many of those, I would be happy to get back to you on a question for the record.

Senator WHITEHOUSE. OK, we will follow up.

Do you know if Marathon Petroleum is a member of either of the two policy committees that you mentioned?

Mr. DURBIN. I believe they participate.

Senator WHITEHOUSE. In both?

Mr. DURBIN. I don't know.

Senator WHITEHOUSE. OK. So a lot of this is going to end up as questions for the record, and I appreciate that you are newer there, and that some of these are specific questions that you shouldn't be expected to know the answer to off the top of your head. So turning them into questions for the record is fine with me.

Do you know much ExxonMobil contributed to the Chamber and its affiliates in 2018?

Mr. DURBIN. I do not. I will get that.

Senator WHITEHOUSE. Ok. Can you tell me what Chamber member companies were consulted by the Chamber about the Chamber's decision to sue EPA to block the Clean Power Plan?

Mr. DURBIN. Again, I can get back to you on the process that was used to determine that.

Senator WHITEHOUSE. I have the question with respect to the Chamber's decision to sue EPA to block the Clean Power Plan, the same question regarding the Chamber's decision to intervene in litigation to support the Trump so called ACE rule, the replacement for the Clean Power Plan. And third, the Chamber's decision to fund a study critical of the Paris Agreement that has since been widely debunked. So that is a QFR, I guess, times three.

Mr. DURBIN. OK.

Senator WHITEHOUSE. So my time has expired for this round of questioning, and I will yield back. My apologies for going over a few seconds.

Senator BRAUN. Thank you. It looks like we are going to have plenty of time to ask questions, aren't we? Good.

[Laughter.]

Senator BRAUN. One of the vexing issues of what we are dealing with is that there has been great progress made here in our own country. I do remember vividly when the Cuyahoga River caught on fire. I couldn't believe that could even happen. I know that in even a local river, the White River, borders the northern edge of our county. Never, 20, 25 years ago, would we have fished in it, let alone eat the fish. Now I routinely see eagles along it. And we do fish, and eat the fish.

So in places, we have made great strides. I really think it is important that I think we are leading the way, but we were the largest emitters. I guess the only good news is internationally, we have been eclipsed by China.

So I don't want to get, and I am really worried about how we get the rest of the world to see the light when coal facilities are still being built, and it doesn't seem like that same trajectory is necessarily occurring.

Mr. Wilkinson, I want to ask you, because I heard when it comes to something like beef production, did I hear correctly that the methods used elsewhere would emit—what was the quantity more in terms of greenhouse gases?

Mr. WILKINSON. Ten to 50 percent, or 50 times more than us.

Senator BRAUN. That is what I thought I heard you say. That is unbelievable in terms of how the methodologies could be that different. I think where beef production in the U.S., you said, was 2

percent of emissions, is that within the country, or is that across the world?

Mr. WILKINSON. No, that is within the country.

Senator BRAUN. OK. And then, what is it in terms of beef production across the world? Assuming if we are much better, where would it stack up in terms of what that particularity would be generating across the world? Do you know that?

Mr. WILKINSON. Depending upon the metrics that you use to measure that, it is anywhere from 3 to 5 percent across the world. We are statistically lower than that because, frankly, we are more efficient. The example I can give you with that is back in the 1970s, we had a third more cows. And yet we produce the same amount of beef today with a third less cows.

Senator BRAUN. Better feed conversion.

Mr. WILKINSON. Better feed conversion, better genetics. Our producers are—that is their life blood. They want to improve all of those traits.

Senator BRAUN. And could you cite a couple of the methods? I was a turkey farmer for 32 years. I know all the advances that were made, better feed conversion. Of course, that lowers your footprint.

What has happened in the cattle industry? I think that is one of the things that has been thrown out there in kind of a figurative way as being a part of the problem. I am glad you pointed out what that is percentage wise here and across the globe.

Talk about a couple or three things that have really made a difference over the last decade.

Mr. WILKINSON. Well, in my lifetime, the biggest one I can point to right off the top is rotational grazing, intensive grazing. When I started out in the industry, when my brother started out in the beef business, we didn't do rotational grazing. It seemed counterintuitive, the fact that we would put our cow herd on a confined area and let them graze that area more intensely. We just let them generally run over the tract of land.

Now we specifically have those areas fenced off, and we rotate them in and out of those various paddocks. As a result of that—and again, it is logic, I guess, when you examine it after this many years—as a result of that, the cattle eat down the grass, the root system goes down deeper into the soil, and more carbon is sequestered.

Another one is distiller's grain. That is a great example of—it causes us to use less corn, and it is a byproduct. But it has improved the efficiency of the animals.

And I have to end up saying for the seed stock producers that we represent that the genetics of the animals, that the seed stock, if you looked at what was a champion bull in 1950 in the Angus breed, it is going to be about this high. I mean, that animal is now bigger in stature; it can put more pounds on more efficiently. So our seed stock producers are doing a wonderful job.

Senator BRAUN. It begs the question—and give me a quick answer here—why has not the rest of the world copied what we have done here, if you are assuming that we still need beef production? Why haven't those techniques been used across that other 3 percent that maybe totals 5? It seems like we could get emissions from

beef production almost down to 3 percent in total if others would copy the methodology.

Mr. WILKINSON. Well, Senator, the first one I am going to have to point out is India. They have an affinity to not want to eat beef. So there is a bit of a problem there.

But if you look at Australia, Brazil, two of our biggest competitors, our geography gives us a competitive advantage over those areas. We are not having to deforest, cut down forests, to increase our grazing capabilities. We have natural prairies and forests where we can graze at. We can take out the fire load out of our forests rather than cut them down.

Senator BRAUN. So it gives us a comparative advantage.

Mr. WILKINSON. Yes, it does give us some advantage.

Senator BRAUN. Thank you.

Senator Whitehouse.

Senator WHITEHOUSE. Thank you again, Chairman.

Mr. Durbin, I will follow up with two questions on our previous line of questioning. Am I correct that there are different membership levels in the U.S. Chamber of Commerce, Signature, Advantage, Elite, and C100?

Mr. DURBIN. There are different levels.

Senator WHITEHOUSE. And am I correct that your Web site shows that the option to serve on these policy committees is for those who subscribe to the Elite and C100 higher membership levels?

Mr. DURBIN. Again, let me get back to you on that question.

Senator WHITEHOUSE. OK. Let me put the Web page into the record as an exhibit so it is clear what I have been talking about.

[The referenced information follows:]

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Discounted rates to attend U.S. Chamber events, including **America's Small Business Summit**	✓	✓	✓	✓	
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Complimentary or discounted entry fees to exclusive policy events and conferences. (e.g., ***Chamber Federation Advocacy and Growth Conferences***)		✓	✓	✓	
President's Update, the monthly letter to the board of directors (*Valued at $10,000*)			✓	✓	
Direct access to the most sought-after leaders at the U.S. Chamber			✓	✓	
An opportunity to serve on one of more than 30 **U.S. Chamber policy committees**			✓	✓	
Committee members help define Chamber positions by providing their views on key issues through meetings, mailings, and surveys.					
Association Committee of 100 (C100). Invitation-only.				✓	

Senator WHITEHOUSE. Just today, the Chamber scorecarded the Senate resolution to disapprove the Trump ACE rule. My information is that the so called ACE rule requires zero emissions from natural gas. And further, that from coal, while it encourages certain efficiency improvements, it offsets those with opportunities for increased generation and could actually increase emissions.

So again, you guys just put this out today, neither you nor I have had a chance to review it. But I would like to ask you, the Chamber, for the record, to respond to how it is that the Chamber is willing to support a rule designed to reduce carbon emissions that actually doesn't reduce carbon emissions, and appears to have been a product of the fossil fuel industry's work.

I don't want to sandbag you with that, because I didn't get it until just now myself. So we will leave that as a question for the record.

Mr. Macchiarola, let me ask you a little bit about API. In my experience, ordinarily, trade associations set their membership dues with some correlation to the member corporations' revenues or profits. Is that the way API operates?

Mr. MACCHIAROLA. Thank you for your question, Senator. API generally sets its dues structure on the basis of production on the upstream side, throughput on the downstream side.

Senator WHITEHOUSE. So bigger companies should be expected to pay more.

Mr. MACCHIAROLA. Larger producing companies within the United States would be expected to pay more, that is correct.

Senator WHITEHOUSE. OK. You—API, I mean—supported the Trump proposal to scrap the rules regarding methane emissions at oil and gas facilities. Is that correct?

Mr. MACCHIAROLA. API supports the current methane rule in place in 2011 and 2016. We support the——

Senator WHITEHOUSE. The August proposal by EPA, you publicly support it, correct?

Mr. MACCHIAROLA. Correct.

Senator WHITEHOUSE. At the same time, ExxonMobil and BP and Shell publicly criticized that proposal. Based on the way in which you have said you calculate your dues, I would expect that ExxonMobil and BP and Shell would be three of API's biggest contributors, correct?

Mr. MACCHIAROLA. That is correct, Senator.

Senator WHITEHOUSE. I am interested in how API took this position, just to use this as one example, contrary to the public positions of three of its largest members. Can I ask you just to frame this out, how much money ExxonMobil, BP, and Shell gave to API for 2018?

Mr. MACCHIAROLA. Senator, with respect to the specific question regarding membership dues, I don't know the answer to that. So I will have to get back to you for the record.

Senator WHITEHOUSE. Not a problem. That is not a problem at all.

Mr. MACCHIAROLA. With respect to the consideration of support or opposition to a specific rulemaking, as you referred in your previous question, Senator, we are a consensus based organization that takes into account the views of the broad spectrum of the

membership, and work very hard to represent the industry and not one individual member, regardless of the size of the member.

Senator WHITEHOUSE. Let me add to the QFR question you are taking back also Marathon Petroleum, in addition to the three companies I named, in terms of what their contributions were to API during or for 2018.

The reason I am asking these questions—may I extend it another minute? The reason I am asking these questions is because Exxon and BP and Shell have taken a number of public positions that are contrary to positions that API then comes and pushes in Congress. The most significant of them is that Exxon, BP, and Shell all publicly say they support a price on carbon.

So my question to you is, can you share with us any sincere effort by ExxonMobil, BP, and Shell to support carbon pricing within your organization or to have you reflect their views in opposing the methane rule? What I am trying to get at is the extent to which Exxon, BP, and Shell are just basically greenwashing themselves with public statements while leaving you to do the dirty work of opposing things they claim to support.

So I don't know what information you can give me along those lines, but that is where this line of questioning is trying to get. I see very big companies that presumably contribute very significantly to your organization that seem to be economic winners from things you do that they claim not to support. And that is the discrepancy that concerns me here.

Mr. MACCHIAROLA. Senator, it doesn't—so that is not unusual for trade associations, first off. And second, it doesn't fall on that side of the ledger every time. For example, I look at the issue of CAFE standards, we had member companies who have positions that would be more against your position on CAFE closer to the position of the Trump administration. And our association actually did not take that position.

So again, to your earlier point, sir, we are a consensus based, principle based organization. We are not an organization that is dictated by one member view. We wouldn't last as a trade association that long, because we don't represent one member, we represent the broad spectrum of the industry.

I appreciate the point, Senator.

Senator WHITEHOUSE. I've gone well over my time, and I will just make a question for the record to see whatever documents you have that document that Exxon, BP, or Shell actually pursued their concerns within your organization as opposed to saying one thing to the public and using your organization to do the opposite. I will follow that up with the question for the record.

Mr. MACCHIAROLA. Senator, to the extent those materials are not proprietary, I am happy to share anything I can to shed some light on a pretty robust policy discussion that again, wants to end up with an outcome that reflects the broad view of the industry, not the view of a specific member. But thank you.

Senator WHITEHOUSE. Thank you, I appreciate it.

Thank you, Chairman Braun. I apologize for going 3 minutes over.

Senator BRAUN. Senator Carper.

Senator CARPER. I was happy to yield my 3 minutes.

Welcome, one and all, to this hearing. Ironically, this kind of hearing is a timely hearing, it comes on the heels of a weekend, a weekend that I spent in Aspen, at the Aspen Institute Seminar where we had Democrats and Republican House members and a couple of Senators. And we had folks from a couple auto companies and people from all different walks of life and businesses who have an interest in these issues.

In fact, the intersection, if you will, of how do we get cleaner air, cleaner water, address climate change, and create economic opportunity. I am one of those people who believe it is possible to do both. In fact, it is necessary for us to do both.

I am a retired Navy captain, a P–3 aircraft mission commander, Vietnam veteran. Tomorrow morning, in fact, I will be at the Naval Air Station in Jacksonville, Florida, with my flight suit on, and go out and fly with a P–8, a new P–8 air crew, and go out and drop some torpedoes out in the ocean. Hopefully not too close to Russian submarines, but we will see.

[Laughter.]

Senator CARPER. Last weekend, there was a lot of news in Florida, because Miami is flooded again. Again. Not the first time. It won't be the last time. And it is just getting worse.

We are not that far away from a place you heard about a lot last year, Ellicott City, Maryland. My wife was just there, went there with some of her friends, just to go on the heels of all the bad weather they had, just to demonstrate some solidarity and help do something for their economy and stay there for a couple of nights and eat in their restaurants.

As you know, they have had two 1,000 year floods in like 18 months. People say, what is a 1,000 year flood? It is something that happens every 1,000 years. They have had two of them in 18 months. So something is happening. I live in the lowest lying State in America, Delaware; we are sinking, and the seas around us are rising. So this is real for us. And we want to make sure that we address it.

And as it turns out, it is not just enough to do rules and regulations. It is not just enough to rely on innovation. We need to do both. And I say probably once a day, we have to be able to walk and chew gum at the same time. It has probably been said here already. There is an opportunity to do both, and we need to do both.

My sister and I were just barely teenagers and we were driving back from Beckley, West Virginia, where we were born, back to Danville, Virginia, where we were growing up, and my mom was driving in our 1955 Chrysler Plymouth, which was like a tank of a car. We were up mountain roads, and it started raining, bad thunderstorms. She lost control of the car, bounced off a rock cliff on the right side, over to the left side, down the mountainside, over and over and over and over again. Kind of came to a rest, and we were all thrown out of the car, we had no seatbelts. They didn't make seatbelts in most cars, and the auto industry did not receive them warmly when they were pressed to do that.

I love the auto industry. I have worked for years to be supportive of the auto industry. I still go to the Detroit Auto Show just about every year. We had auto people with us at this last weekend.

And I have been working and talking over the last week with Michal Freedhoff, who is a chemist, a Ph.D. chemist, and a member of our EPW staff. Smart as a whip. And we have been talking to representatives from all the major auto industries, auto companies, and asking what we can do to be helpful for them.

They are looking for a certain predictability, I think most businesses look for a certain predictability, that is what they are looking for with respect to fuel efficiency standards. The Obama administration left in place a rule, regulation that provided very rigorous standards between 2021 and 2025, I think about 5 percent increases a year. What the auto industry is asking—they are not asking to get rid of fuel efficiency standards, they are asking for some near term flexibility. Maybe 3 percent instead of 5.

And they all wrote a letter to the President about a month or two ago and said, Mr. President, you think you are helping us out by saying we are basically going to flat line everything, like we did in the 1970s, when we raised fuel efficiency standards; remember CAFE? And we hit the target, 27 and a half miles and then just, we went to nothing more, and we stayed there for like 20 years. Maybe more than 20 years.

And the auto companies said, we don't want to do that, that is not what we are asking for. They are going to build a lot of electric powered vehicles; they are going to build hydrogen powered vehicles. And what we are going to do in this Committee and in the legislation that we have reported out to Surface Transportation, is help facilitate, enable them to be successful when they build those vehicles, by providing money for charging stations, electric vehicle fueling stations, hydrogen powered vehicles. That is part of what we are going to be doing.

And seat belts, catalytic converters, air bags; as much as I love the auto industry, they weren't anxious to do any of those things. And now they advertise their products, how safe they are and all this stuff they used to oppose.

So I just want to—that will be an opening statement, I have an opening statement for the record, Mr. Chairman. But I had to just, that was an audible, as they say in football, that was an audible.

So I do have a question or two, if I could, Mr. Chairman.

Senator BRAUN. Yes.

Senator CARPER. Thanks so much. I apologize for being here so late. We had a prayer breakfast in Wilmington, Delaware, this morning, and James Lankford from Oklahoma was our guest speaker. It was great.

This would be for Frank, who I think is somebody who's known Mary Frances Repko for a year or two. I am reminded that every now and then I will hear somebody say in the meeting room, they will say, someone who is my opponent doesn't have to be my enemy.

Mr. MACCHIAROLA. That is absolutely true, Senator.

[Laughter.]

Senator CARPER. Might be true with you and MF; I hope so.

In your testimony, you described the investments in innovative air pollution reduction technologies that have been made by your industry. The question goes on to talk about lead, which everyone

agrees harms children's brains. One of the six criteria air pollutants referenced in your testimony.

The thing is though, getting the lead out of gasoline was not a voluntary measure, as you recall. It was a mandatory EPA rule that was, I think, initially opposed by, I think, by the organization that you represent here today.

I think somebody probably already mentioned this to you before I got here, but I would like to ask, Mr. Chairman, for unanimous consent to insert a copy of the API's testimony opposing EPA's rules to remove lead from gasoline into the record.

[The referenced information follows:]

STATEMENT

by

P.N. Gammelgard
Vice President, Industry Affairs
American Petroleum Institute

before the

Panel on Environmental Science and Technology
Public Works Committee
United States Senate

Washington, D.C.

May 8, 1974

I am P.N. Gammelgard, vice president for Industry Affairs of the American Petroleum Institute. With me are Dr. Neill Weaver, medical director of the Institute, and Mr. L.A. McReynolds of the Phillips Petroleum Company. On behalf of the Institute, I want to thank this panel for the opportunity to present the Institute's views on the phase-down of lead in leaded grades of gasoline.

The Institute's views on the health significance of automotive lead emissions are a matter of public record, both in our comments to EPA on its lead phase-down proposals and in our critique of Dr. Epstein's recent report to the Senate Public Works Committee.

Over the past several years, the Institute itself has expended more than a million dollars in research on the health significance of lead, much of it in cooperation with government. On the basis of this and other research, it is the Institute's judgment that the phase-down of lead in leaded grades of gasoline is not necessary for health reasons. We are aware that a number of papers based on studies supported by EPA and others have recently been published and that some of them associate automotive lead emissions with childhood lead poisoning. We are concerned that these papers appear to suffer from the same weakness found in many earlier studies -- namely, a failure to isolate and differentiate

between exposure to lead from automotive exhaust and exposure to other environmental sources, principally lead-based paint.

Our purpose today, however, is not to dwell on the health aspects of lead, but to discuss the effects of lead phase-down on the petroleum industry and on this country's energy supply. One factor which ought to be kept in focus in assessing the need for the lead phase-down regulation is the effect of the EPA regulation requiring the general availability of unleaded gasoline by July 1, 1974.

This requirement for unleaded gasoline will, by itself bring about a dramatic reduction in lead levels in the ambient air, since there is every indication that the great majority of 1975 and subsequent model year automobiles will be equipped with catalytic converters, which require unleaded gasoline. Furthermore, we understand that most non-catalyst-equipped 1975 model cars will also require unleaded gasoline. The reason is that they will have been certified on unleaded gasoline and their fill-pipes will accommodate only the special nozzles required for dispensing unleaded gasoline.

What this means is that there will be a steady attrition of those vehicles which operate on leaded gasoline, as they are replaced by vehicles using unleaded gasoline. In fact, if current

replacement rates of older cars with new cars continue, about 70 per cent of all gasoline sales will be unleaded by 1980.

EPA has argued that attrition will eliminate any dangers from polynuclear aromatics (PNA) in automotive emissions. (See Federal Register, December 6, 1973.) Surely, the same logic applies to the use of lead antiknocks in gasoline.

Support for this view is clearly indicated in a chart based on EPA's own data, which is attached to this statement as Exhibit I. This chart compares reductions in lead emissions resulting from the "lead-free" regulation. It graphically illustrates that the reductions achieved by the lead-free regulation alone will, by 1985, reach the same negligible level as would be achieved by the combination of the lead-free and the lead phase-down regulations.

Further support for this view arises from the fact that if EPA or individual states implement transportation control strategies, then airborne lead levels, along with the levels of other pollutants in the ambient air, will dramatically decrease, because the volume of traffic will decrease. Once again, there is very little to be gained by implementing the lead phase-down regulation. There is much to be lost.

This nation has just experienced the most severe peacetime energy shortage in history. The end of the Arab embargo -- as

Director John Sawhill of the Federal Energy Office has stressed -- has not resulted in the end of our energy shortage problems. These problems will continue.

The EPA-ordered lead phase-down will, when we can least afford it, result in a substantial crude oil penalty. The reason is that the addition of lead alkyls enables the refiner to increase the octane level of his gasoline in the most energy-efficient way. Other methods of boosting octane exact a substantial penalty in reduced yields of gasoline from crude oil.

We are aware that EPA has sponsored studies of the phase-down regulation at Bonner-Moore and A.D. Little. Unfortunately, these modeling studies do not reflect the true diversity of refinery types and operating conditions that exist in the industry. The impact of the lead phase-down on gasoline yields will vary among individual refineries.

Attached to the text as Exhibits II, III, and IV are tables indicating estimates of gasoline production losses, submitted to API on a confidential and individual basis by three oil companies. Exhibit II provides data on a single refinery. Exhibit III provides data on eight selected refineries of another company. And Exhibit IV provides similar data on all refineries of a third company. Exhibit V is a composite in chart form of

Exhibits II and IV, both of which show data on the gasoline yield penalties associated with the lead phase-down plus the requirement for an unleaded grade and data on the penalties associated with the unleaded grade alone.

As these exhibits show, some refineries can, in fact, anticipate losses in 1975 at least as high as three per cent. Estimated losses in 1979 are more dramatic still. In that year, motor fuel production could be penalized by as much as four per cent. Figures for intervening years and years subsequent to 1979 also indicate losses in production. In our judgment, these projected losses cast strong doubt on the wisdom of a regulation which aggravates short-fall problems.

EPA analyses, based on the increasing use of lighter, catalyst-equipped automobiles, show a net benefit with regard to fuel economy -- a benefit that would more than make up for the loss of gasoline production resulting from the lead phase-down regulation.

It is misleading, however, to use the expected fuel economy gain on the 1975 model cars as justification for the energy penalty associated with the lead phase-down regulation. These are two separate and distinct issues. Lumping them together only clouds the basic fact that the phase-down regulation would cause a significant, tangible loss in gasoline production that this

country cannot afford in a time of energy shortfalls.

Still another consideration associated with the lead phase-down regulation is that it will require substantial and expensive modifications of refinery operations in order to manufacture the high-octane blending stocks needed to replace lead. This investment is in addition to funds which must be allocated to new refinery construction and expansion needed to keep pace with the nation's energy needs. It is presently estimated that total expansion costs simply to meet 1985 demand could run as high as $15 billion.

It is worth pointing out, too, that there are serious doubts about the ability of those highly specialized firms in refinery design and construction to meet the deadlines associated with the lead phase-down regulations. These firms are already strained, trying to meet existing and new construction contracts. It simply may be impossible to complete the construction needed to comply with the lead phase-down regulation which goes into effect on January 1, 1975.

EPA expects some 12-20 small refineries may be forced to shut down as a result of the phase-down regulation, because they will be unable to secure the capital required to make the necessary modifications. We would point out that the nation desperately

needs more, not less refining capacity. Before the oil embargo, the United States was importing over six million barrels of crude oil and refined products daily to meet demand.

It is true that EPA, recognizing the financial hardships involved, has granted a two-year delay in compliance for small refiners. But the delay does not extend to those small refineries operated by major oil companies, despite the fact that all small refineries will face similar severe problems.

It is the view of the Institute that if -- despite the lack of evidence that the phase-down regulation is necessary -- the government still imposes this regulation, then the two-year delay in compliance should be granted not just to all small refineries, but to all refineries, regardless of size.

This approach would provide additional time for attracting and accumulating the necessary capital. It would provide more badly needed lead-time for the highly specialized refinery construction industry. It would help alleviate some of the difficulties stemming from the energy shortage. It would help free more funds more quickly for exploration activities. Finally, an across-the-board delay would allow time both for more definitive research into the health significance of airborne lead and for developing alternatives that will control lead emissions.

I would just make the point here that one of the most promising alternatives is the use of lead traps. In our judgment, further control of lead emissions is not necessary. But if such control is to be exercised, then simple and inexpensive lead traps deserve far more study and attention than they have yet received.

To sum up, the American Petroleum Institute is strongly opposed to the lead phase-down regulation as promulgated by EPA. We believe that the points we have raised would be valid in normal times. In these days of current -- and expected -- energy shortages, we urge that Congress give these points serious consideration.

Gentlemen, this concludes our prepared remarks. We will be glad to try to answer any questions you may have.

Senator CARPER. And my question would be, do you agree that this phase out never would have happened if EPA had just left it, or may—I will say this, it is a better way to ask this question. Would you agree that this phase out might never have happened, or it would have taken a whole lot longer if EPA had just left it up to the industry to get the lead out voluntarily? That is not a trick question, it is just a question from my heart.

Mr. MACCHIAROLA. Yes, thank you for your question, Senator.

It is hard to predict what might have happened, but I certainly take your point that sometimes Government action is required to make progress on the environment. We at API support that, we support a wide measure of rulemakings where the Government steps in and takes action.

But we also have worked very hard as an industry to commit ourselves to reducing emissions through our own technological advancements and either not waiting for regulation or doing it on top of regulation. I think a perfect example of that is what I spoke of earlier, the environmental partnership, which is a program of large member companies and small companies who join together to share practices and to take action on reducing methane emissions. And the progress in just a short period of time, less than 2 years, has been remarkable.

The industry, while producing—increasing production since 2006 by more than 50 percent of natural gas, methane emissions have remained flat. That is a recent NOAA study on the industry.

So I do certainly agree with your point that oftentimes, Government action is required to make this progress. But we as an industry are committed to reducing emissions through our own activities.

Thank you.

Senator CARPER. Thank you very, very much, Frank.

Could I just have a minute to ask something of——

Senator BRAUN. One quick one.

Senator CARPER. Thank you—of Dick Durbin's nephew. Nephew, right? I think.

Cagoule, I could barely spell cagoule a couple of years ago, now I use it a lot. But there used to be a time when we had this hole in the ozone, as you recall. And people tried to figure out what was causing that. It turns out it was chlorofluorinated carbons, and it was coolants out of refrigerators and stuff. So we stopped using those and phased those out and replaced them with HFCs. We find that that is good for the hole in the ozone but not so good for climate change.

So now a number of companies, Honeywell is one of them, Kumars is one of them, these others, American companies, have developed a follow on to the HFCs. They are good for the hole in the ozone and good for climate. And we need the Senate to be able to vote to ratify a treaty, it flows out of the Montreal Protocol.

There are a bunch of us who want to do it, a bunch of Democrats and Republicans, led largely by our colleagues from Louisiana. Any quick comments on that? And I appreciate your support and the support of the Chamber on this.

Mr. DURBIN. Thank you for the question, Senator. Again, I agree with your premise, too, that there are times that the regulation

does help move things forward for us in the environmental arena. I do think that the example you presented there on the stratosphere for ozone is an opportunity for us to work together to continue that and make that progress.

Senator CARPER. That would be great.

Mr. Chairman, that is a great opportunity for us to work on this stuff together. I hope that we will. We can do both. We need to do both.

Thank you all.

[The prepared statement of Senator Carper follows:]

STATEMENT OF HON. THOMAS R. CARPER,
U.S. SENATOR FROM THE STATE OF DELAWARE

Thank you, Chairman Braun and Ranking Member Whitehouse, for holding this hearing. I also appreciate the willingness of our witnesses to share their expertise with us.

Mr. Chairman, I am a big fan of innovation, and I am proud to live in a country with such a rich tradition of industry-led innovation and economic success. And I can truly say—as some of our witnesses will today—that that innovation has resulted in extraordinary improvements in air and water quality, as well as public health and safety.

But I'd be remiss if I did not point out that in so many of those cases, innovation alone was insufficient to protect the public health and safety. In fact, at times, industry has fought tooth and nail to oppose any efforts to protect the public health from dangerous products.

Beginning in the 1950s, the automobile industry fiercely opposed requirements aimed at improving passenger safety, including innovations like seat belts and air bags that we all take for granted today. Thankfully, the Federal Government rejected those arguments and over time required seat belts and air bags, including passenger-side air bags, in all new cars. The result was not economic devastation to the auto industry, but rather saving hundreds of thousands of lives.

In the mid-1970s—at a time when 88 percent of children under the age of 5 had elevated levels of lead in their blood—the oil industry vociferously opposed the EPA phase-out of lead from gasoline. Before the predecessor to this committee, the American Petroleum Institute testified, "[i]n our judgment, further control of lead is not necessary." Thankfully, the EPA phase-out continued uninterrupted, and by the time it concluded, the reductions meant that less than 2 percent of young children had elevated blood lead levels.

In the 1980s, the world recognized that concerted, international action was necessary to halt and reverse the growing hole in the ozone layer. President Reagan's EPA Administrator at the time, Lee Thomas, later recounted that industry lobbied his Administration, claiming that they could not phase-out the chlorofluorocarbons (CFCs) causing the ozone hole—that it would be too costly, and that the science was uncertain.

President Reagan, however, recognized the risk of chlorofluorocarbons, heeded the science, and helped to lead the development and implementation of the Montreal Protocol. The U.S. Senate ratified the resulting treaty unanimously, by a vote of 83–0. Today, 99 percent of ozone depleting substances have been phased out. EPA projects there will be a near complete recovery of the ozone layer by the middle of the 21st century. And the hairspray industry—which predicted economic calamity—survived just fine.

In the early 1990s, while I was serving as Delaware's only Congressman in the House of Representatives, I had the privilege of working alongside the late John Dingell, when he chaired the House Committee on Energy and Commerce. Under Chairman Dingell's leadership, we passed the landmark Clean Air Act Amendments of 1990 with the support of President George H.W. Bush. Operators of coal-fired power plants argued that the law's acid rain provisions would cause rolling blackouts, and cost ratepayers billions of dollars. Instead, the law's cap-and-trade program successfully leveraged the power of market forces to reduce pollution, with costs only one-seventh of what industry projected.

Similarly, for toxic air pollution, the 1990 Clean Air Act Amendments looked to successful ways that industry was already controlling emissions. The law required the largest polluters to install "maximum achievable control technology," based on what each industry's most effective innovators were already doing to reducing pollution. Some might derisively call this a Federal mandate. I call it ensuring fair com-

petition—a level playing field so that polluters don't get an unfair advantage over their cleaner competitors, at the expense of public health.

Unfortunately, when it came to toxic pollution from power plants, EPA dragged its feet. In the 2000s, when Senator Lamar Alexander and I first introduced a bill to require power plants to install already available technology to reduce mercury pollution by 90 percent, the utilities said it couldn't be done. It would cost too much and take too much time, they told us. Thankfully, in 2012, the Obama-Biden EPA finally promulgated the Mercury and Air Toxics Standards, which reduced mercury pollution by 90 percent, and did so faster than the utilities predicted and at one-third of the cost. Today, every power plant in our country complies with those standards.

American industry is great at innovating. But the fact is, companies are motivated chiefly by near term shareholder pressures, not by the longer term goals of protecting the broader public health and welfare. And too many times in our history, industries have been resistant to the Government actions and responsible regulations necessary to address serious health and environmental problems. Yes, lead and mercury levels are way down, our ozone layer is much restored, and Americans are much less at risk as a result, and we can thank smart laws and policies that resulted in unleaded gasoline, innovative scrubbers, and CFC substitutes for these successes.

Sometimes, changing the law or writing a new rule is, in fact, the only way to resolve critical challenges to our environmental quality and public health.

As we look ahead to our continuing challenges—the climate crisis, mercury and other air toxics, emerging contaminants, vastly increasing extinction rates, and others—we will need to deploy all of the tools at our disposal to ensure we leave behind a healthy planet for our children and grandchildren to call home.

So, I hope to learn more about how voluntary actions and industry-led initiatives are going to help. I surely hope that in some cases, voluntary industry efforts will help solve the problem. That said, it is critical we see and accept that there will be many cases in which those efforts are not enough, and the Government needs to step in and act.

Once again, I thank our witnesses for sharing their time and knowledge with us. I hope we will work together as we continue to seek the right marriage of industry and Government leadership to improve the quality of the environment.

Senator BRAUN. Thank you. It is amazing when time flies when you are on an interesting subject. So to respect everyone's time, I am going to ask a question here of Mr. Wilson and then let the Ranking Member finish up, then I will give a little concluding statement.

When it comes to the whole issue of how—first of all, I believe industry, corporations, are generally footdraggers when it comes to health care, which I am involved with. I see this sector being a lot more ahead in the game, which, depending on what you think its speed is, might be disappointing. You ought to see how difficult it has been to get the health care industry, which is the largest sector of our economy, to get with it. Very disappointing.

I know that when it comes to the cost of capital and the return on capital, I am a finance guy, I understand how that works, without a pricing mechanism, how much progress do we have to where people are just extrapolating the returns on investment? And if they are not conscious of the climate, and they are not green in nature, is that a mechanism in and of itself that will have impact, hopefully geometrically better than what we have had up to this point?

Mr. WILSON. I want to make sure I understand your question. Are you asking whether it is possible to achieve sufficient reductions without a policy statement?

Senator BRAUN. I think your answer to that would be no. I am just asking what speed we might see, just for businesses making that calculation, that I am not going to invest here because it is

not addressing the major climate issues, and therefore, it would be a return, a poor ROI.

Mr. WILSON. Right.

Senator BRAUN. Which is basically what you have been pushing and interested in, since you have been trying to direct capital into a better return, because it is conscious of the issues out there.

Mr. WILSON. That is correct. There are a lot of business reasons why companies may take on climate change as an issue. Right.

No. 1, obviously, is efficiency. A lot of companies—there was a lot of low hanging fruit on the table, companies did not have the systems in place to count energy efficiency savings, for example, as a return on investment for a long time. So when we engaged with companies, there was a lot of low hanging fruit like that that they could take advantage of.

Another benefit of this is, companies are in a competition for talent. And talent these days, especially young people, are very engaged in this issue, I can tell you. I have two children, and they are not of working age yet, but already very engaged on this issue. The example you referenced earlier about Amazon, that began with a movement within the employee base of Amazon to push the company to take greater steps on climate change. So that would be another benefit.

The third, of course, is more consumer interest in these kinds of issues. So for everything from automotive, where there's a much more avid interest in fuel efficiency, to the food industry, that we engage with a lot, and there is a lot of interest in not only healthier diets, but more sustainable diets as well, which includes, obviously, better meat production, but also moving away from meat to plant based sources of food.

So there are different reasons why companies may take this as an issue that they have to really think about. However, what we find is that the low hanging fruit is rapidly diminishing, and companies have gone a long way toward what they can do without a price signal. However, obviously, a better signal would accelerate all of the kinds of business cases that we already see and have already raised with companies.

Senator BRAUN. Thank you.

Senator Whitehouse.

Senator WHITEHOUSE. Thanks very much. I will just offer a concluding thought.

First of all, let me thank Dr. Dutton for being here. Science has been warning us for a considerable period of time that this is coming at us. Science kind of provides the headlights for society, giving us a preview of what is coming down the road. For a long time; science has been predicting that the road was going to get pretty damned rough.

But a scientific prediction is a different thing than an actual human experience. And the fossil fuel industry's attacks on science and on its conclusions have kind of fought that science to a standstill, at least during the period when it was just warnings.

Now we have entered the phase where the road is actually really getting rough. And we are seeing this in previously unknown wildfire intensities, and expanding wildfire seasons. We are seeing it in the farming community with very atypical flooding experiences and

very atypical changes in how seasons work, so that crops don't grow the same way.

In my world, the oceans, Ocean State, Rhode Island, we are seeing it with fisheries moving about dramatically. Connecticut and Rhode Island have essentially lost their lobster fisheries, which used to be a pretty big deal. We are seeing it with incredibly obviously measurements of sea level rise, of ocean temperature. Really hard to argue with a thermometer.

And of ocean acidification. Any middle school with an aquarium knows how to do a pH test. And pH tests are pretty hard to argue with, too.

So all of this experience is now piling up. In addition, from the economic side, we are starting to see warnings that weren't apparent just a few years ago. So the warnings out of the Bank of England and out of so many other sovereign banks about a carbon asset bubble crash have the full attention of banks, have the full attention of investors, have the full attention of a community that did not take this terribly seriously until recently.

The warnings about a coastal property values crash coming from not particularly green places like Freddie Mac have the attention of all of the business community members whose livelihoods depend on vibrant coastal communities—insurance, real estate, builders, all of that.

So I think what we are at now is a point where for the first time, there are very serious business interests for whom climate change is no longer just a matter of humoring shareholders and customers, but really goes to a potential dramatic hit to their business model. And if you read what Mark Carney at the Bank of England is warning about in terms of a carbon asset bubble crash, even API's corporate members have a lot to fear from a disorderly transition.

Companies that want to put their hands over their ears and say la, la, la, la, la, and not pay any attention through this stand a very good chance of hitting a wall and having a very hard landing. Whereas with some preparation and care, that could be something you could work your way through with some attentive and thoughtful policy changes.

There is a big difference between jumping out of a plane and jumping out of a plane with a parachute. And the outcome is very different when you hit the ground.

So even API's members, I think, have an enormous stake in getting this right. And certainly, the chambers do, across a much broader array of industries that the Chamber represents.

So I look forward to continuing this discussion. I look forward to the answers to the questions for the record.

In addition to asking to have the Chamber's page about these different levels of membership put into the record, I would also like to have the Chamber's letter of today scorecarding the Senate resolution put into the record.

Then I have three articles, since I raised this issue about the methane, three articles about the fossil fuel industry's performance with respect to methane leakage and flooring. One is a technical presentation, a scientific report called Assessment of Methane Emissions from the U.S. Oil and Gas Supply Chain.

The next is yesterday's New York Times story entitled Despite Their Promises, Giant Energy Companies Burn Away Vast Amounts of Natural Gas. And a final one is today's article from Unearthed, whose title is not readily apparent, here we go, Exxon and BP Among Worst for Flaring in U.S. Oil Fields, Despite Green Pledges.

With your permission, Mr. Chairman, I would ask those to be added to the record.

[The referenced information follows:]

Dudis, Dan (Whitehouse)

From:	U.S. Chamber of Commerce <hill_letters@uschamber.com>
Sent:	Thursday, October 17, 2019 9:21 AM
To:	Dudis, Dan (Whitehouse)
Subject:	U.S. Chamber of Commerce - S.J. Res. 53

Click To View Documents: 191017_KV_S.J.Res.53_Senate.pdf (327KB):

CHAMBER OF COMMERCE
OF THE
UNITED STATES OF AMERICA

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October 17, 2019

TO THE MEMBERS OF THE UNITED STATES SENATE:

The U.S. Chamber of Commerce strongly opposes S.J. Res. 53, which would undo the Environmental Protection Agency's Affordable Clean Energy (ACE) Rule, which addresses greenhouse gas emissions from the electric power sector. **The Chamber will consider including votes on this resolution in our annual *How They Voted* scorecard.**

The Chamber believes the global climate is changing and humans are contributing to these changes. We believe that there is much common ground on which all sides of this discussion could come together to address climate change with policies that are practical, flexible, predictable, and durable. The Chamber also believes in a policy approach that acknowledges the costs of action and inaction and the competitiveness of the U.S. economy.

To be clear, S.J. Res. 53 is *not* a vote to reinstate the Obama-era Clean Power Plan. The Supreme Court has prevented EPA from moving forward with this regulation due in part to its unprecedented scope and unsound legal footing. In addition, the proposed use of the Congressional Review Act may prevent the promulgation of substantially similar regulations in the future, which could serve to restrict future use of the Clean Air Act to reduce emissions and address climate change.

The ACE Rule will result in measurable progress on further reducing the carbon intensity of the electric power sector in a manner consistent with the EPA's authority under the Clean Air Act. If enacted, S.J. Res. 53 would prevent the reduction in carbon emissions envisioned under the rule. Instead of this ill-considered resolution, we urge the Senate to take-up bipartisan energy innovation legislation that has great potential to make additional, meaningful reductions in carbon emissions.

The Chamber urges you to oppose S.J. Res. 53.

Sincerely,

Jack Howard

This letter can be accessed on the Chamber's website here.

GREENHOUSE GASES

Assessment of methane emissions from the U.S. oil and gas supply chain

Ramón A. Alvarez[1*], Daniel Zavala-Araiza[1], David R. Lyon[1], David T. Allen[2], Zachary R. Barkley[3], Adam R. Brandt[4], Kenneth J. Davis[3], Scott C. Herndon[5], Daniel J. Jacob[6], Anna Karion[7], Eric A. Kort[8], Brian K. Lamb[9], Thomas Lauvaux[3], Joannes D. Maasakkers[6], Anthony J. Marchese[10], Mark Omara[1], Stephen W. Pacala[11], Jeff Peischl[12,13], Allen L. Robinson[14], Paul B. Shepson[15], Colm Sweeney[13], Amy Townsend-Small[16], Steven C. Wofsy[6], Steven P. Hamburg[1]

Methane emissions from the U.S. oil and natural gas supply chain were estimated by using ground-based, facility-scale measurements and validated with aircraft observations in areas accounting for ~30% of U.S. gas production. When scaled up nationally, our facility-based estimate of 2015 supply chain emissions is 13 ± 2 teragrams per year, equivalent to 2.3% of gross U.S. gas production. This value is ~60% higher than the U.S. Environmental Protection Agency inventory estimate, likely because existing inventory methods miss emissions released during abnormal operating conditions. Methane emissions of this magnitude, per unit of natural gas consumed, produce radiative forcing over a 20-year time horizon comparable to the CO_2 from natural gas combustion. Substantial emission reductions are feasible through rapid detection of the root causes of high emissions and deployment of less failure-prone systems.

Methane (CH_4) is a potent greenhouse gas, and CH_4 emissions from human activities since preindustrial times are responsible for 0.97 W m^{-2} of radiative forcing, as compared to 1.7 W m^{-2} for carbon dioxide (CO_2) (*1*). CH_4 is removed from the atmosphere much more rapidly than CO_2; thus, reducing CH_4 emissions can effectively reduce the near-term rate of warming (*2*). Sharp growth in U.S. oil and natural gas (O/NG) production beginning around 2005 (*3*) raised concerns about the climate impacts of increased natural gas use (*4*, *5*). By 2012, disagreement among published estimates of CH_4 emissions from U.S. natural gas operations led to a broad consensus that additional data were needed to better characterize emission rates (*4*–*7*). A large body of field measurements made between 2012 and 2016 (table S1) has markedly improved understanding of the sources and magnitude of CH_4 emissions from the industry's operations. Brandt *et al.* summarized the early literature (*6*); other assessments incorporated elements of recent data (*9*–*11*). This work synthesizes recent studies to provide an improved overall assessment of emissions from the O/NG supply chain, which we define to include all operations associated with O/NG production, processing, and transport (materials and methods, section S1.0) (*12*).

Measurements of O/NG CH_4 emissions can be classified as either top-down (TD) or bottom-up (BU). TD studies quantify ambient methane enhancements using aircraft, satellites, or tower networks and infer aggregate emissions from all contributing sources across large geographies. TD estimates for nine O/NG production areas have been reported to date (table S2). These areas are distributed across the U.S. (fig. S1) and account for ~33% of natural gas, ~24% of oil production, and ~14% of all wells (*13*). Areas sampled in TD studies also span the range of hydrocarbon characteristics (predominantly gas, predominantly oil, or mixed), as well as a range of production characteristics such as well productivity and maturity. In contrast, BU studies generate regional, state, or national emission estimates by aggregating and extrapolating measured emissions from individual pieces of equipment, operations, or facilities, using measurements made directly at the emission point or, in the case of facilities, directly downwind.

Recent BU studies have been performed on equipment or facilities that are expected to represent the vast majority of emissions from the O/NG supply chain (table S1). In this work, we integrate the results of recent facility-scale BU studies to estimate CH_4 emissions from the U.S. O/NG supply chain, and then we validate the results using TD studies (materials and methods). The probability distributions of our BU methodology are based on observed facility-level emissions, in contrast to the component-by-component approach used for conventional inventories. We thus capture enhancements produced by all sources within a facility, including the heavy tail of the distribution. When the BU estimate is developed in this manner, direct comparison of BU and TD estimates of CH_4 emissions in the nine basins for which TD measurements have been reported indicates agreement between methods, within estimated uncertainty ranges (Fig. 1).

Our national BU estimate of total CH_4 emissions in 2015 from the U.S. O/NG supply chain is 13 (+2.1/−1.6, 95% confidence interval) Tg CH_4/year (Table 1). This estimate of O/NG CH_4 emissions can also be expressed as a production-normalized emission rate of 2.3% (+0.4%/−0.3%) by normalizing by annual gross natural gas production [33 trillion cubic feet (*13*), with average CH_4 content of 90 volume %]. Roughly 85% of national BU emissions are from production, gathering, and processing sources, which are concentrated in active O/NG production areas.

Our assessment does not update emissions from local distribution and end use of natural gas, owing to insufficient information addressing this portion of the supply chain. However, recent studies suggest that local distribution emissions exceed the current inventory estimate (*14*–*16*), and that end-user emissions might also be important. If these findings prove to be representative, overall emissions from the natural gas supply chain would increase relative to the value in Table 1 (materials and methods, section S1.5).

Our BU method and TD measurements yield similar estimates of U.S. O/NG CH_4 emissions in 2015, and both are significantly higher than the corresponding estimate in the U.S. Environmental Protection Agency's Greenhouse Gas Inventory (EPA GHGI) (Table 1 and materials and methods, section S1.3) (*17*). Discrepancies between TD estimates and the EPA GHGI have been reported previously (*8*, *18*). Our BU estimate is 63% higher than the EPA GHGI, largely due to a more than twofold difference in the production segment (Table 1). The discrepancy in production sector emissions alone is ~4 Tg CH_4/year, an amount larger than the emissions from any other O/NG supply chain segment. Such a large difference cannot be attributed to expected uncertainty in either estimate: The extremal ends of the 95% confidence intervals for each estimate differ by 20% (i.e., ~12 Tg/year for the lower bound of our BU estimate can be compared to ~10 Tg/year for the upper bound of the EPA GHGI estimate).

We believe the reason for such large divergence is that sampling methods underlying conventional inventories systematically underestimate total emissions because they miss high emissions caused by abnormal operating conditions (e.g., malfunctions). Distributions of measured emissions from production sites in BU studies are invariably "tail-heavy," with large emission rates measured at a small subset of sites at any single point in time (*19*–*22*). Consequently, the most likely hypothesis for the difference between the EPA GHGI and BU estimates derived from facility-level measurements is that measurements used to develop GHGI emission factors

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undersample abnormal operating conditions encountered during the BU work. Component-based inventory estimates like the GHGI have been shown to underestimate facility-level emissions (23), probably because of the technical difficulty and safety and liability risks associated with measuring large emissions from, for example, venting tanks such as those observed in aerial surveys (24).

Abnormal conditions causing high CH_4 emissions have been observed in studies across the O/NG supply chain. An analysis of site-scale emission measurements in the Barnett Shale concluded that equipment behaving as designed could not explain the number of high-emitting production sites in the region (23). An extensive aerial infrared camera survey of ~8000 production sites in seven U.S. O/NG basins found that ~4% of surveyed sites had one or more observable high-emission rate plumes (24) (detection threshold of ~3 to 10 kg CH_4/hour was two to seven times higher than mean production site emissions estimated in this work). Emissions released from liquid storage tank hatches and vents represented 90% of these sightings. It appears that abnormal operating conditions must be largely responsible, because the observation frequency was too high to be attributed to routine operations like condensate flashing or liquid unloadings alone (24). All other observations were due to anomalous venting from dehydrators, separators, and flares. Notably, the two largest sources of aggregate emissions in the EPA GHGI—pneumatic controllers and equipment leaks—were never observed from these aerial surveys. Similarly, a national survey of gathering facilities found that emission rates were four times higher at the 20% of facilities where substantial tank venting emissions were observed, as compared to the 80% of facilities without such venting (25). In addition, very large emissions from leaking isolation valves at transmission and storage facilities were quantified by means of downwind measurement but could not be accurately (or safely) measured by on-site methods (26). There is an urgent need to complete equipment-based measurement campaigns that capture these large-emission events, so that their causes are better understood.

In contrast to abnormal operational conditions, alternative explanations such as outdated component emission factors are unlikely to explain the magnitude of the difference between our facility-based BU estimate and the GHGI. First, an equipment-level inventory analogous to the EPA GHGI but updated with recent direct measurements of component emissions (materials and methods, section S14) predicts total production emissions that are within ~10% of the EPA GHGI, although the contributions of individual source categories differ significantly (table S3). Second, we consider unlikely an alternative hypothesis that systematically higher emissions during daytime sampling cause a high bias in TD methods (materials and methods, section S1.6). Two other factors may lead to low bias in EPA GHGI and similar inventory estimates. Operator cooperation is required to obtain site access for emission measurements (8). Operators with lower-emitting sites are plausibly more likely to cooperate in such studies, and workers are likely to be more careful to avoid errors or fix problems when measurement teams are on site or about to arrive. The potential bias due to this "opt-in" study design is very challenging to determine. We therefore rely primarily on site-level, downwind measurement methods with limited or no operator forewarning to construct our BU estimate. Another possible source of bias is measurement error. It has been suggested that malfunction of a measurement instrument widely used in the O/NG industry contributes to underestimated emissions in inventories (27); however, this cannot explain the more than twofold difference in production emissions (28).

The tail-heavy distribution for many O/NG CH_4 emission sources has important implications for mitigation because it suggests that most sources—whether they represent whole facilities or individual pieces of equipment—can have lower emissions when they operate as designed. We anticipate that significant emissions reductions could be achieved by deploying well-designed emission detection and repair systems that are capable of identifying abnormally operating facilities or equipment. For example, pneumatic controllers and equipment leaks are the largest emission sources in the O/NG production segment exclusive of missing emission sources (38 and 21%, respectively; table S3), with malfunctioning controllers contributing 66% of total pneumatic controller emissions (materials and methods, section S1.4) and equipment leaks 60% higher than the GHGI estimate.

Table 1. Summary of this work's bottom-up estimates of CH_4 emissions from the U.S. oil and natural gas (O/NG) supply chain (95% confidence interval) and comparison to the EPA Greenhouse Gas Inventory (GHGI).

Industry segment	2015 CH_4 emissions (Tg/year)	
	This work (bottom-up)	EPA GHGI (17)
Production	7.6 (+1.9/−1.6)	3.5
Gathering	2.6 (+0.59/−0.18)	2.3
Processing	0.72 (+0.20/−0.071)	0.44
Transmission and storage	1.8 (+0.35/−0.22)	1.4
Local distribution*	0.44 (+0.51/−0.22)	0.44
Oil refining and transportation*	0.034 (+0.050/−0.008)	0.034
U.S. O/NG total	13 (−2.1/−1.7)	8.1 (+2.1/−1.4)†

*This work's emission estimates for these sources are taken directly from the GHGI. The local distribution estimate is expected to be a lower bound on actual emissions and does not include losses downstream of customer meters due to leaks or incomplete combustion (materials and methods, section S1.5).
†The GHGI only reports industry-wide uncertainties.

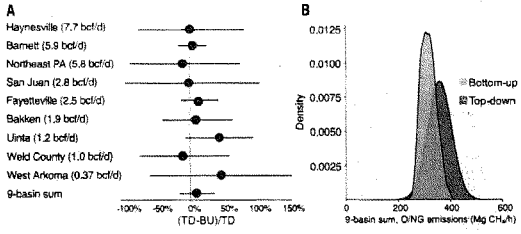

Fig. 1. Comparison of this work's bottom-up (BU) estimates of methane emissions from oil and natural gas (O/NG) sources to top-down (TD) estimates in nine U.S. O/NG production areas. (**A**) Relative differences of the TD and BU mean emissions, normalized by the TD value, rank ordered by natural gas production in billion cubic feet per day (bcf/d, where 1 bcf = 2.8×10^7 m^3). Error bars represent 95% confidence intervals. (**B**) Distributions of the nine-basin sum of TD and BU mean estimates (blue and orange probability density, respectively). Neither the ensemble of TD-BU pairs (A) nor the nine-basin sum of means (B) are statistically different [$p = 0.13$ by a randomization test, and mean difference of 11% (95% confidence interval of −17 to 41%)].

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Gathering operations, which transport unprocessed natural gas from production sites to processing plants or transmission pipelines, produce ~20% of total O/NG supply chain CH_4 emissions. Until the publication of recent measurements (*29*), these emissions were largely unaccounted by the EPA GHGI. Gas processing, transmission and storage together contribute another ~20% of total O/NG supply chain emissions, most of which come from ~2500 processing and compression facilities.

Our estimate of emissions from the U.S. O/NG supply chain (13 Tg CH_4/year) compares to the EPA estimate of 18 Tg CH_4/year for all other anthropogenic CH_4 sources (*17*). Natural gas losses are a waste of a limited natural resource (~$2 billion/year), increase global levels of surface ozone pollution (*30*), and substantially erode the potential climate benefits of natural gas use. Indeed, our estimate of CH_4 emissions across the supply chain, per unit of gas consumed, results in roughly the same radiative forcing as does the CO_2 from combustion of natural gas over a 20-year time horizon (31% over 100 years). Moreover, the climate impact of 13 Tg CH_4/year over a 20-year time horizon roughly equals that from the annual CO_2 emissions from all U.S. coal-fired power plants operating in 2015 (31% of the impact over a 100-year time horizon) (materials and methods, section S1.7).

We suggest that inventory methods would be improved by including the substantial volume of missing O/NG CH_4 emissions evident from the large body of scientific work now available and synthesized here. Such empirical adjustments based on observed data have been previously used in air quality management (*31*).

The large spatial and temporal variability in CH_4 emissions for similar equipment and facilities (due to equipment malfunction and other abnormal operating conditions) reinforces the conclusion that substantial emission reductions are feasible. Key aspects of effective mitigation include pairing well-established technologies and best practices for routine emission sources with economically viable systems to rapidly detect the root causes of high emissions arising from abnormal conditions. The latter could involve combinations of current technologies such as on-site leak surveys by company personnel using optical gas imaging (*32*), deployment of passive sensors at individual facilities (*33*, *34*) or mounted on ground-based work trucks (*35*), and in situ remote-sensing approaches using tower networks, aircraft, or satellites (*36*). Over time, the development of less failure-prone systems would be expected through repeated observation of and further research into common causes of abnormal emissions, followed by re-engineered design of individual components and processes.

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SUPPLEMENTARY MATERIALS

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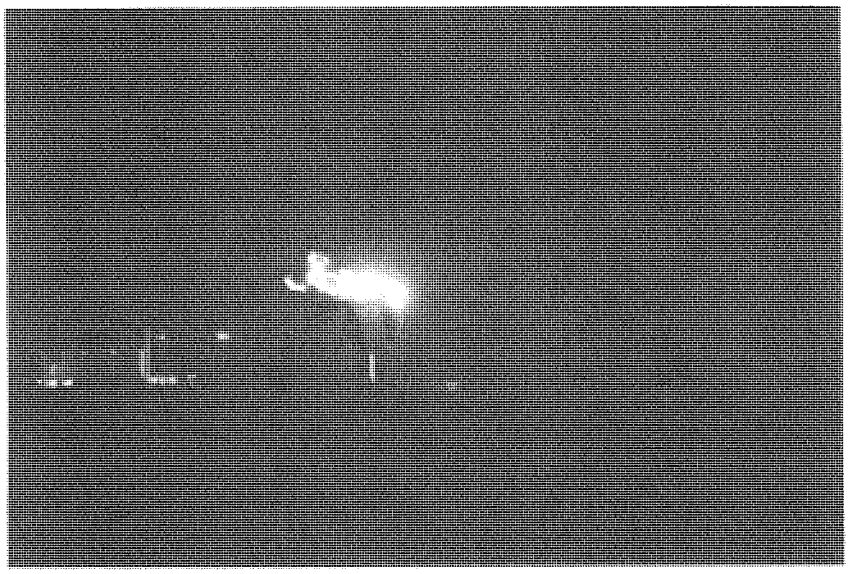

Despite Their Promises, Giant Energy Companies Burn Away Vast Amounts of Natural Gas

By Hiroko Tabuchi

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When leaders from Exxon Mobil and BP gathered last month with other fossil-fuel executives to declare they were serious about climate change, they cited progress in curbing an energy-wasting practice called flaring — the intentional burning of natural gas as companies drill faster than pipelines can move the energy away.

But in recent years, some of these same companies have significantly increased their flaring, as well as the venting of natural gas and other potent greenhouse gases directly into the atmosphere, according to data from the three largest shale-oil fields in the United States.

The practice has consequence for climate change because natural gas is a potent contributor to global warming. It also wastes vast amounts of energy: Last year in Texas, venting and flaring in the Permian Basin oil field alone consumed more natural gas than states like Arizona and South Carolina use in a year.

Exxon's venting and flaring has surged since 2017 to record highs, both in absolute terms and as a proportion of gas produced, the numbers show. Exxon flared or vented 70 percent more gas in 2018 than it did the previous year, according to the data, bringing an end to several years of improvements.

Flaring and venting are legal under state laws, and oil companies acknowledge the practices are wasteful. Typically, venting or flaring occur because there aren't pipelines close enough to a well to capture and transport the gas, or because gas prices are so low that it's cheaper to discard the gas than to try to sell it. Venting can also occur during equipment breakdowns.

Since 2011, the period for which reliable numbers are available, Exxon has flared or vented more gas overall than any other operator in the three oil fields, which include the Eagle Ford and Permian basins in the Southwest, and the Bakken straddling the Canadian border. Companies often treat natural gas as a byproduct when drilling for oil, which is far more lucrative.

The data also shows that BP this year acquired some of the most polluting sites in the Permian and then allowed flaring and venting to increase. BP burned off 17 percent of the gas it produced in the Permian between April and June of this year (the first full quarter after the acquisition) making it the worst performer in percentage terms among the top 50 producers. In the year-earlier quarter, BP had burned only 10 percent.

When asked about its practices, Exxon Mobil said it was committed to a 25 percent reduction in flaring globally by 2020, compared to 2016 levels, to address environmental concerns.

BP said it was investing in upgrades at its Permian wells that would eliminate much of its flaring. The company also said it was not putting new wells in the area unless they had access to a gas pipeline, reducing the need to burn off or vent excess natural gas.

The analysis provides one of the clearest pictures to date of the companies behind the vast emissions of natural gas that have resulted from America's shale oil boom, fueled by the use of hydraulic fracturing, or fracking, to unlock fossil fuels from shale rock.

Last year, operators across the three basins together flared or vented a record 320 million cubic feet of gas, more than 40 percent above levels seen just five years ago. The pace for the first two quarters of 2019 has been even higher.

Rystad Energy, an energy analytics company that compiles industry data from state-level corporate disclosures, provided the venting and flaring data to The New York Times, which performed an independent analysis. Separately, an organization affiliated with Greenpeace, Unearthed, also did its own initial analysis of a similar set of data.

A Chevron site near Midland, Tex. Jessica Luts/Reuters

But flaring releases carbon dioxide, a major greenhouse gas, into the atmosphere, where it traps the sun's heat, driving climate change. Venting directly emits methane, an even more potent greenhouse gas in the shorter term.

Both practices are "a tremendous waste of a natural resource," said Riccardo Puliti, global director for energy at the World Bank, which leads a global public-private partnership that aims to reduce the practice. The World Bank estimates that flaring last year emitted more than 350 million tons of carbon dioxide globally, equivalent to the greenhouse gas emissions of almost 75 million cars.

"We can't afford for this to continue unabated," Mr. Puliti said.

Shale oil has made the United States the world's largest oil producer. But shale wells tend to dry up more quickly than conventional oil fields. That means producers must drill constantly to keep their oil production steady, while venting or flaring off the gas before pipelines can catch up.

The increase comes even as a group of the world's biggest oil companies, including Exxon and BP, announced last month on the sidelines of the United Nations Climate Action Summit in New York that they had made progress in reducing global methane emissions, and that its members were on track to meet a target of keeping methane emissions to below 0.25 percent of global production by 2025. BP separately said this year that it had already met an even more stringent target of 0.2 percent.

But environmental groups have urged companies to provide a better accounting of how they measure their emissions and tally those percentages, which are not easily calculated from flaring or venting statistics.

"They're saying, 'Here's our number. Trust us,'" said Ben N. Ratner, a senior director with the Environmental Defense Fund, a group that works with oil companies to track and reduce methane. "There's been no breakdown of how they arrived at that number. And we don't have all the facts, the transparency, to assess whether that's accurate or not."

When an energy company strikes oil and begins to pump, less-valuable natural gas comes up alongside the oil. That gas could be gathered into pipelines and sold, but drilling has far outpaced pipeline construction, particularly in the booming oil fields of the Permian and Bakken.

Rather than delay drilling, producers will choose to vent or flare.

Many smaller oil producers flare or vent 100 percent of the gas their wells produce, the data shows. "Gas becomes more like a liability," said Artem Abramov, an industry analyst at Rystad Energy. "It's just much cheaper for companies to get rid of it."

The shale-oil producer Exco Resources highlights this trend. This year it applied with Texas regulators to flare almost all the gas it produced in South Texas, even though a pipeline already exists to move it away, because it is cheaper to release the gas than pay the fees to pipe it off and sell it.

In an unusual showdown, the pipeline's operator, Williams Companies, is now challenging Exco, saying that allowing it to flare even though its wells were already hooked up to a pipeline would lead to "unnecessary and wasteful flaring of billions of cubic feet of natural gas." Still, Texas regulators granted Exco's flaring permit. Williams is urging the state to reconsider.

Exco declined to comment.

The Trump administration, as part of its wide-ranging rollback of regulations designed to fight climate change, is moving to eliminate Obama-era rules that would have required oil and gas producers to more aggressively detect and fix gas leaks, and to rein in flaring or venting. Fossil fuel companies argue the rules were too costly.

Among other worst performers are independent petroleum producers, like Marathon Oil, that drill almost exclusively for oil and treat the natural gas that comes up alongside it as a byproduct.

Last year, Marathon Oil vented or flared almost half of the gas produced at its wells in the Bakken. In this year's first half, that proportion increased to more than half. And since 2018, Marathon Oil's overall venting and flaring has surpassed even Exxon's.

A Marathon spokeswoman said the company was "actively pursuing" ways to reduce its emissions.

Chevron, on the other hand, has demonstrated more discipline over the past three years, keeping flaring and venting to less than 3 percent of the gas it drilled, the data shows. Analysts said the company appeared to have stricter internal rules that discourage drilling in areas that offer few prospects of economically recovering the natural gas produced.

"We built a strategy early in our Permian development that, whenever possible, we would not flare to produce," Veronica Flores-Paniagua, a Chevron spokeswoman, said in a statement.

In an interview, Brian Pugh, chief innovation officer at BP's onshore oil and gas business in the United States, said the company was investing in new, centralized gathering and compression facilities in the Permian that would enable it to capture and sell more gas instead of flaring and venting it. Nearly all new wells there will connect to the new facilities, the first of which will go online in the first half of 2020, Mr. Pugh said.

"If you look at us this time next year, we'll be starting to look very, very different," he said.

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Hiroko Tabuchi is a climate reporter. She joined The Times in 2008, and was part of the team awarded the 2013 Pulitzer Prize for Explanatory Reporting. She previously wrote about Japanese economics, business and technology from Tokyo. @HirokoTabuchi • Facebook

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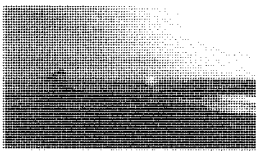

Oil companies are disposing of billions of cubic feet of natural gas into the atmosphere. Image: Unearthed / Counter

Exxon and BP among worst for flaring in US oil fields despite green pledges

An analysis of official industry data by Unearthed reveals the companies most responsible for the massive emissions created by burning unwanted gas

Oil companies are disposing of billions of cubic feet of natural gas into the atmosphere. Image: Unearthed / Counter

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04h

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ExxonMobil and BP are among the worst culprits for wastefully burning off natural gas in the United States' top oil fields, despite presenting themselves as leaders in tackling the problem, *Unearthed* can reveal.

The oil giants have both committed to drastically rein in flaring – where gas is burned with no economic benefit – as a key part of their response to the climate crisis.

But a major new investigation by *Unearthed*, based on official industry data, has found that they are among the worst performers when it comes to minimising emissions from their operations in one or more of the United States' "Big Three" oil fields.

Independent fracking firms, Marathon Oil, Whiting Petroleum and Hess Corporation are also disposing of unprecedented volumes of natural gas, either by releasing it directly into the atmosphere or burning it off – practices called venting and flaring.

In recent years a surge in oil production has lit up the skies across Texas, New Mexico and North Dakota as companies burn off billions of cubic feet of natural gas.

Industry claims to support methane regulation look like greenwashing

Now, for the first time, *Unearthed* can reveal the scale of this waste and the oil companies most culpable for the enormous greenhouse gas emissions created by venting and flaring in America's biggest oil fields

Together, the Eagle Ford basin in Texas; the Permian basin in Texas and New Mexico and the Bakken formation in North Dakota, accounted for 57% of US oil production in 2018.

But they also harbour billions of cubic feet of natural gas and oil companies often find it easier and cheaper to dispose of it into the atmosphere than capture and transport it to where it can be sold and used to generate energy.

Unearthed can reveal that over a period of just 12 months, companies operating in these oil fields have vented or flared 369 billion cubic feet of natural gas, roughly equivalent to the annual emissions of 10 coal-fired power stations or 8 million cars.

This is particularly problematic because the Permian is set to be the focal point of a boom in global oil production over the next decade.

The investigation, based on official industry data provided by Rystad Energy, also found:

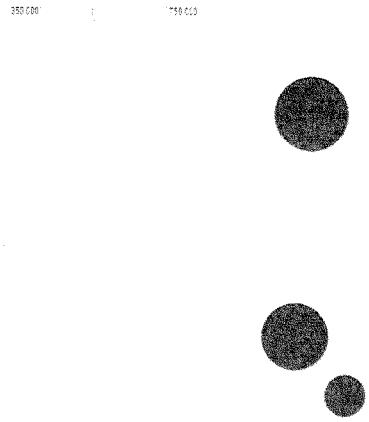
- ExxonMobil has vented or flared more gas than any other company operating in the three oil fields since 2011, despite not being the largest gas producer
- Permian drilling operations acquired by BP in a $10.5 billion deal last year already ranked among the worst in the basin for the proportion of gas vented or flared, but performance has declined further under the British oil major
- Fracking giant Marathon Oil vented or flared more gas than any other company across the "Big Three" in the 12 months up to the end of March 2019, including 52% of the gas it produced in the Bakken

More on the US

- BP backs Trump's Arctic oil drilling plans despite climate risk
- BP lobbied Trump administration to roll back key US climate rules
- Area of protected land larger than California at risk from drilling under Trump

Gas flared or vented in the United States' "Big Three" oil fields, 2011-2018

Total amount of natural gas burned or released from oil and gas operations in millions of cubic feet



Source: Rystad

A Flourish data visualisation

Responding to the investigation, Senator Sheldon Whitehouse [D-RI] told *Unearthed* that the findings appear to contradict the claims of the US oil industry's most powerful lobby group: "These are troubling findings, which belie the American Petroleum Institute's seven-figure ad campaign claiming the industry is working to reduce carbon pollution."

"Industry claims to support methane regulation look like greenwashing: old bad habits from an industry that spent decades trying to deceive the public about climate change," he continued.

Why waste gas

Even though natural gas is big business in the United States, low prices have led companies in the "Big Three" oil basins to dispose of billions of cubic feet of it into the atmosphere.

This is because the companies are targeting the enormous reserves of oil rather than gas, which is present in smaller volumes. And while oil can be loaded onto trucks and driven to a refinery, gas can only be transported via pipeline.

The costs of capturing gas: purchasing access to pipelines or building new ones; and then paying state taxes on the proceeds, can often outweigh the economic benefits, leading companies to release it directly into the atmosphere (venting) or burn it off (flaring) instead. Venting is more damaging than flaring because methane is 84 times more effective at trapping heat than carbon dioxide in the first two decades following its release.

Industry leaders

As pressure on oil companies to demonstrate that they are taking climate change seriously has intensified, ExxonMobil and BP have increasingly sought to portray themselves as industry leaders in reducing emissions from their oil drilling operations.

Both companies are members of the Oil & Gas Climate Initiative (OGCI), a leading trade association, which held high profile events during the recent UN Climate Week in New York, celebrating the achievements of its members in reducing methane emissions.

Tackling venting and flaring are central to OGCI members' joint strategy for how they will contribute to reducing global emissions in line with the Paris climate change agreement.

> Flaring is an important issue we take very seriously

As a result, Exxon and BP have also made individual pledges. Last year Exxon said it would reduce its greenhouse gas emissions by cutting flaring by 25% within two years, adding to a previous commitment to eliminate routine flaring entirely by 2030.

BP has likewise committed to eliminate routine flaring and regularly publicises initiatives tackling methane emissions from its operations. Its chief executive, Bob Dudley, recently said that the level of flaring in the Permian is "not right."

But *Unearthed* can reveal that both companies are failing when it comes to bringing the emissions from some of their US oil operations under control.

Since 2011, ExxonMobil has vented or flared 99 billion cubic feet of gas, more than any other company operating in the Permian, Eagle Ford and Bakken oil fields, despite the fact it was not the largest producer of gas.

In the 12 months between April 2018 and March 2019 alone, Exxon vented or flared 12 billion cubic feet of gas in the Permian, more than any other company.

And despite its commitment to reduce its overall flaring by 25% by 2020, between 2017 and 2018 Exxon's venting and flaring in the "Big Three" oil basins actually increased by 70%, even though gas production rose by only 15%.

Worst companies for venting and flaring by total volume across all three basins, 2011-2018

Rank	Operator	Vented/Flared (MMcf)	Proportion of gas vented or flared
1	ExxonMobil	99467.3	
2	Hess	89030.5	
3	Whiting Petroleum	84447.5	
4	EOG Resources	72367.1	
5	Concho Resources	71481.5	
6	Marathon Oil	59506	
7	Apache	55901	
8	Continental Resources	53917.2	
9	Oasis Petroleum	44949.6	
10	ConocoPhillips	42356.8	

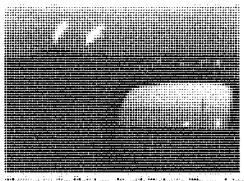
● A Flourish data visualisation

Artem Abramov, partner and head of shale research at Rystad Energy, told *Unearthed*: "In the Permian specifically, Exxon were stepping up, in terms of activity and production, very aggressively last year. We saw that a lot of these new developments were happening in more remote areas without developed infrastructure."

He added that Exxon's drilling program often outpaced the development of infrastructure to take the gas away: "There were some delays and then they had to flare gas for extended periods of time… two to three months wouldn't be too rare I would say."

An ExxonMobil spokeswoman told *Unearthed*: "Flaring is an important issue we take very seriously. We have made great progress in reducing flaring by working with third-party gas gathering systems, accelerating installation of gas facilities, improving facility reliability and curtailing production when appropriate. The company is in full compliance with state and federal flaring regulations and makes every effort possible to exceed those standards."

"In the examples you cite, flaring is done for safety reasons or because the gas cannot be used due to barriers to the development of gas markets and gas infrastructure," she continued.



Flaring in the Bakken, North Dakota. Photo: Linda Davidson / The Washington Post / Getty

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Declining performance

In keeping with Exxon and most of its rivals, BP flares a relatively low percentage of the gas it produces in the Eagle Ford basin – but the same cannot be said for its operations in the Permian.

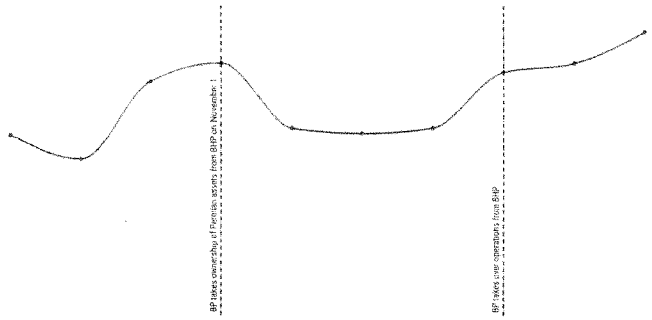
The company took ownership of BHP's Permian operations on November 1 2018, following a $10.5 billion deal. These oil wells were already venting and flaring a higher proportion of gas than any other large producer in the basin, but since BP took over the poor performance has continued.

Between October and December 2018, the percentage of gas vented or flared was 14%, the second highest in the basin. From January to March 2019, BP flared 13.1% of its gas, the third highest in the Permian.

Since BP took over direct operation of its Permian oil wells on March 1, the proportion of gas vented or flared has increased from 12% in February to 18% in May, the most recent month for which there is reliable data.

Proportion of gas vented and flared in the Permian by BHP and then BP

Percentage of gas vented or flared (%)



Source: Rystad

A Flourish data visualisation

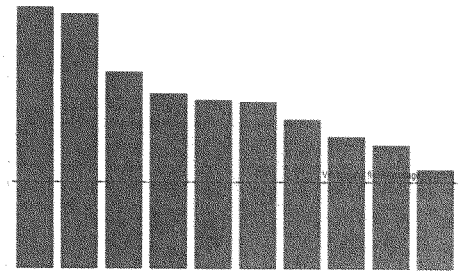
The company declined to reveal whether it knew about the poor emissions performance of these assets before it purchased them. But the reported data, which BP would have had access to, clearly shows that BHP disposed of a higher proportion of gas than any other company in the Permian between 2011 and 2018.

When Bob Dudley was questioned about this performance earlier this year he expressed surprise, telling a June 30 earnings call, "I'm not sure the accuracy of it [sic]. Haven't looked and fact checked it… I'd really like to go in and see those figures because they seem a touch high to me. But don't worry, we'll be all over it."

In February, *Unearthed* revealed that BP had successfully lobbied the Trump administration to scrap a major Obama-era regulation limiting venting and flaring on public lands.

Gas vented or flared by large operators in the Permian, Q2 2018 - Q1 2019

Proportion of gas wasted by large operators - defined as the top 30 gas producers in the basin

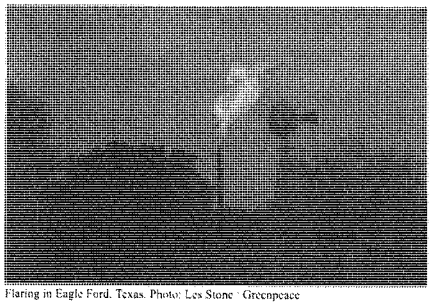


Source: Rystad

A Flourish data visualisation

A spokesperson for BP told *Unearthed*: "We are committed to reducing our flaring in the Permian basin and since BPX Energy began operating our newly-acquired assets in March of this year we have started constructing centralized facilities which, combined with some of our other emissions reduction efforts, will reduce routine flaring."

This won't happen overnight though, and in the meantime BP is likely to continue to flare a high proportion of its gas rather than hold back production. According to Abramov: "any kind of production curtailment… reduces the value of the asset because you delay a lot of cash flow."



Flaring in Eagle Ford, Texas. Photo: Les Stone / Greenpeace

Marathon Oil

Despite the key role played by oil majors, most of the companies venting and flaring the highest volumes of gas across the three oil fields are large independent fracking companies, such as Marathon Oil, which are under far less pressure from investors and civil society to reduce their emissions.

In the 12 months up to March 2019, Marathon vented or flared almost 30 billion cubic feet of gas across the three oil fields, more than any other company.

The vast majority of this (25 billion cubic feet) took place in the Bakken, where Marathon vented or flared an exceptional 52% of the gas it produced.

Abramov told *Unearthed* that even though Marathon is flaring a significantly higher proportion of gas than its peers, the state as a whole is flaring double the amount stipulated by the regulator. He added that this won't necessarily result in strong action from the North Dakota Industrial Commission though: "they are probably trying to find a balance between the environmental perspective and the economic perspective because the state is quite dependent on all the tax revenues they get from the oil industry."

Marathon Oil failed to respond to requests for comment.

Proportion of gas vented or flared by companies in the Bakken, Q2 2018 - Q1 2019

Rank	Operator	Vented/Flared (MMcf)	% Wasted
1	Marathon Oil	25263	
2	Sinclair	614.1	
3	Crescent Point Energy	2103.8	
4	Lime Rock Resources	1446.1	
5	RimRock Oil & Gas	1313.2	
6	Bruin E&P Partners	6348.1	
7	Abraxas Petroleum	2393.7	
8	WPX Energy	7252.6	
9	Kraken Oil & Gas	3447.9	
10	Hess	17066.8	

Source: Rystad

A Flourish data visualisation

Hess Corporation and Whiting Petroleum were also among the companies venting and flaring the most gas across the three basins between April 2018 and March 2019. Whiting, vented or flared 19 billion billion cubic feet of gas during this period, while Hess wasted 17 billion cubic feet.

Both companies failed to respond to multiple requests for comment.

Mark Boling, a former executive at Southwestern Energy, a large independent producer headquartered in Houston, told *Unearthed*: "for many oil and gas companies, if they are not required to do something, they just won't. If it's not making them money and there is no regulatory requirement to do it, they will justify doing nothing by citing their 'obligation' to maximise shareholder value. The regulatory aspects of this, in terms of just making people do what is the right thing to do, has been lacking."

According to a recent investigation by Energy Intelligence, Texas' oil and gas regulator has never denied an oil company's application for a flaring permit.

Illustrating the depth of the problem, one producer in the Eagle Ford basin, Exco Resources, vented or flared 63% of the gas it produced in the 12 months up to March 2019, despite its wells being connected to a gas pipeline. According to reports, Exco simply didn't want to pay the pipeline company to transport the gas. When contacted by *Unearthed*, a spokesperson for Exco said it had "no comment".

Our calculations

Unearthed obtained reported industry data from Rystad Energy and looked at operator production and venting/flaring levels from 2011 through to the present.

We adopted two widely accepted methods for looking at venting and flaring performance. Firstly, the absolute volume of gas wasted; second, the proportion of gas that a company produces that is wasted.

Based on this analysis we compiled league tables for each of the major basins for the period 2011-2018 and for the 12 months up to March 2019 – both in absolute and percentage terms. We also did this for all three basins combined.

The data revealed particular concerns for BP and Exxon in the Permian basin and, in the case of Exxon, the Bakken field. Neither oil major flared a significant percentage of gas in the Eagle Ford basin, where overall flaring and venting numbers are much lower.

We estimated the overall greenhouse gas emissions resulted from the 369 billion cubic feet of gas that was wasted across the three basins based on an estimate that 92% of it was flared and 8% vented. This is based Rystad Energy data for the New Mexico portion of the Permian, where the state regulator requires the breakdown between venting and flaring to be reported by oil companies.

Rystad said that last year an average of 8% of waste gas was vented across the basin and there is no reason to think this figure is any different across the Texas portion of the Permian basin. Given the lack of any venting data for North Dakota, we applied the 8% figure across the three basins to calculate the overall climate impact.

A version of this story was also published in the New York Times.

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We promise that we'll never sell or swap your details and you can opt out at any time – check our privacy policy.

Senator WHITEHOUSE. And I thank all the members of the panel for being here today.

Senator BRAUN. By the way, those will be added to the record, and the record will be open for 2 weeks for any other submissions.

Very briefly, we are going to use this platform often. I think the other news you may or may not know, but we are going to introduce a climate caucus. I was the first Republican asked to be on it, and was proud to be the first one to say yes. There will be others.

I think this is the defining issue going forward. We just need to figure out how we do it in a way that we can pay for it, that everyone is engaged. And also, how we get the rest of the world involved in doing it.

I think with the conscientious effort and speed you are going to see from this country, and I am sure that we both share that interest. This hopefully will be the first of many conversations.

I want to thank all of you for coming in today to share your thoughts.

With that being said, this hearing is adjourned.

[Whereupon, at 11:34 a.m., the hearing was concluded.]

[An additional statement submitted for the record follows:]

STATEMENT OF HON. JAMES M. INHOFE,
U.S. SENATOR FROM THE STATE OF OKLAHOMA

Mr. Chairman, thank you for hosting this hearing on the important ways industry has both voluntarily and effectively reduced its impact on the environment. This is a necessary discussion as, unfortunately, we rarely hear of the many ways industry is already taking initiative to reduce its environmental footprint without overly burdensome and ineffective Government mandates. I am taking this opportunity to highlight an instance when regulators went too far with an emission reduction proposal that harmed American innovation and economic growth.

As a former chairman of this full committee, I distinctly recall the many spirited policy disagreements I had with the Obama administration on environmental regulations. While there were many heavy-handed and harmful proposals during that administration, one of the most ill-conceived was in regard to changes to corporate average fuel economy (CAFE) standards. As many know, days before President Trump's inauguration, the Obama administration's Environmental Protection Agency (EPA) acted unilaterally to lock in its portion of the 2012 CAFE standards through 2025. These standards would have unquestionably hampered production of trucks and SUVs as these types of vehicles do not help automakers meet the arbitrary CAFE standards of 50 miles per gallon fuel economy average by 2025. Government bureaucrats intended to force their radical environmental agenda on Americans despite the reality that SUVs and trucks make up over two-thirds of vehicles sold in America. The standards have also encouraged car companies like Jeep to sacrifice passenger safety by forgoing a spare tire in an effort to reduce vehicle weight to increase average fuel economy. Fortunately, the Trump administration is putting a stop to President Obama's harmful fuel economy standards and has proposed replacing them with standards that will reduce vehicle price tags for consumers while maintaining an ambitious national fuel economy standard.

The Obama-era CAFE standards are one of many instances in which bureaucrats have forced their radical environmental agenda on the American people. These policies are misguided and unfairly limit consumer choice. Oklahomans want affordable vehicles and do not need Washington elites telling them what kind of cars they can own. I continue to be proud of the Trump administration and its efforts to cut red tape and improve CAFE standards. Thankfully we finally have a president willing to stand up for Oklahoma's farmers, ranchers and small business owners.

[Additional material submitted for the record follows:]

American Forest & Paper Association

October 9, 2019

Senate Committee on Environment and Public Works
Subcommittee on Clean Air and Nuclear Safety
Chairman Mike Braun
Ranking Member Sheldon Whitehouse
410 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Chairman Braun and Ranking Member Whitehouse:

Thank you for the opportunity to discuss key considerations for U.S. climate policy.

We appreciate the Committee's outreach to us and other stakeholders. Seeking input from stakeholders on such approaches will allow for more informed and productive discussion and deliberation.

The American Forest & Paper Association (AF&PA) serves to advance a sustainable U.S. pulp, paper, packaging, tissue and wood products manufacturing industry through fact-based public policy and marketplace advocacy. AF&PA member companies make products essential for everyday life from renewable and recyclable resources and are committed to continuous improvement through the industry's sustainability initiative — *Better Practices, Better Planet 2020*. The forest products industry accounts for approximately four percent of the total U.S. manufacturing GDP, manufactures nearly $300 billion in products annually and employs approximately 950,000 men and women. The industry meets a payroll of approximately $55 billion annually and is among the top 10 manufacturing sector employers in 45 states.

AF&PA's sustainability initiative — *Better Practices, Better Planet 2020* — comprises one of the most extensive quantifiable sets of sustainability goals for a U.S. manufacturing industry and is the latest example of our members' proactive commitment to the long-term success of our industry, our communities and our environment. We have long been responsible stewards of our planet's resources. We are proud to report that our members have already achieved the greenhouse gas reduction and workplace safety goals. Our member companies have also collectively made significant progress in each of the following goals: increasing paper recovery for recycling; improving energy efficiency; promoting sustainable forestry practices; and reducing water use.

1101 K Street, N.W., Suite 700 • Washington, D.C. 20005 • (202) 463-2700 • afandpa.org

AF&PA'S Voluntary Emissions Reductions

In 2011, as part of the association's voluntary *Better Practices, Better Planet 2020* sustainability goals initiative, AF&PA set a goal to reduce member greenhouse gas (GHG) emissions—measured in carbon dioxide equivalents per ton of production—by 15 percent. After meeting that goal ahead of schedule, members set a 20 percent reduction goal and they now are close to achieving that goal as well, as emissions were 19.9 percent lower in 2016 than in 2005.

To put these and other emission reductions in context, it is helpful to consider the U.S. Nationally Determined Contribution (NDC that was part of the Paris Accord). Specifically, the U.S. NDC was to achieve a 17% GHG mass reduction between 2005 and 2020, and a 26-28% GHG mass reduction by 2025, with best efforts to achieve a 28% GHG mass reduction by 2025.

The US pulp and paper industry has already exceeded those targets, by reducing direct emissions by approximately 35 percent on a mass basis between 2005-2016. Further, as stated above, AF&PA members have reduced their direct and indirect GHG emissions by 19.9 percent between 2005-2016 on an intensity basis.

In addition to our members' voluntary progress already discussed above, AF&PA currently is developing new sustainability goals to replace the existing *Better Planet* 2020 goals. Among others, we are working on a new GHG reduction goal.

Industry Innovation

The industry also is innovating for the future. The industry's Alliance for Pulp and Paper Technology Innovation—APPTI—works to transform the paper and forest products industry through innovation in its manufacturing and products. For instance, a project is underway to reduce the energy used in certain paper manufacturing processes by 23 trillion BTUs, which would lead to significant GHG reductions. This project is being carried out by a team led by the Georgia Institute of Technology and is funded by APPTI members and the Department of Energy's RAPID Institute.

APPTI identifies high priority, pre-competitive technology challenges for the pulp and paper industry and promotes scientific research and development projects to address them. Current projects under development, if implemented, could achieve significant energy and related GHG reductions for the industry

Climate Policy

AF&PA believes that any comprehensive climate legislation must balance environmental, social, and economic concerns to ensure that our nation's economy and forest products industry remain globally competitive.

In particular, any legislation should recognize the forest products industry's important and unique role in reducing greenhouse gases, including sustainable forest management practices, carbon sequestration, biomass energy use, electricity generation, and paper recovery for recycling. Sustainably managed forests and our products sequester and store approximately 14 percent of annual U.S. carbon dioxide emissions. Paper recycling reuses a renewable resource that sequesters carbon and helps reduce greenhouse gas emissions by avoiding landfill methane emissions and reducing the total energy required to manufacture some paper products. Any climate legislation should recognize early actions taken to reduce greenhouse gas emissions. The forest products industry's use of energy efficiency technology such as combined heat and power technology also needs to be given full consideration.

The carbon neutrality of biomass harvested from sustainably-managed forests has been recognized repeatedly by an abundance of studies, agencies, institutions, legislation and rules around the world and includes the guidance of the Intergovernmental Panel on Climate Change and the reporting protocols of the United Nations Framework Convention on Climate Change.

Prior to 2010, the U.S. clearly recognized forest-based biomass energy as carbon neutral. In EPA's Greenhouse Gas (GHG) Tailoring Rule, for the first time, no such designation was made, subjecting biomass energy used in stationary sources to *Clean Air Act* permit program requirements. In 2011, EPA issued a rule deferring regulation of biogenic carbon dioxide emissions while its Science Advisory Board (SAB) studied the issue and pledged to complete an accounting framework for biogenic emissions from stationary sources by July of 2014, but failed to finish the work.

Numerous EPA documents and policy memos have found positive benefits from forest biomass use, including EPA's original draft accounting framework (September 2011) and revised draft framework (November 2014). Both documents recognize the GHG reduction benefits of bioenergy from forest product mill residuals and byproducts, including black liquor. In April 2018, EPA issued a policy statement to treat biogenic carbon dioxide emissions from the combustion of forest biomass at stationary sources as carbon neutral. As the next step, EPA should implement regulations soon.

From a broader perspective, it is critical to recognize that U.S. manufactures must compete globally. To the extent that Congress adopts laws that increase the domestic

cost of production for US based manufacturing, those higher costs of production will shift production jobs, and economic growth outside of the U.S.

In turn, since U.S. manufacturers are a more efficient user of fuel and natural resources than manufacturers in most other countries, when production shifts to outside the U.S., there will be a net increase in global GHG emissions.

In addition, global energy use trends and emissions projections indicate the US will continue to be comparatively advantaged as an efficient user of fuel and lower emissions intensity for the foreseeable future. This data suggests that policies adopted by Congress that increase competition remove barriers and lower costs to US manufacturing, are the preferred policy prescription for achieving a net reduction in global GHG emissions.

Thank you for seeking our industry's input and we look forward to working with the Committee as this process moves forward.

Best Regards,

Paul Noe
Vice President, Public Policy
American Forest & Paper Association

UT CO
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Via e-mail

October 15, 2019

The Honorable Michael Braun, Chair
The Honorable Sheldon Whitehouse, Ranking Member
Senate Subcommittee on Clean Air and Nuclear Safety
United States Senate
Washington, DC

RE: Hearing on *"Reducing Emissions While Driving Economic Growth: Industry-led Initiatives"*

Dear Senators Braun and Whitehouse:

On behalf of the City of Farmington, New Mexico, these comments are being submitted in support of the Subcommittee's important work in promoting environmental stewardship through innovation that preserves and creates jobs for American workers. The City knows first-hand the vital importance of this mission. Thank you for this opportunity to share our experience involving an exciting and innovative project to reduce substantial carbon emissions that Farmington is helping bring about.

Farmington is a city of nearly 45,000 that serves as the commercial center for northwestern New Mexico and the Four Corners region of the US. For decades, Farmington has been widely identified with two things: hosting the annual Connie Mack World Series baseball tournament and the City's close ties to the extractive energy industry. While baseball continues to thrive in our area, oil, gas and coal mining are facing unprecedented challenges. There are many reasons for this, but mounting climate concerns rank chief among them.

This is a problem that Farmington cannot ignore. Some of the best jobs in our area are tied to the fossil fuel industry and the San Juan Generating Station (SJGS), an 847 MW coal-fired electricity generating station which is partially owned by the City.

The SJGS and associated high-Btu coal mine operated by Westmoreland Holdings are important economic drivers and valuable assets for the City because they provide regional employment, low-cost, reliable and environmentally compliant power generation and other benefits. The SJGS and the mine provide over 460 direct jobs and 1,000 indirect jobs in a rural part of the state and are significant factors in maintaining a stable regional economy. Notably, 40 percent of these plant and mine workers are from the Navajo nation. State and local taxes from the SJGS and mine operations exceed $15 million per year and are a major source of revenues that support local schools.

Even though the SJGS is a low-cost generator and is fully compliant with all emission limits required under a 2013 settlement agreement with the New Mexico Environment Department and the EPA, all other

owners of the SJGS, with the exception of Farmington, announced that they would terminate their ownership in the station in 2022.

With so much at stake, the City was unwilling to allow the generating station and mine to shut down. Farmington engaged in a wide-ranging search for investor interest in the SJGS. Fortunately, the City identified the Enchant Energy investors who were able to formulate a strategy to prevent that from happening. Enchant Energy proposed to convert the SJGS through the use of proven carbon capture utilization and storage (CCUS) technology to allow the plant to continue operating as an ultra-low carbon emitting merchant generator.

Enchant Energy learned that the SJGS is perhaps the best site in the US for the next large-scale installation of CCUS technology. The SJGS underwent extensive environmental upgrades in 2017 following the 2013 settlement and the generating station is located only twenty miles from the Cortez CO2 pipeline, which currently transports CO2 from naturally occurring but declining CO2 source fields in Colorado to the Permian Basin where there is a deep market for pipeline quality CO2. Enchant Energy commissioned Sargent & Lundy, the engineering firm that worked on the Petra Nova carbon capture project, to perform a scoping study of the SJGS carbon capture retrofit concept.

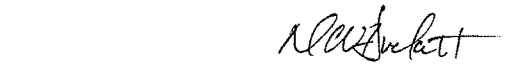
The completed Sargent & Lundy report, which is attached, shows the retrofit with CCUS will be self-financing and will not increase the cost of generation.

The study estimates that the cost of carbon capture at SJGS will range from $39.15 to $43.49 per metric ton, a 35-40 percent reduction from previous installations. The report also shows carbon capture will decrease CO2 emission intensity at the SJGS from 2,201 pounds per megawatt-hour to 249 pounds per megawatt-hour. This carbon reduction is 77 percent less than the 1,100 pounds per megawatt-hour limit mandated by New Mexico's recently passed Energy Transition Act that is designed to transition the state to increasing levels of clean energy supplies. CO2 captured will be 6 million metric tons per year, which will provide 313 million standard cubic feet per day of pipeline-quality CO2 for utilization and sequestration in the Permian Basin.

The success of the SJGS retrofit is highly dependent on the revamped 45Q tax credit, which is providing crucial support to the deployment of CCUS technology that makes the project economically feasible. The project will generate $2.5 billion of 45Q tax credits covering the project's estimated CapEx of $1.3 billion by almost two times. Aided by the 45Q tax credits, the retrofit plan will save jobs and tax base, continue to allow Farmington to benefit from low-cost power, and will be a crucial next step in positioning the region, the state and the nation to become leaders in the expected growth of the carbon capture industry.

As Farmington's experience illustrates, the significance of this Subcommittee's actions cannot be underestimated. The City strongly supports your efforts to press forward to provide additional tools that will enable the nation's creative minds and willing workers to continue to thrive. Thank you again for this opportunity to provide Farmington's comments for inclusion in the record.

Sincerely,



Nate Duckett
Mayor

cc: Senator Barrasso
Senator Carper

OFFICE of the MAYOR

October 16, 2019

The Honorable Mike Braun
United States Senate
374 Russell Senate Office Building
Washington, DC 20510

The Honorable Sheldon Whitehouse
United States Senate
530 Hart Senate Office Building
Washington, DC 20510

Dear Chairman Braun and Ranking Member Whitehouse,

The National Audubon Society recognizes the vital importance of sustaining America's remaining grassland and prairie ecosystem. With more than 80% of this ecosystem owned or managed by cattle ranchers, we work collaboratively and creatively to support private ranchers, supporting their efforts to implement regenerative grazing best practices to sustain this ecosystem while creating economic value for ranchers.

Audubon's groundbreaking North American Grasslands and Birds Report makes clear our commitment to the conservation of grasslands and grazing lands for the benefit of declining grassland birds, the climate, pollinators, water quality, and sustainability of rural ranching communities and their economies.

Supported by our 1.7 million members, Audubon's Conservation Ranching Initiative represents 70 landowners encompassing 2,000,000 acres across 11 states, from California to North Dakota to Missouri. On behalf of the National Audubon Society, I wish to promote conservation-focused cattle production, using methods such as regenerative grazing and native grasses as forage, as a science-based means to reducing harmful atmospheric emissions. These methods also promote the conservation of grasslands, America's most imperiled ecosystem.

With only 3% of American grasslands formally protected, cattle ranchers are the truest stewards of the prairie. While often maligned as "flyover country" lacking the majesty of mountains, forests or coasts, these communities and special ecosystems represent the heartland of America. Indeed, the prairie is an iconic American landscape that is robust with life, from thousands of species of pollinating butterflies and bees and the flowers they pollinate, to the Whooping Cranes and bison that rely on healthy prairie ecosystems. Audubon is working with ranchers to ensure that these jewels of America's landscape are preserved for future generations, not only as a place where our food supply can be grown, but also as a landscape critical for many species of wildlife and plants. Beyond benefits for wildlife and plants, regenerative grazing methods can also sequester immense amounts of carbon out of the atmosphere, serving as a natural mitigation tool for the growing effects of climate change. Recent studies indicate that nearly 50% more carbon is stored in grasslands than in forests across the globe. Furthermore, the loss of 60% of the grasslands has already contributed a significant amount of soil carbon released into the atmosphere. In the Prairie Pothole Region—

which encompasses large areas of the North-Central United States including most of the Dakotas—the amount of carbon sequestered in grasslands is truly incredible, with conservative estimates suggesting over 81 metric tonnes of CO_2 equivalents per square meter. These studies highlight the incredible capabilities of grasslands to act as sinks for atmospheric carbon, promoting not only food security, but also an incredibly important nature-based tool that helps to combat climate change.

When properly implemented, cattle ranching can be an enormously effective tool to preserve America's grasslands for both people and wildlife, as well as act to buffer the effects of climate change. Cattle can be raised on ranches that not only protects grasslands and the planet, but also returns a premium on each pound of beef sold by ranchers, preserving one of America's oldest professions. Regenerative ranching can be used to decrease emissions while also promoting grassland conservation and providing a livelihood for America's ranchers.

Sincerely,

Marshall Johnson
Vice President of Conservation Ranching Initiative
The National Audubon Society

cc: Chairman Barrasso and Ranking Member Carper

PCA Since 1916
America's Cement Manufacturers™

Portland Cement Association
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Washington, DC 20036-4104
202.408.9494 Fax 202.408.0877
www.cement.org

October 17, 2019

The Honorable Mike Braun
Chairman
Subcommittee on Clean Air &
Nuclear Safety
Committee on Environment
& Public Works
United States Senate
Washington, D.C. 20510

The Honorable Sheldon Whitehouse
Ranking Member
Subcommittee on Clean Air &
Nuclear Safety
Committee on Environment
& Public Works
United States Senate
Washington, D.C. 20510

Dear Chairman Braun and Ranking Member Whitehouse:

I am writing to you on behalf of the Portland Cement Association (PCA) in support of the hearing entitled, "*Reducing Emissions While Driving Economic Growth: Industry-led Initiatives.*" Sustainability and environmental stewardship are top priorities for America's cement manufacturers.

PCA, founded in 1916, is the premier policy, research, education, and market intelligence organization serving America's cement manufacturers. PCA members represent 92 percent of the United States' cement production capacity and have distribution facilities in every state in the continental U.S. Cement and concrete product manufacturing, directly and indirectly, employs approximately 610,000 people in our country, and our collective industries contribute over $125 billion to our economy. Portland cement is the fundamental ingredient in concrete. The Association promotes safety, sustainability, and innovation in all aspects of construction, fosters continuous improvement in cement manufacturing and distribution, and promotes economic growth and sound infrastructure investment.

Portland cement is not a brand name, but the generic term for the type of cement used in virtually all concrete. Concrete forms when portland cement is mixed water, and aggregate (sand and rock), and allowed to harden. Cement holds the concrete together and has a role similar to flour in a cake mix. Concrete is the most-utilized material after water in the world; the U.S. uses about 260 million cubic yards of concrete each year. It is used to build highways, bridges, runways, water & sewage pipes, high-rise buildings, dams, homes, floors, sidewalks, and driveways.

Cement, the essential material to make concrete, is manufactured through an energy-intensive process. The heart of the process is the cement kiln, a large rotating industrial furnace in which limestone (the critical raw ingredient) and other materials are heated to 3,500 degrees Fahrenheit. At this temperature, the materials become molten and then recombine into small stones called

clinker, which is then conveyed to mills to be crushed into the final cement powder. During the heating phase, the molecular structure of the calcium carbonate (CaCO3) found in the limestone breaks apart to form calcium oxide (CaO) and carbon dioxide (CO2), which is released as process emissions. These emissions are a chemical "fact of life" in cement manufacturing, which constitutes 60% of industry CO2 emissions. Currently, there is no commercially viable technology to prevent or reduce the released CO2 resulting from the chemical process.

Cement manufacturers have invested significantly to reduce CO2 and other emissions by implementing R&D driven technology improvements, increasing energy efficiency, and reducing reliance on fossil fuels through the use of lower carbon-intensive alternative fuels. The cement industry lowered energy consumption 37 percent since 1972 through equipment and process improvements. Further, while increasing production by 26 percent between 2010 and 2016, the cement industry decreased its GHG emissions by six percent through efficiency improvements in the manufacturing process. Further, cement manufacturers have reduced energy use by 40% from 7.8 gigajoules per equivalent tons in 1972 to 4.6 gigajoules per equivalent ton in 2016. For 2017, twenty-six (28%) of cement plants won awards from the Department of Energy's EnergyStar program for their efficiency efforts.

The cement industry uses a wide variety of fuels, natural gas, coal, and secondary materials like tires to achieve the high temperatures necessary to create cement. Secondary material is a term for post-industrial, post-commercial, post-consumer paper, plastic, and other materials that have tremendous energy value. Their use as fuels helps to reduce industrial emissions of greenhouse gases (GHG) and other emissions. They also limit landfill disposal of materials that can become public health vectors and safety risks, conserve natural resources, and provide low-cost sustainable fuels.

Currently, 15% of the fuels used by the cement industry are alternative fuels, such as tires, biofuel, and biomass, that would have ended up in landfills. There is an opportunity for manufacturers to use more alternative fuels to conserve natural resources and achieve lower emissions. However, federal regulations inhibit expanding to other sources like fabric, paper, and plastic, which are a standard alternative fuel in Europe. Our members are constrained through RCRA, the CAA, and the EPA regulating the use of non-hazardous secondary materials and wastes as fuels. In response to a 2007 court decision restricting the combustion of solid waste for energy recovery, EPA issued a regulation in 2011 known as the Non-Hazardous Secondary Materials (NHSM) Rule, allowing for secondary materials to be used for energy recovery if they met specific legitimacy criteria. In theory, the rule provided a way to distinguish between true waste materials with little to no value and material streams that, while once disposed of as waste, could be put to far more productive use as alternative fuels. In practice, the rule has become yet another roadblock to sound energy and materials recovery policy.

PCA urges Congress to amend the definitions of "Recovered Materials" and "Recovered Resources" within RCRA so the cement industry can increase its use of alternative fuels. We also encourage the Committee to urge the EPA to use its broad authority under the NHSM rule to increase the availability of secondary paper, plastics, fabrics, and other materials as alternative fuels. Through the increased use of alternative fuels, the cement industry can further reduce its GHG and other air emissions while providing a solution to the national waste problem.

While the cement industry has worked to reduce its GHG emissions, further support from the federal government is necessary. PCA is encouraged by the Committee's passage of the Utilizing Significant Emissions with Innovative Technologies Act (USE IT Act). PCA believes that this legislation is an important step to help develop the technology needed to address climate change.

PCA appreciates the opportunity to share our member's efforts to improve efficiency and reduce emissions. We look forward to working with the committee on future legislation and agency oversight to ensure cement manufacturers have the support required from the federal government to enable the industry's continued reduction of its carbon footprint in a responsible and sustainable manner.

Sincerely,

Sean O'Neill
Senior Vice-President, Government Affairs
Portland Cement Association

Enchant Energy
San Juan Generating Station – Units 1 & 4

CO_2 Capture Pre-Feasibility Study

FINAL

Revision 0

July 8, 2019
Project No. 13891-001

Prepared by

Sargent & Lundy

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Executive Summary

The San Juan Generating Station (SJGS) facility is an 847 MW coal-fired power plant located in northwest New Mexico that has been identified as a candidate for retrofitting carbon capture utilization and sequestration (CCUS) technology. The SJGS has two operating coal-fired utility boilers, Unit 1 and Unit 4, and two recently retired units, Units 2 and 3; the retired units have been left in place with much of the auxiliary equipment mothballed.

This pre-feasibility study is being conducted to evaluate the technical feasibility and cost of a CCUS retrofit project based on amine-based CO_2 capture technology at SJGS, considering the current federal and state regulatory requirements. The current study represents expected utility requirements and capital costs that correspond to the current advancement of the amine-based technology and rely on information published by both Mitsubishi Heavy Industries (MHI) and Shell on their recent installations and developments. Specifically, this study builds on the information provided from recent experience and installations of both MHI and Shell at Petra Nova and Boundary Dam, respectively.

Furthermore, this study considers the cost savings associated with using existing infrastructure from the recently retired Units 2 and 3 at SJGS to supply the CO_2 capture utility requirements. Using the existing auxiliary systems lowers the project capital costs and reduces the overall cost of capture, making this facility an attractive candidate for CCUS.

Even while including the cost of construction for the CO_2 pipeline connection from power plant to the nearby interstate Cortes CO_2 pipeline, the cost to implement CO_2 capture at SJGS is estimated to be $39-43/tonne, as shown in Table ES-1. These costs are in line with the U.S. Department of Energy's (DOE) long-term goal of $40/tonne, which does not include the capital cost of the new pipeline.

Table ES-1: Cost of CO_2 Capture

Description	Units	85% Capacity Factor	100% Capacity Factor
Total Project Cost	$	1,295,280,000	1,295,280,000
CCF		0.1243	0.1243
Annualized Capital Cost	$/yr	161,000,000	161,000,000
Annual O&M Cost	$/yr	99,939,000	115,389,000
Total Annual Cost	$/yr	260,939,000	276,389,000
CO_2 Captured	mmscfd	313	368
Annual CO_2 Captured	tonnes/yr	6,000,000	7,060,000
Cost of Capture	**$/tonne[1]**	**43.49**	**39.15**

Note 1. Cost of capture reported as dollars per metric ton (equivalent to 2,240 lbs).

In addition to the lower cost to implement CO_2 capture at SJGS, the facility is located nearby to a CO_2 pipeline. This will require minimal pipeline costs in comparison with many coal-fired facilities as well as a market opportunity for sale of the produced compressed CO_2.

As part of the next steps of this project, it is recommended that a more in-depth front-end engineering and design (FEED) study be conducted to advance the project definition, engage the technology providers to provide site-specific performance data, and develop a detailed cost estimate. During the future phases, it is recommended that the CO_2 capture system be competitively bid to obtain site-specific performance and design information, and competitive pricing for the subcontracted CO_2 capture system cost. CO_2 technology original equipment manufacturers (OEMs) have indicated that overall capital costs of the facilities have reduced in the last 10 years, due to modularization and optimization of the process. Depending on the advances made over the last 3-5 years, it is expected that OEMs will be able to provide optimized auxiliary power and steam requirements. As such, the overall plant derate may also be optimized and reduced in future applications of this technology.

If the FEED study demonstrates the viability of the project, it could become the first large-scale CCUS retrofit of a coal-fired power plant that has the potential to reduce 6,000,000 tonnes CO_2/year.

1 Introduction

1.1 Project Background

The San Juan Generating Station (SJGS) facility is a nominal 847 MW-net coal-fired power plant located in northwest New Mexico approximately 15 miles northwest of the City of Farmington ("Farmington"). The power plant has been identified as a candidate for retrofitting carbon capture utilization and sequestration (CCUS) technology. SJGS currently has two operating coal-fired utility boilers, Unit 1 and Unit 4, and two recently retired units, Units 2 and 3. The retired units have been left in place with much of the auxiliary equipment mothballed.

SJGS Units 1 and 4 fires western bituminous coal supplied by the adjacent mine, San Juan Coal Company, owned by Westmoreland Holdings. The current coal supply contract expires in June 30, 2022; however, San Juan Coal Company has offered SJGS a new contract for 3.2 million tons of coal per year for the years 2022 through 2033. Recently passed state legislation, (the New Mexico Energy Transition Act) requires the environmental improvement board, or local board, to adopt regulations limiting carbon dioxide (CO_2) emissions from coal-fired electric generating facilities with an originally installed capacity exceeding 300 MW to no more than 1,100 pounds CO_2 per megawatt-hour (lb/MWh) by January 1, 2023. Installation of CCUS technology on existing coal-fired generating facilities will likely be required to comply with this regulation. The majority shareholder of the facility, Public Service of New Mexico (PNM), has announced they will not renew the coal contract in 2022 and intend to retire the power plant.

SJGS is currently owned by a group of public utilities, investor owned utilities, and municipal power entities pursuant to the Amended San Juan Participation Agreement (ASJPA). Farmington is currently a 5.076% part-owner of the facility and has the right under the ASJPA to acquire interests held by all the other owners effective at the termination of the existing coal contract on June 30, 2022. Enchant Energy LLC ("Enchant") has entered into an Agency Agreement with Farmington to develop and manage the CCUS retrofit process and Enchant intends to acquire ownership of SJGS with the exception of Farmington's current plant ownership interest on June 30, 2022 through the assignment by Farmington to Enchant of Farmington's acquisition rights under the ASJPA. Enchant and Farmington expect to execute this assignment agreement in July 2019 after the conclusion of this pre-feasibility study.

This pre-feasibility study is being conducted to evaluate the technical feasibility and the cost of a CCUS retrofit project at SJGS taking into consideration current federal and state regulatory requirements.

As part of the next steps of this project, it is recommended that a more in-depth FEED study be conducted to advance the project definition, engage the technology providers to provide site-specific performance data, and develop a detailed cost estimate. If the FEED study demonstrates the viability of the project, it could become the first large-scale CCUS retrofit of a coal-fired power plant that has the potential to reduce 6,000,000 tonnes CO_2/year.

1.2 Sargent & Lundy Experience

S&L is an industry leader in CO_2 capture FEED studies and implementation. S&L has been conducting studies and performing detailed balance-of-plant (BOP) engineering and technical evaluations for carbon capture projects since 2007. S&L has completed several FEED studies for these and other clients in which S&L prepared the preliminary system engineering, project layout, cost estimating, and preliminary design. S&L has extensive experience conducting technical evaluations for CO_2 capture projects, as well as performing several FEED studies for clients including preliminary engineering, project layout, conceptual design, and cost estimates. The most notable project was the Petra Nova Carbon Capture Project.

S&L worked on the CCUS development and implementation for NRG and Petra Nova from 2011 to 2017. Notably, that project among other things included: owner's Engineer during development and design phase of the project, including design reviews and HAZOP; a detailed design of the ductwork system for the 240 MWe slipstream (646,500 scfm) of flue gas; and an evaluation of MHI's amine-based process which produced 1.6 million tons of CO_2 per year (4776 tons/day).

Beginning in 2018, S&L has been supporting the development of a commercial carbon capture design and costing study for the Nebraska Public Power District and the DOE. S&L's role includes performing studies, BOP and engineering and design, constructability review and cost estimating.

2 CO_2 Capture Technology

Several CCUS technologies are been developed to capture and utilize CO_2 from combustion sources, including coal-fired power plants. However, given the timeframe to achieve compliance with current New Mexico emission standards requirements, the retrofit of SJGS with CCUS technology must be based on commercially available capture technology for coal-fired power plants the size of SJGS. Based on the current status of capture technology development, amine-based CO_2 capture is the only commercial technology available at this scale. Amine-based absorption technologies have been demonstrated as technically feasible and amine-based technologies have been permanently installed at both the Petra Nova and Boundary Dam facilities. Petra Nova has been operating with CCUS technology since January of 2017 and Boundary Dam since the fall of 2014, both capturing 90% of CO_2 emissions.

As such, this pre-feasibility study will be conducted based on implementing a typical amine-based system capable of treating flue gas from SJGS Units 1 and 4. Suppliers of these systems are MHI, Shell, and Fluor. Amine-based capture, systems offered by all these vendors include the same general equipment/components, designed based on the use of their own proprietary solvent. This pre-feasibility study is not based on detailed engineering; thus, design considerations and costs included in this report are representative of the use of any of these vendors; and any of these three systems would be integrated in a similar approach.

2.1 Process Description

In general, amine-based CO_2 capture system consists of a quencher (or pre-scrubber), an absorber, and a stripper. Compression and dehydration are also included to produce CO_2 at pipeline requirements. In addition, the flue gas will require a booster induced draft (ID) fan to overcome the pressure loss through the CO_2 capture system. A high-level block diagram of the system is shown in Figure 2-1.

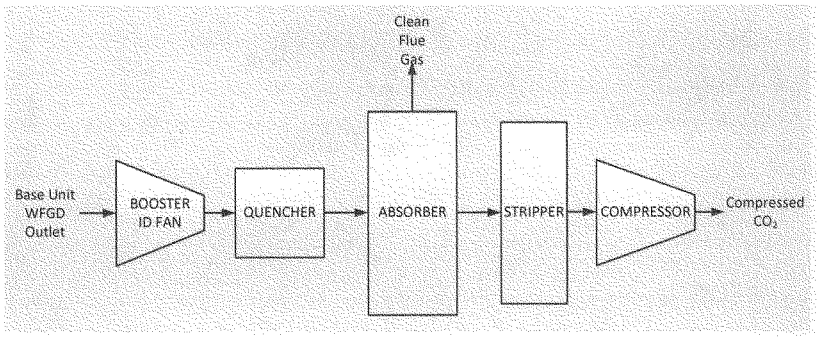


Figure 2-1: CO_2 Capture Block Diagram

Amine solvents are sensitive to impurities and will react with sulfur dioxide (SO_2) and sulfur trioxide (SO_3) molecules present in the flue gas. These reactions contaminate the solvent by forming intermediate salts, which in turn leads to higher solvent regeneration requirements and increased operational costs. SO_2 concentrations of 10 ppm or less are generally required for effective CO_2 capture. While SJGS Units 1 and 4 are equipped with recently upgraded limestone forced oxidation wet flue gas desulfurization (WFGD) systems for SO_2 control, the existing WFGDs do not provide the SO_2 and SO_3 removal efficiency required for an amine-based system. As such, additional SO_2 and SO_3 removal is required for more efficient operation of the CO_2 capture system.

2.1.1 Quencher and Pre-Scrubber

Additional SO_2 and SO_3 removal can be achieved using a caustic solution to pre-scrub the flue gas upstream of the absorber. The pre-scrubber is integrated with the quencher, which is designed to reduce flue gas temperatures to optimize CO_2 capture kinetics and efficiency in the absorber. Residual particulates, water, sulfates, and other soluble components removed from the flue gas in the quencher will build-up in the cooling contact water as it is recycled. In addition, a large volume of water will be collected in the quencher as it is condensed from the saturated flue gas. To maintain the liquid recirculation rate and limit the buildup of impurities in the recirculating solution, a blowdown stream is required to reduce the concentration of contaminants and overall liquid volume. The blowdown stream will be sent to the cooling tower as makeup water.

2.1.2 Absorber

Cooled flue gas from the quencher passes through a counter-current packed absorber column, where the amine-solvent absorbs CO_2 present in the flue gas. Several levels of packing, spray zones, and trays facilitate the required liquid-to-gas contact to ensure a high level of CO_2 absorption by the solvent Properly designed absorber columns can achieve CO_2 capture efficiencies of 90% or more. A water wash is located at the top of the absorber to remove any entrained solvent in the flue gas. The clean gas exits the absorber and is exhausted through a new stack located on top of the absorber.

2.1.3 Stripper

The CO_2–rich solvent from the absorber enters the top of a stripper column, where CO_2 is desorbed from the amine-solvent through the addition of heat to break the bond between the amine-solvent and the dissolved CO_2. The reboiler at the base of the stripper utilizes low quality steam as the source of energy to vaporize water in the dilute solvent. The hot-lean (or regenerated) solvent which is free of CO_2 is returned to the absorber.

2.1.4 Compressor

A mixture of CO_2 and steam exits the top of the stripper and is sent to the compressor system, which both dehydrates and compresses the CO_2 stream. The compressor is designed to pressurize the CO_2 product stream to pipeline quality. As part of this process, additional moisture is removed to provide a CO_2 stream with $\geq$ 99% purity at around 2,215 psia. Moisture removed from the dehydration system and during the compression process is collected and sent back to the stripper.

2.1.5 SJGS Arrangement

Figure 2-2 shows a simplified process flow diagram (PFD) of the CO_2 capture system for SJGS. Based on a preliminary review of flue gas flow rates, it is expected that the CO_2 capture system would consist of 2x50% trains, which would be sized to treat the entire flue gas volume of SJGS Units 1 and 4.

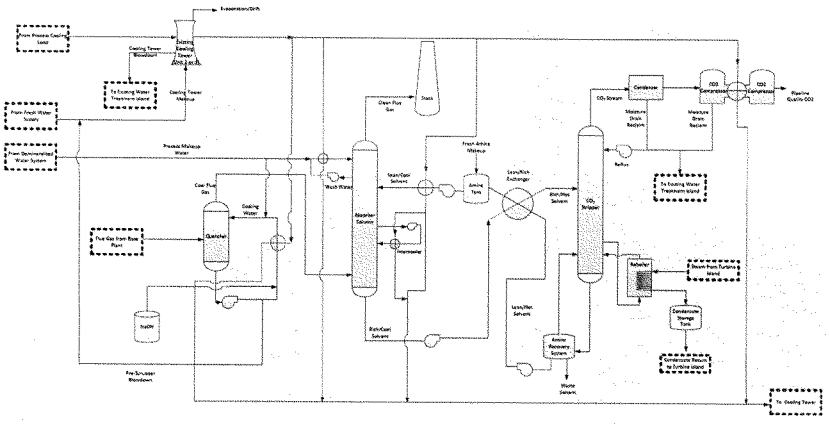


Figure 2-2: Commercial Amine Based Process Flow Diagram – 1x50% Train

2.2 Integration with SJGS Units 1 and 4

A PFD of the CO_2 capture system was developed and is included in Appendix B. Figure 2-3 highlights the tie-in locations to the CO_2 capture facility boundary limits. A visual representation of the proposed plant layout is provided in Appendix D.

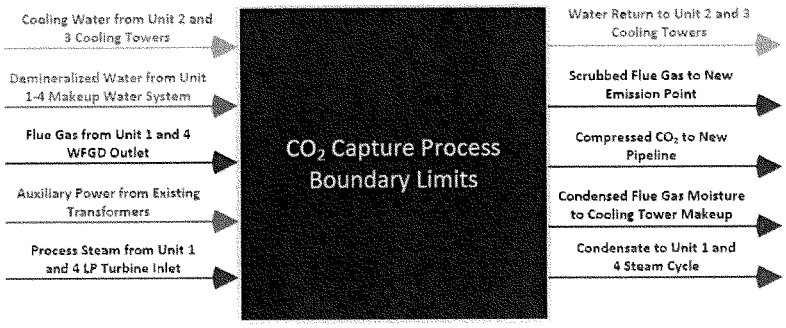


Figure 2-3: Integration Block Flow Diagram

Circulating cooling water to and from the CO_2 capture facility will be cooled via cooling towers in the Units 2 and 3 areas and will require new underground piping The Unit 3 cooling tower has remained intact, and will be repurposed for this service, with some repair work expected. The Unit 2 cooling tower has been demolished, leaving the infrastructure such as the piping and foundation in place. A new cooling tower will be constructed in place of the old Unit 2 tower. It is assumed that due to the proximity to the Unit 3 cooling tower, new circulating water pumps would not be needed. However, for integration with the new cooling tower in the Unit 2 area, the existing pumps will be replaced to overcome the additional distance and pressure drop of the system. A new piperack will be installed from the Unit 1-4 boiler buildings to the CO_2 capture facility; the pipe rack will include demineralized water for makeup to the wash water and process steam from Unit 1 and 4 steam turbines.

New ductwork to the San Juan CO_2 capture facility would be tied into Units 1 and 4, downstream of the existing WFGD systems, prior to the stack breaching. Two new booster ID fans will be located in the CO_2 capture facility to overcome the pressure drop associated with the new equipment. Flue gas would be routed from the tie-in to the CO_2 capture facility via elevated ductwork. The ductwork would combine with the piperack from the boiler building and the duct bank or cable tray from the existing auxiliary power transformers; this would become the utility rack once combined and would enter the CO_2 capture facility from the southwest corner.

Scrubbed flue gas would exit the absorber vessel through a new stack located on top of the absorber.

Energy for the stripper would be provided by low quality steam, from the units' existing steam cycle. Low quality steam would be extracted from the crossover between the intermediate (IP) and low pressure (LP) sections of the steam turbines. After the steam condenses in the stripper reboiler, the associated condensate would be pumped back to the base plant's condensate system.

For this evaluation S&L assumed that the CO_2 capture facility would be designed with two parallel 460 MW-equivalent (MWe) trains in a 2x50% configuration for the facility. Two trains allow more flexibility at more optimal performance. A single large train of 915 MWe could be installed but is not preferred due to turndown capabilities associated with feeding this equipment from multiple units. Unit 4 is the larger of the two units, at 544 MW-gross train, and should it be offline, the turndown through the CO_2 capture facility would fall below the 50% typical turndown rate.

San Juan recently retired two of four units, leaving auxiliary equipment that could be utilized for the new CO_2 capture facility. For example, as previously discussed, the cooling water demand for each CO_2 capture train is expected to be similar to the original circulating water rate for the retired units (Units 2 & 3). Therefore, the existing Unit 3 cooling tower could be repurposed, to provide cooling for the CO_2 system. Unit 2 cooling tower has since been demolished, leaving the foundation. A new tower will be built in its place, sized for the original water demands. Through such repurposing, the cost for new cooling towers to provide cooling to the CO_2 capture facility is reduced through reuse of the existing equipment and infrastructure.

Cooling towers consume significant quantities of water; however, the makeup water does not require high quality. The retirement of Units 2 and 3 is expected to provide sufficient margin in the makeup water capacity to the facility. To minimize the amount of makeup water required for the cooling tower, water generated in the process could be used as makeup to the maximum extent possible.

Cooling tower blowdown would be treated in the existing wastewater treatment system, which is sized to treat cooling tower blowdown from all four units. Since the circulating water streams are expected to operate at similar temperatures at the inlet to the cooling towers and are approximately the same flow rates, it is expected that the blowdown rates would be similar enough to be accommodated by the existing system with Units 2 and 3 offline.

A small quantity of high-quality process water would be required for operation of the CO_2 equipment for solvent regeneration or absorber water balance purposes. The water would be sourced from the plant's existing demineralized water makeup system. Based on the fact that SJGS was designed to operate with four units and now only runs two units, it is expected that there is sufficient margin in the demineralizer system to accommodate the CO_2 capture facility.

The CO_2 capture and balance of plant (BOP) systems include a significant number of pumps, compressors, fans, and other components which would result in significant auxiliary power consumption. The primary power consumer is the compressor, which pressurizes the CO_2 stream to the required pipeline pressure. For the purposes of this study, it is assumed that power would be supplied by the

existing facility's auxiliary power system from the Units 2 and 3, which are no longer in operation and an additional new auxiliary power transformer.

There is additional integration with the facility based on disposal or treatment of wastes generated by the degradation products of the amine-based solvent. As part of amine solvent-based systems, the degraded solvent will be filtered out occasionally and disposed of separately off-site.

3 Project Design Basis

3.1 Flue Gas Conditions

Table 3-1 summarizes the major inputs and assumptions used as the basis for the design of the SJGS CO_2 capture system. These inputs were based on publicly available information. Assumptions based on typical industry standards and engineering judgment were also used, where appropriate.

Table 3-1: Flue Gas Properties

Stream Characteristics		Existing FGD Outlet Unit 1		Existing FGD Outlet Unit 4	
Temperature	°F	129		129	
Pressure	psia	12.241		12.241	
N_2	lb/hr-vol%	2,784,625	68.17	4,502,289	68.38
O_2	lb/hr-vol%	177,619	3.80	349,124	4.64
H_2O	lb/hr-vol%	415,475	15.82	654,005	15.45
CO_2	lb/hr-vol%	781,916	12.18	1,190,946	11.51
SO_2	lb/hr-ppmv	147.06	15.8	313.83	20.9
SO_3	lb/hr-ppmv	12.72	1.1	19.37	1.0
NOx	lb/hr-ppmv	843.47	125.7	1,244.11	115.0
NH_3	lb/hr-ppmv	24.84	10.0	40.05	10.0
Hg	lb/TBtu	1.20		1.20	
Total Flow	lb/hr-acfm	4,160,664	1,254,165	6,697,983	2,021,601
MW - Moist.	g/mol-lb/lb	28.52	0.111	28.48	0.108

3.2 Utility Usage Rates

Table 3-2 summarizes the expected SJGS CO_2 capture facility requirements and estimated utility consumption for each unit and the total plant. This information is based on S&L's experience with the commercial amine-based processes. The values used below are a ratio or factored from past studies. Project specific values will be calculated and validated with a selected OEM during the FEED study or detailed design.

Table 3-2: CO_2 Capture Facility Requirements and CO_2 Quality

CCS Data for SJGS	Unit 1	Unit 4	Total Plant	Source
Existing Plant Data				
Plant Gross Output, (MW_{gross})	370	544	914	Farmington
Total Plant Heat Input, (mmBtu/hr)	3,667	5,409	9,076	2017 IRP[1]
Existing Aux Power, (MW)	30	37	67	Farmington
Existing Net Power, (MW_{net})	340	507	847	Calculation
Existing Heat Rate, (Btu/kW_{net}, HHV)	10,786	10,669	10,716	2017 IRP[1]
Stack SO_2, (lb/MMBtu)	0.039	0.054	0.048	CAMD[2,3]
Stack CO_2, vol %	12.2	11.5	12	Calculation
CCS Requirements				
Demineralized Water, (gpm)	23	64	87	Internal Database
Steam to CO_2 System, (lb/hr)	816,000	1,262,000	2,078,000	Internal Database
Steam Extracted for IP/LP, (lb/hr)	705,840	1,091,630	1,797,470	Estimated
LP Steam to CO_2 System, %	36	37	36	Calculation
Additional Cooling Water Flow for CO_2, (gpm)	131,000	200,000	331,000	Internal Database
Plant Derating due to Extraction, (MW)	48	74	122	Estimated
Plant Gross Power Derating, %	13	14	13	Calculation
Revised Gross Output, (MW_{gross})	322	470	792	Calculation
Total Aux Load for CCS Plant, (MW)	49	75	124	Internal Database
Total Aux Load for CCS Plant, %	13	14	14	Calculation
Net Change w/ CCS				
Total New Net Power, (MW)	243	358	601	Calculation
Total Plant Power Net Reduction, %	29	29	29	Calculation

Note 1. Extracted from PNM 2017-2036 Integrated Resource Plan (IRP). July 3, 2017.
Note 2. Data from Air Markets Program Database (AMPD) 12/1/2017 to 3/31/2019.
Note 3. An average of all the SO_2 data points from the top 10% of the full load.

3.3 CO_2 Production

The CO_2 rates for SJGS are provided in Table 3-3. Based on the information provided, controlled CO_2 emissions from SJGS are approximately 249 lb/MWh-gross on a weighted average basis assuming for 90% capture.

Table 3-3: CO_2 Rates for San Juan Generating Station

SJGS CO_2 Rates		Unit 1	Unit 4	Total Plant
Baseline Plant CO_2 Emissions Rate[1]	(lb/MWh_{gross})	2,165	2,236	2,201
Post-Project CO_2 Emission Rate	(lb/MWh_{gross})	243	254	249
Max Full Load Post-Project CO_2 Capture Rate	(lb/hr)	703,724	1,071,852	1,775,576
Post-Project CO_2 Capture Rate[2]	(mmscfd)	124	189	313
	(mmscfy)	45,200	68,845	114,045

Note 1. Data from the United States Environmental Protection Agency's (EPA) Air Market Program Database (AMPD) - Annual average for 2014-2018 – Total plant is estimated based on the average of Units 1 and 4.
Note 2. Values calculated assuming an annual average facility capacity factor of 85%.

4 Project Considerations

4.1 Permitting Considerations

4.1.1 State CO_2 Requirements

New Mexico recently enacted Energy Transition Act (ETA, SB 489) requires electric generating facilities in the state with an originally installed capacity exceeding 300 MW, to comply with a CO_2 emissions standard requiring emission of under 1,100 lb/MWh by January 1, 2023. Installation of CCUS at SJGS will decrease CO_2 emissions by $\geq$ 90%, or approximately 6 million tons per year. More specifically, CCUS installation at SJGS would limit CO_2 emissions to 243 lb/MWh-gross and 254 lb/MWh-gross for Units 1 and 4 respectively, which is 77% below the emissions standard required by the Energy Transition Act.

There is an expected 30 to 36 month period of construction required for a project of this magnitude.

4.1.2 Water Rights

Currently, SJGS has excess infrastructure capable of handling up to 30,000 acre-feet/annum (AFA) and permits to consume up to 19,000 AFA. The operating Units 1 and 4 utilize 12,000 AFA, leaving excess capacity to process 18,000 AFA and excess water consumption rights of 7,000 AFA. The project requires an increase in the makeup water demand to the cooling towers above the current Units 1 and 4 demands. However, the blowdown flow can be treated with the existing waste water treatment system, which currently recycles up to 98% of Units 1 and 4 blowdown water. A similar water recycle/reuse rate is expected from the new blowdown stream. The net result of this will be to minimize the net fresh water makeup to only 6,000 AFA. Therefore, additional water handling facilities or water consumption rights are not expected to be needed.

4.1.3 Air Emissions

SJGS is subject to federal and state regulations on emissions. As a result of the environmental upgrade completed in 2017, the plant is currently fully compliant with all limits required under a 2013 settlement agreement with the New Mexico Environmental Department and the EPA. SJGS had selective non-catalytic reduction (SNCR) technology installed for NOx control on Units 1 and 4. The SNCR was determined to be the Best Available Retrofit Technology (BART) at the time of the settlement agreement. The installation of SNCR on the SJGS brought the plant into compliance with Section 113(g) of the Clean Air Act.

The settlement agreement also resulted in a lower SO_2 permitted emission rate for Units 1 and 4 and the retirement of Units 2 and 3 by the end of 2017. The settlement agreement does not have an expiration or renewal date.

SJGS will continue to be compliant with the terms of the 2013 settlement agreement. Installation of CCUS will not increase emissions of any controlled pollutants and, in addition to CO_2 reductions, will likely reduce facility emissions of particulate, SO_2, NOx, ammonia and mercury.

4.2 Plant Derate and Additional Auxiliary Power Demand

There are two parameters that will reduce the base facility's net power output: steam extraction and auxiliary power usage. The steam extraction from the IP/LP cross-over reduces the overall gross capacity of the turbine by removing the steam prior to passing through the LP turbine. For the purposes of this pre-feasibility study, steam demand and corresponding plant derate was estimated based on the current technology requirements and similar units. Based on the estimated steam consumption it is predicted that the gross output is derated by approximately 48 MWe on Unit 1 and 74 MWe on Unit 4.

The CO_2 capture facility also uses power to operate the meehanical equipment required to compress the CO_2. This power need is expected to be provided by the station's existing auxiliary power transformers and an additional auxiliary power transformer. This power usage requirement will reduce the net power that can be provided to the grid. Auxiliary power demands were factored from publicly available information for the current technology requirements. Based on the sizes of the facility, the total net output of the generating unit for each case is provided in Table 4-1.

Table 4-1: Plant Net Output with CO_2 Capture

	Unit 1	Unit 4	Total
Gross Boiler Size/Steam Generation	**370**	**544**	**914**
Base Plant Auxiliary Power	30	37	67
Baseline Net Boiler Output	**340**	**507**	**847**
Process Steam Equivalent Power Derate	48	74	122
CO_2 Facility Process Auxiliary Power	49	75	124
Net Power Output (MW)	**243**	**358**	**601**

During the FEED Study or detailed design, the steam consumption and power consumption will be solicited from the selected OEM, and heat balances will be developed to calculate the plant derate.

Typically, a CO_2 capture project can be adversely affected by the amounts of steam and power consumption required for the carbon capture operations resulting in lost revenues and profit. For SJGS, the overall net power output is estimated to be reduced by 246 MW due to the retrofit at 100% capacity utilization. Since SJGS will operate as a merehant plant after retrofit, the economic impact of the lost output due to auxiliary load and steam usage has been estimated at the expected cost of generation including fuel cost.

The new net power output after CCUS technology is installed will be approximately 600 MW. Currently, there is a significant amount of time in which the facility has been historically dispatched at or below 600 MWn. If this load demand were to stay the same, the SJGS would be able to operate at or near 100% boiler capacity, resulting in the maximum CO_2 production rate. It is therefore reasonable for a facility such as SJGS to evaluate the cost of the unit derate based on the cost of additional fuel and operating

costs to provide the steam and auxiliary power required for CO_2 capture, rather than based exclusively or predominantly on the cost of lost generation.

4.3 CO_2 Market Opportunities

There is an opportunity for CO_2 to be sold for enhanced oil recovery (EOR) in the SJGS area. The facility is located within relatively close proximity to the Cortez compressed CO_2 pipeline, owned by Kinder-Morgan, which supplies CO_2 to the Permian Basin oil fields in southeast New Mexico and West Texas. The proximity of SJGS to the pipeline would require an additional connecting branch line of approximately 20 miles in length.[1] This proximity provides SJGS with CO_2 market opportunities, as the Permian Basin is one of the largest users of CO_2 for EOR in the world. In addition, the oil fields in the Permian Basin are also connected to EPA-certified sites for permanent storage of the captured CO_2.

For these reasons, SJGS can capture and compress CO_2 for EOR and permanent storage. The market for CO_2 can provide the facility $15-20/tonne in revenue for the sale of the compressed and purified CO_2. In combination with the U.S. EPA's 45Q tax credits, this provides SJGS the opportunity to continue operation of the facility with 90% CO_2 reduction, without a significant financial burden as is typical with most pollution control equipment.

4.4 Conceptual Site Arrangement

The major process equipment and BOP systems needed for a complete CO_2 capture facility require a significant footprint, on the order of 800'x750'. The San Juan property includes a relatively large open area directly north of the station.

Due to the retirement of two units, it is estimated that the entire CO_2 capture facility could be installed in an area of unused property to the north of the Unit 3 cooling tower. The location of the project on the north end of the facility provides a good location for routing the CO_2 pipeline, since the tie-in to the Cortez pipeline will likely be to the northeast of the SJGS facility.

Integrating the CO_2 capture facility in this location will provide close proximity to the process steam from the boiler building to the south and existing waste water treatment facility to the east of the proposed location. Furthermore, the proposed location will be directly adjacent to the Unit 3 cooling tower that will provide a significant source of the cooling demand for the facility. There are some drawbacks to the proposed location, with flue gas routing being the main concern. The flue gas tie-in would be located downstream of the existing WFGD systems and would need to be routed approximately 3,000 feet to the CO_2 capture facility. This will incur a significant cost for ductwork and support steel that will be offset by a relatively minor benefit of needing slightly less cooling water in the quencher due to thermal loss over the length of ductwork.

[1] The Petra Nova project built near Houston, Texas, required approximately 80 miles of pipeline to be built to connect the project to an EOR field.

The arrangement also will require newly routed underground circulating water pipes from the Unit 2 cooling tower area located south of the boiler building. The piping would be installed directly below power lines and will have to be routed with care to avoid existing underground circulating water piping.

A proposed plant integration layout is included in Appendix C.

5 Cost Estimate

5.1 Major Cost Inputs & Assumptions

The previous sections describe the design considerations that were made in generating capital and operating costs for the new CO_2 capture facility. The following major assumptions were made in developing the order-of-magnitude capital costs:

- Equipment previously used at the facility during Units 2 and 3 operation could be repurposed with minor allowances needed for repairs and reintegration. This includes the Unit 3 cooling tower, Units 2 and 3 dedicated auxiliary power system, and Unit 3 circulating water pump.
- New cooling tower will be built on existing Unit 2 infrastructure.
- Equipment used as part of a common system has sufficient margin to accommodate the new utility requirements of the CO_2 capture system, based on CO_2 capture demand rates similar to or lower than the previous Units 2 and 3 utility rates. This includes the cooling water, blowdown wastewater treatment system, and demineralized makeup water system.
- While all of the equipment that is expected to be reused may not be in ideal condition, it is assumed that a relatively small amount of repairs would be needed to make them operable again. Allowances are included.
- No major steam turbine redesign is required to extract process steam. An allowance is included.
- Pipeline equipment and installation costs were furnished as part of a budgetary quote.
- CO_2 compressor equipment costs were based on a budgetary quote. Labor for installation was estimated along with integration of a dehydration system.
- Costs for the amine-based capture equipment was scaled based on publicly available costs for the Petra Nova facility.
- The CO_2 capture facility will be contracted as an Engineering, Procurement, and Construction (EPC) project. As such, the appropriate risk fee is included.

The following major assumptions were made in developing the order-of-magnitude operating and maintenance (O&M) costs:

- Utility rates are expected to be similar to S&L's previously completed CO_2 studies and publicly available information for similar amine-based systems.
- A contingency equal to 20% of the direct costs has been included.
- Electricity for auxiliary power and steam derate will be based on the current fuel cost and operating costs.
- No current operators from the existing facility will be used to operate or maintain the CO_2 capture facility. 18 new personnel are included, which includes four personnel per shift (two auxiliary operators and two maintenance personnel). There will be four shifts per week - Day, Evening, Graveyard, Weekend. In addition to these 16 personnel, two lab technicians and process support personnel will be on staff. This staffing plan is based on assuming the CO_2 process will not be staffed by anyone at the base facility.

- Maintenance costs are based on 2.5% of the equipment and materials for the complete project, including pipeline.
- CO_2 island chemical and disposal costs are based on publicly available data for various amine-based solvent suppliers.

5.2 Cost Inputs

CO_2 capture order-of-magnitude costs were estimated based on S&L's experience along with site specific SJGS considerations. All costs are provided in 2019 dollars with no escalation or financing costs (i.e., allowance for funds during construction) included. This type of costs estimate is referred to as an "overnight" cost estimate. Labor costs were estimated for each individual subcontracted process or component rather than a blanket percentage over the whole project and include the associated labor indirect costs which apply to this type of work such as overtime, per diem, contractor's G&A and profit. This capital cost estimate is a factored estimate, equivalent to an AACE Class 5 estimate. During the FEED study or detailed design, a more detailed capital cost estimate will be developed based on input from a selected OEM and detailed design.

Indirect project costs, such as engineering, construction management, startup and commissioning support, construction materials and initial fills for testing were also included in the estimate to provide a total capital investment. An allowance for owner's costs, provided by Enchant Energy, has been included.

Operating costs were estimated based on a capacity factor of 85% and are provided in 2019 dollars. Unit costs for consumables were estimated by S&L, except as noted.

Fixed O&M costs are based on 18 additional operators for the combined system; however, there is the potential for some employees to be shared between current plant personnel and the new CO_2 capture facility. Maintenance material and labor costs were estimated for the project based on the cost of material and equipment for the CO_2 capture system.

5.3 Capital Costs

The overall cost for the commercially available amine-based CO_2 capture system is provided in **Table 5-1** and Appendix D.

Table 5-1: Capital Cost Summary of CO_2 Capture System ($2019)

	Material / Equipment	Labor	Total
BOP Cost	**$ 110,360,000**	**$ 79,250,000**	**$ 189,610,000**
Civil / Sitework	*$ 4,020,000*	*$ 7,150,000*	*$ 11,170,000*
Mechanical /Equipment	*$ 31,370,000*	*$ 37,500,000*	*$ 68,870,000*
Structural / Ductwork	*$ 58,560,000*	*$ 24,770,000*	*$ 83,330,000*
I&C	*$ 5,630,000*	*$ 820,000*	*$ 6,450,000*
Electrical	*$ 14,780,000*	*$ 10,010,000*	*$ 24,790,000*
CO_2 Island Cost (Ineluding Compression Island)	**$ 253,010,000**	**$ 309,230,000**	**$ 562,240,000**
Pipeline Cost (Furnished / Installed)			**$ 40,000,000**
Total Direct Capital Cost			***$ 796,850,000***
EPC Construction Overheads[1]			$ 119,530,000
Engineering[2]			$ 39,840,000
EPC Contingency			$ 159,370,000
EPC Risk Fee			$ 79,690,000
Total Indirect Costs			***$ 398,430,000***
Total EPC Cost			**$ 1,195,280,000**
Owner's Cost			**$ 100,000,000**
Total Project Cost[3]			**$ 1,295,280,000**

Note 1. Construction Overheads Includes:
Scaffolding, Overtime, Per Diem, Consumables, Sales Tax, Contractors Administration Fee, Contractor Profit
Note 2. Engineering Includes:
Engineering services, Field Support, Start-Up/Commissioning, SU/S Parts/Initial Fills
Note 3. Costs Exclude:
Escalation, AFUDC, Right of Way & Land Purchase, Insurance, Site Security

5.4 Operating Costs

Total overall O&M cost for the commercially available amine-based CO_2 capture system is provided for the entire facility at two different capacity factors. A capacity factor of 85% is used to determine a typical annual production capacity, while 100% is used to show the maximum costs associated with the system. Table 5-2 provides a breakdown of the annual O&M cost.

Table 5-2: Annual O&M Cost Summary of CO_2 Capture Systems ($2019)

Description	85% Capacity Factor	100% Capacity Factor
Total Fixed Operating Cost	**12,360,000**	**12,360,000**
Annual Operating Labor	2,430,000	2,430,000
Maintenance Material & Labor	9,930,000	9,930,000
Total Variable Operating Cost	**87,579,000**	**103,029,000**
Demin Makeup Water	30,000	40,000
Water Treatment	830,000	970,000
CO_2 Island Chemical and Disposal Costs	28,839,000	33,919,000
Purchased Steam & Power Cost	57,880,000	68,100,000
Total Annual O&M Cost ($/yr)	**99,939,000**	**115,389,000**

5.5 Cost of Capture

To calculate the total cost per mass of CO_2 captured, all costs should be evaluated on an annual basis. In previous DOE case studies, a capital annualization factor of 0.1243 was used for other projects of equivalent risk to evaluate costs on a constant dollar basis. This methodology was used to calculate the total cost of capture for this pre-feasibility study.

Table 5-3 provides an estimate of the total quantity of CO_2 captured in a year as well as the evaluated cost for the CO_2 capture system.

Table 5-3: Cost of CO_2 Capture

Description	Units	85% Capacity Factor	100% Capacity Factor
Total Project Cost	$	1,295,280,000	1,295,280,000
CCF		0.1243	0.1243
Annualized Capital Cost	$/yr	161,000,000	161,000,000
Annual O&M Cost	$/yr	99,939,000	115,389,000
Total Annual Cost	$/yr	260,939,000	276,389,000
CO_2 Captured	mmscfd	313	368
Annual CO_2 Captured	tonnes	6,000,000	7,060,000
Cost of Capture	**$/tonne[1]**	**43.49**	**39.15**

Note 1. Cost of capture reported as dollars per metric ton (equivalent to 2,240 lb).

6 Summary and Conclusions

This study establishes the technical feasibility and costs associated with the implementation of amine-based carbon capture technology at the San Juan Generating Station site. The current study represents expected utility requirements and capital costs that correspond to the current advancement of the amine-based technology and rely on information published by both MHI and Shell on their recent installations and developments. Specifically, this study builds on the information provided from recent experience and installations of both MHI and Shell at Petra Nova and Boundary Dam, respectively. Furthermore, this study considers the cost savings associated with using existing infrastructure from the recently retired Units 2 and 3 at SJGS to supply the CO_2 capture utility requirements. Using the existing auxiliary systems lowers the project capital costs and reduces the overall cost of capture, making this facility an attractive candidate for CCUS.

The total project cost was estimated to be $1.295 B, which considers the current level of technology advancements and cost savings for application at SJGS. Even while including the cost for the CO_2 pipeline, the cost to implement CO_2 capture at SJGS is estimated to be between $39-43/tonne. This is in line with the DOE's long-term goal of $40/tonne, which does not include the capital cost of new pipeline.

In addition to the lower cost to implement CO_2 capture at SJGS, the facility is located in relatively close proximity to a CO_2 pipeline. This will require minimal pipeline costs in comparison with many coal-fired facilities as well as a market opportunity for sale of the produced compressed CO_2.

As part of the next steps of this project, it is recommended that a more in-depth FEED study be conducted to advance the project definition, engage the technology providers to provide site-specific performance data, and develop a detailed cost estimate. At this time, minimal engineering has been conducted for the design of the CO_2 capture system integration to develop an order of magnitude cost.

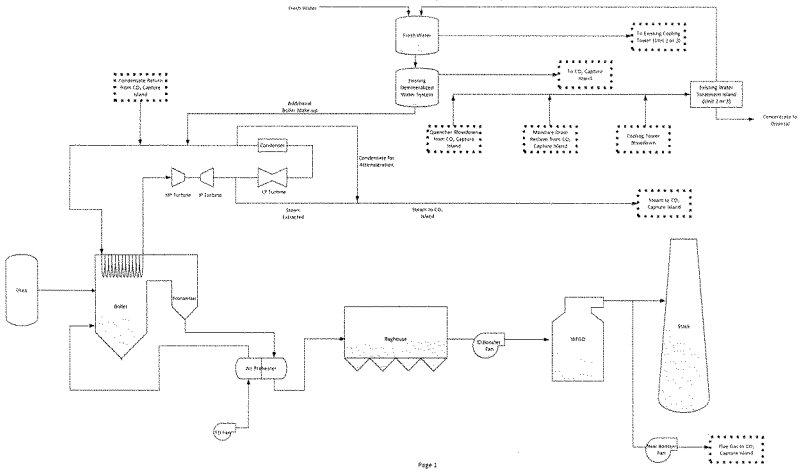
During the future phases, it is recommended that the CO_2 capture system be competitively bid to obtain site-specific performance and design information, and competitive pricing for the subcontracted island cost. CO_2 technology OEMs have indicated that overall capital costs of the facilities have reduced in the last 10 years, due to modularization and optimization of the process. Depending on the advances made over the last 3-5 years, it is expected that OEMs will be able to provide optimized auxiliary power and steam requirements. As such, the overall plant derate may also be optimized and reduced in future applications of this technology.

APPENDIX A:

BASE PLANT PROCESS FLOW DIAGRAM

Enchant Energy San Juan Generating Station CO_2 Capture Pre-Feasibility	Sargent & Lundy	Project No.: 13891-001 Issue: Rev 0 Date: 7/3/2019

Base Plant PFD (Unit 1 or 4)



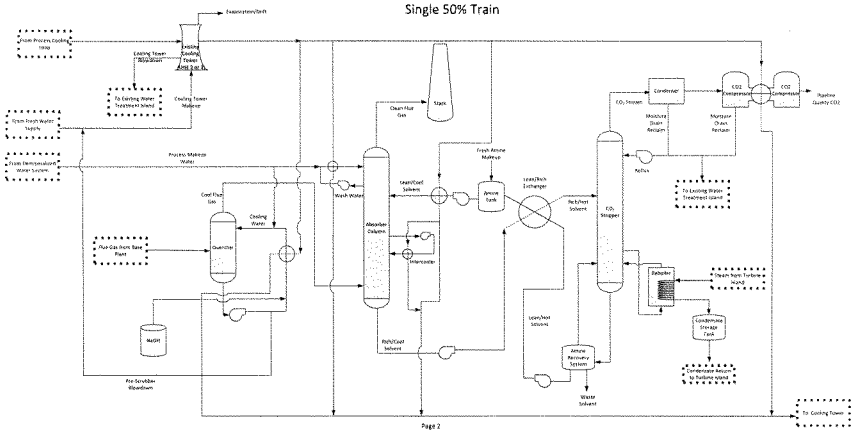
Page 1

APPENDIX B:

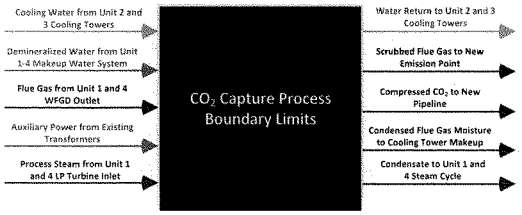
CO_2 FACILITY PROCESS FLOW DIAGRAM

Enchant Energy San Juan Generating Station CO_2 Capture Pre-Feasibility	Sargent & Lundy	Project No.: 13891-001 Issue: Rev 0 Date: 7/3/2019

Commercial Amine Based
CO_2 PFD
Single 50% Train

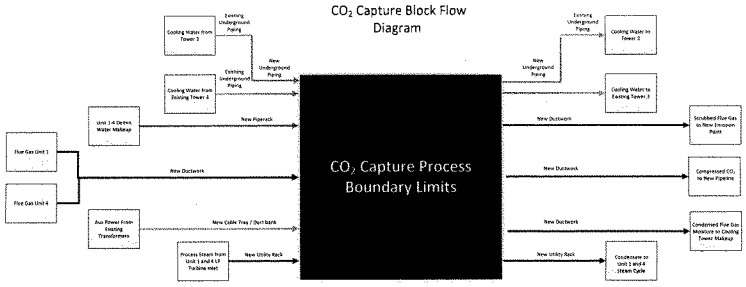


High Level CO_2 Capture Block Flow Diagram



Enchant Energy San Juan Generating Station CO_2 Capture Pre-Feasibility	Burns & Lundy	Project No.: 13891-001 Issue: Rev 0 Date: 7/3/2019

CO_2 Capture Block Flow Diagram



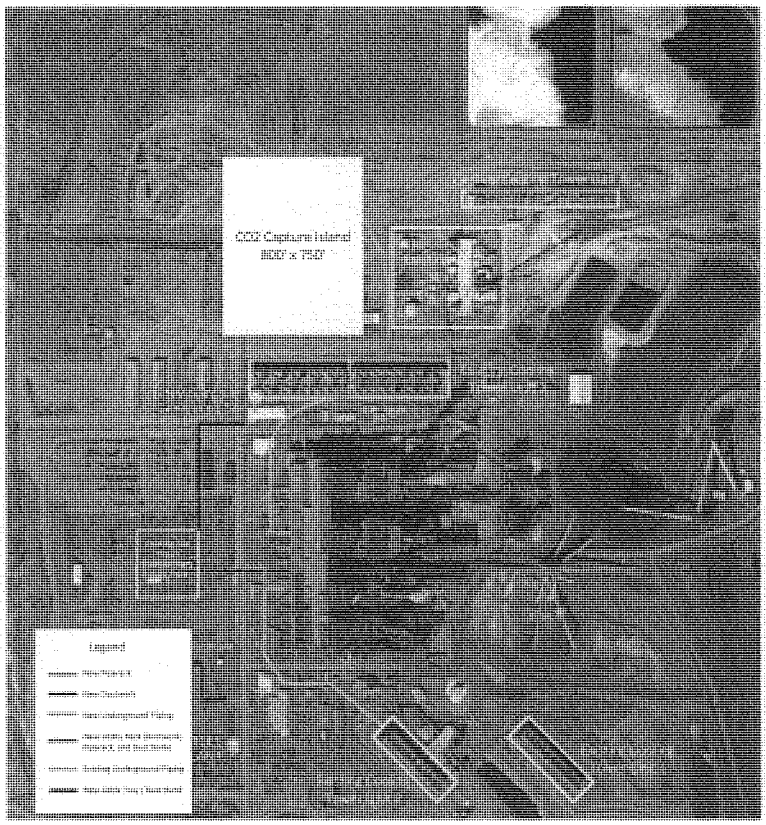
APPENDIX C:

GENERAL ARRANGEMENT AND PLANT LAYOUT

Enchant Energy
San Juan Generating Station
CO_2 Capture Pre-Feasibility
General Arrangement Drawings

Sargent & Lundy

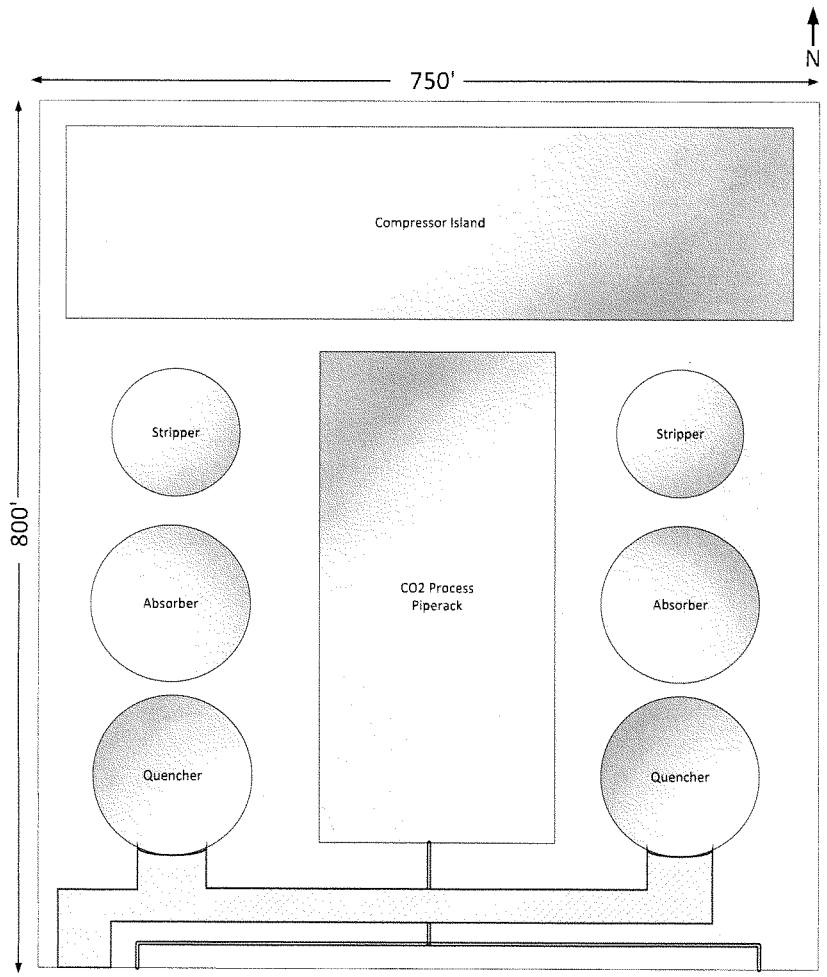
Project No.: 13891-001
Issue: Rev 0
Date: 7/3/2019



Enchant Energy
San Juan Generating Station
CO_2 Capture Pre-Feasibility
General Arrangement Drawings

Sargent & Lundy

Project No.: 13891-001
Issue: Rev 0
Date: 7/3/2019



APPENDIX D:

DETAILED CAPITAL COSTS

Summary San Juan CO_2 Capture Capital Costs

	Material / Equipment	Labor	Total
BOP Cost	**$ 114,360,000**	**$ 80,250,000**	**$ 194,610,000**
Civil / Sitework	*$ 4,020,000*	*$ 7,150,000*	*$ 11,170,000*
Mechanical / Equipment	*$ 31,370,000*	*$ 37,500,000*	*$ 68,870,000*
Structural / Ductwork	*$ 58,560,000*	*$ 24,770,000*	*$ 83,330,000*
I&C	*$ 5,630,000*	*$ 820,000*	*$ 6,450,000*
Electrical	*$ 14,780,000*	*$ 10,010,000*	*$ 24,790,000*
CO_2 Island Cost (Including Compression Island)	**$ 253,010,000**	**$ 309,230,000**	**$ 562,240,000**
Pipeline Cost (Furnished / Installed)			**$ 40,000,000**
Total Direct Capital Cost			*$ 796,850,000*
EPC Construction Overheads[1]			$ 119,530,000
Engineering[2]			$ 39,840,000
EPC Contingency			$ 159,370,000
EPC Risk Fee			$ 79,690,000
Total Indirect Costs			***$ 398,430,000***
EPC Capital Cost[3]			**$ 1,195,280,000**
Owner's Cost			**$ 100,000,000**
Total Project Cost			**$ 1,295,280,000**

Note 1. Construction Overheads
- Scaffolding
- Overtime
- Per Diem
- Consumables
- Sales Tax
- Contractors Administration Fee
- Contractor Profit

Note 2. Engineering
- Engineering services
- Field Supoort
- Start-Up/Commissioning
- SU/S Parts/Initial Fills

Note 3. Costs Exclude:
- Escalation
- AFUDC
- Right of Way & Land Purchase
- Site Security

APPENDIX E:

DETAILED O&M COSTS

Summary San Juan Combined Cost of CO_2 Capture

Input Data:		Unit 1	Unit 4	Total Plant	Total Plant
Plant Gross Capacity (Max Normal)	MW	370	544	914	914
Base Plant Aux Power Consumption	MW	30	37	67	67
Base Plant Net Capacity @ Max Normal Load	MW	340	507	847	847
CO_2 Capture Aux Power Consumption	MW	49	75	124	124
CO_2 Island Steam Derate	MW	48	74	122	122
Post CO_2 Net Capacity @ Max Normal Load	MW	243	358	601	601
Capacity Factor	%	85%	85%	85%	100%
CO_2 Capture Design (@ 100% Capacity Factor):					
CO_2 Capture System Size	MWe	370	544	914	914
Total Unit Derate due to CO_2 Capture	MW	97	149	246	246
CO_2 Capture Rate	lb/hr	703,724	1,071,852	1,775,576	1,775,576
Carbon Capture Design @ Capacity Factor	ton CO_2/year	2,619,960	3,990,500	6,610,470	7,777,020
	mmscfd	125	189	312	368
O&M Unit Pricing:					
Water Cost	$/1000gal	1.30	1.30	1.30	1.30
Waste Water Treatment Cost	$/1000gal	1.5	1.5	1.5	1.5
CO_2 Transportation, Storage, Monitoring Cost	$/tonne	not included	not included	not included	not included
CO_2 Capture Island O&M Rates (@ Capacity Factor):					
Demin Water Makeup Rate	gpm	23	34	57	57
Waste Water Production Increase	gpm	487	744	1,232	1,232
Variable O&M Summary:					
Water Cost	$/yr	10,000	20,000	30,000	40,000
Additional Water Treatment Cost	$/yr	330,000	500,000	830,000	970,000
CO_2 Island Chemical and Disposal Costs	$/yr	11,499,000	17,340,000	28,839,000	33,919,000
Total Steam & Power Cost	$/yr	22,820,000	35,060,000	57,880,000	68,100,000
Total Variable O&M Cost (First Year)	**$/yr**	**34,659,000**	**52,920,000**	**87,579,000**	**103,029,000**
Fixed O&M Cost:					
Additional Operators [1]	#			18	18
Operator Wage [2]	$/hr			65	65
Additional Operating labor ($/hr, 40 hrs week)	$/yr			2,430,000	2,430,000
Maintenance Material and Labor	$/yr			9,930,000	9,930,000
Additional Administrative labor	$/yr			0	0
Fixed O&M Cost	**$/yr**			**12,360,000**	**12,360,000**
Total O&M Cost:	**$/yr**			**99,939,000**	**115,389,000**
Cost of Capture:					
EPC Capital Cost	$			1,195,280,000	1,195,280,000
Owners Cost	$			100,000,000	100,000,000
Total Project Cost	$			1,295,280,000	1,295,280,000
Annualization Factor [2]				0.1243	0.1243
Annualized CapEx	$/yr			161,000,000	161,000,000
Total Annual Cost	$/yr			260,939,000	276,389,000
Total Annual CO_2 Production @ Capacity Factor	tonne/yr			6,600,000	7,060,000
Cost of Capture	**$/tonne**			**43.49**	**39.15**

Note 1. 4 personnel per shift (2 auxiliary operators, 2 maintenance personnel). 4 shifts per week - Day, Evening, Graveyard, Weekend. Plus 2 lab techs/process support. Assumes no sharing with base facility staffing for operators.
Note 2. DOE annualization factor, based on a 5-year capital expenditure period for a high-risk project.

The Heritage Foundation

BACKGROUNDER
No. 3444 | OCTOBER 16, 2019
THOMAS A. ROE INSTITUTE FOR ECONOMIC POLICY STUDIES

Pursuing Policies to Drive Economic Growth and Reduce Emissions

Nicolas D. Loris

KEY TAKEAWAYS

Economic growth and a clean environment are not mutually exclusive objectives. Rather, it is economic progress that drives positive environmental outcomes.

Extreme, top-down climate regulations significantly harm Americans both as taxpayers and energy consumers—all for negligible environmental benefit.

Pro-growth policies are pro-environment, too. Reforms should break down barriers to technological innovation, empower consumers, and improve access to markets.

Through investment in new technologies and through legislation, environmental trends have improved significantly in the United States. Pollutants known to cause harm to public health and the environment are declining.[1] As a country grows economically, it increases the financial ability of its citizens to care for the environment and reduce pollutants emitted from industrial growth. In fact, The Heritage Foundation's *Index of Economic Freedom* and Yale University's *Environmental Performance Index* show a highly positive correlation between a country's environmental performance and its economic freedom.[2]

In a competitive marketplace, companies respond to price signals, and entrepreneurs continually search for promising new opportunities. Market pressures to attract customers incentivize improvements in operations, investment, and resource use. These

This paper, in its entirety, can be found at **http://report.heritage.org/bg3444**

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efficiency gains provide price-competitive products with smaller environmental footprints.

For example, beverage manufacturers have significantly reduced the amount of plastic to make and package water bottles; moreover, Coca-Cola's PlantBottle, which is made partially from plants, is a decade old—and market access continues to expand.[3] Grocery stores and office buildings use energy-efficient lights and install motion-activated lights in less trafficked areas to cut costs. On a microeconomic level, individuals and businesses have a financial motivation to do more with less. On a larger scale, the cumulative effect of this incentive structure is that companies provide consumers with the goods and services they want—while using fewer resources and emitting fewer unwanted emissions.

However, profits alone do not drive investment decisions. Businesses could be responding to shareholder, social, or consumer pressures. Owners and investors may have their own non-monetary objectives, combating climate change being one of them. Indeed, investments in climate mitigation and adaptation continue to grow across many sectors of the economy. Entrepreneurs have found creative solutions that create new job opportunities and generate higher levels of prosperity while reducing emissions in the process.

Some compelling consumer-centric, industry-led examples include:

- The energy industry has undergone a massive transition over the past decade, largely because of market forces.[4] In 2008, coal provided roughly 50 percent of the country's electricity generation. A decade later, coal's share of the pie was 27.4 percent.[5] The increased penetration of natural gas through smart extraction technologies and declining costs of renewable power have fundamentally changed the energy landscape. In places like Pennsylvania, more residents are moving away from home heating oil to cheaper, cleaner natural gas. More than 50 percent of Pennsylvania households use natural gas for their home heating source, compared to just 17 percent using fuel oil.

- The U.S. natural gas industry's ascension as a leader in exports is paying dividends economically and environmentally across the globe. A new study from the Department of Energy's National Energy Technology Laboratory analyzed life cycle greenhouse gas emissions from U.S. liquefied natural gas (LNG) exports. In different scenarios of comparing U.S. LNG shipped to European and Asian markets, when compared to coal use or Russian piped gas, the life cycle emissions from U.S. LNG exports are lower.[6]

- In direct response to tough economic competition, the Nuclear Energy Institute organized nuclear power plants nationally to find operating efficiencies that reduced costs by 19 percent, resulting in $1.6 billion in savings and keeping emissions-free electricity in the marketplace.[7]

- The U.S. has become the world's leading oil and natural gas producer, providing affordable, reliable power to families and businesses. At the same time, methane emissions from the natural gas industry have fallen from 1990–2017, according to the Environmental Protection Agency.[8]

- Electricity market choice at the wholesale and retail levels empowers households and firms. Businesses have committed to using more renewable power,[9] driven in part by what the *Stanford Social Innovation Review* calls "strategic concern driven by market forces."[10] Where retail choice exists, households have the opportunity to choose from what generating source they receive their electricity. Additionally, increased demand response and real-time pricing enables consumers to reduce energy consumption, thus saving money and lowering emissions.

- Despite the regulatory morass and government subsidies that impede technological breakthroughs, financiers and entrepreneurs are progressing to advance alternative energy sources. Several advanced nuclear start-up technologies are emerging,[11] and developers of the technologies believe they can be cost-competitive with conventional sources of energy without subsidies.[12] Companies are making improvements in large-scale and small-scale battery storage.[13] While utility-scale energy storage is currently cost prohibitive, research and investment in various battery technologies (e.g., lithium-ion and sodium-sulfur) have investors and entrepreneurs hopeful.[14] Furthermore, natural gas combined-cycle generators continue to evolve, improving efficiency and consequently reducing sulfur dioxide, nitrous oxide, and carbon dioxide.[15]

- The demand for plant-based and lab-grown meat has increased over the past several years. Fast-food restaurants sold 228 million plant-based burgers so far this year, up 10 percent from the previous year.[16] While the figures pale in comparison to beef consumption, demand is on the rise.

- The cement industry is collaborating with the Massachusetts Institute of Technology to explore how to improve efficiencies in cement processes, which will improve resiliency, reduce emissions, and save lives.[17] New investments in cement, steel, plastic, and other building materials will make our houses and highways sturdier and our products more durable—with a smaller environmental footprint.[18]

- The cryptocurrency industry, labeled as a major climate problem because of its energy-intensive operations, is becoming part of the solution. Cryptocurrency miners are turning associated gas that would be flared into usable energy. Energy companies can install facilities and datacenters to mine cryptocurrency, which generates "over 15 times more revenue than the market price of the fuel, while limiting carbon footprint."[19]

- Markets and investments are occurring for carbon-dioxide removal, and those markets are taking a number of different forms. Some companies and nonprofit organizations are protecting forests and planting more trees, while others are investing in direct air capture or topsoil-management programs for farmers and grazers.[20] Interestingly, voluntary markets are emerging for these carbon-removal processes.[21] In the agricultural space, farmers and researchers have found that some crops pair well with the shade provided by solar panels; as a result, their growth increased their carbon-dioxide uptake.[22]

- For several reasons, including economic opportunity and shareholder pressure, investors have taken initiatives to reduce greenhouse gas emissions. Led by Bill Gates, Breakthrough Energy Ventures is a more than $1 billion investor-led fund "to make sure that everyone on the planet can enjoy a good standard of living, including basic electricity, healthy food, comfortable buildings, and convenient transportation, without contributing to climate change."[23] According to 2017 report from the World Wildlife Fund, 48 percent of Fortune 500 companies have a climate change or clean energy target.[24] Amazon's recent announcement to have 100,000 electric delivery vehicles on the road by 2030 is just one of many examples.[25]

The aforementioned examples provide a mere snapshot of industry-led initiatives driving economic growth and reducing emissions. Some of those endeavors will have bigger economic and environmental impacts than

others. Nevertheless, it is clear for a variety of financial and non-financial motivations that the private sector has led, and continues to lead, in creating jobs, investing in innovative ideas, and fueling the economy—while reducing emissions. The American entrepreneurial spirit will meet consumers' needs while taking environmental strides forward.

Federal Policies: Increased Costs and Unintended Consequences

Unlike "win-win" private-sector-led initiatives, federal climate policy that drives energy prices higher will exact significant harm on American households and on the economy broadly. Policies like the Green New Deal would cost Americans both as taxpayers and energy consumers. Notably, higher energy bills affect low-income households disproportionately because these homes spend a higher percentage of their budgets on energy costs. Americans with after-tax incomes of less than $30,000 spend *23 percent* of their budgets on energy, compared to just 7 percent for those earning more than $50,000.[26] According to the 2011 National Energy Assistance Survey, a poll of low-income families, 24 percent went without food for a day, and 37 percent decided to forgo medical and dental coverage, in order to pay higher energy bills. Nearly one in five had a family member who became sick due to the home being too cold.[27]

Moreover, the direct energy and taxpayer costs are a small component of the overall cost Americans would suffer. Energy is a necessary input for nearly all goods and services we consume. Consequently, Americans would pay more for food, health care, education, clothes—and every other good or service that requires energy to make and transport. When it comes to businesses, large or small, they will either pass higher costs onto consumers or absorb them. Passing higher prices onto consumers suppresses demand. If businesses can manage to absorb the pricier energy, it means less money is available for investing in new technologies or hiring more people. Green New Deal–type policies act as a vice that squeezes both the production and consumption sides of the economy, resulting in lower output, lower household income, and higher rates of unemployment. Depending on the policy, the costs of stranded assets and lost shareholder value could easily end up in the trillions.

Americans have little appetite to pay such costs. A January 2019 poll conducted by the Energy Policy Institute at the University of Chicago and The Associated Press-NORC Center for Public Affairs Research found that 68 percent of Americans oppose paying an additional $10 per month to

fight climate change.[28] Forty-three percent of respondents were not even willing to pay an additional dollar on their electricity bill to combat climate change.[29] Similarly, a more recent *Washington Post* and Kaiser Family Foundation poll found that 51 percent of respondents would not be willing to pay an additional $2 per month on their residential electricity bill, and 71 percent of respondents would be unwilling to pay an additional $10 per month.[30] Importantly, the polls fail to include how much abated warming Americans would receive from paying an additional $1, $20, or $50 per month—which would be insignificant.

In addition to the economic harm caused by government intervention, these policies cause a number of unintended consequences. They include:

- **Cronyism, corporate welfare, and less innovation.** Americans distrust the federal government intervening in decisions better left for producers and consumers to make on their own.[31] Federal and state subsidies and mandates enacted to slow global warming have concentrated *benefits* for politically preferred energy projects—and dispersed the *costs* to the rest of America. Energy cronyism benefits a select few and creates a vicious loop of politicians, lobbyists, and special interests. The economic pain cuts deeper than wasted taxpayer money because government interventions distort free enterprise, create government dependence, and allow Washington to direct the flow of private-sector investments. Perhaps most perverse is that energy cronyism obstructs the long-term success and viability of the technologies and energy sources they intend to promote. Instead of relying on a process that rewards competition, taxpayer subsidies prevent a company from truly understanding the price point at which the technology will be economically viable. When the government plays favorites, valuable resources get stuck in unproductive places.

- **Fewer resources available for environmental protection.** Economy-killing climate regulations would not only harm the livelihoods of the American people—but it would leave us in a worse position to improve the environment. By making us poorer, we would have fewer resources available to address climate and environmental challenges that exist today and in the future. Money diverted to higher energy bills could otherwise be spent on practical purposes that help households and businesses adapt to a changing climate. For instance, investing in more robust infrastructure can sensibly protect homes and storefronts against natural disasters, no matter the cause of the extreme weather event.

- **Shifting emissions to countries with less rigorous environmental and safety standards.** Despite the increased use of emissions-free energy sources and technologies, conventional resources such as coal, oil, and natural gas will likely dominate the energy and transportation landscape well into the future. Therefore, policies that restrict natural-resources production in the U.S. will not measurably affect energy consumption behavior, nor will it affect which type of energy consumers buy domestically or internationally. Higher energy prices from curtailed domestic supply could reduce consumption marginally, but it would also provide opportunities for increased natural resource production around the world—in places where environmental standards are not as rigorous as in the United States. Energy-intensive manufacturers that built their plants in America, citing affordable energy as a reason, may choose to build their next factories elsewhere. Decisions to curtail resource extraction in the U.S. would likely have the unintended environmental consequence of increasing global greenhouse gas emissions and criterion pollutants that adversely affect public health and the environment.

Climate Science: Certainties and Uncertainties

Climate change is real, and it is clear that man-made emissions are having an impact. The Intergovernmental Panel on Climate Change, 5th Assessment (IPCC) attributes at least half of the warming from 1951–2010 to human activities.[16] Sea levels have been rising since the planet gradually warmed after the Little Ice Age. However, the IPCC *does not* conclude that the world has until 2030 to avoid catastrophic global warming.[32] Distinguishing what climatologists know, what they do not know, and what they might know is necessary so that objective, transparent science can guide public policy.

For instance, uncertainty exists with regard to the accuracy of climate models (running too hot), how a doubling of carbon-dioxide emissions impacts global temperatures, and which trajectory greenhouse gas concentrations most accurately reflects the future. Furthermore, the Integrated Assessment Models used to justify the social cost of carbon dioxide and other greenhouse gas emissions are *not* credible for policymaking: The outputs change significantly with reasonable changes to the inputs. Subjecting the models to reasonable inputs for climate sensitivity and discount rates dramatically lowers the figure for the social cost of carbon dioxide. Furthermore, attempts to forecast economic damages centuries into the

future (as the integrated assessment models do) strain credibility when moving to the real world of policy implementation.

With regard to extreme weather events, the IPCC report and other mainstream science confirms the lack of trends for frequency and intensity of natural disasters. Tropical cyclone activity is not becoming more frequent. The IPCC notes in its most recent scientific assessment that "[n]o robust trends in annual numbers of tropical storms, hurricanes and major hurricanes counts have been identified over the past 100 years in the North Atlantic basin," and that there are "no significant observed trends in global tropical cyclone frequency." Further, "confidence in large scale changes in the intensity of extreme extratropical cyclones [such as "Superstorm" Sandy] since 1900 is low."[33] A recently published article in the *American Meteorological Society* further shows that there has been no increase in trends for frequency or intensity of land-falling hurricanes in the continental U.S. since 1900.[19]

Warming could impact future tropical cyclone intensity and rainfall rates, but the National Oceanic and Atmospheric Administration clearly states:

> In terms of detection and attribution, much less is known about hurricane/tropical cyclone activity changes, compared to global temperature. In the northwest Pacific basin, there is emerging evidence for a detectable poleward shift in the latitude of maximum intensity of tropical cyclones, with a tentative link to anthropogenic warming. In the Atlantic, it is premature to conclude with high confidence that human activities—and particularly greenhouse gas emissions that cause global warming—have already had a detectable impact on hurricane activity.[34]

Moreover, the IPCC found evidence for increases, decreases, and "no trend at all" in flood activity or severity.[21] As the U.S. National Climate Assessment summarized:

> The IPCC Fifth Assessment Report did not attribute changes in flooding to anthropogenic influence nor report detectable changes in flooding magnitude, duration, or frequency. Trends in extreme high values of streamflow are mixed across the United States. Analysis of 200 U.S. stream gauges indicates areas of both increasing and decreasing flooding magnitude but does not provide robust evidence that these trends are attributable to human influences.[35]

Trends in local events like hail and thunderstorms were also inconclusive.[23] Data for tornado activity in the U.S. shows tornadoes occur no more

frequently now than in the past and that the number of strong tornadoes (category F3 and above) has actually decreased.[24] As for droughts, the IPCC overstated previous conclusions about increasing trends and that "the compelling arguments both for and against a significant increase in the land area experiencing drought has hampered global assessment."[25]

Science should be a guiding principle for Congress; however, the politicization of science jeopardizes sound policymaking.

Policies to Drive the Economy and Environment Forward

Skepticism of costly, ineffective climate policies is not an excuse to do nothing. Americans want affordable, reliable energy *and* they want a clean environment. Policy and regulations significantly lag behind innovation, market trends, and consumer preferences. Institutional barriers stymie economic and environmental progress.

Policymakers should advance policies that will drive energy and environmental innovation. Breaking down barriers to competition, freeing up innovative pathways for new technologies, and freely trading energy technologies will meet America's—and the world's—energy needs while reducing emissions. Specifically, Congress and state policymakers should:

Open Access to America's National Laboratories. The Department of Energy's role, through its system of national laboratories and scientific research facilities, should be to conduct basic research to meet national objectives that the private sector would not undertake. Too often, advocates of government spending on technology-specific activities tout the federal government's involvement in commercial successes, such as the Internet or the Global Positioning System. Yet, the initial intention for these government projects was not any private commercial need. Entrepreneurs saw a *commercial* opportunity in these defense technologies and created commercially viable products.

Congress should create a pathway that allows the private sector, using private funds, to tap into that research and commercialize it. Congress should also give lab directors more autonomy and allow federal lab employees (when appropriate and without violating conflict of interest rules) to push research into the marketplace if they see an opportunity. While these activities happen to some degree today, giving the labs more autonomy with proper oversight and transparency will encourage more innovation at the national labs.[36]

Allow Department of Defense Energy Research to Expand Commercial Opportunities. The Department of Defense can also serve as a

good conduit for innovative breakthroughs on energy technologies, but spending on energy use should be mission-driven first. Certainly, alternative technologies provide advantages that enhance mission capabilities. Lighter, more efficient batteries lengthen the duration of a foot soldier's mission and reduce the weight of a soldier's backpack. Solar photovoltaics can also lighten a soldier's load and extend the travel distance of a drone. More fuel-efficient engines reduce the need for refueling. Developing micro grids and utilizing very small modular nuclear reactors can safely provide reliable power to isolated bases for long periods.[37]

Fix the Regulatory and Policy Obstacles for Commercial Nuclear Power. Facing a complex and burdensome regulatory system, commercial nuclear power in the U.S. has unnecessarily high construction costs. The regulatory system that licenses and permits nuclear reactors has failed to keep up with technological innovations and overregulates existing nuclear technologies. Instead of addressing underlying government-imposed problems, policymakers have focused on mitigating the cost of those policies through subsidies, leading to a predictable path of failure: While such an approach may spur some amount of commercial activity, it is limited only to what is subsidized.

Nuclear plants in America today continue to exhibit superior safety performance. Policy and regulations should reflect that track record. Congress should instill regulatory discipline at the Nuclear Regulatory Commission (NRC), encourage the Environmental Protection Agency to right-size radiation-exposure standards, review foreign ownership caps, reform the NRC's cost-recovery structure, and introduce market principles into spent-fuel management.[38]

Fix the Regulatory and Policy Obstacles for Renewable Energy. Like most other energy projects, renewable power projects face excessive and duplicative regulations that increase costs and cause delays. Siting and permitting issues can be particularly problematic for wind and solar because the most advantageous locations for generations are in more remote areas. Therefore, additional transmission lines are necessary to take the power to densely populated places. Complex regulatory processes mean a company has to hire more lawyers and compliance officers to navigate complex, unclear regulatory schemes and fend off legal challenges to development.

Two of the biggest hindrances to energy project development are the National Environmental Policy Act (NEPA) and the Endangered Species Act (ESA). Congress should repeal NEPA and reform ESA laws by removing redundancies and transitioning authority to the states when applicable. Congress should also allow renewable energy companies to form Master

Limited Partnerships (MLPs). Under an MLP, businesses have the tax structure of a partnership or a limited liability company, but ownership equity trades publicly on a securities exchange. The combination of the partnership tax status and the liquidity of a publicly traded company make MLPs an attractive investment vehicle.

Yet another policy that senselessly drives up the cost of renewable energy is the Trump Administration's stance on tariffs. Section 201 tariffs hurt the growth of the solar industry,[39] and steel and aluminum tariffs increase construction costs of wind turbines.[40] Most important, these tariffs hurt consumers.

End Tariffs, Promote Free Trade, and Expand Technological Innovation Internationally. In addition to solar tariffs, the Administration should pursue a zero-tariff policy and end tariffs for all energy sources. Tariffs adversely affect investment in new, cleaner energy technologies. The economic uncertainty created by the tariffs and the threat of tariffs and inaction in company exemption requests results in investment dollars sitting on the shelf. Companies do not know whether to move forward with projects or whether the costs of the tariffs mean that projects will become uneconomical. Opportunities for renewable natural gas and nuclear build-out and for new manufacturing factories may no longer be available.

In addition to removing the tariffs, policymakers should work with other countries to open up their energy markets. For instance, the shale revolution in the U.S. is largely responsible for providing families and businesses with cheap energy while also lowering emissions. Investment and innovation have the power to unlock an abundance of shale resources in developing countries like China. Currently, China has the world's largest shale gas reserve.[41]

Commercial nuclear energy trade is another avenue that can meet the world's energy needs while reducing emissions. For instance, Saudi Arabia is an important new market in the nuclear industry from both nonproliferation and commercial standpoints. Completing such an agreement would also allow the U.S. industry to compete in Saudi Arabia. Even where an American company fails to win a bid to build a reactor, U.S. companies can supply technical expertise and supply components for new nuclear power plants. Expanded commercial nuclear trade would incentivize both cooperation and competition—and help bring new nuclear technologies to the market.

Encourage Choice in Electricity Markets. Competitive electricity markets have served customers well. Some states have accomplished transition from monopolies to competition more successfully than others, and

additional free-market reforms are necessary to spur more entrepreneurial activity in electricity markets. However, when the underlying structure of competition is sound, the benefits to energy consumers are unambiguously positive.

Competition in electricity services allows greater customer choice through the power of the consumers' own dollars rather than through the disconnected votes of a small panel of public utility commissioners. Consumer choice comes not only in the form of resource choice (renewables, conventional fuels, or a mix) but also in financial choices (e.g., fixed rates, risk preferences, indexed rates, or short-term or long-term contracts). In the end, because electricity providers have to work for their customers, prices are competitive and quality improves.[42] States should fix anti-competitive energy policies such as renewable energy mandates, which have wreaked havoc in the electricity sector by putting politics and special interests over customers.

Eliminate All Subsidies for All Forms of Energy. Favoritism in the energy sector takes many forms. Over the years, Congress has implemented numerous policies that use the political process to support the production or consumption of one good over another, including direct cash grants, special tax treatment, taxpayer-backed loans and loan guarantees, and socialized risk through insurance programs, mandates, and tariffs. Whatever shape the favoritism takes, the results are the always the same: The government delivers benefits to a small, select group—and spreads the costs across families and consumers. Eliminating cronyism and corporate welfare has bipartisan support. If Congress removes all of the policies that pick winners and losers, the most innovative and cost-competitive fuels and technologies will flourish.

Expand Energy Infrastructure. A significant obstacle that prevents investment in cleaner energy sources or fuel switching is the lack of infrastructure to deliver the energy where it needs to go. Natural gas to the northeast region offers a price-competitive alternative to home heating oil; however, pipeline infrastructure is lacking. Out of the 5.7 million households who still rely on home heating oil, 85 percent reside in the northeast.[43] Last year, a tanker carrying Russian natural gas docked in Boston to supply Americans with energy despite the abundance of resources domestically.[44] Moreover, efficiently siting and permitting new transmission lines could expand the consumption of renewable power where, for example, there is a surplus of hydroelectric power in Canada.[45] Additional infrastructure would also allow energy-intensive manufacturing processes, like the cement industry, to fuel switch to save money and reduce emissions.[46]

Streamlining the environmental review and permitting processes for new pipelines and grid investments would be a welcome step in the right direction. However, taxpayers should not subsidize those investments, and Congress should eliminate any federally imposed cost-socialization requirements through which regulatory agencies support expensive, uneconomic projects by spreading the costs to citizens who derive little, if any, benefit from those projects. Congress should be mindful of protecting private property rights and respect the state authority to control local and regional needs.

Make Immediate Expensing a Permanent Fixture of the Tax Code. Immediate and full expensing for all new plant and equipment costs—for any industry or type of equipment—would allow newer equipment to come online faster, which would improve energy efficiency and overall economic efficiency. The current system of depreciation raises the cost of capital and discourages companies from hiring new workers and increasing wages for existing employees.

The Tax Cuts and Jobs Act allows for full expensing for short-lived capital investments until 2022. Policymakers should expand this to all investments and extend it permanently to encourage investment in capital that will drive growth and reduce industry's environmental footprint.

Repeal New Source Review (NSR). NSR is a vaguely written rule that disincentivizes efficiency improvements in power plants and other major industrial plants.[47] In areas that meet air-quality standards, plants must follow Prevention of Significant Deterioration (PSD) rules to demonstrate that the construction and operation of new projects and major modifications will not increase emissions above a specified threshold. There are several problems with NSR and PSD. What constitutes a significant modification is subjective under the rules. The amendment excludes routine maintenance, repair, and replacement, but what falls under the definition of "significant modification" remains murky—despite multiple administrative attempts to clarify the meaning. Plant upgrades can improve efficiency and reduce operational costs, thereby lowering electricity costs, increasing reliability, and providing environmental benefits. Nevertheless, NSR requirements for upgrades discourage these activities.

Repeal the Foreign Dredge Act and the Jones Act. Congress enacted the Merchant Marine Act (more colloquially known as the Jones Act) and the Foreign Dredge Act in the early 20th century to protect American maritime interests from foreign competition. These efforts to bolster the domestic shipbuilding industry have failed. By restricting competition, these laws not only increase costs to consumers but also increase congestion

on the roads and at America's ports. As North Carolina State University professor Thomas Grennes points out, "The long-term trend toward moving cargo traffic from water to land has increased congestion on highways, railroads, pipelines and ports."[48] Providing more pathways to transport U.S products by repealing these protectionist statutes would save consumers money while reducing increased emissions due to artificially higher levels of congestion.

Conclusion

Americans want a clean, healthy environment; they want breathable air and drinkable water. Americans also need affordable, reliable power to light and heat homes, to power schools and hospitals, and to get to work every day. Economic growth and environmental protection should not be thought of as balancing priorities, but instead of pursuing policies that will move the country in the right direction on both. Policy reforms that open access to markets, eliminate cronyism, and remove burdensome regulatory obstacles for all energy sources and technologies will improve the economy and the environment.

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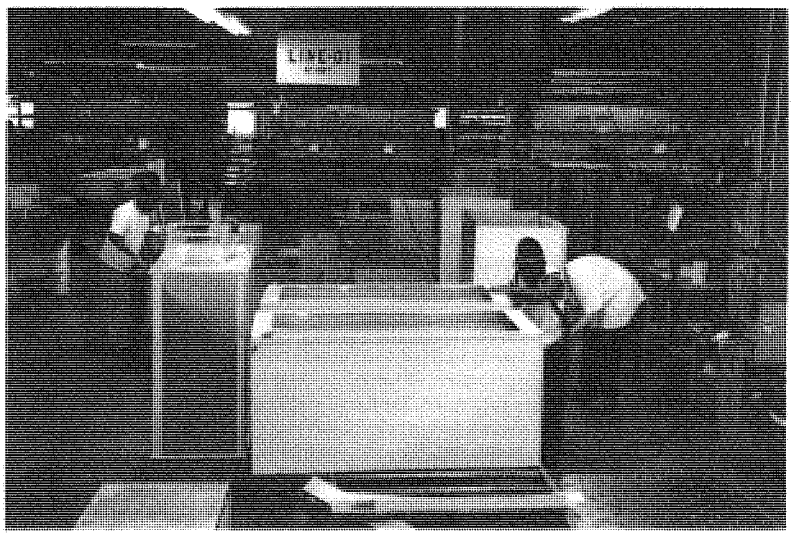
U.S. Chamber of Commerce

The Kigali Amendment is a Win for the Environment and the U.S. Economy

JOE JOHNSON
Executive Director, Federal Regulatory Process Review and Analysis



Workers assemble refrigeration units at Victory Refrigeration in Cherry Hill, NJ.

Photo credit: Mike Mergen/Bloomberg.

Environmental concerns often present trade-offs between economic performance and the environment, but sometimes a new technology comes along that represents an environmental advance and also gives U.S. companies a leg up on their competitors. The Kigali Amendment to

the Montreal Protocol on ozone-depleting substances establishes a gradual, market-driven phasedown of current-generation hydrofluorocarbons (HFCs) and transition to next-generation technologies.

In 1987 the Montreal Protocol became the first multi-national agreement to limit ozone-depleting substances. Over the years – and through multiple revisions – it serves as a case study on international cooperation to address environmental issues.

The Montreal Protocol has been successful because of its ability to harness market forces to foster the development of new technologies. This innovation-fostering framework has allowed U.S. manufacturers to become world leaders in providing the safest, most effective HFC technologies for the heating, cooling, and refrigeration industries.

The most recent revision to the Montreal Protocol, called the Kigali Amendment, is currently awaiting ratification by the Senate. The Kigali Amendment, named for the capital city of Rwanda where it was negotiated, furthers the innovation-fostering model by providing a gradual, market-based phasedown of currently-used hydrofluorocarbons (HFCs) to allow for a more cost-effective transition to next-generation technologies, such as hydrofluroolefins (HFOs) which have significantly less environmental impact. U.S. companies have already invested billions of dollars in research to develop and produce these new technologies, and ratification of the Kigali Amendment will help ensure that American firms and workers will supply the world with these important products.

World demand for heating, cooling, and refrigeration equipment is expected to grow dramatically over the next decade, as developing nations rapidly expand the number of customers for these products. The Air-Conditioning, Heating & Refrigeration Institute and the Alliance for Responsible Atmospheric Policy recently released a study, *Economic Impacts of U.S. Ratification of the Kigali Amendment*, which highlights how ratification of the Kigali Amendment will help the U.S. maintain and grow its technology and manufacturing leadership in these industry sectors.

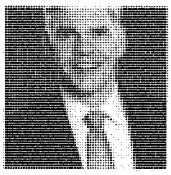
According to the study, ratifying the Kigali Amendment will support U.S. industry sectors that produce heating, air-conditioning and vehicle air-conditioning, and refrigeration equipment by expanding their share of world markets. Ratification would increase U.S direct manufacturing employment by 33,000 over the next decade, in addition to the already-projected 47% baseline increase over that same period. In addition, ratification would indirectly add 117,000 more jobs, for a grand total of 150,000 additional by 2027. This growth all due to increased demand in these key sectors.

Similarly, ratification of the Kigali Amendment will boost output in the U.S. manufacturing sector by an additional $12.5 billion by 2027, on top of an already-projected increase of $27.3 billion due to growth in global demand. With the Kigali Amendment in place, total industry output is projected to grow by over 70% by 2027. Importantly, the Kigali Amendment's ratification will grow the U.S. share of the world market for heating, air-conditioning, and refrigeration equipment by 25% over its current share – without ratification that share will decline by nearly 14%.

Ratification of the Kigali Amendment would improve the environment by further reducing ozone-depleting substances, which are also potent greenhouse gases. However, in addition to improving the environment, ratification would be a big win for the U.S. economy and American workers by allowing U.S. firms to capture a greater share of a growing global market in heating, cooling, and refrigeration.

The Kigali Amendment shows that by harnessing the power of markets and encouraging innovative technologies it is possible to ensure a healthy, clean environment while promoting economic growth and job creation.

About the Author



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Joe Johnson, Ph.D, serves as the Executive Director for Federal Regulatory Process Review and Analysis in the U.S. Chamber's Environment, Technology, and Regulatory Affairs department.

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NATIONAL ASSOCIATION OF
Manufacturers

Leading Innovation. Creating Opportunity. Pursuing Progress.

Testimony

of Ross Eisenberg
Vice President
Energy and Resources Policy
National Association of Manufacturers

before the House Committee on Energy and Commerce
Subcommittee on Environment and Climate Change

on "Building a 100 Percent Clean Economy:
Pathways to Net Zero Industrial Emissions"

September 18, 2019

SUMMARY OF TESTIMONY

In the eyes of America's manufacturers, it's time to act on climate—and the real question for policymakers now should not be *whether* to act on climate but *how* to do so effectively. We are already doing our part to reduce greenhouse gas emissions, and we will continue to do so. Over the past decade, manufacturers have reduced the carbon footprint of our products by 21 percent while increasing our value to the economy by 18 percent. Overall, the U.S. manufacturing sector has one of the world's lowest carbon intensities per dollar of GDP, a fraction of the carbon intensities of other major manufacturing economies like China and India.

The type of deep decarbonization needed to reach the targets sought by the Committee will require a dramatic set of technological and lifestyle changes across the economy. It is not, however, impossible. We need policies that unleash innovation because the manufacturing sector is different from other sectors, and the technologies that may work in other sectors may not work in ours.

The federal government also has a clear role in setting climate policy. This begins by reengaging on the international stage to achieve a binding, fair global climate treaty. The NAM also recommends Congress enact a single, unified climate policy that meets specific targets, ensures a level playing field, avoids carbon leakage and preserves consumer choice and manufacturing competitiveness.

Finally, there are many near-term actions that Congress and the Administration could take to accelerate manufacturers' progress toward deep GHG emissions reductions. The NAM recommends:

- Enact the Clean Industrial Technology Act (H.R. 3978/S. 2300);
- Pass legislation and take regulatory action to improve New Source Review;
- Ratify the Kigali Amendment and/or enact legislation to phase out hydrofluorocarbons;
- Commercialize and deploy carbon capture, utilization and storage technology;
- Permanently authorize the provisions of Title 41 of the FAST Act;
- Scale up investment in public- and private-sector energy and water efficiency;
- Fund and expand climate and clean energy R&D federal programs at the Department of Energy and elsewhere; and
- Pave the way for a smart grid.

TESTIMONY OF ROSS EISENBERG

BEFORE THE HOUSE COMMITTEE ON ENERGY AND COMMERCE
SUBCOMMITTEE ON ENVIRONMENT AND CLIMATE CHANGE

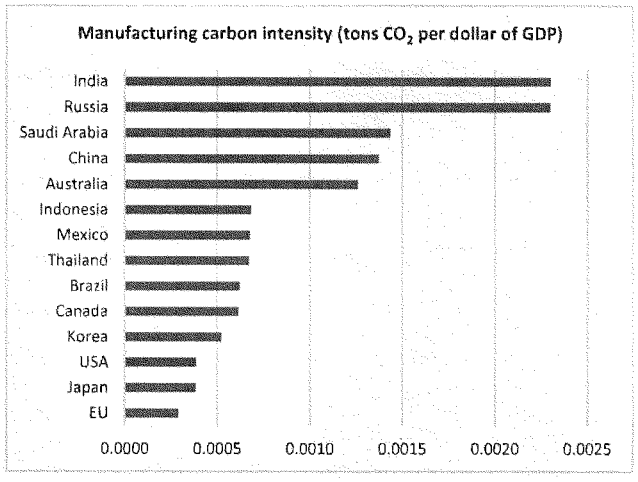
Hearing on:
"Building a 100 Percent Clean Economy: Pathways to Net Zero Industrial Emissions"

SEPTEMBER 18, 2019

Good morning, Chairman Tonko, Ranking Member Shimkus and members of the Subcommittee on Environment and Climate Change. My name is Ross Eisenberg, and I am vice president of energy and resources policy at the National Association of Manufacturers. The NAM is the nation's largest industrial trade association, representing 14,000 small, medium and large manufacturers in every industrial sector and in all 50 states. I am pleased to represent the NAM and its members and provide testimony on manufacturers' commitment to addressing climate change.

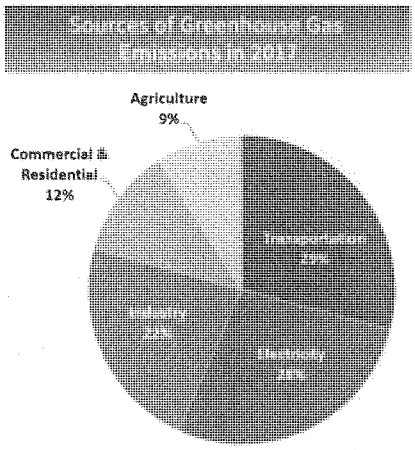
In the eyes of America's manufacturers, it's time to act on climate—and the real question for policymakers now should not be *whether* to act on climate but *how* to do so effectively. Manufacturers are doing our part to reduce GHG emissions, and we will continue to do so. Over the past decade, manufacturers in the U.S. have reduced the carbon footprint of our products by 21 percent while increasing our value to the economy by 18 percent. Overall, the U.S. manufacturing sector has one of the world's lowest carbon intensities per dollar of GDP, a fraction of the carbon intensities of major manufacturing economies like China and India.

As the Committee considers how to reach its ambitious goals, I must stress that the type of deep decarbonization needed will require a dramatic set of technological and lifestyle changes across the economy. It will be extremely difficult. It will require the collective effort of all sectors and stakeholders, all producers and end users. It will require global coordination and enforcement. And it will carry a cost.



It is not, however, impossible. Manufacturers appreciate the careful, deliberate approach this Committee has taken to assessing the scope of the problem and the effect policies would have on the many stakeholders involved. Two defining views have emerged from Committee members: whether we should focus on crafting policies that spur innovation, or whether we should craft policies that enable the federal government to take action. I believe we need both.

We need innovation because the manufacturing sector is different from other sectors, and the technologies that may work in other sectors may not work in ours. Manufacturers primarily emit GHGs in two ways: energy-related emissions and process-related emissions. The types of energy and processes used across manufacturing sectors are typically very different. For instance, the manufacturing process to make a brick is markedly different than the process used to make steel. The same goes for other energy-intensive sectors like paper, plastic, rubber, fertilizer and aluminum, not to mention finished goods like cars, trucks, airplanes, computers, food and beverages, and household products. Innovation is and will always be the key to reducing the carbon intensity of these sectors.



Source: Environmental Protection Agency

Innovation by itself will not be enough, however. The federal government has a clear role in setting climate policy. This begins by reengaging on the international stage to achieve a binding, fair global climate treaty. The goal of such an agreement must be to address the climate threat in a manner that prevents carbon leakage by ensuring that no country gains a competitive advantage by failing to take action to reduce carbon emissions. It must be fair, on target, enforceable, transparent, innovative and pro-trade. It must also protect

intellectual property rights and eliminate all possible tariff and non-tariff barriers to the purchase of environmental goods and technologies.

With the backdrop of an effective international treaty, the NAM also recommends Congress enact a single, unified climate policy that meets specific targets, ensures a level playing field, avoids carbon leakage and preserves consumer choice and manufacturing competitiveness. Any solution must be economy-wide and apply to all sources of emissions. It must work in lockstep with the global framework to avoid carbon leakage—in other words, it shouldn't simply offshore carbon emissions from one country to another, which *won't* help address climate change but *can* hurt our economy. It must be a holistic replacement for the current patchwork of federal, state and local laws and regulations that address climate change, and it must displace current and future climate liability suits (which make a lot of noise but do not actually solve the problem). It should be fuel-neutral and should not require any particular manufactured product to be phased out of the economy. It should provide compliance flexibility for regulated entities and give credit for early action. Finally, it should seek to balance any new costs on manufacturers with relief in other areas, with the goal of keeping manufacturers whole.

This last point—the math—bears more explanation. The average manufacturer pays about $20,000 per employee, per year to comply with regulations, nearly double the amount of companies in other sectors.[1] Small manufacturers pay even more, incurring regulatory costs of about $35,000 per

[1] https://www.nam.org/the-cost-of-federal-regulation/.

employee, per year.[2] Any new cost imposed by a climate policy will be added to that already-hefty base of regulatory expenditures. To the extent manufacturers must bear extra costs, Congress should consider reducing regulatory, tax or other economic burdens on manufacturers to make them whole. A particular focus should be placed on regulations of other air pollutants, which may be reduced as a "co-benefit" of reducing GHGs.

The math also matters for internal decision-making purposes on manufacturing shop floors. A great deal of the potential GHG reductions available to the manufacturing sector will come from the purchase and installation of new, more efficient equipment and the design of new manufacturing processes. Manufacturers budget for discretionary investments and are constantly looking for opportunities, but at the end of the day, the decision whether to spend that money on new equipment must be justified. This involves consideration of a wide range of factors, such as payback time, the risk of stranded investments, operating risks, reliability, environmental permitting and external factors like the future of the plant itself in a highly competitive, constantly evolving global marketplace. Impacting *this* math should be one of the top priorities of anyone seeking to reduce the carbon intensity of the manufacturing sector.

There are many near-term actions that Congress and the Administration could take to accelerate manufacturers' progress toward deep GHG emissions cuts. The following bipartisan measures would reduce GHG emissions from the manufacturing sector meaningfully and ensure that emissions continue to decline

[2] *ibid.*

while the larger, more complicated international and federal climate policies are worked out. The NAM recommends the following:

- Enact the Clean Industrial Technology Act (H.R. 3978/S. 2300). CITA would set up a transformational industrial technology program at the Department of Energy and would drive new technologies aimed at increasing the technological and economic competitiveness of manufacturing in the United States. The program would also find pathways to reduce GHG emissions and create a technical assistance program to help local communities and states evaluate and incentivize the adoption of technologies that reduce industrial GHGs.

- Pass legislation and take regulatory action to improve New Source Review, a federal air permitting program that has, at times, stood in the way of efficiency upgrades and environmentally beneficial projects at manufacturing facilities. Simple reforms to NSR could unlock a massive market for the installation of efficient technologies that would drive manufacturers' already-impressive emissions reductions down even further.

- Ratify the Kigali Amendment and/or enact legislation to phase out hydrofluorocarbons (HFCs). The Kigali Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer was agreed to in October 2016 by more than 170 countries and entered into force in January 2019. The Kigali Amendment sets a path for phasing out HFCs, GHGs that are used in many manufactured products. HFCs were primarily used to replace ozone-depleting substances, but their high potency as GHGs has led to the development of replacement products with a smaller environmental impact. These products already exist or are close to market. The Kigali Amendment would reduce the global warming equivalent of 4.1 billion tons of CO_2 per year by 2050. It could also create up to 150,000 more U.S. jobs by 2027 if ratified.

- Commercialize and deploy carbon capture, utilization and storage technology. The expanded Section 45Q carbon capture tax credit established by Congress in 2018 was a positive development for CCUS adoption. However, for the 45Q tax credit to achieve its potential, regulators must clarify the rules to access the credit so that project developers have the certainty they need to make investments in CCUS projects. Lawmakers should also develop a clear standard for the handling of long-term liability for CO_2 transfers; resolve pore space ownership issues; correct barriers to CO_2 storage on federal lands; reform the class

VI underground injection program to foster the build-out of underground CO_2 storage projects; increase funding for federal CCUS research, development and demonstration programs and ensure programs are authorized; and reduce permitting barriers that delay construction of CCUS projects.

- Permanently authorize the provisions of Title 41 of the FAST Act. FAST-41 is a voluntary permitting improvement program for infrastructure projects that are likely to require a total investment of more than $200 million. The bulk of the projects in the program are clean energy or resiliency based, and FAST-41 has improved their permits' cycle time, reduced conflict among agencies and generated more complete environmental permitting than in the past. Significant emissions reductions will require massive deployment of new infrastructure; these projects will need access to FAST-41.

- Scale up investment in public- and private-sector energy and water efficiency. These oft-ignored strategies can generate significant climate savings. The International Energy Agency found that energy efficiency alone could meet up to 40 percent of the Paris Agreement's global GHG reduction goals.[3] A recent study by the Natural Resources Defense Council projected that to reach an 80 percent GHG emissions reduction goal, the U.S. could get almost 42 percent of the way by maximizing energy-efficiency investments and strategies.[4]

- Fund and expand climate and clean energy R&D federal programs at the Department of Energy and elsewhere. Federal agencies house a multitude of valuable tools and resources to help reduce emissions, such as the Advanced Research Projects Agency – Energy, the DOE Advanced Manufacturing Office and the Federal Energy Management Program. These programs should be sufficiently funded and expanded.

- Pave the way for a smart grid. Modernization of the electric grid will allow for better integration of advanced technologies, onsite generation and end-use efficiency. It would also reduce GHG emissions. A 2010 DOE study found that smart grid improvements could eliminate 277 million to 359 million tons of CO_2 per year.[5]

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[3] https://www.iea.org/newsroom/news/2018/october/energy-efficiency-is-the-answer-for-building-a-secure-and-sustainable-energy-syst.html.
[4] https://www.nrdc.org/sites/default/files/americas-clean-energy-frontier-report.pdf.
[5] https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-19112.pdf.

The strength of the manufacturing sector—its diversity—also makes it challenging to approach from a climate policy standpoint. The NAM believes we can be a part of the solution and looks forward to working with this Committee to pass and implement several of our preferred climate policy solutions.

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