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Testimony on "American Energy Security and Innovation: Grid Reliability Challenges in a Shifting Energy Resource Landscape"

Subcommittee on Energy and Power of the Committee on Energy and Commerce

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Thank you for the opportunity to testify before the House Energy and Commerce Subcommittee on Energy and Power on "American Energy Security and Innovation: Grid Reliability Challenges in a Shifting Energy Resource Landscape." U.S. electricity generation is undergoing a transition, including a measurable shift from coal to natural gas and renewable electricity sources.

Any evaluation of this transition and its impacts, however, must consider that our electricity generation produces the carbon pollution responsible for climate change, and that climate change impairs electricity reliability. A discussion about electricity security and innovation that ignores global warming is like a discussion about personal wellness that ignores cigarette smoking, diet and exercise. Since coal fired power plants emit one-third of the climate pollution in the U.S., it is irresponsible to assess changes in our electricity system while ignoring climate pollution and its impacts.[1]

This testimony will address the following issues that are essential to an informed discussion of electricity security and reliability.

1. Americans understand that extreme weather is related to man-made climate change that costs our economy billions of dollars annually
2. Electricity reliability threatened by climate related extreme weather
3. We must reduce carbon pollution from power plants
4. We must increase investments in emerging no and low carbon technologies
5. We must enhance our electricity system's resilience to damages from extreme weather

1. Climate change is real, here, and due to human activity

There is a scientific consensus that climate change is due to the emission of carbon pollution and other heat trapping gases. The production, transportation, and combustion of fossil fuels produce carbon pollution responsible for climate change. The costly damages from climate change impacts – particularly extreme weather – increase the imperative to reduce this pollution by transitioning to significantly cleaner fuels.

The National Academy of Sciences left no doubt about the scientific consensus about carbon pollution, climate change, and its impacts. It reported in 2010 that:

> There is a strong, credible body of evidence, based on multiple lines of research, documenting that climate is changing and that these changes are in large part caused by human activities…The core phenomenon, scientific questions, and hypotheses have been examined thoroughly and have stood firm in the face of serious scientific debate and careful evaluation of alternative explanations.[2]

The American Meteorological Society came to a similar conclusion last year.

> There is unequivocal evidence that Earth's lower atmosphere, ocean, and land surface are warming; sea level is rising; and snow cover, mountain glaciers, and Arctic sea ice are shrinking. The dominant cause of the warming since the 1950s is human activities. This scientific finding is based on a large and persuasive body of research.

> The observed warming will be irreversible for many years into the future, and even larger temperature increases will occur as greenhouse gases continue to accumulate in the atmosphere. Avoiding this future warming will require a large and rapid reduction in global greenhouse gas emissions.[3]

The National Climate Assessment is a congressionally mandated assessment of the latest climate science. The 2013 draft was undertaken by over two hundred scientists.[4] It determined that

> Sea level rise, combined with coastal storms, has increased the risk of erosion, storm-surge damage, and flooding for coastal communities, especially along the Gulf of Mexico, the Atlantic seaboard, and Alaska.[5]

Kevin E. Trenberth, senior scientist at the National Center for Atmospheric Research, recently noted:

> All weather events are affected by climate change because the environment in which they occur is warmer and moister than it used to be. The air is on average warmer and moister than it was prior to about 1970 … [This] contributes to more intense precipitation events that are widely observed to be occurring.[6]

These are dozens of scientific organizations that conducted or assessed independent, peer reviewed studies that all came to the same conclusion: climate change is real and humans are responsible. Those that deny this climate science are akin to tobacco industry apologists who once denied the link between cigarette smoking and cancer.

Most severe extreme weather cost 1,107 lives, $188 billion in damages in 2011-2012

The impacts of climate change – including extreme weather, sea level rise, and the spread of tropical diseases – have real costs. The U.S. was battered by many severely damaging climate-related extreme weather events over the past two years. The National Oceanic and Atmospheric Administration reported that in 2011 and 2012 there were a total of 25 floods, drought, storms, and wildfires that each caused at least $1 billion in damages.[7] Together, these 25 $1 billion-dollar minimum in damages events caused 1,107 fatalities, and caused up to $188 billion in total damages.[8] *The New York Times* warned that "the economy won't function very well in a world full of droughts, hurricanes, and heat waves."[9]

A recent study by Munich Re, the world's largest reinsurance firm, found that North America is experiencing a tremendous rise in extreme weather disasters—a nearly fivefold increase over the past three decades.[10] The firm concluded that this is due to climate change.

No state is immune to the most destructive extreme weather. For instance, between 1980 and 2012 Kentucky was harmed by three dozen severe weather events that each caused a total of at least $1 billion in damages in the affected states.[11] These events include heavy precipitation and severe thunderstorms, tornadoes, flooding, heat waves and drought. The National Climate Assessment draft noted that "The Southeast has experienced more billion-dollar in damages disasters than any other region" in the United States. [12]

Kentucky agriculture was harmed by the 2012 drought – the worst in sixty years. According to the University of Kentucky's agriculture extension program,

> "The drought dominated the U.S./Kentucky farm economy conversation in 2012. Crop yields suffered greatly and high feed costs coupled with depleted pastures and water supplies adversely impacted livestock prices and profit margins."[13]

Climate related extreme weather has continued in 2013. As of May 7th, President Barack Obama has issued 17 presidential disaster declarations for severe storms and flooding.[14] And this does not include the recent Mississippi River flooding from Wisconsin to Missouri, and the flooding in North Dakota.[15] Nor does it include the deadly California wildfires. None of these events have yet received presidential disaster declarations.

The threat of wildfires outside of California remains high too. The National Interagency Fire Center's May 1st report noted that

> "Severe drought conditions across the western U.S. had a significant effect on fuel conditions. Nearly all areas west of the Rocky Mountains… are experiencing both live and dead fuel moistures which are extremely low and raise the probability for sever early season fire activity that will likely continue into the summer."[16]

This may be due to the ongoing drought. The U.S. drought monitor shows that nearly half of the US in drought as of April 30th. It reports that "The Upper Midwest continued to deal with long-term precipitation deficits despite seasonal spring flooding, while an early end to the western Water Year caused drought to intensify across the Southwest."[17]

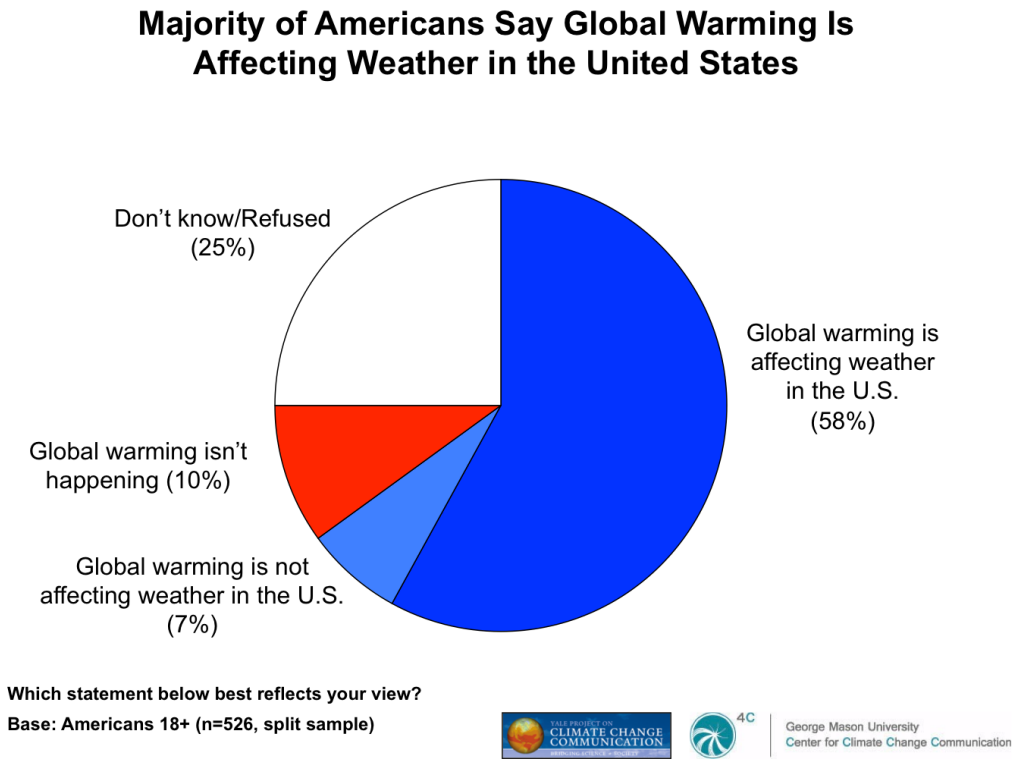
Americans understand that climate change is affecting U.S. weather

The vast majority of Americans understand that there is a scientific consensus about climate change. A recently released Gallup poll found that 62 percent of Americans believe that "scientists think warming is occurring," while 28 percent believe it is ambiguous. Only 6 percent think that scientists do *not* believe climate change is underway. [18] This poll also found that 57 percent of respondents believe that climate change is due to "human activities," while only 39 percent think it is from "natural causes."[19]

Americans also understand that the recent spate of extreme weather is related to climate change according to a recent poll by the Yale Project on Climate Communication and the George Mason University Center for Climate Change Communication.[20] Highlights from the poll include the following findings.

> About six in ten Americans (58%) say "global warming is affecting weather in the United States."
>
> Many Americans believe global warming made recent extreme weather and climatic events "more severe," specifically: 2012.

Many Americans (51%) also say weather in their local area has been worse over the past several years.

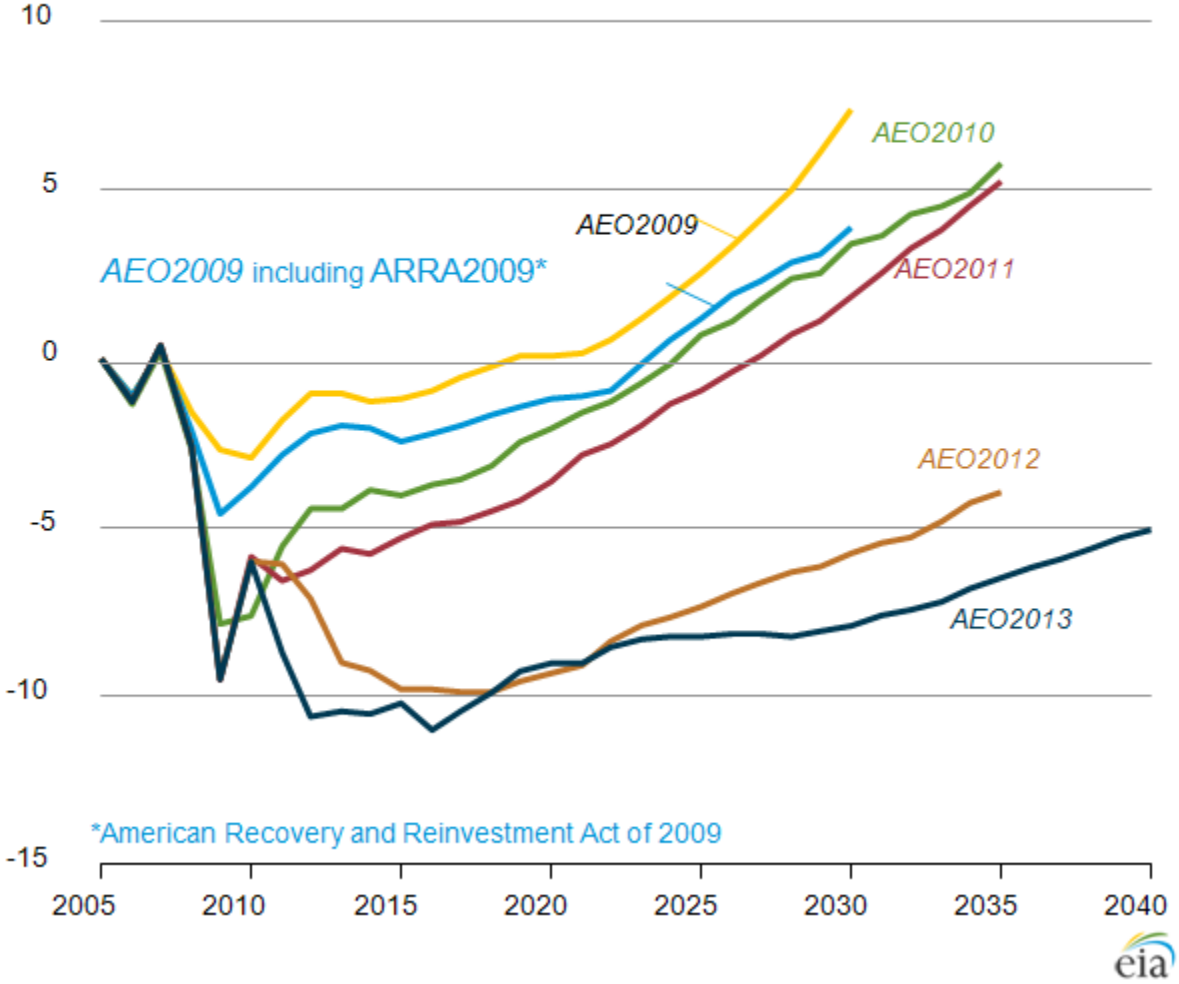


U.S. reduced climate pollution, but will miss 2020 reduction goal

In 2009 President Obama committed the United States to 2020 greenhouse gas pollution levels "in the range of" a 17 percent reduction below 2005 levels.[21] The Environmental Protection Agency recently reported that "Greenhouse gas emissions in 2011 were 6.9 percent below 2005 levels," or slightly more than 40 percent towards this 2020 goal.[22] This is due to reductions of carbon pollution from motor vehicle emissions, lower electricity demand, and a shift from coal to natural gas and renewable-electricity generation. The Energy Information Administration, however, projects that carbon pollution from the energy sector will rise again beginning in 2017 without additional action as fossil fuel generated electricity grows.[23]

Other nations are more aggressively reducing their climate pollution. The European Union's 2020 goal to lower its emissions by 20 percent compared with 1990 levels, and it is on pace to achieve it.[24] Australia and New Zealand both have programs to achieve steep reductions in carbon pollution over the next four decades.[25] [26]

Figure 13. U.S. energy-related carbon dioxide emissions in recent AEO Reference cases

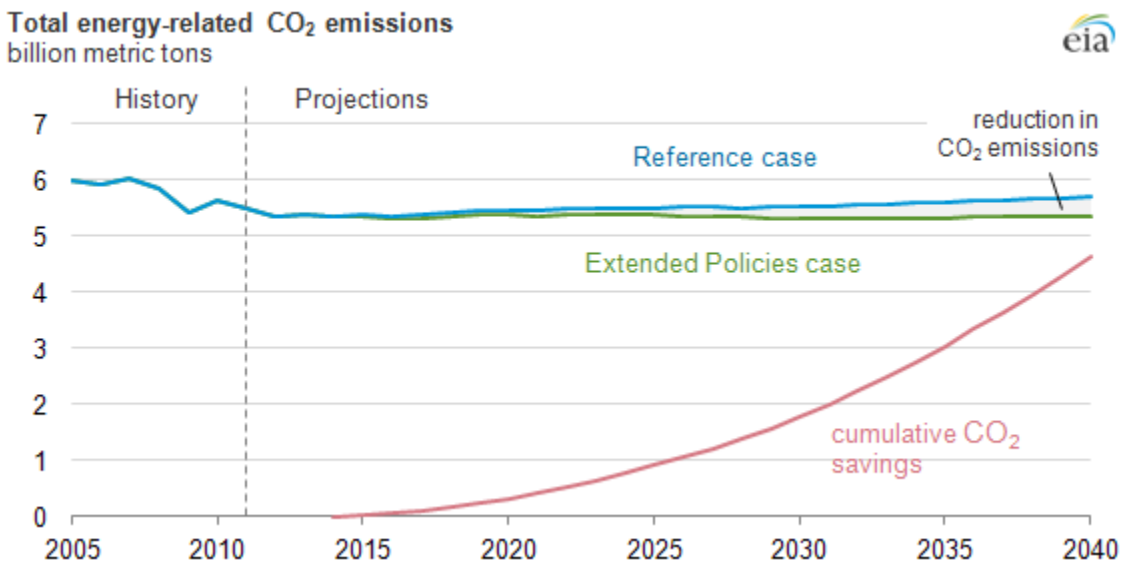


Source: Energy Information Administration

Last week EIA projected that

> Extending certain federal energy efficiency and renewable energy laws and regulations could reduce annual energy-related carbon dioxide emissions in the United States in 2040 by roughly 6% relative to a Reference case projection that generally assumes current laws and policies.[27]

However, that would still leave U.S. emissions far above the level necessary to offset the worst impacts of climate change.



Source: Energy Information Administration

Federal natural disaster relief and recovery cost taxpayers $136 billion in FY 2011-13, or $400 per household annually

The Center for American Progress recently released "Disastrous Spending: Federal Disaster-Relief Expenditures Rise amid More Extreme Weather," which estimates that the federal government spent $136 billion for disaster relief and recovery in 2011 to 2013.[28] These funds are from taxpayers, and are nearly $400 per home per year.

TABLE 1

Federal spending on disaster relief and recovery, 2011–2013

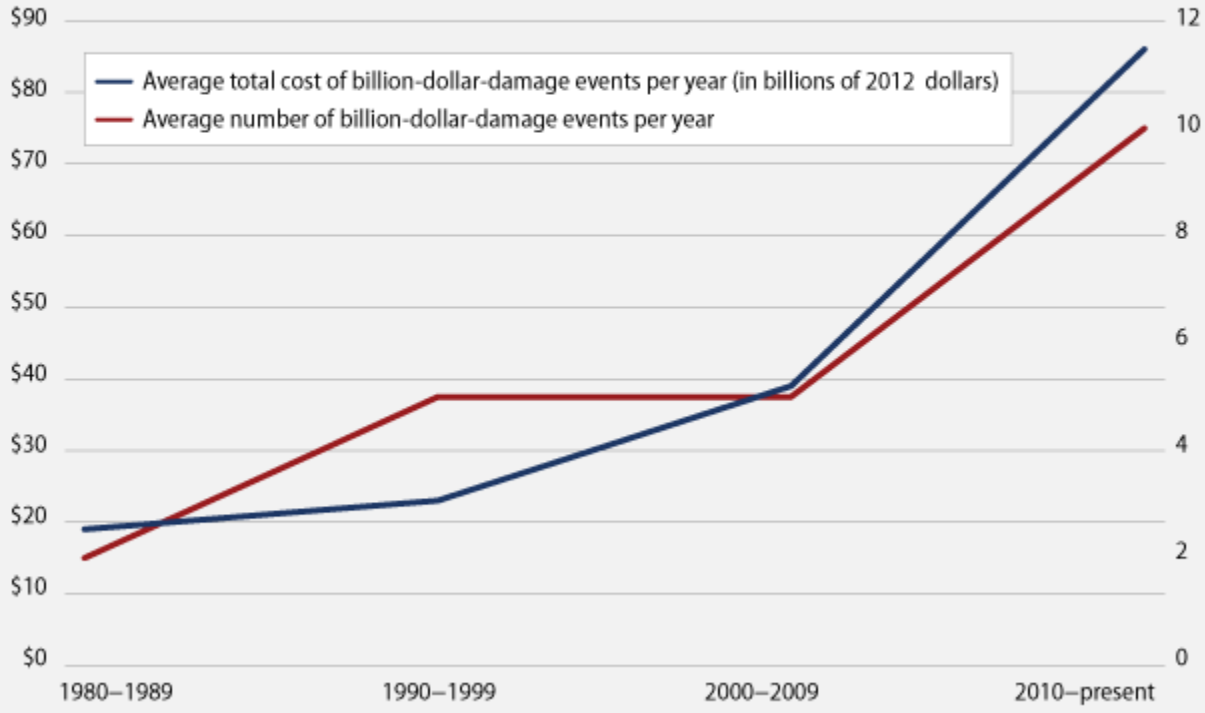
Fiscal year appropriations or supplemental bill spending	Estimated disaster-relief spending (in millions of $)
FY 2011	$21,376
FY 2012	$32,412
FY 2012 supplemental appropriations	$8,174
FY 2013	$14,321
FY 2013 Superstorm Sandy supplemental appropriations	$60,210
Total	**$136,493**

Notes: The Treasury Department has two disaster-related programs, but funding levels are unavailable. Figures are rounded.
Sources: Annual department budget reports; appropriations and supplemental appropriations law. For more detail, see the attached spreadsheet.

This CAP report also found that the most destructive severe weather events have grown both number and damages over the past three decades.[29] If this trend continues at the same rate, the United States will experience more frequent and severe extreme weather events in the years to come, meaning that the federal government will have to spend more and more funds on disaster-relief efforts, leaving taxpayers with the bill.

FIGURE 1

Billions of dollars in damages from extreme weather events increasing in frequency, cost from 1980–2012



Source: National Oceanic and Atmospheric Administration.

U.S. can expect more extreme and severe weather according to scientists

As if the recent bout of extreme weather is not bad enough, scientists predict that it could get much worse due to climate change. NASA just released a study that "projects warming-driven trends in rainfall…which may increase the risk for extreme rainfall and drought."[30] NASA's study predicts that

> Some regions outside the tropics may have no rainfall at all. In the Northern Hemisphere, areas most likely to be affected include the deserts and arid regions of the southwest United States, Mexico, North Africa, the Middle East, Pakistan, and northwestern China.[31]

The National Climate Assessment draft predicts that our temperature will continue to rise, and we will continue to experience extreme weather related to climate change.

> Global climate is projected to continue to change over this century and beyond. The magnitude of climate change beyond the next few decades depends primarily on the amount of heat-trapping gases emitted globally, and how sensitive the climate is to those emissions.
>
> U.S. average temperature has increased by about 1.5°F since record keeping began in 1895; more than 80% of this increase has occurred since 1980. The most recent decade was the nation's warmest on record. U.S. temperatures are expected to continue to rise.
>
> Heavy downpours are increasing in most regions of the U.S., especially over the last three to five decades. Largest increases are in the Midwest and Northeast. Further increases in the frequency and intensity of extreme precipitation events are projected for most U.S. areas.
>
> Global sea level has risen by about 8 inches since reliable record keeping began in 1880.It is projected to rise another 1 to 4 feet by 2100.[32]

More extreme weather is also predicted for the southeast United States by the National Climate Assessment draft.

> The Southeastern region is exceptionally vulnerable to…extreme heat events, and decreased water availability.
>
> Temperatures across the Southeast are expected to increase during this century, fluctuating over time because of natural climate variability. Major consequences of warming include significant increases in the number of hot days (95F).
>
> Summer heat stress is projected to reduce crop productivity, especially when coupled with increased drought.[33]

2. Electricity reliability threatened by climate change

Like many other categories of infrastructure, electricity generation and transmission are vulnerable to extreme weather, and by extension, climate change. The Congressional Research Service evaluated the impact of weather on electricity reliability in its "Weather-Related Power Outages and Electric System Resiliency" report from August 2012.[34] It concluded that "power delivery systems are most vulnerable to storms and extreme weather events."[35]

CRS determined that "Cost estimates from storm-related outages to the U.S. economy at between $20 billion and $55 billion annually. Data also suggest the trend of outages from weather-related events is increasing."[36]

The Department of Energy's database of grid disturbance events also shows an increasing number of power outages from 1992 to 2010, and that 78 percent of the reported 1,333 grid disruptions were weather-related.[37] Evan Mills, the author of the DOE study, "believes the reasons for the increased trend in outages may be due to a combination of power grid deterioration and a real increase in the number of observed extreme weather events."[38]

Severe drought of 2012 interfered with electricity generation

In addition to severe storms disrupting power transmission, extreme drought reduces water flows that can impair the operation of electricity generation units because they require huge amounts of water for "cooling, fuel processing, and emission control," according to the Department of Energy.[39]

The severe drought of 2012 interfered with the operation of numerous power plants. In August 2012, National Geographic magazine reported

> Record heat and drought conditions across the United States this summer have plagued power plants that require cool water to produce electricity. From Connecticut to California, high water temperatures and diminished access to water caused by drought have forced a number of power plants to ramp down production... At least one plant has suspended operations.[40]

For instance, the Millstone nuclear plant in Waterford, CT had to shut down in mid-August 2012 because water from the Long Island Sound "was too warm to cool critical equipment outside the core. Two Midwestern coal plants – one in Illinois- had to stop operating because of low water levels and "water-intake pipelines ended up on dry ground from the prolonged drought." [41]

The Department of Energy concluded that "Drought (affected by climate change) combined with possible exhaustion of aquifers could lead to population and power use shifts that could change electrical load patterns."[42]

Fracking for tight oil and shale gas vulnerable to extreme weather, too

A significant portion of the transition from coal to natural gas, and from imported to domestic oil, is driven by the recent expansion of the production tight oil and shale gas via hydraulic fracking. This technique requires copious amounts of water. A shale gas well requires at least one million gallons of it.[43] Climate related extreme weather – particularly drought – can therefore disrupt the production and supply of these fuels.

Such a disruption occurred during the 2012 drought. In July 2012, CNN Money reported

> One of the worst droughts in U.S. history is hampering oil production... [the energy] boom is possible partly by hydraulic fracturing.
>
> [It requires] lots of water. Each shale well takes between two and 12 million gallons of water to frack. That's 18 Olympic-sized swimming pools worth of water per well.[44]

In August 2012, CNN Money reported that the drought was hurting oil-fracking production.

> The drought is affecting energy production in West Texas, North Dakota, Kansas, Colorado and Pennsylvania, states in which hydraulic fracturing, also known as fracking, has become popular.[45]

Superstorm Sandy and other severe storms disrupt electricity reliability

Too much water (and wind) can also disrupt electricity transmission. The combination of Superstorm Sandy followed by a Nor'easter severely disrupted electricity service in the northeast. According to the Department of Energy, 8.6 million customers experienced electricity outages from the storms.[46] The bulk of the outages were in New Jersey, where 10 percent of all customers (383,143) still didn't have power at least one week after the storm.[47] It took until early December for the restoration of power to all customers.[48]

We must act to ensure reliability of our electricity generation and transmission

The National Climate Assessment draft predicts that future clime change related events will interfere with electricity transmission.

> Electricity is essential to power multiple systems, and a failure in the electrical grid can affect water treatment, transportation services, and public health. These infrastructure systems – lifelines to millions – will be affected by various climate-related events and processes.[49]

Reliable electricity generation and transmission is threatened by extreme weather linked to climate change. Therefore, policies that attempt to enhance reliability of the electricity system *cannot* ignore the impacts of climate change.

Policies to achieve a more secure, reliable electricity system must accomplish three goals.

- Slow climate change by reducing carbon pollution from power plants, the largest uncontrolled source of emissions.
- Provide financial incentives for innovative energy efficiency and no or low carbon electricity technologies, which would reduce reliance on dirty fossil fuels responsible for climate change.
- Enhance the resilience of the electricity infrastructure to extreme weather, sea level rise, and other impacts of climate change.

3. Reduce climate pollution from power plants

Power plants are the largest source of climate pollution

Electricity generation is the largest domestic contributor to climate change, responsible for more than one-third of the greenhouse gas pollution in the U.S. in 2011.[50] Society bears the cost of this carbon pollution from power plants due to the effects of climate change. Meanwhile, there is no cost to the power companies that emit carbon pollution since it is uncontrolled – it is essentially free to them. These companies have no economic incentives to reduce this threat to the climate. This market failure must be corrected by requiring power plants to significantly reduce their carbon pollution.

Strong public support for power plant pollution reductions

As previously noted, Americans understand that the impacts of climate change include extreme weather. They also strongly support government action to reduce carbon pollution responsible for climate change. A *USA Today* poll from February 2013 found that "84% of Americans say climate change is definitely or probably occurring; 64% favor regulating greenhouse gas emissions to fix problem."[51]

A poll released at the beginning of 2013 by the Yale and George Mason Universities' climate communications programs also found strong support for setting carbon pollution reduction standards.[52] Highlights of the poll include the following findings.

> Across party lines, there is support for taking action to reduce global warming, with pluralities of all groups favoring medium-scale efforts. Even among Republicans, a sizeable majority support making some effort to address global warming.
>
> Policies to promote renewable energy are favored by the majority of voters across party lines. Majorities support eliminating federal subsidies to the fossil fuel industry, but oppose ending subsidies to the renewable energy industry.
>
> Registered voters support regulating carbon dioxide as a pollutant.[53]

A poll by the Benenson Strategy Group for the League of Conservation Voters reiterated strong public support for action. After hearing both sides of the debate, Benenson found that "support remains strong even in the face of opposition attacks. After hearing this messaging from both sides, 65% still say they support the President taking significant action right now."[54]

Major utilities testify in favor of carbon pollution reductions to address climate change

On March 5, 2013, senior representatives from three major utilities testified before this subcommittee, and they agreed that action was necessary to reduce carbon pollution from power plants to curb climate change. In response to questions, witnesses from American Electric Power, Entergy, and Xcel all favored carbon pollution reductions.[55]

Mr. Mark McCullough, Executive Vice President of American Electric Power, said that "We do support a legislative approach [to carbon pollution reductions' over a regulated approach, and depending upon the details, would be very supportive."[56]

Mr. William M. Mohl, President of Entergy Wholesale Commodities, also endorsed carbon pollution reductions from the utility industry, preferably with a price signal. He noted that "We support some type of market-based price signal that puts a price on carbon emissions…We believe that that provides the incentive to develop new, cleaner technologies."[57]

Mr. Benjamin Fowke, Chief Executive Officer of Xcel, noted that "regulatory uncertainty" about utility carbon pollution reductions makes it more difficult for companies to plan their future investments.[58]

Government can adopt pollution limit legislation, carbon tax, and the Clean Air Act to reduce power plant pollution

There are several ways to reduce carbon pollution from power plants. Congress could pass a law establishing carbon pollution limits for power plants and other major sources. The House of Representatives passed the bipartisan American Clean Energy and Security Act in 2009, but the Senate was unable to muster 60 votes necessary to pass a companion bill.[59]

Alternatively, Congress could pass a progressive carbon tax to be levied on every ton of pollution from large power plants (and other major emitters).[60] If the price was set at an effective level, power plants and other big emitters would have an economic incentive to reduce their pollution. This system would also raise billions of dollars of revenue that could offset a reduction in payroll taxes, support investments in clean power, and/or reduce the deficit. Both conservative and progressive nongovernmental organizations have endorsed a carbon tax. Hopefully, Congress will enact such a tax as part of comprehensive tax reform or a budget deficit reduction plan.

In the absence of Congressional action, President Obama has the authority and obligation under the Clean Air Act to set a carbon pollution standard for existing power plants and other major emitters. In 2007 the Supreme Court ruled in *Massachusetts v. EPA* that greenhouse gases are pollutants under the Clean Air Act, and as such, the agency's administrator must consider whether these pollutants "may reasonably be anticipated to endanger public health or welfare."[61] If the administrator finds that this is the case, the EPA has the authority to limit pollutant emissions.

After the decision, EPA scientists conducted an assessment of the public health and welfare impacts of carbon and other climate change pollutants, and concluded that these emissions endangered the public. Agency Administrator Stephen Johnson wrote a January 2008 memo to President Bush stating, "Your Administration is compelled to act on this issue under existing law."[62] The president ignored this recommendation.

In December 2009, EPA Administrator Lisa Jackson adhered to the recommendation of agency scientists and finally made the endangerment finding for six major greenhouse gases, including carbon dioxide. [63] Jackson noted that the "impact on morbidity and mortality associated with higher temperatures" provided support for "a public health endangerment finding."[64]

EPA should set carbon pollution standard for existing power plants

After lengthy consultation with large numbers of stakeholders, the EPA proposed a carbon pollution standard for new power plants in March 2012.[65] Since power plants are designed to last for at least 50 years, this rule would effectively prevent the construction and operation of new coal-fired plants that don't incorporate carbon pollution capture and storage, therefore ensuring that we will not build the next generation of uncontrolled coal-fired power plants that would further worsen climate change.

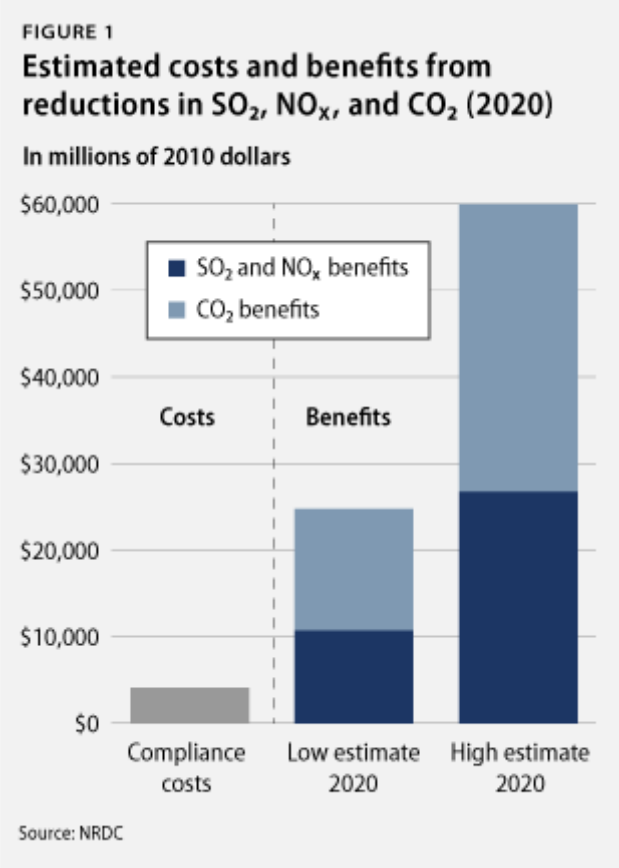
There was overwhelming public support for the new power plant rule. Americans submitted 3.2 million comments in favor of limiting carbon pollution for both new *and* existing power plants—a record number for the agency.[66]

The agency was supposed to finalize the carbon pollution standard for new power plants by mid-April, thought it missed that deadline. It is important that EPA finalize this standard, so that it can develop and propose a standard for existing power plants.

A carbon pollution standard for existing power plants would require emissions reductions from roughly 600 existing coal-fired power plants.[67] These plants would probably employ some combination of fuel-switching to natural gas or co-firing with biomass; demand reduction via energy efficiency measures; and development of clean, renewable electricity generation.

The Natural Resources Defense Council, (NRDC) an environmental advocacy organization, released a plan to unlock the Clean Air Act's potential to curb carbon pollution from existing power plants. The plan would cut emissions from existing power plants by 26 percent by 2020. It would create a flexible approach for states and power plants to meet carbon pollution levels.

The plan achieves climate protection and public health benefits, grossing between $26 billion and $60 billion in 2020 for a net benefit between 6 times and 15 times more than the cost of the cleanup. There would also be no disruption in power supply even as emissions decline.[68]



Reducing power plant pollution will have little impact on electricity reliability

Many opponents of pollution reduction requirements for power plants claim that they will reduce electricity reliability. This ignores recent history where several studies found that most "grid disturbances" were due to storms, tornadoes, cold, fire and other weather related events.[69] There appears to be little evidence of this occurrence.

The most recent false reliability claims were made about the Mercury Air Toxics Standard (MATS) for power plants. There is little evidence that reducing these dangerous pollutants by 90 percent would impair reliability. A Department of Energy study on this claim concluded that

> EPA rules will not create resource adequacy issues.
>
> To the extent that any localized reliability issues arise as the power sector adjusts to these rules, flexibility mechanisms in the Clean Air Act exist to ensure that any issues could be fully addressed before electricity delivery would be affected.[70]

Commissioner John R. Norris of the Federal Energy Regulatory Commission testified before this Subcommittee in 2011 that MATS would not make our electricity system less reliable. He said

> With the information we have in hand and the tools available to mitigate any potential reliability concerns, I believe we can manage the integration of these new environmental requirements into the power system while maintaining a reliable electric grid.[71]

In 2012, the Congressional Research Service came to the same conclusion, determining that

> Although the rule may lead to the retirement or derating of some facilities, almost all of the capacity reductions will occur in areas that have substantial reserve margins.
>
> To address the reliability concerns expressed by industry, the final rule includes provisions aimed at providing additional time for compliance if it is needed to install pollution controls or add new capacity to ensure reliability in specific areas. As a result, it is unlikely that electric reliability will be harmed by the rule.[72]

The standard to reduce carbon pollution from existing power plants would certainly include similar safeguards, and pose no threat to reliability. As noted earlier, the evidence suggests that climate related extreme weather poses a much greater threat to utility operations.

Reducing power plant carbon pollution will have little impact on electricity rates

Undoubtedly, opponents of reducing carbon pollution to fight climate change will claim that a power plant standard would lead to sky-rocketing electricity prices. Modeling conducted for NRDC by ICF International using the Integrated Planning Model (IPM®) used by EPA, combined with NRDC assumptions, found that this plan would *reduce* wholesale power prices primarily because a major portion of the carbon pollution cuts would occur from energy efficiency measures that *reduce* the use of electricity. The analysis predicts that retail electricity prices would remain about the same, while families' electricity bills would decline because they would use less electricity due to efficiency measures.[73]

Past utility industry predictions were wrong about high cost of pollution reductions

Industry sponsored studies frequently attempt to estimate the future cost of pollution reductions, and predict that cutting pollution will cause huge hikes in electric rates, reductions in jobs, and all sorts of other economic havoc. However, similar predictions about the acid rain control program for power plants were completely wrong.

In the late 1980's EPA studied the proposal to reduce the sulfur and nitrogen pollution from power plants responsible for acid rain. It predicted that the "annual cost of the program was expected to be $2.7 billion – 4.0 billion."[74]

The utility industry predicted that the cost of acid rain controls would be even higher – and it was even more wrong. For instance, a study for the Edison Electric Institute (EEI) predicted

> That the acid rain provisions alone of H.R. 3030 could cost electric utility ratepayers $5.5 billion annually between enactment and the year 2000, increasing to $7.1 billion per year from 2000-2010. These estimates were developed in an analysis conducted by Temple, Barker & Sloane.[75]

Yet an EPA analysis a decade later determined that the actual cost of cutting sulfur emissions by 40 percent was substantially lower—"$1 to $2 billion per year, just one quarter of original EPA estimates."[76]

4. Invest in efficiency, clean energy alternatives

Federal investments in emerging clean energy technologies less than fossil fuels investments

The U.S. has a long history of providing financial assistance to new energy technologies. A DBL Investors analysis, "What Would Jefferson Do?" determined that oil and gas received $442 billion in tax breaks and subsidies over the past 90 years, while renewable energy received only $5.6 billion over the past 15 years.[77] This is $80 invested in oil and gas production for every $1 invested in renewable electricity. Some of the fossil fuel tax breaks, such as the deduction for intangible drilling costs for oil companies, are nearly 100 years old.[78]

A 2011 study by Management Information Services Inc. for the Nuclear Energy Institute found that natural gas and coal received $121 billion and $104 billion, respectively, in government support from 1950-2010. Meanwhile, wind, solar, and ethanol received only $74 billion over this same time period.[79]

Summary of Federal Energy Incentives 1950-2010

	Oil	Natural Gas	Coal	Hydro	Nuclear	Renewables including ethanol	Geothermal	Total received, billions of 2010 $
Total received, billions of 2010 $	$369	$121	$104	$90	$73	$74	$7	$837
Share	44%	14%	12%	11%	9%	9%	1%	

Source: Management Information Services Inc.[80]

The Environmental Law Institute conducted a similar study, "Estimating U.S. Government Subsidies to Energy Sources: 2002-2008." It concluded that nearly $6 in federal government energy subsidies went to "traditional fossil fuels" for every $1 for "traditional renewables" (excluding biofuels). [81]

The American Recovery and Reinvestment Act provided boost to emerging clean energy technologies

The American Reinvestment and Recovery Act included $23 billion for wind, solar and geothermal power to help these industries become more cost competitive.[82] These investments helped the U.S. double renewable electricity generation in four years. In addition, the Production Tax Credit for wind power and the Investment Tax Credit for solar power also create incentives to invest in these emerging technologies.

These efforts are working. *Bloomberg New Energy Finance* reports that "the levelized costs of electricity for renewable technologies have plummeted" in the U.S.[83] Wind power is a major electricity generator in the U.S. Iowa produces nearly 20 percent of its electricity from wind.[84] Texas leads the nation in overall wind electricity generation, and was the first state to reach 10,000 megawatts of wind energy installation.[85]

The Energy Information Administration reports that new wind energy is cheaper than a new conventional coal plant, new advanced nuclear plant, or new natural gas fired combustion turbine.[86]

Solar power, too, is becoming much more affordable and prevalent. The Solar Energy Industry Association reported in January 2013 that the cost of a solar electricity system has dropped and deployment has grown

> More solar capacity was installed in the first three quarters of 2012 than in all of 2011. The industry expects to have installed more than one gigawatt of solar in the fourth quarter of 2012 alone, while in 2010 we installed 852 megawatts for the entire year. And we expect 2013 will be another year of record growth for our industry.[87]

Other nations powered by renewable electricity

Other countries also found that renewable electricity is cheaper than fossil fuel power. *Bloomberg New Energy Finance* just reported that in Australia "wind energy is 14% cheaper than new coal and 18% cheaper than new gas."[88]

Germany reported that "all renewable energies combined accounted for about 26 percent of electricity production over the first nine months" of 2012.[89] In 2012 "solar power's share in the country's [Germany] electricity production rose to 6.1 percent from 4.1 percent."[90] This occurred even though Germany receives less sunlight than anywhere in the U.S. except for Alaska.[91]

Portugal's electricity network operator recently announced that renewable energy supplied 70 percent of total consumption in the first quarter of this year. Portuguese citizens are using less energy and using sources that never run out for the vast majority of what they do use.[92]

Policies to increase investments in clean energy

There are several primary ways that the government invests in clean energy: direct spending, tax incentives, and credit support through loans and loan guarantees. Public market financing provides a fourth means. A comprehensive clean energy investment program will utilize all four tools, recognizing that each one meets specific needs. A progressive carbon tax could provide the funds to be invested in new energy technologies. These tools are:

Direct spending: The government should provide direct support of $9 billion per year for research and development in both the public and private sector. In the public sector, this should be continued mainly through the Department of Energy and its affiliated labs. The Advanced Research Projects Agency–Energy (ARPA-E) program, which invests in private sector research, should be strengthened by doubling its funding. The proposed $9 billion in research funding would return us to the peak level of government investment in energy R&D in the late 1970s (in real dollars).[93]

Tax incentives: The production tax credit for wind energy has been a huge driver for deploying clean energy at scale by leveraging at least $10 in private investment for every $1 in tax credits.[94] Thanks to this investment incentive, there is enough wind energy to power more than 13 million homes. This credit—set to expire at the end of 2013—should be extended for several years.[95]

Credit programs: The Department of Energy Loan Guarantee Program should be improved upon with a new Clean Energy Deployment Administration (or "Green Bank"), which would provide a range of financing tools to enable clean energy deployment.[96]

Public market financing tools: Ultimately, we need to finance clean energy just like we finance traditional energy: through public equities and corporate debt. There are multiple ways to encourage this, but the most likely is to adapt master limited partnerships and real estate investment trusts to meet the needs of clean energy technologies.

Establish federal policies that increase demand for clean electricity

Increasing market demand for clean energy is essential to provide investors with more certainty about the return on their investment in emerging technologies. There are several policies that could accomplish this goal.

Twenty-nine states and the District of Columbia require their utilities to generate a designated portion of their electricity from wind, solar, geothermal, and other renewable energy sources.[97] These programs encouraged investments in clean power sources and helped to nearly double nationwide renewable electricity generation over the past four years.[98]

Despite some utility industry and other special interest claims, these renewable electricity standards appear to have no pattern on their impact on utility rates. Richard Caperton, Managing Director of the energy program at the Center for American Progress, analyzed the "the average annual electricity rate change in states with these standards, compared to the average for states without these standards." (see table below) He concluded that

> State renewable energy standards have no predictable impact on electricity rates. Even using an approach that attempts to isolate these standards from other factors driving rate changes, there's simply too many other factors.[99]

Congress could enact a similar clean energy standard that would require utilities to produce 80 percent of their electricity from no- or low-carbon sources by 2035.[100] It is essential that a clean energy standard require that at least 35 percent of the total electricity generation in 2035 come from renewables and efficiency measures so as to provide certainty about the market demand for clean energy.[101]

President Obama provided a boost to clean energy investments with an executive order to require that federal agencies become more sustainable. Executive Order 13514 directs "Federal agencies to reduce greenhouse gas pollution … and leverage Federal purchasing power to support innovation and entrepreneurship in clean energy technologies."[102]

The order sets a goal for agencies to "use at least 5 percent electricity from renewable sources."[103] Some agencies have already met this target, including the Department of Energy and the General Services Administration.[104] The administration should require all federal agencies to achieve this measure by 2014. Federal agencies should meet a 10-percent-renewable standard by 2017, and a 15-percent standard by 2020. This would notably increase demand for renewable electricity.

Use appropriate federal lands and waters to support clean-energy development

Federally owned real estate produces coal and natural gas used to generate electricity. Approximately 43 percent of all coal and 20 percent of natural gas currently produced in the United States comes from public lands or waters.[105] Despite the tremendous potential of clean energy production on federal property, only 1 percent of the country's wind electricity and practically none of its solar power come from public lands and waters.[106]

The Department of the Interior already met the president's goal of authorizing 10,000 megawatts of renewable energy on federally managed waters and lands.[107] The federal government should build on this success by implementing a "clean resources standard" for public lands and waters. This would require federal land and water management agencies to ensure that 35 percent of the electricity from resources on public lands is clean and renewable—from wind, solar, geothermal, biomass, and small hydropower.[108]

When done responsibly, electricity generation is an appropriate use for many public places. It is important, however, that any energy development on public lands avoid sensitive areas, employ the most modern technology, and be in full compliance with environmental laws.

The integration of renewable electricity technologies should have no impact on reliability

The North American Electric Reliability Corporation "State of Reliability 2013" report found that "bulk power system reliability remains adequate."[109] It also found that variable power sources – such as wind turbines – have had no impact on reliability. It concluded

> There were no significant reliability challenges reported in the 2011/2012 winter and the 2012 summer periods resulting from the integration of variable generation resources. More improved wind forecast tools and a wind monitoring displays are being used to help system operators manage integration of wind resources into real-time operations.[110]

5. Increase the resilience of electricity infrastructure

Investments in community resilience save money

Many communities are undertaking efforts to make their buildings, shelters, water treatment, electricity, roads, and other vital infrastructure more resilient to damage from extreme weather. Such efforts are expensive, particularly for cash-strapped communities and states that are still recovering from the Great Recession. But making these investments can help save money in the future, when storms, floods, heat waves, droughts, and wildfires will become more frequent and/or more devastating. The Federal Emergency Management Agency, or FEMA, estimates that "a dollar spent on [pre-disaster] mitigation saves society an average of $4" in lower damages.[111]

After a devastating flash flood in 1984, for example, Tulsa, Oklahoma, crafted a resilience program to control flood damages by relying on natural systems and other methods to improve water drainage. The Tulsa city government reports that "Since the City adopted comprehensive drainage regulations 15 years ago; we have no record of flooding in any structure built in accord with those regulations."[112]

Napa County, California, created a flood-control-protection project to limit flood damage. The project is paid for in part by passing a half-cent local sales-tax increase to fund the local share of this project. The project's goal is to achieve "a savings of $26 million annually in flood damage costs."[113]

It is imperative that the federal government provides technical and financial assistance to the most at-risk communities; such efforts are an excellent economic investment. Because the

federal government pays for a major share of disaster recovery, investing in resiliency now will help protect taxpayers from more deficit spending in the future.

The federal government invests less in community resilience

Despite the myriad benefits of investments in community resilience, federal assistance for resilience, or "pre-disaster mitigation," has actually declined over the past decade.[114] Rep. Lois Capps, her Energy and Commerce Committee colleagues Henry Waxman, Ed Markey, Eliot Engel, Doris Matsui, John Sarbanes, and 34 additional representatives wrote a letter to President Barack Obama in February urging him to appoint a blue-ribbon panel that would:

> Develop a comprehensive plan to help local communities prepare for the anticipated impacts of increased climate-related extreme weather.
>
> Estimate the financial support necessary for communities to develop and implement plans to increase their resilience to floods, severe storms, droughts, heat waves, sea level rise, wildfires, and day-to-day economic impacts.
>
> Identify federal programs that already provide funding for resilience efforts.
>
> Recommend a dependable revenue stream to provide additional resources for local pre-disaster mitigation planning.[115]

The Obama administration should adopt Rep. Capp's proposal.

The administration's proposed FY 2014 budget has an enhanced focus on community resilience. The budget:

> Includes $200 million for "Climate Ready Infrastructure" that build enhanced preparedness to extreme weather and other impacts of climate change in their planning efforts, and that have proposed or are ready to break ground on infrastructure projects to improve resilience.
>
> These investments will support a broader Administration commitment to help communities become more resilient through direct technical assistance, provision of useful data and tools on projected impacts, and support for planning.[116]

In addition, technical-assistance grants for community-resilience projects are available through the Department of Housing and Urban Development's Sustainable Communities program. These programs are an important start, but they provide only a small amount of the revenue that is essential for building more resilient communities across the nation.

Congressional Research Service recommendations for utility resilience

Last August, the Congressional Research Service issued "Weather-Related Power Outages and Electric System Resiliency." It included a number of valuable recommendations that would increase the resilience of utilities' transmission network.

> Suggested solutions for reducing impacts from weather-related outages include improved tree trimming…placing distribution and some transmission lines underground, implementing Smart Grid improvements to enhance power system operations and control, inclusion of more distributed generation, and changing utility maintenance practices and metrics to focus on power system reliability.[117]

In addition, CRS had some recommendations for Congress to help reduce the likelihood and length of extreme weather related power outages. We urge the Subcommittee to give these recommendations serious consideration.

> A number of options exist for Congress to consider which could help reduce storm-related outages. These… [include] greater strategic investment in the U.S. electricity grid. Congress could empower a federal agency to develop standards for the consistent reporting of power outage data.
>
> Many distribution systems are in dire need of upgrades or repairs. The cost of upgrading the U.S. grid to meet future uses is expected to be high, with the American Society of Civil Engineers estimating a need of $673 billion by 2020. While the federal government recently made funding available of almost $16 billion for specific Smart Grid projects and new transmission lines under the American Recovery and Reinvestment Act of 2009, there has not been a comprehensive effort to study the needs, set goals, and provide targeted funding for modernization of the U.S. grid as part of a long-term national energy strategy.[118]

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