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HOUSE DEMOCRATIC POLICY COMMITTEE

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House of Representatives
COMMONWEALTH OF PENNSYLVANIA
HARRISBURG

HOUSE DEMOCRATIC POLICY COMMITTEE HEARING

Topic: Carbon Neutrality

418 Main Capitol Building – Harrisburg, PA

March 2, 2015

AGENDA

- 10:00 a.m. Welcome and Opening Remarks
- 10:10 a.m. Dr. Richard Alley, Evan Pugh Professor, Penn State University
- 10:40 a.m. Panel on Expanding Renewable Energy:
- Bruce Burcat, Executive Director, Mid-Atlantic Renewable Energy Coalition
 - Tom Tuffey, Vice President of Project Services, Community Energy
 - Terry Fitzpatrick, President and CEO, Energy Association of Pennsylvania
- 11:20 a.m. Panel on Reducing Energy Demand (Act 129 Segment):
- James Cawley, Commissioner, Pennsylvania Public Utility Commission
 - Maureen Mulligan, Policy Director, Keystone Energy Efficiency Alliance
 - Terry Fitzpatrick, President and CEO, Energy Association of Pennsylvania
- 12:00 p.m. Panel on Reducing Methane Emissions:
- Dr. Tony Ingraffea, Dwight C. Baum Professor in Engineering, Cornell University
 - Rob Altenburg, Director, PennFuture Energy Center
 - Mark Boling, President of V+ Development Solutions/General Counsel/Secretary, Southwest Energy
- 12:40 p.m. Closing Remarks

Carbon Neutrality: What Is It? Why Do We Need To Reach It?

Testimony of

Dr Richard B. Alley*
Pennsylvania State University

For the hearing entitled

How Can Pennsylvania Achieve Carbon Neutrality?

Before the

Commonwealth of Pennsylvania House Democratic Policy Committee

Minority Caucus Room 418

Main Capitol Building

Harrisburg, PA 17120

March 2, 2015, 10:00 a.m. to 1:00 p.m.

*Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author and do not necessarily reflect those of the Pennsylvania State University, the Intergovernmental Panel on Climate Change, the National Research Council, the US Climate Change Science Program, or other organizations.

Synopsis. Our use of fossil fuels brings great benefits and costs. Because we are burning fossil fuels roughly 1 million times faster than nature saved them for us, we must find alternatives before too long. Strong scholarship shows that delaying this unavoidable switch, while releasing the carbon dioxide from the fossil-fuel burning, will cause changes in the climate system that are more and more expensive, so that humanity will be better off economically to start very soon to make the transition in a wise way. Furthermore, the relevant scholarship shows that starting soon to make this transition wisely can increase national security, take out insurance against unexpected damaging events, honor the Golden Rule, increase employment, and help preserve endangered species.

Introduction. My name is Richard Alley. I am an Evan Pugh Professor of Geosciences and Associate of the Earth and Environmental Systems Institute at the Pennsylvania State University. I have authored over 250 refereed scientific papers, which are “highly cited” according to a prominent indexing service, and I have made many hundreds of public presentations concerning my areas of expertise. My research is especially focused on the great ice sheets of Greenland and Antarctica, their potential for causing major changes in sea level, the climate records they contain, and their other interactions with the environment; I also study mountain glaciers, and ice sheets of the past. I have served with distinguished national and international teams on major scientific assessment bodies, including chairing the U.S. National Research Council’s Panel on Abrupt Climate Change (report published in 2002), and serving the U.S. Climate Change Science Program, and the Nobel-Peace-Prize-Winning Intergovernmental Panel on Climate Change (IPCC) in various ways on their Second (1995), Third (2001) and especially Fourth (2007) Assessment Reports. I have had the honor on several occasions of providing requested testimony and briefings to high government officials at the federal as well as state level, including to legislative committees chaired by members of both major political parties, and to executive officials in administrations of both major political parties, drawing on my expertise to provide scientific guidance to those working for the public good. My testimony here is updated from my testimony of November 17, 2010 to the Subcommittee on Energy and Environment of the House Committee on Science and Technology of the United States House of Representatives, and to this Committee on June 7, 2012 and December 16, 2013; the consistency of this testimony reflects the consistency of the scientific understanding. My advice is nonpartisan, and I am not lobbying for any particular bills or policies; however, I summarize the clear evidence that wise use of our scientific knowledge and related scholarship in policies will make us better off in many ways.

Background on Assessment. Scientists argue. This is a fundamental part of science; ideas that have proven successful through the most tests and challenges are generally the most reliable for our use. Governments have long supported science, because of the great advantages we get from the application of scientific discoveries in medicine, agriculture, manufacturing, and other aspects of our lives. Governments also have developed methods, often called “assessment”, to obtain the most useful information from scientists for policy-making and other government functions, while allowing the scientists to go back to doing science including arguing about those results to see if they can be improved further. Assessment involves asking scientists to volunteer for the public, in the public eye, to summarize the state of science, and to show what is solid, what is still speculative, and what is known to be wrong.

In the United States, scientific assessments are especially done by the U.S. National Academy of Sciences, together with the National Academy of Engineering and the Institute of Medicine, operating as the National Research Council. Established in 1863 by legislative action of the U.S. House of Representatives and Senate, signed into law by President Abraham Lincoln, “The Academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art.” The Academy assembles panels representing the full range of credible scientific views. As described in many sources (and summarized in Alley, 2011, chapter 5), panels do make recommendations that may serve to reduce research funding in their area, and that may disagree with research thrusts or public statements by panel members, because of the requirement that the panels accurately assess the full scientific knowledge for the public.

The Intergovernmental Panel on Climate Change (IPCC) fulfills a similar role for the world, for climate change. The IPCC was founded in 1988 by the United Nations and World Meteorological Organization to assess the best scientific evidence on climate change. The IPCC issued Assessment reports starting in 1990, 1995, 2001, 2007, and now 2013 (First, Second, Third, Fourth, and Fifth Assessment Reports). The reports are prepared by three working groups, WGI, II, and III, which consider what will happen to climate (WGI), what it means to humans and other living things, and how we might adapt (WGII), and what can we do to reduce or eliminate human-caused climate change (III). The IPCC is not policy-prescriptive, and does not do research; it assesses science. The WGI report is issued first, followed by WGII and WGIII. I served in some ways for the Second and Third Assessment Reports, served more extensively in the Fourth Assessment, but did only a little reviewing and was not otherwise instrumental in the Fifth Assessment Report. I also have served the US National Academy of Sciences and National Research Council in various ways, and was elected to membership in the National Academy of Sciences.

Background on Climate Change and Global Warming. Scientific assessments such as those of the National Academy of Sciences (e.g., National Research Council, 1975; 1979; 2001; 2006; 2008; 2010; 2011; 2013), the U.S. Climate Change Science Program, and the Intergovernmental Panel on Climate Change have for decades consistently found with increasingly high scientific confidence that human activities are raising the concentration of carbon dioxide and other greenhouse gases in the atmosphere, that this has a warming effect on the climate, that the climate is warming as expected, and that the changes so far are small compared to those projected if humans burn much of the fossil fuel on the planet. Consistency between the new IPCC Fifth Assessment Report from WGI and the earlier reports is very high.

The basis for expecting and understanding warming from carbon dioxide is the fundamental physics of how energy interacts with gases in the atmosphere. This knowledge has been available for over a century, was greatly refined by military research after World War II, and is directly and routinely confirmed by satellite measurements and other data (e.g., American Institute of Physics, 2008; Harries et al., 2001; Griggs and Harries, 2007; Alley, 2011).

Although a great range of ideas can be found in scientific papers and in statements by individual scientists, the scientific assessments by bodies such as the National Academy of Sciences consider the full range of available information. The major results brought forward for the public and policymakers are based on multiple lines of evidence provided by different research groups with different funding sources in different states and nations, and have repeatedly been tested and found to be accurate. Just as a tapestry cannot be destroyed by cutting one thread, the “picture” of climate change is based on an interwoven web of mutually supporting results, such that removing the work of any scientist or small group of scientists would still leave a strong scientific basis for the main conclusions.

Fundamentals. *[The statements in this section and the next are supported by numerous references available through the reports of the US National Research Council, the UN Intergovernmental Panel on Climate Change, and many other sources; I am not providing detailed referencing for most of the material in these two sections for ease of reading, and because those sources are so complete.]* Humans burn large amounts of coal, oil and natural gas (fossil fuels), providing roughly 85% of our total energy use. In the United States, fossil-fuel burning provides approximately 100 times as much energy per person as we generate internally from the food we eat, and we use this energy to accomplish things that we enjoy, and that do much good for us. U.S. fossil-fuel use amounts to almost 10 tons per person per year; oxygen is added during burning, releasing almost 20 tons of carbon dioxide per person per year to the atmosphere.

The carbon dioxide that humans have released by fossil-fuel burning, plus the smaller supply from sources including deforestation and cement manufacture, has raised the concentration in the atmosphere and is moving into the ocean and making it more acidic, although some carbon dioxide is being taken up by processes including reforestation. Human activities have increased the atmospheric concentration by more than one-third since the start of the industrial revolution, after many millennia of naturally stable levels. Ice-core data provide strong confidence that the current level is higher than at any time over the last 800,000 years, and additional data from other sources suggest that the current level has not been reached for millions of years. Various indications in the atmosphere, including changes in the isotopic composition of the carbon dioxide, and the slow drop in oxygen as it is used in combustion, confirm the “bookkeeping” that the rising carbon dioxide comes primarily from our burning of fossil fuels.

The Earth’s average temperature is increasing. This is shown by thermometer records as analyzed by researchers working for NASA, NOAA, and other groups. Thermometers outside of cities typically show warming, as do thermometers in the ground, in the ocean, and on satellites as analyzed by different groups. Warming is also indicated by changes in temperature-sensitive snow and ice, and in the places species live and when they do things during the year.

The warming is not perfectly smooth, and a year may be cooler than the previous year for many reasons, including the effects of a large volcano putting sun-blocking particles in the stratosphere, or a change in the coupled ocean-atmosphere circulation shifting heat into the ocean more rapidly, or a change in the brightness of the sun. Adding the warming-or-cooling

effects of these various climate influences to the warming influence of our increasing carbon dioxide and other greenhouse gases gives the observed variability in the warming trend. A widely discussed “slowdown” in warming in the last decade or so has resulted in part from these variable influences, as discussed in the new IPCC report, and likely in part from failure to fully include data from the Arctic, the most rapidly warming large region (Cowtan and Way, 2013). Local cold does not in any way disprove the globally averaged warming; on the 20th of February, 2015, I was supposed to discuss global warming with a local high school that was closed because of cold, but on that day we were almost as warm as regions near the North Pole, while the Arctic, the Northern Hemisphere, the Tropics, the Southern Hemisphere, the Antarctic and the world as a whole remained well above average temperature.

Warming is expected from the known physics of the rising carbon dioxide. Strong scientific effort has been invested in learning whether any other cause could explain the warming. Over the satellite record, the sun’s energy output has probably decreased very slightly, and no other natural cause of the observed warming can be found. The pattern of warming, in space and time, is consistent with that expected from the combined effects of the known causes of climate change, including natural and human-produced, with warming from carbon dioxide important.

The accuracy of climate-change projections made over recent decades, and the ability to explain the changes that have occurred and are occurring, contribute to the high scientific confidence that useful projections can be provided for many aspects of the climate system.

(Note that the scientific community cannot accurately predict what decisions policymakers will make, and because humans are so important in the future of the climate, science thus cannot *predict* climate. Instead, *projections* are provided, by estimating the climate response to various possible human paths.)

These projections indicate that if humanity continues to rely on fossil-fuel burning, consumes most of the fossil fuel that is estimated to be practicably available, and releases the carbon dioxide to the air, the coming climate changes will be much larger than those that have occurred to date. Some of this change is already committed—the atmosphere has not experienced the full warming from past human influence because some heat is going into the ocean and to melt ice—but most of the change depends on future emissions of carbon dioxide.

Impacts. Some of the impacts of warming are highly likely, and easy to understand, including an increase in record high temperatures and heat waves, and a decrease in record low temperatures and cold snaps. Because warmer air can “hold” more water (higher equilibrium vapor pressure), rainfall can be more intense when it occurs in a warmer world, which would tend to contribute to an increase in flooding. Expansion of the subtropical dry zones is expected, and summertime drying in many regions, which may increase drought. More energy will be available, so the top wind speed of hurricanes may increase. Sea-level rise is expected to continue and probably accelerate, in response to expansion of ocean water as it warms, and melting of land ice transferring water to the ocean. Many of our crops suffer heat stress on the hottest days now, even if supplied with enough water and fertilizer, so despite

the fertilizing effect of higher carbon-dioxide levels, food production may drop as the warming continues. In general, the changes will cause both “winners” and “losers”, but as the changes become large, the losers are expected to dominate the winners. Losers are especially projected to occur among poor people in hot places now, and future generations.

Much scholarship has been devoted to assessing the economic implications, because money spent to reduce global warming now could also be invested in other ways, or used for consumption now. (The reader should recognize that discussions of economics, and of what is or is not a subsidy, as summarized below, are inherently less certain than is our understanding of the warming influence of our CO₂; however, the sources cited here are generally well-respected internationally. There is additional discussion of the social cost of carbon in the WGII reports of the IPCC, with great agreement in the relevant scholarship that there is a significant social cost of carbon.)

Strong evidence exists that humanity will overall be economically better off if the science of global warming is incorporated properly into planning. In particular, studies typically show a notable cost of emitting carbon dioxide that is borne by society rather than directly by those who mine, sell, or burn the fossil fuels. The Interagency Working Group on Social Cost of Carbon, United States Government, in May of 2013, updated estimates of this cost, with advances in scholarship showing the cost to be larger than previously estimated.

This social cost of carbon is often considered to be a subsidy for fossil fuels. The International Monetary Fund (IMF, 2013) included the social cost of carbon in their estimate that total subsidies for fossil fuels worldwide in 2011 totaled approximately 2 ½ % of world gross domestic product (GDP), or 8% of total government revenue; this is more than 20 times larger than global renewable-energy subsidies as estimated by the International Energy Agency (2012); the IMF found that the US is the single largest subsidizer of fossil fuels.

In turn, various studies (see, e.g., WGII and WGIII reports of the IPCC) show that this social cost of carbon in turn means that humanity is not following an economically optimal path in regards to energy and environment. Thus, wise actions to remove this subsidy, by pricing the release of carbon dioxide or in other ways, will be economically beneficial, likely with the increase in employment and well-being that goes with an improved economy.

Various recent reports have also looked at the national-security implications of climate change, finding that climate change endangers national security, and thus that slowing and reducing climate changes can improve national security. The Quadrennial Defense Review Report (2010, pp. 84–85) is a good starting point, as is the report of the CNA Military Advisory Board (2014) of distinguished high-ranking military veterans.

Additional scholarship, much of it summarized by the IPCC WGII and the reports of the National Research Council, shows that climate change places rare and endangered species in greater danger. As noted above, these sources also summarize the evidence that the damages from climate change fall disproportionately on poor people, especially those living in hot places, and on future generations. Many groups, including many religious groups, note that this raises strong questions about the Golden Rule.

Tipping Points, and Abrupt Climate Change. A golden retriever leaping to the side will force a canoe to lean, but usually the canoe will remain upright. If an ice chest slides across the seat towards the retriever, this positive feedback will cause the canoe to lean further. In exceptional circumstances a tipping point may be crossed, leading to an abrupt change as the canoe dumps the dog, ice chest, and paddlers into the water.

Much scientific and popular discussion has focused on the possibility that human-caused climate change may force the Earth to cross one of its tipping points. Paleoclimatic history shows clearly that very large, rapid and widespread changes occurred repeatedly in the past (e.g., National Research Council, 2002; 2013; CCSP, 2008). An ice-sheet collapse, a large change in the circulation of the North Atlantic Ocean, a rapid outburst of methane stored in sea-floor sediments, a sudden shift in rainfall patterns, or others are possible even if not considered likely, based on current scientific understanding (CCSP, 2008).

The available assessments, and in particular that of the U.S. Climate Change Science Program (CCSP, 2008), do not point to a high likelihood of triggering an abrupt climate change in the near future that is large relative to natural variability, rapid relative to the response of human economies, and widespread across much or all of the globe. However, such an event cannot be ruled out entirely, and rapidly arriving regional droughts seem more likely than the others considered, with potentially large effects on ecosystems and economies, while a rapid ice-sheet shrinkage raising sea level continues to receive focused research attention.

Projections of warming from a given release of greenhouse gas generally include a best estimate, the possibility of a somewhat smaller or somewhat larger rise, and the slight possibility of a much larger rise; because of the way feedbacks interact in the climate system, very large changes remain possible if unlikely, and are not balanced by an equal probability of very small changes (e.g., Meehl et al., 2007). The possibility of an abrupt climate change gives a similar shape to the uncertainties about damages from whatever warming occurs, with a chance of very large impacts having very large costs, but not an offsetting chance of large benefits.

The new National Academy report (National Research Council, 2013), from a committee that included me, notes that there are many tipping points in ecosystems and economies. Even a small sea-level rise may be sufficient to cause large damages if it causes a storm surge to overtop a levee that otherwise would have been sufficiently high. Even gradual climate change thus can trigger unexpected and costly impacts. In turn, slowing down warming can be seen as taking out insurance against the possibility of such damaging surprises.

Resources. As summarized in many sources, including Alley (2011), nature offers vast, renewable resources, with current technologies capable of extracting far more energy sustainably than now used by humanity. The area needed to power all of humanity with these current technologies is small compared to the area now used to feed us. As noted above, wisely beginning the transition to a sustainable energy system is economically as well as environmentally favorable, based on extensive scholarship.

Summary. With high scientific confidence, human release of carbon dioxide from fossil-fuel burning, as well as some other human activities, are having a warming influence on the climate. The influence is projected to become much larger if we continue to burn most of the available fossil fuels. Impacts are expected to become notably negative. Uncertainties are real, but primarily on the “bad” side (with larger, more-costly changes more likely than smaller, less-costly changes). Because fossil fuels are being burned much faster than new ones are made naturally, the current system is unsustainable. Natural, sustainable resources are available to provide much more energy than now used by humanity, and existing technologies can extract this energy, using a much smaller area of the Earth than is now used to feed us. Inclusion of the solid science in planning can lead to decisions that improve human welfare, increase national security, give a cleaner environment, and honor the Golden Rule.

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**House Democratic Policy Committee Hearing
How Can Pennsylvania Achieve Carbon Neutrality?
Expanding Renewable Energy
Bruce Burcat – Mid-Atlantic Renewable Energy Coalition
March 2, 2015**

Introduction

Thank you for allowing me to testify today on expanding renewable energy. I represent an organization, the Mid-Atlantic Renewable Energy Coalition, which we call MAREC. MAREC is a Pennsylvania non-profit organization with the purpose of advancing renewable energy development in the Mid-Atlantic region. MAREC's membership consists of wind developers, wind turbine manufacturers, service companies, nonprofit organizations and a transmission company dedicated to the growth of renewable energy technologies to improve our environment, boost economic development in the region and diversify our electric generation portfolio, thereby enhancing energy security.

Pennsylvania is a key state in the MAREC footprint. While it ranks 16th in the nation in wind energy development, the State ranks highest in wind development in the Mid-Atlantic region.

<http://awea.files.cms-plus.com/FileDownloads/pdfs/Pennsylvania.pdf>. This development is in large part due to the enactment of Pennsylvania's Alternative Energy Portfolio Standard (AEPS) in 2004. As you know, House Bill 100 would increase the Tier I, non-solar renewable energy and the solar carve-out requirements of the AEPS. The bottom line is that Pennsylvania's AEPS is working and the State has benefitted significantly from wind power and other forms of renewable energy that have been developed in the State. From economic development to helping promote a cleaner environment, the AEPS has been a very effective piece of legislation.

Benefits of Wind Energy

I wanted to provide you with a perspective on how Pennsylvania has benefited from wind energy development and how expanding renewable energy in PA will provide substantially greater benefits.

Economic Development

First, the Commonwealth has 1,340 MW of installed wind energy capacity in operation and according to the National Renewable Energy Laboratory the state has the potential to install approximately 2,000 MW of additional onshore wind energy capacity.

http://apps2.eere.energy.gov/wind/windexchange/wind_resource_maps.asp?stateab=pa. As wind turbine technology continues to improve, the numbers for new capacity will also increase.

Wind energy development creates jobs and investment. The wind industry has invested \$2.7 billion in the projects that have been developed in Pennsylvania and supports over 1,000 direct and indirect jobs in the Commonwealth. There are over 28 wind-related manufacturing facilities here in Pennsylvania making PA a leader in wind-related manufacturing. <http://awea.files.cms-plus.com/FileDownloads/pdfs/Pennsylvania.pdf>.

Wind farms contribute to the local tax bases in which they are located and they pay landowners substantial fees for developing on their properties. Annual local property tax payments by wind project owners provide millions of dollars to the tax base of communities over the life of the projects. In addition, landowners are currently receiving land lease payments of over \$4 million per year for the 25 operating wind farms in PA according to AWEA. <http://awea.files.cms-plus.com/FileDownloads/pdfs/Pennsylvania.pdf>.

Environmental

We know that wind and renewable energy development plays a critical role in helping improve the environment. The wind energy generated from wind farms in Pennsylvania avoids close to 2 million metric tons (2204.62 lbs. per metric ton or 1000 kg) of carbon dioxide emissions annually. Wind energy often displaces traditional fossil fuel generation resources when competing in PJM's wholesale electricity market, thus eliminating the harmful emissions from these resources, because wind is a zero emitting resource. Conventional generating resources require the use of water in their generation of electricity. Wind energy uses virtually no water in its process to generate electricity saving 727,000,000 gallons of water per year in Pennsylvania.

Consumer Benefits

Wind provides tangible consumer benefits. There are number of key studies that indicate that as wind energy becomes more prevalent in structured markets like the electricity market run by the regional grid operator, PJM Interconnection, LLC, which includes Pennsylvania, there is a "price suppression" effect that causes the wholesale cost of electricity to decrease. This effect is present, because of the manner in which these wholesale markets are run and the fact that energy generated from wind has no fuel cost, when we know that other traditional generating resources do have fuel costs, which can be quite volatile. When available, wind providers generally bid in at prices that are lower than traditional generation providers. The result is that the most expensive generation is displaced, consequently reducing the clearing price of electricity produced at that time, resulting in saving to consumers.

Also, during the extreme cold snap known as the “polar vortex” which occurred on January 6th and 7th, 2014, wind energy saved electricity users in the Mid-Atlantic and Great Lakes states at least \$1 billion according to an American Wind Energy Association study of the event. <http://awea.files.cms-plus.com/AWEA%20Cold%20Snap%20Report%20Final%20-%20January%202015.pdf>. Power plant outages and gas price spikes during the polar vortex caused electricity prices to reach record levels in PJM. Because of high demand and low supply, electricity and natural gas prices rose to dozens of times their normal levels in many regions – especially in the Mid-Atlantic and Great Lakes region. Electricity prices would have been even higher, but for the fact that wind energy production was running at high levels during the event.

Supporting Studies

There have been several PJM specific studies performed which evaluate the price suppression effects of wind resources. A study conducted in 2013, Synapse Energy Economics found that doubling the use of wind energy in PJM beyond existing requirements would decrease consumer electric bills by \$6.9 billion per year as a result of this price suppression effect of wind energy participating in the PJM market. <http://www.synapse-energy.com/Downloads/SynapseReport.2013-05.EFC.Increased-Wind-Power-in-PJM.12-062.pdf>.

An important study on renewable energy integration was performed by General Electric for PJM at the request of PJM’s stakeholders. The results of the study were quite significant:

- First, the study found reliability was not harmed with very high levels of renewable energy penetration, including a 30% renewables integration scenario.
- The 30% renewables integration case examined by the study found that carbon dioxide emissions declined by 27 to 41 percent as opposed to the business as usual case of just 2 percent renewable energy integrated into the PJM grid. The 20% case found carbon dioxide emission reductions of 14 to 18 percent. The study also found substantial reductions of other harmful emissions in all scenarios run against the business as usual case (NOx - nitrogen oxides and SOx - sulfur oxides).
- Increasing wind energy production produces very large reductions in the cost of producing electricity in the region. The study found that obtaining 20% of PJM’s electricity from wind energy would reduce the overall cost of producing electricity by \$10 billion annually, while 30% wind scenario in the study reduces production costs by \$15 billion annually.

<http://www.pjm.com/~media/committees-groups/committees/mic/20140303/20140303-pris-executive-summary.ashx>

Conclusion

Due in large part to the AEPS wind developers have found Pennsylvania to be a very desirable place to locate and develop their projects; the State's economy has benefitted; and the environmental gains are clear. The AEPS is being met with reasonable costs and consumers will see greater pricing benefit as wind development ramps up in the next few years. There is no doubt that the State will gain additional advantages by increasing the AEPS compliance requirements and expanding its use of renewable energy technologies.

Thank you again for this opportunity to speak on this important issue.

House Democratic Policy Committee
March 2, 2015

Tom Tuffey, VP Community Energy

Community Energy is veteran of 15 years headquartered in Radnor, PA.
Key actor in building PA wind energy to leading position in East. Focused on solar energy since 2010.

CE in Three market sectors: very large scale utility, mid scale, and community scale.

Large Scale announced projects:

- Comanche in Colorado.....120 MW
- Butler in Georgia....100 MW
- North Star in Minnesota....100 MW
- Eastern Shore in Virginia....80 MW
- Total announced is 400 MW or close to \$800 M in capital with local economic multiplier

Mid Scale.....over 30 project is last 4 years in 10 states....built or under construction

- 7 projects in NJ....37 MW
- Over 100 MW in North Carolina
- One project just on line in NY and 26 MW in development
- Maryland....50 MW in development
- 2 projects producing power in Mass with 4 more in development
- One project in PA5 MW Keystone from 2012.....market stuck

Community Scale....new model where consumer may buy from cost effective project at scale and have invoice on regular utility bill.

- 3 project .5MW apiece in Colorado
- 4 projects under development Mass
- 7 projects under development Minn

Total project pipeline in excess \$1B....with economic multiplier many billions of opportunity

What is working in todays booming solar market?

- Technology cost continue to decrease and tracker technology give increased production when needed most...summer air conditioner load
- Cost of money has decreased for financing....entrance of YieldCo investment partners
- Build at scale to achieve economy of scale and lower cost of power
- State Policy

(MORE ON BACK)

Other state policies to consider and learn from (representative, not complete):

Solar Renewable Energy Credits:

- SREC in PA started at \$350...went to \$20...now at \$60.....with open borders likely to decline
- NJ SREC is \$200 and closed border
- Mass SREC is \$300-400 and closed border
- NY is competitive

Electric Utility purchase at scale to add to portfolio....address summer peak, PUC approval

- Colorado, Minnesota, Georgia, others in west

Feed in Tariff.....set price offered by utility, PUC approved

- Indiana
- NY Long Island Power Authority

Net meter rules favoring placing projects where best suited.

- NY and Mass

State Tax Credit....North Carolina

Community Scale Model to allow all residents to participate....favors the 70% that cannot do their own rooftop.

- Mass
- Colorado
- Minnesota
- Washington, DC
- Vermont
- New York now has a house bill under review

Take aways:

- Market has changed significantly.....many boom areas
- Although PA is a huge electric power producer and exporter, PA missing solar boat
- Convene industry group to determine what works elsewhere and what then appropriate for Commonwealth

**Testimony of Terry Fitzpatrick
President and CEO
Energy Association of Pennsylvania
Before the Pennsylvania House Democratic Policy Committee
March 2, 2015**

Good morning Chairman Sturla and members of the Committee. I am Terry Fitzpatrick, President & CEO of the Energy Association of Pennsylvania (EAP), a trade association whose members include electric and natural gas utilities (also known as electric and natural gas distribution companies) operating in Pennsylvania. Thank you for this opportunity to testify on behalf of our electric distribution company (EDC) and natural gas distribution company (NGDC) members regarding House Bills 100, 129 and 200. House Bill 100 would increase the requirements for purchases of alternative energy under the Alternative Energy Portfolio Standards Act (AEPS Act). House Bill 129 would amend Act 129 of 2008 by, among other things, removing the cap on funding and extending energy efficiency and demand reduction programs to NGDCs. House Bill 200 would provide funding of \$25 million, paid for by increasing the Gross Receipts Tax, for solar projects under the PA Sunshine Solar Program.

HOUSE BILL 100

Before discussing this legislation, I will review some background regarding the electric industry and the AEPS Act. EDCs are sometimes referred to as “wires companies” because they own and operate the transmission and distribution portions of the electric grid. EDCs have a direct relationship with customers – providing bills, administering low income assistance programs, and responding to service outages, among other things. EDCs serve as the “default supplier” of electricity to customers who do not choose to purchase supplies from an electric generation supplier (EGS). Since EDCs do not own electric generating plants, they purchase supplies in the wholesale market in order to provide default service, including supplies of alternative energy

needed to comply with the AEPS Act. EDCs have a legal right to fully recover the costs they incur to procure these supplies, but they do not earn a profit on default service.

EDCs are just one of the players in Pennsylvania's competitive electric industry structure. Since passage of the Electricity Generation Customer Choice and Competition Act (Competition Act) in 1996, the general policy of the Commonwealth is to rely on markets to promote efficiency throughout the electric industry and to offer customers innovative choices and the lowest possible prices. At the wholesale level, electric generators compete on the basis of cost to sell into markets regulated by the Federal Energy Regulatory Commission and administered in this region by PJM Interconnection. At the retail level, EGSs compete to sell electricity to customers. Some EGSs attract customers by offering the lowest price, while others compete based on the environmental attributes of their supplies. For example, in the PPL Electric Utilities' service territory where this hearing is being held, a review of the Public Utility Commission's "powerswitch" website shows twenty-nine EGSs that offer to sell renewable energy to customers, six of which offer Pennsylvania-produced renewable energy.¹

The AEPS Act is an exception to Pennsylvania's general policy of relying on electricity markets. As currently written, it mandates that EDCs and EGSs purchase increasing amounts of alternative energy as part of their portfolios, so that a total of 18% of retail sales come from such sources by the year 2021. Of this amount, 10% must come from "Tier II" sources such as waste coal and hydropower, and 8% must come from "Tier I" sources, which are renewable sources such as wind, biomass, and solar. Within both of these tiers, the eligible sources compete on a basis of cost, with the exception of a "solar carve-out" under which 0.5% of total sales must

¹ <http://www.papowerswitch.com/shop-for-electricity/>; renewable energy products are available via suppliers in other EDC territories as well. PPL was used as an illustrative example.

come from solar photovoltaic ("PV") sources by 2021. In Pennsylvania, solar energy is the only form of energy that is insulated from competition with any other type of generation source.

Since EDCs have a right to recover their costs of complying with the AEPS Act, an increase in the mandated level of purchases – with a corresponding increase in compliance costs – does not threaten them with financial harm. However, EDCs are concerned over the cumulative impact of public policies that increase the price of electricity in the long run. Electric and gas customers in Pennsylvania have benefited from lower supply prices in recent years due to the influx of new gas supplies from shale plays. However, energy markets do not remain static, and these prices may rise in the future. In addition, many electric and gas utilities are investing more to replace and modernize their distribution infrastructure. As a result, EDCs are concerned about policies that make it more difficult for customers to pay their electricity bill.

House Bill 100 would significantly increase the mandated purchases of alternative energy under the AEPS Act. The Tier I requirement would be almost doubled – from 8% in 2021 to 15% in 2023. In addition, the solar carve-out would be tripled – from 0.5% in 2021 to 1.5% in 2023. While we have not attempted to project the magnitude of the increase, additional mandates will increase costs for customers. EDCs are concerned about the impact of these costs on customers, particularly low and fixed income customers, on small businesses, and on economic competitiveness. According to statistics compiled by the Energy Information Administration, electricity prices in Pennsylvania for 2013 were 2.6% below the national average. That is a marked improvement from 15% above the national average in 1996 – when the Competition Act was passed. The General Assembly should consider carefully any policies that contribute to increases in the cost of electricity, especially at a time when we are all working to increase jobs and economic growth in the Commonwealth. We also ask you to consider that citizens who are

concerned regarding carbon emissions can take advantage of Pennsylvania's robust competitive electric retail market and choose an EGS that sells renewable energy.

HOUSE BILL 129

House Bill 129 would expand Act 129's applicability to natural gas distribution companies (NGDCs) and make changes to the current Act that would impact EDCs. Act 129 of 2008 is, in part, a statewide energy efficiency and conservation program for regulated electric distribution utilities which requires mandatory reductions in electric energy consumption and demand. The proposed changes on the electric side include removal of the two percent spending cap for Act 129 programs, allowing for utility companies to recover revenues decreased as a result of reduced energy consumption due to the implementation of an energy efficiency and conservation plan, and modifying the definition of the current Total Resource Cost test to include societal costs in determining cost-effectiveness.

EAP would not recommend the removal of the spending cap from Act 129. EDCs spent close to \$250 million last year on their Act 129 energy efficiency and conservation programs, an amount that is ultimately borne by all ratepayers and does not include *other* utility-run conservation programs such as the Low-Income Usage Reduction Program (LIURP)². This number also represents the fifth-largest statewide spending on such programs in the nation.³ In addition, Pennsylvania remains the only state whose statute imposes penalties on utilities for customer failure to adopt energy efficiency and conservation measures so as to enable utilities to meet mandatory targets without the opportunity for shared benefits of achieving savings goals

² While technical analysis of this program indicates that it is providing net benefits, that does not mean that customers should be required to pay ever-increasing amounts to expand the program, especially given most customers receive, at best, indirect benefits.

³ As of 2012; *Edison Foundation, Summary of Electric Utility Customer-Funded Energy Efficiency Savings, Expenditures, and Budgets: Issue Brief, March 2014.*

through performance incentives (in contrast, more than half of states offer performance incentives to utilities⁴). Electric and gas utilities agree with the goals of energy conservation and efficiency, however, prescriptive mandates may not be the best method of achieving them.

EAP would, however, support allowing EDCs (and NGDCs, if Act 129 is extended to them) to recover lost revenue as a result of decreased usage by customers. As of 2014, 32 states have approved fixed cost recovery mechanisms – 14 with revenue decoupling and 19 with lost revenue adjustment mechanisms (two with both).⁵ As previously stated, it is important to align the utility's financial goals with societal goals. Cost recovery and performance incentives would help accomplish this alignment. To better achieve this goal, we recommend that the revenue recovery language be strengthened by changing the permissive “may” to the mandatory “shall.”

Additionally, EAP is concerned regarding the inclusion of societal costs as a factor in the current Total Resource Cost (TRC) test. First, “societal costs” are inherently difficult to quantify, and determining even an approximate value of these costs and benefits is usually challenging and contentious. There is not a single definition, set of elements, or scope of application that applies universally, even among states that incorporate this variable. Any arbitrary or misapplied monetization can significantly impact the test results providing an incomplete or incorrect picture of the true environment in which the program will be delivered. It is also important to note that the most often cited societal cost is related to air emissions, which are already factored into energy prices through the cost of environmental compliance such as emissions controls at power plants and allowance purchases. These costs should not be double counted by placing a separate adder in the TRC calculation.

⁴ As of 2014, 29 states offered incentives, up from 23 in 2012; *Edison Foundation, State Electric Efficiency Regulatory Frameworks: IEI Report, December 2014.*

⁵ *Edison Foundation, State Electric Efficiency Regulatory Frameworks: IEI Report, December 2014.*

The legislation as proposed also fails to include societal benefits in the determination of cost-effectiveness. The TRC test compares the program benefits of avoided supply costs to costs for administering the program and the cost of upgrading equipment. To adjust this equation to account for societal costs without societal benefits would be wholly unbalanced. EDCs are primarily concerned with what makes a program cost-effective and reasonable so as to support cost recovery from all ratepayers.

In addition, the proposed bill would require natural gas distribution companies to reduce natural gas weather-normalized consumption and demand 1% by 2018 and 3% by 2020. NGDCs are opposed to these new requirements. First, it is important to note that in Pennsylvania and across the country residential natural gas consumers are already leaders in energy efficiency. Natural gas usage per household has decreased even as demand overall for energy has risen. This trend is due in part to existing utility energy efficiency programs, the development of increasingly more efficient natural gas appliances, and increased thermostat control among others.⁶

Natural gas utilities in Pennsylvania already participate in a variety of statewide energy efficiency programs. In 2011, Pennsylvania NGDCs spent \$15 million on energy efficiency programs for all classes of customers, both residential and commercial. In 2012, that number had risen to nearly \$20 million. As a part of these programs, gas utilities provide valuable tools, incentives and information to help their customers understand and reduce their energy usage. These include:

⁶ "Natural Gas Efficiency Programs Brief, Investment and Savings Impacts, 2012 Program Year." American Gas Association. <https://www.aga.org/natural-gas-efficiency-programs-brief-2012-investments-and-savings>

- Offering cash rebates and other financial subsidies for high-efficiency natural gas appliance purchases and whole home or building efficiency improvements.
- Providing home energy audits, weatherization kits and telephone hotlines.
- Supplying information on insulation, programmable thermostats, and high-efficiency appliances.
- Connecting customers with experienced and reliable appliance and service providers.
- Providing web-based information resources and energy usage calculators.

Any additional natural gas energy efficiency programs would have to allow for direct program costs to be recovered from ratepayers. Direct program costs include utility-subsidized customer equipment replacement and upgrades, subsidies for the weatherization of homes and businesses, and the costs of energy audits, technology demonstrations, and consumer and building operator training – all of which end up being paid for by increases in rates.

HOUSE BILL 200

With respect to House Bill 200, which would provide a dedicated \$25 million funding stream for the PA Sunshine Solar Program paid for by an increase in the Gross Receipts Tax, EAP members also have reservations. Investors in Pennsylvania solar projects already benefit from three separate subsidies – 1) the federal 30 percent solar investment tax credit, 2) the solar carve-out and associated REC values, and 3) the cross-subsidization of transmission and distribution costs for customer-generators by all other customers through net metering. Adding a fourth separate subsidy stream borne by all ratepayers to support solar developers is not the best use of Pennsylvania's limited resources.

Thank you for the opportunity to testify today, and I'd be happy to answer any questions.

Prepared Testimony of

James H. Cawley
Commissioner
Pennsylvania Public Utility Commission

before the

Pennsylvania House of Representatives
Democratic Policy Committee

Hearing on Achieving Carbon Neutrality –
Reducing Energy Demand

March 2, 2015



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Chairman Sturla, Representative Vitali, and Members of the Committee:

Thank you for the opportunity to present testimony on the provisions of House Bill 129, Printer's No. 585, of this 2015 Session which amend Act 129 of 2008.

Although I have been greatly assisted by the Public Utility Commission staff experts who have accompanied me today, and although my remarks may well be the views of my four colleagues as well, please hold me solely responsible for what follows because the Commission has not taken an official position on House Bill 129.

My testimony is divided into the following parts:

1. A brief history of Act 129 and its provisions.
2. How the percentage incremental reduction required of each electric distribution company (EDC) for overall electricity consumption and peak load was determined for implementation purposes.
3. The costs incurred to implement energy efficiency and conservation (EE&C) plans and to meet the required reductions in overall electricity consumption and peak demand contained in Act 129.
4. The benefits realized through these programs.
5. Previously submitted Commission suggestions for improvement of the EE&C and demand response provisions of Act 129.
6. My specific comments on the provisions of House Bill 129, Printer's No. 585.

A Brief History of Act 129 and Its Provisions

Act 129 was signed into law on October 15, 2008, with an effective date of November 14, 2008. The Policy Objective of the law stated: "It is in the public interest to implement cost-effective energy efficiency and conservation measures that reduce electricity price volatility, promote economic growth and ensure affordable and reliable electric service to all Pennsylvania residents and businesses."

The Act created an Energy Efficiency & Conservation Program to be overseen by the PUC. It required Electric Distribution Companies (EDCs) with at least 100,000 customers to adopt and implement cost-effective energy efficiency and conservation plans to reduce energy consumption and demand. New plans were to be submitted every five years or as the PUC directed, and each of the multi-year phases was divided into planning years (PY1, PY2, etc.).

EDC plans were filed with the PUC by July 1, 2009, and the PUC approved them by November 1, 2009. The EDCs began program implementation soon thereafter.

In Phase I of implementation, the plans were required to reduce retail electricity *consumption* (1% by May 31, 2011 and 3% by May 31, 2013) relative to the baseline period from June 1, 2009 to May 31, 2010, and to reduce *peak demand* in the 100 highest annual peak consumption hours (4.5% by May 31, 2013) relative to the baseline period from June 1, 2007 to May 31, 2008.

The total cost of any plan could not exceed 2% of the EDC's total annual revenue as of December 31, 2006. These costs could be recovered from the EDC's customers by means of an annual cost-recovery mechanism in accordance with Section 1307 of the Public Utility Code (essentially an annual estimation of the anticipated cost in the subsequent year which is recovered in current rates, and an annual true-up based on experience). But the "decreased revenues of an electric distribution company due to reduced energy consumption or changes in energy demand" could not be recovered on a current basis but had to await the EDC's next rate increase request where any alleged decrease in revenues would be examined together with the utility's other revenues and expenses under the "just and reasonable" standard of Section 1308.

The cost effectiveness of each EDC's plan and its elements were determined by a PUC-approved "Total Resource Cost" (TRC) test which could be met "if over the effective life

of each plan not to exceed 15 years, the net present value of the avoided monetary cost¹ of supplying electricity is greater than the net present value of the monetary cost of energy efficiency conservation measures.”² The TRC test excludes environmental and societal costs and benefits³ unless such costs and benefits were already embedded in the wholesale cost for generation of electricity.

The PUC was authorized to obtain the expert assistance by competitive bid of a “Statewide Evaluator” (SWE) to formulate review criteria and compliance procedures and results using a Technical Reference Manual (TRM) and to generally give technical and economic advice.

Rather than financial incentives to achieve the stated goals, penalties of between \$1 million and \$20 million were authorized for an EDC’s failure to achieve the mandated consumption and peak demand reductions.

If benefits exceeded costs, the PUC was required to “adopt additional required incremental reductions in consumption” after 2013.

Energy efficiency and conservation measures defined by the Act were:

- Solar/solar photovoltaic panels
- Energy efficient windows and doors
- Energy efficient lighting
- Geothermal heating
- Insulation
- Air sealing

¹ “Avoided monetary cost” includes energy, capacity, ancillary, and transmission and distribution costs.

² TRC test example: Calculate the cumulative electricity cost savings over the life of a Compact Fluorescent Light (CFL) bulb and reduce these savings by the incremental cost of a CFL relative to a standard light bulb, including any EDC administrative costs of the EDC’s light bulb program.

³ Examples of excluded benefits include carbon emission reductions, water, natural gas, and oil use savings, home and business comfort, sulfur dioxide (SO₂), nitrous gas (NO_x), and particulate emissions reductions which improve air quality.

- Reflective roof coatings
- Energy efficient heating and cooling equipment/systems
- Energy efficient appliances
- Other technologies, practices, or measures approved by the PUC

Costs

The EDCs' total budgeted costs to implement the EE&C plans for Phase I were \$978 million. For the entirety of Phase I, the total cost to the EDCs to successfully implement these plans was \$803.7 million (funds in excess of costs were refunded to ratepayers). The total cost of implementation, including estimated participant costs,⁴ was \$1.755 billion (\$1,755,384,000).

Benefits

The total avoided costs (or benefit) to consumers was \$4.2 billion. That is, the benefits of the Phase I programs were more than double their costs.

All EDC plans were cost effective. The seven EDCs collectively saved 5,403,370 MWh/yr and 1,540.61 MW as of May 31, 2013 (end of PY 4). All EDCs exceeded their individual 2013 compliance targets for electricity consumption savings and peak demand reductions as established by the Commission based upon their reported and verified Phase I energy and demand savings. Confirmed savings at the conclusion of the first phase of the EE&C program were 123% of statutory requirements for energy, and 113% for demand.⁵ Total estimated benefits of this phase were \$4,192,389,000. Therefore, with the total estimated costs of \$1,755,384,000, the benefits exceeded the costs by \$2,437,006,000, resulting in a benefit cost ratio of 2.4.

⁴ Implementation costs include EDC and contractor Act 129 administrative costs and customer investment costs on efficiency measures.

⁵ West Penn was fined \$1.3 million for failing to achieve the required 1% of energy consumption savings by May 31, 2011, but it achieved the May 31, 2013 energy consumption and peak demand savings requirements.

There were also quantifiable indirect benefits for our state and local economies.

- o With the implementation of Act 129, the Commission instituted a Conservation Service Provider (CSP) registry program as required by the Act. CSPs provide services to help EDCs carry out the various conservation load programs throughout the Commonwealth.⁶ To date, approximately 140 businesses have registered to perform such services.

- o Act 129 has benefitted all customer classes directly and indirectly through reduced energy consumption and decreases in peak prices, thereby lowering billed amounts. This is particularly true for Pennsylvania's low-income customers who typically receive various forms of public assistance. Low-income customers receive additional assistance and offerings under the EE&C plans.⁷ In total, energy reductions from Phase I amounted to 201,072 MWh for low-income customers, equal to 3.7% of total Phase I savings.

- o The electric grid benefits by shaving (lowering) peak loads, thereby helping to increase reliability and reducing the need to call on increased sources of generation, which typically are the dirtiest and most expensive sources of generation available and typically are needed during the worst air quality days. The associated emissions reductions from Act 129 include an estimated reduction of more than 2,500 tons of NO_x emissions, nearly 6,500 tons of SO₂ emissions, and nearly 3.9 million tons of CO₂ emissions.⁸

⁶ CSPs are service providers that assist in program implementation, actual installment of energy efficiency equipment, customer outreach, assistance and marketing, or help with plan performance measurement. CSP participation in these plans provides local jobs and tax bases for local and state economies.

⁷ Act 129 programs provided additional funding above and beyond existing Low Income Usage Reduction Programs (LIURP).

⁸ NO_x is a generic term for mono-nitrogen oxides NO and NO₂ (nitric oxide and nitrogen dioxide). Nitrous oxide gives rise to nitric oxide (NO) on reaction with oxygen atoms, and this NO in turn reacts with ozone. As a result, it is the main naturally occurring regulator of stratospheric ozone. It is also a major

As a result of the success of Phase I, and pursuant to statutory requirements, the Commission implemented a Phase II of EE&C programs for the planning period June 1, 2013 through May 31, 2016, for PY5, PY6, and PY7. Phase II was preceded by an energy efficiency baseline study for residential and commercial sectors and an energy efficiency potential study during Phase I. The results of these studies helped the Commission to establish cost effective energy savings requirements for each of the EDCs for Phase II as follows:

EDC	3 Year % of 2009/10 Forecast Reductions	3 Year MWh Value of 2009/10 Forecast Reductions
Duquesne	2.0	276,722
Met-Ed	2.3	337,753
Penelec	2.2	318,813
Penn Power	2.0	95,502
PPL	2.1	821,072
PECO	2.9	1,125,851
West Penn	1.6	337,533

Percent goals were again measured against the 2009/2010 forecast period baseline.

Over-compliance from Phase I carried over into Phase II, but the Phase II targets are not cumulative from the Phase I targets (reduction requirements are cumulative within a phase, but not between phases).

greenhouse gas and air pollutant. Considered over a 100-year period, it has 298 times more impact per unit mass (global warming potential) than carbon dioxide. SO₂ refers to sulfur dioxide, an oxide of sulfur, and CO₂ refers to carbon dioxide, a common greenhouse gas.

The SWE completed its PY5 report for the first year of Phase II, for the period June 1, 2013 through May 31, 2014. As a result of Phase II programs, when combined with over-performance carry-over from Phase I, the seven EDCs collectively saved 1,019,155 MWh and 202 MW during PY5, attaining 62% of their overall statewide Phase II energy efficiency goals, 73% of statewide low-income energy efficiency goals, and 109% of the governmental, non-profit and institutional (GNI) energy efficiency goals.⁹ Total estimated monetary benefits of PY5 of Phase II to date of \$559,789 exceeded total estimated costs of \$323,209, by \$236,580, resulting in a benefit cost ratio of 1.73. Total estimated CO₂ reductions related to PY5 of Phase II were 785,423 tons.

In preparation for Phase III of EE&C programs, the SWE has prepared a draft Demand Response Potential Study,¹⁰ a Commercial and Residential Light Metering Study, Residential and C&I Baseline Studies, and a draft Energy Efficiency Potential Study in order to provide the technical foundation for Phase III energy efficiency and demand response requirements. Commission staff is in the process of finalizing these studies for release to interested stakeholders along with a tentative order establishing these energy efficiency and/or demand response targets for Phase III.

Suggested Improvements to Act 129

Appendix A provides a detailed discussion of suggested amendments to Act 129 previously shared with members of the Legislature (Appendix B contains implementing amendments for these suggestions). Included in these suggestions are various clarifications to the Act to (1) provide a more sound, legal, quantitative basis and criteria for establishing future

⁹ An additional 1,028,647 MWh of carry-over from over-performance during Phase I, when combined with the 1,019,155 MWh related to Phase II programs, results in the overall 62% energy efficiency attainment applicable to Phase II requirements.

¹⁰ Demand Response Potential Study Report for Pennsylvania, January 14, 2015.

demand response targets, (2) delay the period necessary to implement future demand response targets, (3) provide more direction as to the continuation of various customer “carve out” requirements implemented subsequent to Phase I, (4) provide the Commission with additional time to review plan submissions, and (5) provide the Commission with greater flexibility in imposing penalties for non-performance (the Commission is required to impose a minimum \$1 million penalty on an EDC if requirements are missed, even by 1 MWh):

- Inclusion of “Peak Demand” in many of the sections which reference reductions in “consumption” to clarify that the Act contemplates the potential for ongoing reductions in consumption and peak demand. Corresponding changes in the timing of future demand reductions are also suggested.
- Additional procedural clarifications as they relate to evaluation of costs and benefits, as well as revising or adding requirements for EDC Act 129 plans.
- Clarification that the Commission’s program cost effectiveness evaluation will be conducted every five years, and will be based on a projection of benefits and costs, not historical data.
- Provision for additional time for the Commission to approve or disapprove an EDC Act 129 plan.
- Granting the Commission greater flexibility to approve fines up to \$20 million, rather than requiring the imposition of a minimum fine of \$1 million for what may be very minor violations of a plan.
- Procedural changes to be followed when an EDC fails to achieve its required usage reduction goals.
- Adding an inflation adjustment to the 2% program cost cap to maintain program spending at constant dollar levels.
- Changing the reporting obligation to once every 5 years consistent with current cost/benefit studies conducted on plan cost effectiveness.
- Definitional changes to “Peak Demand” and “Total Resource Cost Test”. For the latter, a plan life should be extended beyond 15 years to account for longer-life energy efficiency measures.

PJM Demand Response Filing with the Federal Energy Regulatory Commission and EPA's Proposed Emission Reduction Rules for Existing Power Plants

The Committee should be aware of two developments on federal level that could significantly affect Pennsylvania's demand response programs.

First, PJM Interconnection, L.L.C. (PJM), the regional transmission organization that operates the transmission grid owned by Pennsylvania's EDCs, is attempting to fundamentally alter the manner in which demand response is integrated into PJM energy and capacity markets as a result of a series of lawsuits filed by the Electric Power Supply Association (EPSA)¹¹ and FirstEnergy Service Company (FES).¹² In *EPSA*, the U.S. Court of Appeals for the D.C. Circuit held that the Federal Energy Regulatory Commission (FERC) lacked jurisdiction over demand response resources voluntarily participating in the energy markets where there is state regulatory authority to regulate such resources. In light of the *EPSA* decision, FES then requested FERC to rule that no demand response be permitted in the capacity markets (FERC has yet to rule on the complaint).

In response to the *EPSA* decision and FES's FERC filing, PJM filed with FERC a proposal that demand response no longer be directly bid into the capacity market. Consequently, the wholesale market equivalent of Act 129's Conservation Service Providers (CSPs) no longer would be able to participate directly on behalf of their end-use customers. The PUC is opposing this filing.

¹¹ *Elec. Power Supply Ass'n v. FERC*, 753 F.3d 216 (D.C. Cir. 2014) (vacating *Demand Response Compensation in Organized Wholesale Energy Markets*, Order No. 745, FERC Stats. & Regs. ¶ 31,322 (2011), order on reh'g and clarification, Order No. 745-A, 137 FERC ¶ 61,215 (2011)).

¹² *FirstEnergy Service Co. v. PJM Interconnection, L.L.C.*, FERC Docket No. EL14-55-000 (amended complaint filed Sept. 22, 2014), available at <http://elibrary.ferc.gov/idmws/search/results.asp>. FirstEnergy requested that FERC direct PJM to remove all PJM Tariff provisions that allow or require PJM to compensate demand response providers as a form of supply in the PJM capacity market.

PJM's filing, if successful, would require that wholesale load reductions be bid into the wholesale capacity market by electric generation suppliers (EGSs), electric cooperatives, and EDCs. This may require the PUC to seek statutory authority to ensure that customers can mitigate the cost of capacity in current wholesale markets.

For example, the Commission may need additional authority to direct EGSs and default service suppliers to support customer and Conservation Service Provider (CSP) demand response services. Alternatively, the Commission may need authority to develop and fund more robust state demand response programs to replace the capacity payments lost in the PJM wholesale markets that previously provided the incentive and mechanism for customer participation in three-year forward capacity markets.

Secondly, the U.S. Environmental Protection Agency (EPA) has begun a rulemaking to implement a "Clean Power Plan"¹³ which proposes emission guidelines for reducing carbon emissions from existing electric utility generating units. EPA's proposal establishes state-specific "goals" for carbon dioxide emission reductions, and requires states to develop a plan that sets source-specific standards of performance to achieve those goals.

This is pertinent for today's hearing because EPA's proposal anticipates taking advantage of opportunities for lower-emitting generation and reduced electricity consumption, including using and expanding "zero-emitting generation" (additional renewables and nuclear) and increasing demand-side energy efficiency. Cumulative EE reductions of about 1.5% per year would be necessary under the Clean Power Plan (CPP) if we were to match EPA's estimated contribution of EE to achieving statewide carbon emission reductions. Our current potential study estimates annual future electricity consumption reductions under Act 129 equal to 0.9% per year based on the 2% revenue cap given current projections of EE acquisition cost

¹³ *Carbon Pollution Emission Guidelines For Existing Stationary Sources Electric Utility Generating Units*, Docket EPA-HQ-OAR-2013-0602.

estimates (i.e., EDC program costs and incentive payments to customers). Thus, if Pennsylvania were to achieve EE reduction levels equal to or better than that assumed by the EPA, it is likely we will need to modify the 2% revenue cap.

If this proposed rule becomes final and is upheld by the courts, the PUC may need to ask the Legislature to modify, extend, or strengthen our current energy efficiency, demand response, and alternative energy statutes.

My Comments on the Provisions of House Bill 129, Printer's No. 585

- Currently under Act 129, in implementing an energy efficiency (EE) and conservation plan, EDCs are prohibited from spending in excess of 2% of their annual revenue. This legislation would remove that cap.
 - *This will provide potentially necessary flexibility to respond to EPA's Clean Power Plan and PJM's Demand Response (DR) program modifications.*
- Allows natural gas and electric distribution companies to recover revenues decreased as a result of reduced energy consumption due to the implementation of an energy efficiency and conservation plan.
 - *These § 2806.3(i)(2) & (3) provisions will increase the cost impact of EE/DR programs on non-participants through a reconciliation mechanism, not just by base rate filings. Utilities will also have more of an incentive to overstate estimated EE/DR savings in order to receive revenues on a current basis.*

Importantly, Section 1308 general rate cases are specifically designed to compare claimed revenue losses in relation to all revenues and expenses (which individually or together may more than offset the alleged revenue losses). General rate cases, which can last up to nine months, also provide adequate time for testing claims of lost revenues due to implementation of mandated EE&C programs. Section 1307 true-up proceedings do not. I note that leaves § 2806.1(k)(3) in place (allowing for rate case recovery of decreased revenues due to implementation of mandated EE&C programs). The utility should not be given two bites at the apple; it should be able to recover such losses in either a rate case or a reconcilable automatic adjustment clause under § 1307, but not both. Note that § 2806.3((b)(1)((i)(H) mandates recovery of such losses in a § 1307 proceeding. Section 2806.3(i) provides for utility recovery of "reasonable and prudent costs incurred in the provision or management of a plan," which is proper.

There may be more effective rate adjustment mechanisms for stabilizing revenues for utilities that are losing commodity revenues as a result of energy efficiency measures, weather, or other events, including revenue stabilization adjustments and weather adjustment mechanisms. These types of mechanisms can result in customer credits or charges, depending on the actual increase or decrease in usage.

- Makes Act 129 applicable to natural gas distribution companies. Currently, Act 129 only applies to electric distribution companies;
- Requires that natural gas distribution companies develop and file an energy efficiency and conservation plan by July 1, 2016.
- Requires that natural gas distribution companies reduce demand 1% by May 31, 2018 and 3% by May 31, 2020.
 - *These last three together: good idea.*

Suggestions for needed amendments:

- *Section 2806.3(c) – replace “demand” with “consumption” to make clear that it intends a 1% reduction in consumption, not demand, which is sometimes meant to describe peak usage and not annual usage. To conform them to 66 Pa.C.S. § 2806.1(c)(1) & (2), HB 129’s § 2806.3(c)(1) & (2) would read:*

(1) By May 31, 2018, total annual weather-normalized consumption of the retail customers of each natural gas distribution company shall be reduced by a minimum of 1%. The 1% demand reduction in consumption shall be measured against the natural gas distribution company’s expected demand load as forecasted by the commission for June 1, 2016, through May 31, 2017, with provisions made for weather adjustments and extraordinary demand load that the natural gas distribution company must serve.

(2) By May 31, 2020, the total annual weather-normalized consumption of the retail customers of each natural gas distribution company shall be reduced by a minimum of 3%. The 3% demand reduction in consumption shall be measured against the natural gas distribution company’s expected demand load as forecasted by the commission for June 1, 2016, through May 31, 2017, with provisions made for weather adjustments and extraordinary demand load that the natural gas distribution company must serve.

- *Section (d)(2); after “disapprove a plan”, insert “in whole or in part”. This would allow parts of a plan to move forward, and other aspects of the plan to be modified and implemented later, without delaying the entire plan. In this same section, Commission staff has indicated that an initial 180-day review period may be necessary under certain circumstances.*
- *Modifies the definition of the Total Resource Cost test used in evaluating EE/C plans to include societal costs; changes the maximum timeframe of the test to 20 years (from 15 years).*
 - *These are positive changes. I suggest a broadening of Act 129’s definition of “Total Resource Cost Test” at § 2806.1(m), even more than House Bill 129 proposes by including societal costs, by deleting the words “of supplying electricity” in that definition. Often, the benefits of EDC energy efficiency investments such as installation of insulation, weatherization (air sealing), vent sealing, etc., are understated because they fail to include the benefits of simultaneous savings in natural gas, oil, and water use. Deleting “of supplying electricity” would permit other economic benefits to be accounted for in the TRC. Also, expanding the test benefit analysis period from 15 years to 20 years is, again, a positive step. Even better would be to expand this to investment life. Insulation, for example, could possibly have a 30 year life.*

I would be happy to answer your questions.

Appendix A

Proposed Legislative Changes to the Energy Efficiency and Conservation Program 66 Pa.C.S. § 2806.1

a) Program

- The term “peak demand” should be added after the term “consumption” whenever subsections (c) and (d) are referenced to make the language consistent with the requirements of both subsections (c) and (d).
- Add a provision requiring procedures for determining cost-effective additional required incremental reductions in consumption, peak demand or both consistent with subsections (c) and (d).
- Add a provision requiring procedures to establish requirements for plans submitted under subsection (b).

b) Duties of electric distribution companies

- Under (b)(1)(i) the term “peak demand” should be added after the term “consumption” whenever subsections (c) and (d) are referenced to make the language consistent with the requirements of both subsections (c) and (d). For example, (b)(1)(i)(A) should read that the plan shall include specific proposals to implement energy efficiency and conservation measures to achieve or exceed the required reductions in consumption and peak demand under subsections (c) and (d).
- Under (b)(1)(ii), add a provision giving the Commission discretion to change the plan requirements under (b)(1)(i)(A)-(K) based on cost-effectiveness, market potential and public interest. This provision will make it clear that the Commission has the discretion to increase or decrease the percent of savings to come from government, educational and nonprofit institutions, based on the cost-effectiveness and market potential for such energy savings. In addition, the provision will make it clear that the Commission can modify the requirements related to low income customers and other underserved customers based on cost-effectiveness, market potential and public interest.
- Under (b)(1)(ii), the term “peak demand” should be added to make it clear that the plans shall set forth the manner in which the company will meet the required reductions in consumption and peak demand as adopted by the Commission under subsections (c) and (d).

c) Reductions in consumption

- Under (3) the language should explicitly require that the determination by the Commission must demonstrate that the benefits of the program will continue to exceed the costs, prior to the Commission adopting additional incremental reductions in consumption. The determination should be forward looking based on costs, benefits and potential for energy savings during the period for which the Commission is setting the additional required incremental reductions in consumption.

d) Peak demand

- Under (2), in the last sentence, the term “consumption” should be replaced with the term “peak demand” to make it consistent with the requirement that the plans shall reduce peak demand.
- Also, under (2), in the last sentence, the date that the reductions are to be accomplished should be moved from no later than May 31, 2017, to no later than May 31, 2018. This change would provide more time for the Commission to set a more rigorous peak demand reduction requirement and the EDCs more time to obtain the resources to meet that more rigorous requirement. We note that with the date change to May 31, 2018, the peak demand reductions will still occur during the summer of 2017. This is due to the fact that the PJM system peak demand occurs in the summer months of June through September, thus, a peak demand reduction requirement that is to be accomplished no later than May 31, 2018, will actually occur from June 1, 2017 through September 30, 2017.

e) Commission approval

- Under (1) the term “peak demand” should be added after the term “consumption” whenever to make the language consistent with the requirements of both subsections (c) and (d).
- Under (2) extend the time period given to the Commission to approve a plan from 120 days of plan submission to 180 days of plan submission. This will give the Commission and all interested parties time to more fully review and propose changes to improve each plan.

f) Penalties

- Under (2) and (2)(i) add the term “peak demand” after the term “consumption” such that it explicitly provides for penalties for an EDC that fails to achieve the reductions in

consumption or peak demand under subsections (c) or (d), so that it is consistent with the requirements of (c) and (d).

- Under (2)(i) give the Commission more discretion to impose penalties that are commensurate with an EDC's failure to meet the required reductions. Under the current language, an EDC is subject to at least a \$1,000,000 whether they fail to achieve the reductions by one megawatt-hour or 5,000 megawatt-hours. In addition, the current language is silent on the imposition of penalties for an EDC's failure to achieve 10% of its reductions from government, school districts, institutions of higher learning and nonprofit entities. Finally, the term "peak demand" should be added to make the language consistent with the requirements of subsection (d). The language should be changed such that the EDCs may be subject to a civil penalty not greater than \$20,000,000 for a failure to achieve the required reductions in consumption or peak demand under subsections (c) or (d) in a manner prescribed by the Commission.
- Subsection (f)(2)(ii) should be eliminated. Transferring the responsibility to achieve the reductions in consumption under subsections (c) or (d) to the Commission absolves the EDCs of any responsibility for future reductions and the associated penalties for a failure to meet those reductions. It may also cause the implementation of competing programs where the Commission is responsible for the peak demand reductions and the EDC remains responsible for the consumption reduction program in a scenario where an EDC meets the consumption reduction target but fails to meet the peak demand reduction target. The transfer of responsibility will increase the costs associated with running such programs as it will add another layer of administration on top of such programs. These added costs will be borne by the ratepayers. We note that under such a scenario EDCs will still be involved as they have the requisite information about their customers' electricity usage and system capabilities to determine how to best target conservation and demand response measures.

g) Limitation on costs

- The Commission should be given discretion to increase the limitation on plan costs above the current 2% of the EDC's total annual revenue as of December 31, 2006. Such discretion could allow for an increase in plan costs every five years based on the Consumer Price Index or some other benchmark. We note that costs associated with implementing the plans as well as the energy efficiency measures incented by the plans are likely to increase over time due to inflation, technology advancement and market

penetration of energy efficiency measures, among other factors. Having a fixed budget indefinitely will likely decrease the impact and effectiveness of the program over time.

- In addition, the language should be revised to clarify that the total annual average cost of a plan cannot exceed the cap. Again, in order to fully implement the intent of the legislation, the Commission interpreted this cost limitation as an average annual cost over the life of a plan, which can run up to five years. A strict reading of the current language could limit the total cost of a five year plan to the 2% cap amount, resulting in one-fifth of the funds currently funding the plans. Such a result would severely restrict funding of the program which in turn would severely limit the impact and effectiveness of the program.

h) Costs

- No proposed changes.

i) Report

- Under (2) change the requirement for an annual report to the Consumer Protection and Professional Licensure Committee or the Senate and the Consumer Affairs Committee of the House of Representatives to a requirement for a report every five years, consistent with the requirements under subsections (c) and (d) for the Commission to determine the cost-effectiveness of the program.

j) Existing funding sources

- No proposed changes.

k) Recovery

- No proposed changes.

l) Application

- No proposed changes.

m) Definitions

- Change the definition of “electric distribution company total annual revenue” to amounts collected by the electric distribution company for generation, transmission, distribution and surcharges by retail customers. We note that in 2006, some of the EDCs were out from under rate caps and had customers obtaining generation from electric generation suppliers. A strict reading of the current definition could exclude the amounts collected by the EDC for generation and transmission which the EDC forwarded to the EGS serving the customers. This would result in a significant reduction in the

funds available for the program, frustrating the purpose of the program and limiting its impact and effectiveness.

- Revise the definition of “peak demand” to “The period when the load served by an electric distribution company is at or near the highest level expected to occur or capable of occurring during a period.” This definition more accurately reflects the technical meaning of the term, “peak demand.”
- Revise the definition of “total resource cost test” by eliminating the phrase “over the effective life of each plan not to exceed 15 years” and replace it with the phrase “over the effective life of the energy efficiency and conservation measure.” This would allow for a more accurate cost-benefit analysis of measures that have a useful life of greater than 15 years.

Appendix B

Implementing Amendments for Proposed Legislative Changes to the Energy Efficiency and Conservation Program 66 Pa.C.S. § 2806.1

a) Program

2806.1(a)(4): An analysis of how the program and individual plans will enable each electric distribution company to achieve or exceed the requirements for reduction in consumption and peak demand under subsections (c) and (d).

2806.1(a)(6): Procedures to make recommendations as to additional measures that will enable an electric distribution company to improve its plan and exceed the required reductions in consumption and peak demand under subsections (c) and (d).

2806.1(a)(9): Procedures to ensure compliance with requirements for reduction in consumption and peak demand under subsections (c) and (d).

2806.1(a)(12): Procedures to evaluate the costs and benefits of the program in each electric distribution company's service territory and to adopt additional required incremental reductions in consumption and peak demand required under subsections (c) and (d).

2806.1(a)(13): Procedures to revise and add requirements for energy efficiency and conservation plans filed by electric distribution companies under subsection (b) based on cost-effectiveness, market potential and the public interest in each electric distribution company's service territory.

b) Duties of electric distribution companies

2806.1(b)(1)(i)(A): The plan shall include specific proposals to implement energy efficiency and conservation measures to achieve or exceed the required reductions in consumption and peak demand under subsections (c) and (d).

2806.1(b)(1)(i)(B): A minimum of 10% of the required reductions in consumption and peak demand under subsections (c) and (d) shall be obtained from units of Federal, State and local government, including municipalities, school districts, institutions of higher education and nonprofit entities.

2806.1(b)(1)(i)(D): The plan shall state the manner in which the plan will achieve the requirements of the program under subsection (a) and will achieve or exceed the required reductions in consumption and peak demand under subsections (c) and (d).

2806.1(b)(1)(ii): A new plan meeting the requirements set forth by the commission in accordance with subsection (a) shall be filed with the commission every five years or as otherwise required by the commission. The plan shall set forth the manner in which the company will meet the required reductions in consumption and peak demand under subsections (c) and (d).

c) Reductions in consumption

2806.1(c)(3): By November 30, 2013, and every five years thereafter, the commission shall evaluate the projected costs and benefits of the program period established under subsection (a) and of approved energy efficiency and conservation plans submitted to the program. The evaluation shall be consistent with the total resource cost test or a cost-benefit analysis determined by the commission. If the commission determines that the benefits of the program exceed the costs for an electric distribution company during the period established by the commission, the commission shall adopt additional required incremental reductions in consumption for that electric distribution company in the established period.

d) Peak demand

2806.1(d)(2): By November 30, 2013, and every five years thereafter, the commission shall compare the total projected costs of energy efficiency and conservation plans implemented under this section to the total projected savings in energy and capacity costs to retail customers in this Commonwealth or other projected costs determined by the commission. If the commission determines that the projected benefits of the an electric distribution company's plans exceed the projected costs for that electric distribution company, the commission shall set additional incremental requirements for reduction in peak demand for the 100 hours of greatest demand or an alternative reduction approved by the commission, for that electric distribution company. Reductions in demand shall be measured from the electric distribution company's peak demand for the period from June 1, 2011, through May 31, 2012.

The reductions in ~~consumption~~ peak demand required by the commission shall be accomplished no later than May 31, 2017~~8~~ and every five years thereafter.

e) Commission approval

2806.1(e)(1): The commission shall conduct a public hearing on each plan and allow for the submission of recommendations by the Office of Consumer Advocate and the Office of Small Business Advocate and by members of the public as to how the electric distribution company could improve its plan or exceed the required reductions in consumption and peak demand under subsections (c) and (d).

2806.1(e)(2): The commission shall approve or disapprove a plan filed under subsection (b) within 1280 days of a submission date set by the commission. The following shall apply to an order disapproving a plan:

(i) The commission shall describe in detail the reasons for the disapproval.

(ii) The electric distribution company shall have 60 days to file a revised plan to address the deficiencies identified by the commission. The revised plan shall be approved or disapproved by the commission within 60 days.

f) Penalties

2806.1(f)(2): The following shall apply to an electric distribution company that fails to achieve the reductions in consumption or peak demand required under subsection (c) or (d):

(i) The electric distribution company shall be subject to a civil penalty ~~not less than \$1,000,000 and not to exceed \$20,000,000~~ for failure to achieve the required reductions in consumption or peak demand under subsection (c) or (d) or the plan requirements set by the commission under subsection (b). Any penalty paid by an electric distribution company under this subparagraph shall not be recoverable from ratepayers.

(ii) If an electric distribution company fails to achieve the required reductions in consumption or peak demand under subsection (c) or (d), ~~responsibility to achieve the reductions in consumption shall be transferred to the commission.~~ The commission shall do all of the following:

(A) ~~Implement a plan~~ Set a timeline for the electric distribution company to achieve the required reductions in consumption or peak demand under subsection (c) or (d).

(B) ~~Contract with a conservation service providers as necessary to implement any portion of the~~ Set additional plan requirements as necessary to enable the electric distribution company to achieve or exceed the consumption or peak demand requirements under subsection (c) or (d), which may include requiring the electric distribution company to contract with a conservation service provider to administer the electric distribution company's energy efficiency and conservation plan.

g) Limitation on costs

2806.1(g): Limitation on costs. – The total annual cost of any plan required under this section shall not exceed 2% of the electric distribution company's total annual revenue as of December 31, 2006. The commission may increase the total annual cost of any plan required under this section, provided that such increases are required to obtain additional incremental cost-effective consumption or peak demand requirements, they do not occur more than once every five years and that the increase is not greater than the change in the Bureau of Labor Statistics, PA-NJ-DE-MD Electric Price Index over the preceding five years. The provisions of the paragraph shall not apply to the cost of low-income usage reduction programs established under 52 Pa. Code Ch. 58 (relating to residential low income usage reduction programs).

i) Report

2806.1(i)(2): Beginning five years following the effective date of this section and annually every five years thereafter, the commission shall submit a report to the Consumer Protection and Professional Licensure Committee of the Senate and the Consumer Affairs Committee of the House of Representatives.

m) Definitions

2806.1(m): Definitions.

"Electric distribution company total annual revenue." Amounts ~~paid to~~ collected by the electric distribution company for generation, transmission, distribution and surcharges by retail customers.

"Peak demand." ~~The highest electrical requirement occurring during a specific period~~ The period when the load served by an electric distribution company is at or near the highest level expected

to occur or capable of occurring during a period. For an electric distribution company, the term shall mean the sum of the metered consumption for all retail customers over that period.

“Total resource cost test.” A standard that is met if, over the effective life of energy efficiency and conservation measures in each plan ~~not to exceed 15 years~~, the net present value of the avoided monetary cost of supplying electricity is greater than the net present value of the monetary cost of energy efficiency and conservation measures.

Dr. Anthony Ingraffea's Testimony at the House Democratic Policy Committee Hearing

Main Capitol Building

Harrisburg, PA

March 2, 2015

Good afternoon. I am Dr. Anthony Ingraffea, the Dwight C. Baum Professor Emeritus of Civil and Environmental Engineering at Cornell University. Thank you very much for the opportunity to present testimony to you today on methane emissions in Pennsylvania and why they must be reduced.

I am providing you with three handouts: a brief CV, a summary of the science on methane emissions and climate change, and a copy of this testimony. I was a paid consultant to, and researcher for, the oil and gas industry for over 25 years, focusing on the mechanics of drilling and cementing, hydraulic fracturing, and pipeline analysis and design. This background positioned me to be able to contribute to a number of recent peer-reviewed papers on life-cycle emissions of natural gas, methane, from gas and oil development, especially those coming from shale formations.

I will begin by briefly laying out the basic science of why eliminating methane emissions from gas and oil development is crucial in our fight to control climate change. I will then turn to Pennsylvania and its contribution to methane emissions.

The basic science of methane emissions and climate change

I will briefly summarize what you can read in the handout entitled "Climate Change Impacts of Modern Gas and Oil Development". Methane, natural gas, is a greenhouse gas. According to the most recent report of the Intergovernmental Panel on Climate Change, methane is second only to carbon dioxide as a global warming agent, accounting for about one-third of the anthropogenic radiative forcing on the planet. Although it is relatively short-lived in the atmosphere compared to carbon dioxide, it is much more potent as a warming agent: up to 34 more time potent over a 100-year period, but up to 86 times more potent over the crucial next 20 years. That means that a very small emission of methane has the same effect as a large emission of carbon dioxide. Before 2011, there was very little peer-reviewed literature on methane emissions from gas and oil production, and no such literature pertaining to production from shale formations. Since then, there has been a deluge of studies, many of them like the one I co-authored in 2011 were estimates based on scant and uncertain data. However, in the last 3 years many studies have resulted in actual measurement of emissions. These have been done in various locations, and using different approaches to measure emissions from all along the so-called life-cycle of natural gas: from drilling a well to distributing gas to customers. Although there is currently no scientific consensus concerning the measured life-cycle emission rate, there is a growing literature that points to emission rates much higher, perhaps 2 to 3 times higher, than the current EPA estimate of about 1.5% of total production of natural gas. Recent papers have also concluded that there is no climate benefit to using methane for transportation, or for residential/commercial space and water

heating, but a potential benefit to using methane to generate electricity if the worldwide emission rate is less than about 2.7% of total production of natural gas.

The Main Sources of Methane Emissions in Pennsylvania

There are many sources of methane emissions in Pennsylvania throughout the life-cycle of natural gas. I will highlight here trends in some of those sources. The figures I am about to present to you are all derived from the US Department of Energy/Energy Information Agency state capacity data, from US EPA activity data for the Northeast US, and from the US Department of Transportation Pipeline and Hazardous Materials Safety Administration.

Natural gas processing plants emit significant amounts of methane and VOCs during normal operations and much more during accidental events: in 2020 there were 2 plants processing about 50 billion cubic feet per year, by 2013 there were 27 processing about 820 billion cubic feet per year.

Compressor stations leak methane and are frequent point sources of large emissions because of blowdowns: in 2010 there were 305, by 2013 there were 595.

Gathering pipelines are unregulated and built for short-term use: in 2010 there were about 405 miles of gathering lines, while in 2013 there were nearly 700 miles.

Old cast iron gas distribution pipelines under our cities can leak significantly: recent peer-reviewed papers show leak rates can reach nearly 3% of supply in major cities, and Pennsylvania has the fourth largest mileage of cast iron gas mains in the country.

Abandoned, lost and orphaned wells can leak methane: According to a 2014 peer-reviewed paper by Kang et al., there are between 300,000 and 500,000 abandoned and orphaned wells in PA, and the methane emission rate from these in 2010 was estimated to be between 0.3 and 0.5% of gross methane production in PA.

And of course in 2007 there were just a few shale gas/oil wells in PA and now there are over 9,000 active wells. Each of these can emit during drilling and flowback periods, and each is accompanied by infrastructure that can also leak methane.

What Does All This Mean for Pennsylvania?

What does all this mean for methane emissions in Pennsylvania? In sum, it means a 20.8% increase in mid- and downstream methane emissions since 2010, mostly from rapid growth in gathering and processing capacity. It also means that state emissions from mid- and downstream natural gas infrastructure accounted for 5% of the US emissions from the same sources in 2012.

In the past year, there have been two peer-reviewed papers reporting on actual measurement of methane emission rate in Pennsylvania. The first (Caulton et al.) looked at the southwest and found an emission rate between 3 and 17%, while a later paper (Peischl et al.) focused on the northeast and

found a much lower rate. Much more work needs to be done to identify a spatially and temporally accurate average value of emissions for the state.

Why is the industry emitting all that methane when it is valuable? My colleague today, Mark Boling, was asked that question in a hearing last year of the US Senate Committee on Environment and Public Works. With his usual candor, Mr. Boling said, "I know that it does sound like a no-brainer, so to speak, that if it's going to make everyone money, why wouldn't you do it, but that presupposes you're not in a capital-constrained environment, in terms of the investments being made by industry. And in certain cases [if] they feel like those dollars can go into things that could probably make them more money, they may not necessarily do it." That answer was given at a time when a barrel of oil was selling at nearly twice its present value.

What should be done in Pennsylvania to diminish methane emissions? Rigorous enforcement of all regulations pertaining to methane emissions control; enactment of new regulations regarding purposeful emissions from drilling, blowdowns at compressor stations, processing plants, and pipeline pig and transfer stations; finding and fixing the large leakers among the hundreds of thousands of abandoned wells; acceleration of replacement of cast iron distribution mains under our cities. And all this should be done in the next decade if there is to be a meaningful effort in our fight against climate change.

Prof. A. R. Ingraffea

Dwight C. Baum Professor of Engineering Emeritus
Weiss Presidential Teaching Fellow
Cornell University

Background, Publications, and Projects Related to Hydraulic Fracturing, Methane Emissions, Gas Pipeline Safety, and Renewable Energy Strategy

PROFESSIONAL SOCIETIES

American Rock Mechanics Association/Foundation

- Founding Member
- Member of the Board, 1999-2003

International Society for Rock Mechanics

Society of Petroleum Engineers

American Society of Civil Engineers, Fellow

AWARDS IN ROCK MECHANICS

National Research Council/U.S. National Committee for Rock Mechanics 1978 Award for Outstanding Research in Rock Mechanics at the Doctoral Level

National Research Council/U. S. National Committee for Rock Mechanics 1991 Award for Applied Research for the paper, "Simulation of Hydraulic Fracture Propagation in Poroelastic Rock with Application to Stress Measurement Techniques", co-authored by *TJ Boone*, *Int. J. Rock Mech. Min. Sci. & Geomech. Abstr.*, **28**, 1, 1-14, 1991.

International Association for Computer Methods and Advances in Geomechanics 1994 Significant Paper Award: One of Five Significant Papers in the category of Computational/Analytical Applications in the past 20 years, "A Numerical Procedure for Simulation of Hydraulically-driven Fracture Propagation in Poroelastic Media", co-authored with *TJ Boone*, *Int. J. Num. Analyt. Meth. in Geomech.*, **14**, 1, 1990.

INDUSTRY RECOMMENDED PRACTICE

Principal Author of American Petroleum Institute Recommended Practice: **API 1102** - Steel Pipelines Crossing Railroads and Highways

ARCHIVAL JOURNAL PUBLICATIONS

Bold Italics indicate student or post-doctoral fellow of Prof. Ingraffea

Bold indicates Oil&Gas industry scientist/engineer

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2. "Laboratory Testing of the Crack - at - an - Interface Problem," Sandia National Laboratories Contract No. 13 - 5038, 5/79 - 5/80, \$42,000, Principal Investigator.
3. "Research in Fracture Mechanics", Exxon Education Foundation, 9/89-9/92, \$30,000, Principal Investigator.

4. "Numerical Investigations into Crack Propagation in Rock," National Science Foundation Grant CEE - 8316730, 6/1/84 - 5/30/86, \$150,000. Principal Investigator
5. "Influence of Perforations Upon Subsequent Hydraulic Fracturing," Digital Equipment Corp. and Dowell Schlumberger, 1/88 - 12/96, \$448,000. Principal Investigator.
6. "Computational Simulation of Hydrofracturing", NSF CISE Postdoctoral Associate Award for Dr. K. Shah. 11/95-10/97, \$46,200. Principal Investigator.
7. "Evaluation of Cased and Uncased Gas Distribution and Transmission Piping Under Railroads and Highways", Gas Research Institute, 11/86 - 1/94, \$ 3,602,035. Co-Principal Investigator. T. D. O'Rourke and H. Stewart, Co-Principal Investigators.
8. "An IGERT Training Program In Sustainable Energy Recovery From The Earth-Education At The Intersection Of Geosciences And Engineering". July 2010-June 2015, National Science Foundation, \$1,137,047. Co-Principal Investigator. Prof. Jeff Tester, Principal Investigator, Profs. Terry Jordan, Paulette Clancy, Co-PI's.



**Before the Pennsylvania House of Representatives
Democratic Policy Committee Hearing on "Carbon Neutrality"
March 2, 2015**

Introduction:

Good morning Chairman Sturla, Representative Vitali and members of the Democratic Policy Committee.

My name is Maureen Mulligan, filling in for Christina Simeone, deputy director of the Kleinman Center for Energy Policy at the University of Pennsylvania. I am the Policy Director of Keystone Energy Efficiency Alliance (KEEA), a non-profit, 501 (c)(6) corporation promoting energy efficiency in Pennsylvania. KEEA has approximately 50 members, largely comprised of energy efficiency businesses and experts, many of who are working in utility Act 129 programs. Today I will be talking to you about energy efficiency, Act 129 and how these resources can help Pennsylvania meet carbon emissions reductions proposed by the U.S. Environmental Protection Agency's (EPA) Clean Power Plan (CPP) rule that aims to limit carbon emissions from existing power plants. KEEA supports Pennsylvania's effort to develop a strong state plan that incorporates EPA's building block # 4. KEEA will focus on BB#4, energy efficiency, which our organization views as the least cost compliance options, a significant job creator and certainly one of the easiest resources to ramp up to meet the EPA compliance targets.

The Clean Power Plan:

Proposed in June 2014, the CPP aims to nationally reduce carbon emissions from existing power plants by 30% by the year 2030. Each state has a specific carbon reduction target based on application of four carbon reducing strategies or "building blocks" including, 1) increased efficiency at coal plants, 2) enhanced utilization of high efficiency natural gas capacity, 3) increased use of zero carbon resources (e.g. nuclear, renewables) and 4) reduced electricity demand (i.e. efficiency). Pennsylvania's goal in the proposed rule is to reduce emissions by 31% by 2030. The final CPP rule, which may include revisions from the proposal, will be promulgated in summer or early fall of 2015. State compliance plans could be due to EPA as soon as June 2016, though legal challenges and other delays are expected. If states cannot submit acceptable compliance plans to EPA in the required timeframe, EPA could impose a federal plan that by nature will not be tailored to individual state needs.

Given the committee's interest in exploring carbon neutrality, the CPP should present an opportunity because approximately 41 percent of the state's gross greenhouse gas emissions come from the electric power sector.¹ The power sector represents the single largest source of greenhouse gas emissions in the state and the CPP is specifically designed to lower emissions in that sector. Today, I have been asked to focus on the energy efficiency "building block" of the CPP, which assumes states can increase demand-side energy efficiency efforts to reach 1.5 percent annual consumption savings by 2030.

Energy Efficiency Considerations for Pennsylvania CPP Compliance:

The good news is energy efficiency is the least cost resource available to meet incremental energy needs. For example, the unsubsidized levelized cost of energy for energy efficiency ranges from \$0-\$50/megawatt hour (MWh), \$37-\$81/MWh for wind, \$67-\$87/MWh for gas combined cycle, and \$66-\$151/(MWh) for coal.² Energy efficiency avoids pollution emissions, providing a low-cost compliance opportunity to meet air quality goals. Energy efficiency can be an important strategy to lowering energy costs for homes and businesses as the cheapest form of energy is energy saved. With rising costs of new generation and generation citing woes, it is important the state turn first to how to make what we have work better for us. In turn, our buildings and homes will save customers money, reduce carbon, create jobs, increase property values and make the US and Pennsylvania more competitive.

Act 129 and CPP Compliance

Utility-supported energy efficiency in Pennsylvania, via Act 129, has been extremely cost effective, providing on average \$2.40 in Pennsylvania ratepayer benefits for every \$1 in costs.³ The Act 129 statewide evaluator, commissioned by the PUC to analyze program costs and benefits among other tasks they verified more than \$4 billion in benefits from Phase I alone. Act 129 presents several attractive features as a compliance tool for the CPP. In fact, Act 129 can meet even the most stringent compliance standards,⁴ that require a policy to be 1) permanent (i.e. emissions reductions will continue through the future attainment date), 2) surplus (i.e. additional to baseline measures and no double counting), 3) enforceable (i.e. performance can be evaluated and remedied, if needed), and 4) quantifiable (i.e. must have a measurable impact on emissions). Since Act 129 is a legislatively required program complete with reporting requirements, independent

¹ PA DEP, "Pennsylvania Climate Change Action Plan Update", December 2013, using 2010 inventory figures for in-state electricity production (123.32 mmtco2e) and total statewide gross emissions on a production basis (300.18 mmtco2e). located at [http://files.dep.state.pa.us/Air/AirQuality/AQPortalFiles/Advisory%20Committees/CCAC/Docs/Final Climate Change Action Plan Update.pdf](http://files.dep.state.pa.us/Air/AirQuality/AQPortalFiles/Advisory%20Committees/CCAC/Docs/Final%20Climate%20Change%20Action%20Plan%20Update.pdf)

² Lazard's Levelized Cost of Energy Analysis, Version 8.0 (September 2014)

³ SWE Report (214), Final Annual Report Phase I: June 1, 2009-May 31,2013

⁴ The "control strategy pathway" to SIP implementation requires policies to be federally enforceable and documentation must show that the policy is permanent, quantifiable, enforceable and surplus. Other pathways include "baseline emissions projection pathway", "emerging/voluntary measures pathway", and "weight of evidence pathway". As an existing policy, Act 129 may be better suited for the "baseline emissions projection pathway".

auditing, enforcement and penalty mechanisms, measurement and verification of energy savings, and other features, it provides the kind of regulatory certainty that is attractive for CPP compliance. The CPP requires states to meet specific carbon emissions reductions, although states are provided flexibility on how they reach their reduction targets. In addition, EPA estimates that utility bills will be an average of eight percent lower in 2030 than they were in 2012 as a result of the Plan. Such a reduction in total system cost is only possible if states leverage demand side energy efficiency in their state plans.

The phase one annual efficiency and conservation goals were set through legislation at 1 percent per year in the first three-year phase and every company exceeded these goals. Now Pennsylvania is in the second phase of the program. The PUC set more modest statewide average goals than Phase I at approximately 0.75 per year⁵ with West Penn having the lowest goal at 1.6% for the Phase and PECO the highest at 2.9% which was set based on the outcome of the PUC's commissioned Potential Study. Future annual savings targets will be set by the PUC in 2015 depending on program potential and cost-effectiveness. The commission released late last week the new Potential Study for both energy efficiency and demand response. Both DR and EE are intended to reduce the costs of maintaining the power system, meet reliability standards and future capacity needs. The new Potential Study, which will help determine the goals for Phase III, is currently showing there is still much potential for cost effective savings under the Act 129 programs. The Statewide Evaluator (SWE) examines the technical, economic and achievable potential for each EDC as well as each customer class. Even with the current limitations under the law, the SWE shows the potential by 2020 to be 13.2% cumulative across the EDCs. Without a budget cap, they estimate the annual saving could range from 1.2% to 2% of 2010 load. The largest savings beginning June 1, 2016 based on a five year plan would average 4.5% statewide. Although these numbers are compelling, with changes to legislation, the potential is higher. Under the SWE analysis, all classes of customers would benefit from continued programs out to 2020. Depending on sector, lighting, HVAC, water heating and appliance swap-outs account for much of the potential in the residential sector; lighting and refrigeration for commercial sector and motors, lighting and HVAC account of a large amount of the potential in the industrial sector.

Reducing peak demand is proving to be consistently cheaper than expanding traditional generation plus it is a central building block for EPA compliance pathways. The CPP arrived at the 1.5 percent annual savings,⁶ rate starting in 2017 based on best practices in 12 states from 2006-2012. Act 129 program goals should be increased from historic levels to better match the EPA's 1.5% suggested target under the current draft rules. Representative Vitali's proposed legislative changes to Act 129 will significantly help remove some of the current barriers to achieving greater savings from lower cost energy efficiency resources while simultaneously helping to contain costs under the upcoming EPA CPP. Alliance for an Energy Efficient Economy, a well responded national organization with

⁵ In phase 1, each EDC has the same consumption reduction target of 3 percent over 3 years. In phase 2, EDC targets ranged from 1.6 percent to 2.9 percent over two years.

deep expertise with state energy efficiency program analysis claims that emission reductions below 2012 can be achieved at no net cost to the economy.

PA DEP's holds responsibility to ensure CPP compliance, but PA PUC administers Act 129. Coordination will be required between the two agencies to ensure an adequate regulatory arrangement under the CPP. Act 129 caps EDC spending on efficiency at 2 percent of total annual revenues as calculated on December 31, 2006. This spending cap may prevent Act 129 from increasing energy efficiency savings goals. Removal of the spending cap simply eliminates a redundant mechanism since there are already two ways Act 129 keeps spending in check. First, there is a very detailed manual called "The Technical Resource Manual" that is currently updated yearly where qualifying efficiency measures are added to the resource manual that are strictly scrutinized for cost effectiveness. In addition, Act 129 uses a total resource cost test that further ensures all electricity utility plans approved by the PUC meet cost/benefit thresholds so consumers are only paying for measures and programs that meet the test.

Jobs Impacts

Understandably, legislators are concerned about jobs lost under the CPP. Lawrence Berkeley National Laboratory conducted a multi-state study and found 6.2 person-years of employment were created in the energy efficiency service sector per \$1 million invested. By that metric, Pennsylvania may have created more than 10,000 jobs under PA Act 129. While ACEEE projects call for 7,900 new efficiency sector jobs by 2020 and 16,600 jobs by 2030 if Pennsylvania utilizes demand side energy efficiency to meet the Clean Power Plan's standards.

Efficiency Beyond Act 129

Non-utility delivered energy efficiency programs such as private sector investments through energy savings performance contracting, industrial efficiency, building codes are happening to varying degrees in Pennsylvania and present opportunities for low cost CPP compliance that haven't been accounted for under EPA's analysis and are outside of the Act 129 programs. Keeping building codes current is another path Pennsylvania can use to capture energy efficiency savings for GHG compliance purposes. The theory is that many of these carbon reducing energy efficiency investments are occurring in the market independent of the carbon reduction requirement and may therefore present low to no cost incremental emissions reductions. These emissions reductions will need to be tracked so they meet any requirements EPA may require to be included as a true reduction. Increased measurement and evaluation will ensure those benefits will be captured and also provide valuable information currently not consistently collected. Having said that, most energy savings performance contracts have stringent performance oversight for financial reasons and therefore may present an attractive compliance opportunity.

Thank you for the opportunity to testify today and KEEA appreciates your interest in these important and timely energy issues.

**Testimony of Robert C. Altenburg
Director, PennFuture Energy Center
Before the PA House Democratic Policy Committee
March 2, 2015**

Good morning Chairman Sturla, members of the House Democratic Policy Committee, and especially members of the public that have joined us today.

My name is Rob Altenburg and I am the director of the Energy Center for Enterprise and the Environment at Citizens for Pennsylvania's Future, also known as PennFuture. We are a nonprofit membership-based environmental advocacy organization focusing on land, air, water and energy issues that impact Pennsylvania. I'm very happy to be here today.

Introduction

Fifty years ago this year, in 1965, a report titled *Restoring the Quality of Our Environment*¹ was issued by President Lyndon Johnson's Science Advisory Committee. In its introduction, the President said "our present efforts in managing pollution are barely enough to stay even, surely not enough to make the improvements that are needed." Those words could easily be used today to describe our response to carbon pollution and climate change.

That report specifically warned of the dangers of climate change,² and we have learned a lot more over the past 50 years. We know we must improve energy efficiency and increase the use of clean renewable energy. While the federal Clean Power Plan³ and state action like HB 100, 200, and 129 are a good start, our energy sector—and especially our natural gas industry—has to become as efficient as possible.

We can debate whether natural gas is a bridge to a clean energy economy or to continued dependence on fossil fuels, but Pennsylvania is on that bridge. For the near term at least, we are dependent on natural gas. This year low gas prices coupled with retirements of aging coal plants will result in gas being the largest source of generation on our electric grid. As our grid's largest electricity exporter, that means we share our dependence on gas with over 51 million people across 13 states and the District of Columbia. We will easily exceed the Environmental Protection Agency (EPA) Clean Power Plan's expectations for shifting capacity from coal to gas. Unfortunately, if methane leakage is not sufficiently controlled, that shift will exacerbate climate change.

Addressing Methane Leakage

Pennsylvania attempts to control methane leakage with a complicated patchwork of approaches. At its core, we are offering the natural gas industry a trade. We give operators faster, easier, and cheaper permitting with less oversight and no public comment period, and in exchange, operators agree to meet some additional conditions.

¹ President's Science Advisory Committee, *Restoring The Quality of Our Environment*, (November, 1965).

² *Id.* at appendix Y1.

³ 79 Fed. Reg. 34830.

Permit Exemptions

Part of this approach relies on permit exemptions. For new wells and well heads, the Department of Environmental Protection (DEP) has “Exemption 38”.⁴ This exempts operators that adopt some additional measures from the pre-construction plan approval requirements. One of the measures is an annual leak detection and repair (LDAR) program. While LDAR is a positive step, Exemption 38 asks for a very minimal program.

First, it requires no leak detection at all for the first two months of operation and then only asks for annual testing thereafter as opposed to the quarterly testing required by the DEP in other cases and by several other states. Perhaps more troubling, though, is the lack of clear standards. The EPA, for example, has established what is known as Method 21⁵ that describes how to detect certain leaks. This contains detailed protocols related to calibration of test instruments, placement of detector probes, length of testing, etc. Exemption 38, on the other hand, provides very limited instructions. In some cases where it does specify a procedure, it conflicts with Method 21. This lack of standards will surely result in inconsistent interpretations between operators. Worse yet, we may see operators making choices to deliberately avoid identifying reportable leaks.

This failure is compounded because Exemption 38 has no record keeping requirements unless a leak is actually detected. The DEP has said that applicable federal regulations⁶ contain record keeping requirements.⁷ This may be true for specific equipment to which federal regulations apply, but this is in no way comprehensive. The DEP also said the facility-wide cap of 2.7 tons per year of Volatile Organic Compounds (VOCs) will ensure any leakage is minimal.⁸ While possible, the fear of exceeding the cap could just as easily encourage companies to under-report leakage.

Even if all these issues were addressed, this only impacts new construction. Thousands of unconventional wells and well heads still have a blanket exemption from operating permit requirements. **In fact, the DEP’s current guidance lists sources of methane as “trivial activities” that do not require operating permits.**

General Permits (GPA/GP-5)

Wells and well heads are only part of the story. There are also significant emissions from compression and processing facilities. These facilities require both pre-construction plan approvals and operating permits. For the vast majority of these, this requirement is satisfied through the use of the GP-5 general permit rather than receiving individual consideration through the permitting process.

The use of general permits should be limited to smaller sources but in practice, that is difficult to guarantee. The DEP rules are clear in that they do not allow major sources to use the GP-5 general permit; however, the criteria for determining whether or not a series of interrelated gas processing facilities should be considered a single major source or a series of

⁴ PA DEP, *Air Quality Permit Exemptions*, Document ID: 275-2101-003, (August 10, 2013).

⁵ *Determination of Volatile Organic Compound Leaks*, 40 CFR 60, Appendix A.

⁶ 40 CFR 60 Subpart OOOO.

⁷ PA DEP, *Comment/Response Document, Proposed Revisions to the Air Quality Permit Exemptions List Categories No. 33 and No. 38*, Response to Comment 16 (August 10, 2013).

⁸ *Id.* at Response to Comment 16.

minor sources is a matter of debate and litigation. The DEP's current guidance on the topic⁹ differs from the EPA's interpretation¹⁰ so it is unclear if GP-5 is being used in areas where it shouldn't be allowed.

Compounding this issue, the DEP recently removed the limit which originally had prevented sources emitting the equivalent of more than 100,000 tons of carbon dioxide per year from using GP-5.¹¹ This is significant for the natural gas industry where the majority of emissions are of the greenhouse gas methane. DEP's action, which was finalized three days before Gov. Wolf took office, was justified on the basis of a recent U.S. Supreme Court decision.¹² However, that decision in no way mandates that DEP make the policy decision to offer a streamlined 30-day permitting option for such large emitters.

Even so, the size of these sources is only part of the issue. Pennsylvania's Air Pollution Control Act specifies that general permits may only be used for sources that "are similar in nature and can be adequately regulated using standardized specifications and conditions."¹³ For the processing facilities in question, that isn't necessarily the case. These facilities are both more complex and less similar to each other than the types of sources covered by other DEP general permits. They are more complex because they can include nine different categories of sources and there is a range of allowed sources within each category. They are less similar, facility to facility, because they are not designed according to a standard model, rather according to the number of wells being served, the location and elevation of those wells, the composition of the gas being produced and a whole series of other factors including the operational preferences of the company that owns the wells (which may differ from the company that operates the compressor). Each GP-5 facility is necessarily customized but when GP's are used, the DEP is not permitted to customize permit conditions.

Even if a general permit is permissible and appropriate for a particular source, there is still an implication for public participation. While every general permit in the air program requires a 45-day public comment period, the problem is that the public comment period comes before the general permit is issued, not when the permit is used. This means that **by the time a citizen learns that he or she could be impacted by a new operation, it could be years after the deadline to file comments.**

Conclusion

Many of the problems with our current patchwork approach could be resolved if Pennsylvania adopted a clear and consistent program that considers both the needs of our communities and our experience in working with the industry.

Recently, EPA Administrator Gina McCarthy announced plans to propose new limits on methane emission leakage from the oil and gas industry.¹⁴ While it's encouraging to see the federal government specifically address methane leakage, we shouldn't rely on the EPA.

⁹ PA DEP, *Guidance for Performing Single Stationary Source Determinations for Oil and Gas Industries*, Document Number: 270-0810-006, (October 6, 2012).

¹⁰ Gina McCarthy, *Withdrawal of Source Determinations for Oil and Gas Industries*, (September 22, 2009).

¹¹ 45 Pa.B. 370 (January 17, 2015).

¹² *Utility Air Regulatory Group (UARG) v. EPA* decision, No. 12-1146 (June 23, 2014).

¹³ 32 P.S. § 693.7(b).

¹⁴ Gina McCarthy, *Remarks at GE Oil and Gas Annual Meeting*, (February 2, 2015).

Pennsylvania's role as an energy producer means we have an extensive amount of gas infrastructure in a relatively small area. This makes it even more important for us to be a leader in emissions controls. We may also find that we have more options for cost-effective controls than states with a fraction of our production.

We simply cannot afford to wait for federal action to protect our citizens and our environment. Even if our state's Constitution didn't require the Commonwealth to serve as a trustee of our natural resources,¹⁵ the Clean Air Act requires that the EPA delegate authority to states to implement adequate standards of their own design.¹⁶ Our Governor and Legislature should ensure we seize the opportunity to implement the best possible plan for Pennsylvania.

¹⁵ Pa. Const. Art. I § 27.

¹⁶ 42 U.S.C. § 7411(c).

Testimony
Before the
Pennsylvania House Democratic Policy Committee

On

How Can Pennsylvania Achieve Carbon Neutrality?

Mark K. Boling
Executive Vice President, Southwestern Energy Company, and
President, V+ Development Solutions,
a division of Southwestern Energy Company

March 2, 2015

1 Good afternoon Chairman Sturla, Representative Vitali and other members of the
2 Policy Committee. My name is Mark Boling and I am Executive Vice President of
3 Southwestern Energy Company (Southwestern) and President of our V+ Development
4 Solutions division (V+). The mission of Southwestern's V+ Division is to identify and
5 implement solutions to the challenges of shale gas development that achieve the proper
6 balance among the environmental, social and economic impacts of our activities.
7 Southwestern is an independent exploration and production company, and is the fourth
8 (4th) largest producer of natural gas in the United States. I appreciate the opportunity to
9 appear before you today and provide testimony regarding methane emissions from
10 natural gas systems.

11
12 Advances in horizontal drilling and hydraulic fracturing technologies have
13 resulted in a dramatic increase in U.S. natural gas supplies. The corresponding drop in
14 natural gas prices has given many American businesses a competitive advantage in the
15 world marketplace, and has spawned a manufacturing renaissance in the United States.
16 This abundant supply of natural gas has also allowed the United States to improve its
17 trade imbalance, significantly enhance its energy security and reduce its greenhouse gas
18 emissions faster than any other industrialized country. According to the Energy
19 Information Administration (EIA), switching from coal to natural gas in the U.S. power
20 generation sector has averted over a billion tons of CO₂ emissions from 2005-2013.¹

21
22 The Marcellus Shale region is the largest shale gas basin in the United States,
23 accounting for more than 40% of U.S. shale gas production,² with most of this
24 production occurring in Pennsylvania. The EIA estimates that Marcellus production
25 increased from 1.1 billion cubic feet per day (bcfd) in January 2007 to current levels of

¹ See Attachment 1 to this testimony.

² <http://www.eia.gov/todayinenergy/detail.cfm?id=17411>

26 over 16.5 bcfd. Southwestern is one of the largest producers and acreage holders in the
27 Marcellus Shale.³

28
29 The rapid development of the Marcellus Shale in Pennsylvania has raised
30 legitimate concerns about potential environmental and community impacts associated
31 with shale development activities, including methane emissions from natural gas
32 production, gathering, transmission and distribution facilities.⁴ Methane, which is the
33 largest component of natural gas, is a powerful, short-lived greenhouse gas, and the
34 climatic benefits of natural gas over other fossil fuels can be eroded if significant
35 quantities of methane escape from the natural gas system.

36
37 Southwestern understands the environmental and economic value of mitigating
38 methane emissions from its facilities. As part of our effort to realize this value,
39 Southwestern participated in three (3) studies, led by the Environmental Defense Fund
40 (EDF), that examined methane emissions from the production, gathering & processing
41 segments of the natural gas supply system. Results of these studies have been
42 published in peer review publications and have been utilized in updating emission
43 factors and in formulating emission reduction policies in the United States.⁵

44
45 Southwestern has also teamed up with an IBM led research team that has been
46 awarded \$4.5 million by DOE's Advanced Research Projects Agency-Energy (ARPA-E)
47 to develop a new, low-cost optical sensors network that will enable enhanced methane
48 leak detection from natural gas systems. In addition, Southwestern is working with an
49 EDF led group to develop the next generation of low-cost methane leak detectors. The
50 ARPA-E and the EDF Methane Detector challenge will revolutionize detection and
51 quantification of methane emissions.

³ In 3Q 2014, SWN was the second largest producer in the Appalachia (which covers the Marcellus and the Utica) and held the third largest acreage. <http://www.swn.com/investors/LIP/latestinvestorpresentation.pdf>

⁴ See Attachment 2 to this testimony.

⁵ <http://epa.gov/climatechange/ghgemissions/usinventoryreport/natural-gas-systems.html>

52

53 Southwestern is also sponsoring a research project led by the Colorado School of
54 Mines, the National Renewable Energy Laboratory and the National Oceanic and
55 Atmospheric Administration (NOAA) that is designed to reconcile top-down and
56 bottom-up methane emission estimates from various onshore basins in the United
57 States.

58

59 Internally, Southwestern has implemented a Leak Detection and Repair (LDAR)
60 program across all of our company's operations. In 2014, SWN surveyed
61 approximately 3,150 locations and repaired 1,248 leaks (percentage of equipment with
62 leaks <1.0%), recovering an estimated 350 MMSCF of methane. Southwestern is also a
63 proud participant in the Environmental Protection Agency's Natural Gas STAR
64 Program, which encourages companies to recover or reduce methane emissions. In
65 2012, Southwestern was named Natural Gas STAR Production Partner of the Year, with
66 total methane emission reductions of over 37 Bcf for the period 2006-2012.

67

68 Based on this experience and our analysis of several peer-reviewed studies
69 concerning methane emissions, we would like to provide the Committee with four (4)
70 key take-away observations:

71 1) Methane emission rates below 1% of gross production ensure that natural gas has
72 immediate climatic benefits over other fossil fuels in any end-use application.⁶

73 2) Studies that have identified high methane emission rates by certain "top-down"
74 measurements "are unlikely to be representative of the entire natural gas industry".⁷ In
75 fact, a recent study conducted by NOAA estimates that methane emissions from the
76 Marcellus region in northeastern Pennsylvania are 0.18-0.41% of gross production.⁸

⁶ Greater focus needed on methane leakage from natural gas infrastructure, Alvarez et al. (2012), www.pnas.org/cgi/doi/10.1073/pnas.1202407109

⁷ Methane Leaks from North American Natural Gas Systems, *Brandt et al, 2014, SCIENCE VOL 343 14 FEBRUARY 2014* ; Global Bottom-Up Fossil Fuel Fugitive Methane and Ethane Emissions Inventory for Atmospheric Modeling, *Schwietzke et al, 2014, dx.doi.org/10.1021/sc500163h*

⁸ Quantifying atmospheric methane emissions from the Haynesville, Fayetteville, and northeastern Marcellus shale gas production regions, J. Peischl et al. (2015), [doi:10.1002/2014JD022697](https://doi.org/10.1002/2014JD022697)

- 77 3) Greenhouse gas emissions from shale gas and conventional gas development are “nearly
78 identical”, and CO₂ emissions from natural gas-fired power plants are approximately
79 50% less than CO₂ emissions from coal-fired plants.⁹
- 80 4) “Super-emitter” sources account for the vast majority of methane emissions from the
81 natural gas supply system.¹⁰ This “fat-tail distribution” concept also extends to
82 abandoned oil and gas wells in Pennsylvania, as noted in a recent paper¹¹ where three
83 (3) out of the 19 measured wells had methane emissions “three orders of magnitude
84 larger than the median flow rate.”

85

86 To pursue effective methane reduction policies and programs on a broader scale,
87 Southwestern has applied what it has learned from the above-described work to form
88 Our Nation’s Energy Future (ONE Future) coalition. The ONE Future coalition is a
89 group of eight companies¹² from across the natural gas supply chain that is dedicated to
90 reducing methane emissions from the entire value chain to below an aggregate
91 leak/loss rate of 1%. ONE Future member companies will employ a flexible,
92 performance-based framework to cost-effectively manage their methane emissions.¹³ If
93 adopted widely, the ONE Future system of emissions management could lower total
94 methane emissions to less than one percent of gross production – the point at which the
95 use of natural gas for any purpose provides clear and immediate greenhouse gas
96 reduction benefits as compared to any other fossil fuel. In addition, the flexible,
97 performance-based design will allow companies to optimize their emission reduction
98 efforts by focusing capital deployment on their highest-emitting sources as the natural

⁹ Harmonization of initial estimates of shale gas life cycle greenhouse gas emissions for electric power generation; Heath et al. (2014), www.pnas.org/cgi/doi/10.1073/pnas.1309334111. Also, see Attachment 3 to this testimony.

¹⁰ Measurements of methane emissions at natural gas production sites in the United States, Allen et al. (2013), www.pnas.org/cgi/doi/10.1073/pnas.1304880110; Toward a better understanding and quantification of methane emissions from shale gas development, Caulton et al. (2014), www.pnas.org/cgi/doi/10.1073/pnas.131654611; Methane Emissions from Process Equipment at Natural Gas Production Sites in the United States: Pneumatic Controllers, Allen et al. (2014), dx.doi.org/10.1021/es5040156; Measurements of Methane Emissions from Natural Gas Gathering Facilities and Processing Plants: Measurement Results, Mitchell et al. (2015), DOI: 10.1021/es5052809, Methane Emissions from Natural Gas Compressor Stations in the Transmission and Storage Sector: Measurements and Comparisons with the EPA Greenhouse Gas Reporting Program Protocol, Subramian et al. (2015), DOI: 10.1021/es5060258

¹¹ Direct measurements of methane emissions from abandoned oil and gas wells in Pennsylvania, Kang et al. (2014), www.pnas.org/cgi/doi/10.1073/pnas.1408315111

¹² AGL Resources, Apache Corporation, BHP Billiton, Columbia Gas Transmission, Hess Corporation, Kinder Morgan, Inc., National Grid, Southwestern Energy Company

¹³ See Attachment 4 to this testimony.

99 gas industry serves our nation's growing energy demand, especially in the power
100 sector.

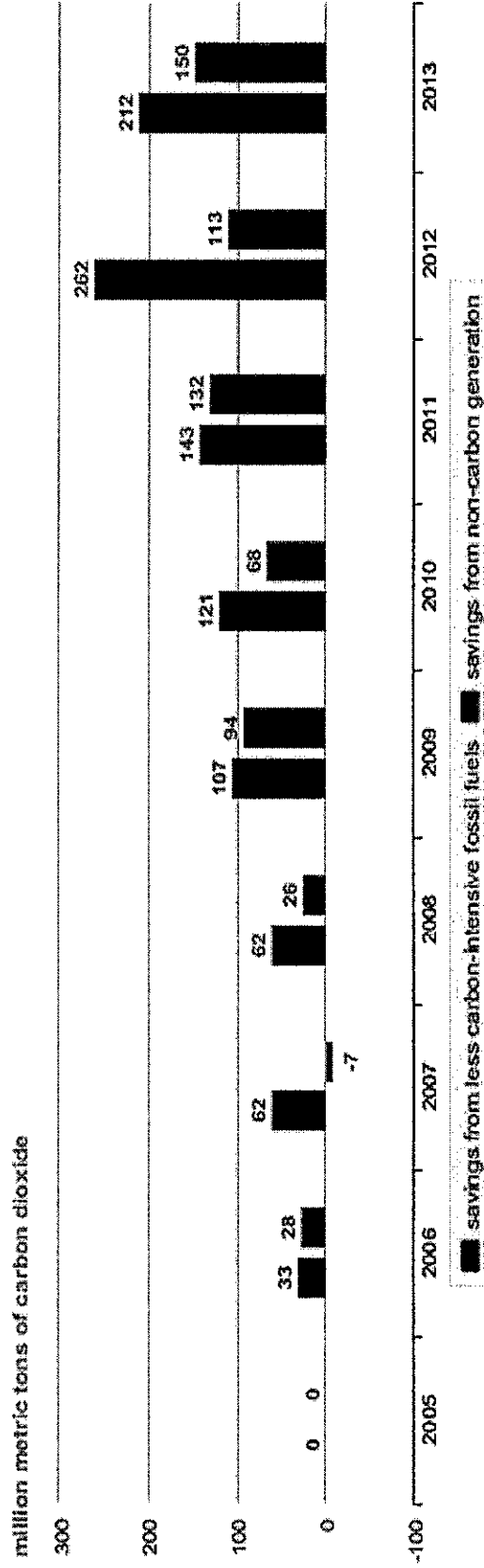
101
102 In summary, Southwestern believes that the development of America's natural
103 gas resources is an important part of achieving a secure, low-carbon energy future for
104 our country, but only if it is done right. The good news is that the solutions to "doing it
105 right" are out there and if industry, environmental groups and regulators work together
106 in a collaborative way, these solutions can be found and implemented. The methane
107 emission work that Southwestern and other industry partners have participated in over
108 the last few years demonstrates that methane emissions from the natural gas system can
109 be effectively minimized by applying reasonable emission capture and control policies.

110
111 Mr. Chairman, this concludes my testimony. I would be happy to answer any
112 questions you may have.

Over a billion tons of CO₂ not emitted due to fuel switching to natural gas



Electric power sector carbon dioxide savings since 2005 from less carbon-intensive fossil fuels and from non-carbon generation, 2005-13

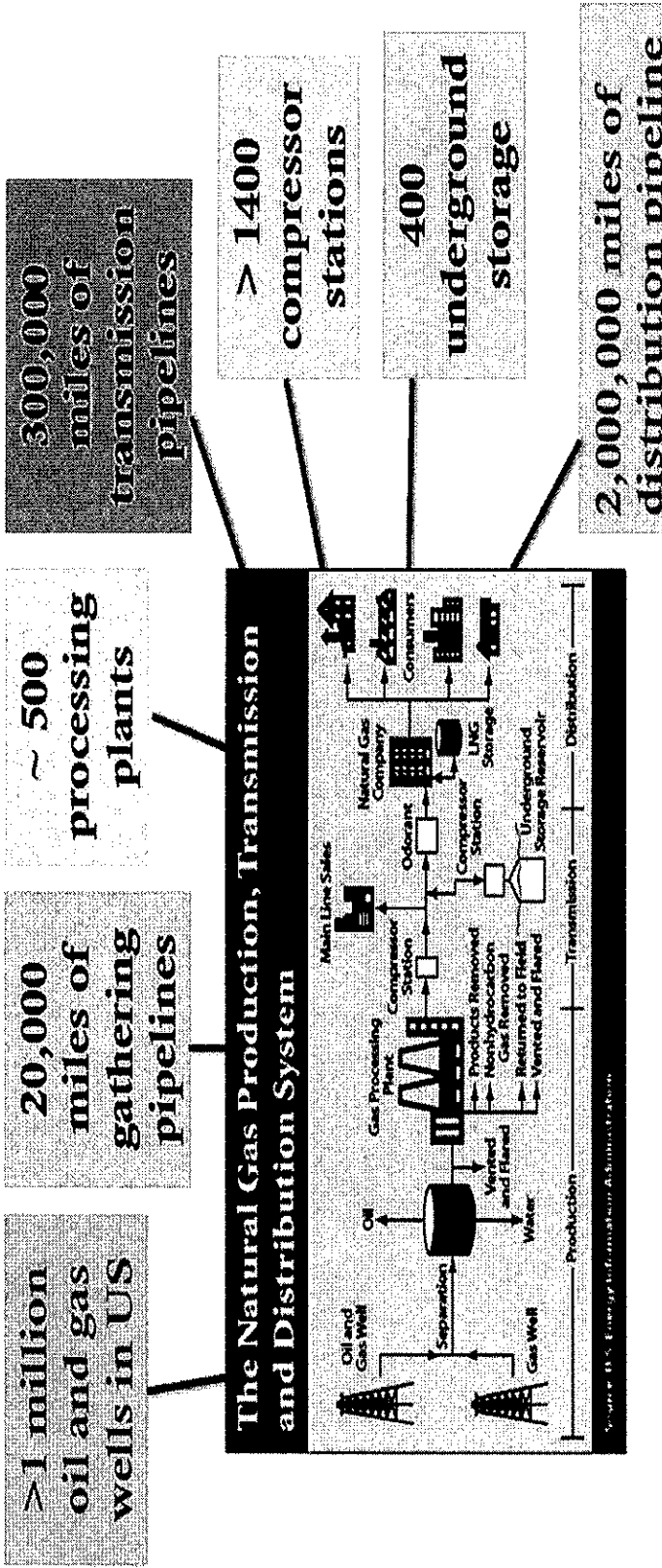


Source: U.S. Energy Information Administration, Monthly Energy Review (September 2014), Tables 12.1 and 1.1. Population growth, Census Bureau as of September 3, 2014. GDP, Bureau of Economic Analysis, as of July 31, 2014.



$$\frac{R^2}{A} \rightarrow V^+$$

Natural Gas System Infrastructure



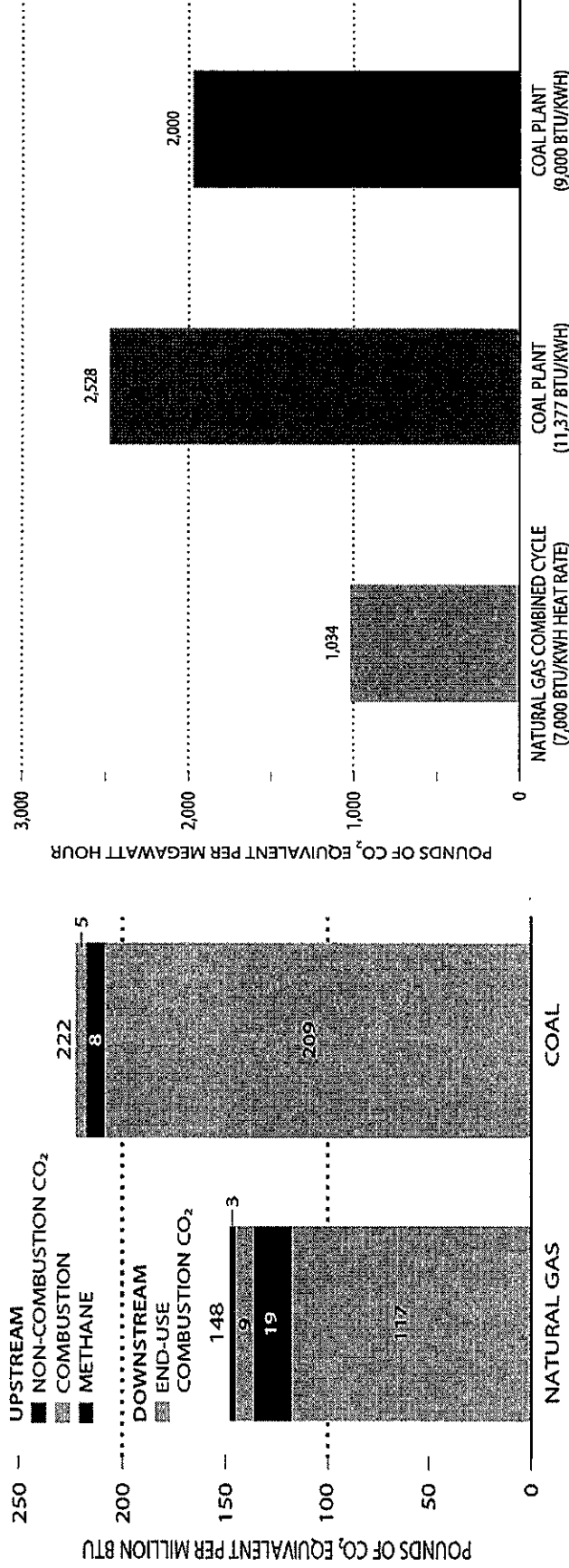
Source: Gabriella Petron, NOAA

$$\frac{R^2}{A} \rightarrow V^+$$

Natural Gas Has Lower GHG Emissions



LCA GHG Emissions from Natural Gas-Fired Plants are 50-60% Lower than Existing Coal-Fired Plants



Gas-Fired Generation has 99% Lower SO₂ and Mercury Emissions and about 82% Lower NO_x Emissions Relative to Pulverized Coal Units

Source: NRC (2011)



ATTACHMENT 4



About the ONE Future Coalition

Background:

ONE Future is a coalition of companies from across the natural gas industry focused on identifying policy and technical solutions that yield continuous improvement in the management of methane emissions associated with the production, processing, transmission and distribution of natural gas. If adopted widely, our system of emissions management could lower total methane emissions to less than one percent of gross production – the point at which the use of natural gas for any purpose provides clear and immediate GHG-reduction benefits as compared to any other fossil fuel.

Members of ONE Future:

- AGL Resources
- Apache Corporation
- BHP Billiton
- Columbia Pipeline Group
- Hess Corporation
- Kinder Morgan, Inc.
- National Grid
- Southwestern Energy Company

Quick Summary of the ONE Future Approach:

Rather than prescribing the use of specific technologies or practices, ONE Future participants start with a goal: achieving an average rate of emissions intensity across all their facilities by a specific date. Each company then has the flexibility to determine the most cost-effective pathway to achieve that goal – and agrees to demonstrate progress according to specific reporting protocols.

- **How is a company's target emissions rate determined?** ONE Future focuses on ensuring that total methane emissions from across the entire gas value chain will eventually amount to less than 1% of total natural gas throughput/production. Each industry sector's reduction target is determined by their proportional share of current emissions that can be abated cost-effectively. Participating companies then implement measures to ensure that their emissions are reduced to or below their sector's sub-target.
- **ONE Future focuses on achieving results with credibility.** Companies will document and report progress under ONE Future's approach but the ONE Future approach also allows a company to focus on achieving efficiencies across the entire operation – as a basic business activity, rather than a burden.
- **Why start with a performance target vs. a known technology?** Setting a performance target allows a company to deploy capital where it will be most effective in reducing emissions. This is important, because most studies clearly show that the majority of methane emissions come from a small fraction of sources. ONE Future's approach allows companies to focus their resources on identifying and addressing those major sources.
- **How much will ONE Future accomplish?** A 1% methane emissions rate would equate to roughly 37 million tons of CO2 equivalent in emissions reductions.

Our Nation's Energy Future Coalition (ONE Future)

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