**EPA’s "Clean Power Plan”: Is It About Clean Power or Just Carbon Reduction?**

**Boston Action Research, a Project of Civil Society Institute**

**November 2015**

**Introduction**

The EPA’s Clean Power Plan (CPP) was adopted by the EPA in early August of this year. The carbon regulations are shrouded in uncertainty as to their ultimate implementation and impacts. Given the regulation’s highly flexible nature, states have several largely unfettered options for compliance, making any prediction about the resulting energy mix in this country very difficult to ascertain.

This paper concludes that the CPP is a useful and necessary step in taking a national policy stance on climate change. (For example, the CPP does set in motion a discussion at the grassroots level for the energy mix states will use to meet the EPA rule on CO2 emissions.) Additionally, it sets a precedent so that EPA can more aggressively regulate power sector CO2 in the future – assuming the legal challenges fail. However, the EPA regulations are also insufficient in important ways:

* The CPP is not a “clean power” plan, but a plan to limit CO2 emissions. A more accurate name would be CO2 Reduction Plan.
* A true *plan* for clean power would take decisive steps to phase out all energy sources that are a danger to public health, clean air and clean water and are prone to excessive construction time horizons and cost overruns, such as new nuclear and coal-fired power plants.  Reducing CO2 would be one of many policy goals in a clean power plan, along with improving economic and social justice issues and improving health.
* The CPP has major gaps; it neither takes into account the harm done by methane releases from natural gas drilling and infrastructure, nor does it address the water and air emissions issues associated with the unconventional drilling of shale gas.
* As the CPP is formulated, new nuclear power additions and uprates of existing plants are certainly options. The constraint is financial, as demonstrated by continued rising costs of existing plants and excessive costs and construction delays of new construction.

It is important to distinguish between a true plan versus a “grab bag” of steps, some of which go in one direction while others move along contradictory paths. An actual “Clean Power Plan” would more closely resemble what is now being implemented in Germany[[1]](#footnote-1).

It is naïve to assume that a truly clean power plan and a new energy system powered by renewable energy will happen overnight.  But a plan to move toward a sustainable, renewable energy future is achievable as the mature technologies of solar and wind power are phased in and replace the baseload energy provided by coal, nuclear and natural gas.  It is the phasing in of renewable energy and the methodical phasing out of traditional energy sources that constitutes a plan.  "All-of-the- above" may have the virtue of seeming inclusive, but it also reflects an indecisive and halting leadership whose intent is to avoid conflict with entrenched fossil and nuclear interests. The still-absent consensus on a national energy policy is critical for the US in that it is the prerequisite to moving towards a sustainable electric power sector[[2]](#footnote-2) on a consistent and rapid basis.

A true national sustainable energy plan would prioritize renewables and energy efficiency, with the goal of phasing out conventional sources of power over time. Such a policy harbors significant public benefit in terms of cost, public health, and water conservation, as well as climate benefits. To demonstrate these benefits, the Civil Society Institute commissioned an 80 percent renewables scenario by 2050. Among the chief benefits of such an approach are:

* Coal-fired power can be phased out by 2040.
* Virtually all nuclear capacity can be phased out by 2050.
* Natural gas demand falls significantly below current usage.
* Electricity demand drops significantly.

**The Clean Power Plan**

***Basics***

In the Clean Power Plan’s carbon rule, the EPA establishes “emission performance standards” for carbon emissions from power plants on a per megawatt hour basis. The EPA calculated current MW per hour fossil steam plants (mostly coal, and to a lesser extent oil/gas) rates at 2,160 pounds per MWh in the Eastern Interconnection and natural gas combined cycle plant rates at 894 pounds per MWh. Using its three building blocks (discussed shortly), the EPA then determined that fossil steam plant rates were to reach 1,305 pounds per MWh and combined cycle natural gas plants 771 pounds per MWh by 2030.[[3]](#footnote-3)

The building blocks used by the EPA demonstrate that these emission rates are achievable, a step necessary to anchor the legality of the rule as stipulated in the Clean Air Act. They are not measures states are mandated to implement. Rather, they demonstrate that reductions in carbon emissions are achievable to a certain level. The EPA establishes its legally binding target for the power sector at a reduction of 32% of 2005 levels by 2030.[[4]](#footnote-4) These building blocks (Best System of Emissions Reductions or BSER) include:

1. Increasing the efficiency of the power plants themselves;
2. Shifting from coal-fired power to natural gas-fired power; and
3. Building out renewable energy resources.[[5]](#footnote-5)

However, other measures can be employed by states to reduce carbon emissions outside of the building blocks, such as documented end-use energy efficiency gains[[6]](#footnote-6) and new nuclear power plants or uprates in existing nuclear power plants.[[7]](#footnote-7)

The EPA also translated these rates into tons of carbon emissions for each state. States can rely on a rate-based approach for each power plant to comply or a mass-based approach that targets a specific amount of tons of carbon reduced for each state. The EPA prefers that states utilize the mass-based approach, which also allows for the formation of interstate carbon allowance trading regimes.[[8]](#footnote-8)

According to the plan, states must begin complying with the rule by 2022, in order, among other things, to allow them time to determine additional natural gas pipeline infrastructure.[[9]](#footnote-9) They must reach the targeted 32% reduction by 2030.[[10]](#footnote-10)

The EPA creates a Clean Energy Incentive Program (CEIP) in the rule to incentivize state adoption of energy efficiency and renewable energy prior to 2022, when the compliance period begins. In the CEIP, the EPA provides additional carbon emission allowances for energy efficiency programs and solar and wind investments made after approval of a state’s State Implementation Plan. However, in the case of energy efficiency, the investment must still be providing reductions in energy usage in the 2020-2021 timeframe. For renewable energy, investments must apply to projects coming online in the 2020-2021 timeframe. The energy efficiency portion of the CEIP applies to energy efficiency programs in low-income communities.

States must submit their state implementation plans (SIPs) in 2016 or in 2018 if they convince the EPA they need an extension. If states refuse to submit a plan, the EPA can impose a Federal Implementation Plan (FIP) on them.

In October of 2015 EPA issued a draft Federal Implementation Plan for states that do not adopt a plan of their own in time. (However, states can gain approval for their own plan subsequently). The agency clearly prefers that states adopt a mass-based plan of their own.

In the federal plan, EPA says that it “recognizes that the mass-based trading approach would be more straightforward to implement compared to the rate-based trading approach…”, citing “experience with mass-based trading programs,” including sulfur dioxide and nitrogen oxide emissions trading programs, among others, already in place.[[11]](#footnote-11)

However, leakage (a shift from existing natural gas plants covered under the rule to new natural gas plants not covered under rule) remains an issue. To combat this, EPA proposed 3 options for states that can also work in tandem:

• “First, states can include new, modified and reconstructed Electric Generating Units (EGUs) under a mass-based program cap. Essentially, this is the model currently in place in California and RGGI, in which the cap covers all EGUs, not only those that existed as of a certain date.

• Second, as an alternative or in addition to the first option, the Final CPP provides that states can allocate a certain quantity of allowances for free to existing EGUs and providers of incremental renewable energy and energy efficiency. Specifically, the Final CPP provides that a plan that contains the allowance set-aside provisions from the model rule included in the FIP will be “presumptively approvable.”

• Finally, states can demonstrate that other allocation mechanisms included in their plan will counter the risk of leakage.”[[12]](#footnote-12)

The Plan does mandate states to engage in community discussions about the implementation of their plans.[[13]](#footnote-13)

***Possible Outcomes for the Rule***

As of October 2015, twenty-four states have filed suit against the CPP rule[[14]](#footnote-14) while fifteen states and a number of businesses have publicly supported it.[[15]](#footnote-15) The rule may or may not be stringently enforced depending on the next administration in Washington.[[16]](#footnote-16) This, in addition to the complexity, extreme flexibility, and “grab bag” nature of the rule means that the resulting energy mix and actual impact of the rule are uncertain.

In terms of state compliance, the allowed-for range of responses is quite striking:

“[S]tate plans can include a vast array of different techniques. States can ramp up renewable energy to hit their targets, for instance. They can reduce output from their existing coal plants and ramp up output from natural gas plants. They can build nuclear plants or increase output from existing nuclear plants. States could figure out how to reduce losses from their power lines. Utilities could even enact programs to help homes and businesses use energy more efficiently. Or states could go more radical still. They could implement a carbon tax (yes, EPA [allows this](http://www.nationaljournal.com/energy/obama-climate-carbon-tax-EPA-cap-and-trade-20150803?utm_content=bufferb8b70&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer)). They could even join [existing cap-and-trade systems](http://www.vox.com/2014/5/30/5764506/will-obamas-climate-rules-revive-cap-and-trade) — like RGGI in the Northeast — or start new ones. Indeed, the EPA's final rule makes it easier for states to join such trading programs.”[[17]](#footnote-17)

Coal is widely seen as the big loser under the CPP rules. Some observers insist that wind is the big winner or that renewables and natural gas will end up being the ultimate preferred approaches.[[18]](#footnote-18) The EPA and other analysts are counting on state emphasis on energy efficiency due to its low cost.[[19]](#footnote-19) However, the politics of a state and continued attacks on aggressive efficiency programs by utility companies and the American Legislative Exchange Council (ALEC) may hamper that outcome.

The state lawsuits challenging the EPA could derail or substantially weaken the rule. Opponents of the rule argue that it is inappropriate for the EPA to regulate CO2 emissions beyond the “fenceline”[[20]](#footnote-20) of existing power plants. Renewable deployment, for instance, reduces emissions but is not a measure taken directly at a power plant to reduce CO2 emissions. Renewable energy investments are investments made beyond the fenceline of those plants. If complainants win on this point, the EPA would have to adjust the emissions rates and targeted tons of carbon emission reductions for the states, weakening the rule.[[21]](#footnote-21)

According to energy analyst Michael Levi, the bottom line is this:[[22]](#footnote-22)

“There is a lot of reporting, including by many who should know better, claiming that the plan will result in massive amounts of renewable generation and no increase in natural gas above business as usual in the long run (2030ish in this case). Once the building blocks are used to determine state targets, the states decide how to meet those targets. At that point, it’s as if the building blocks never existed. If a state wants to use only solar to meet its targets, it can do that. If it wants to use only natural gas or nuclear, it can do that too.

“The second reason you’re hearing that the final plan will rely largely on efficiency and renewables is that when the EPA models the real-world impact of the rule, it reportedly foresees lots of new efficiency and renewable energy, and not much new coal to gas switching. But this is a feature of the EPA model, not something that the rule requires. In particular, the EPA model is well known to predict huge increases in efficiency. If, as many experts assume, it is substantially overestimating the efficiency response, you’ll see more coal-to-gas switching (and more renewables investment) in the real world response. Something similar applies to misestimates of renewables investment ...”[[23]](#footnote-23)

The Union of Concerned Scientists seems to reflect Levi’s sentiment in its analysis, stating, “[S]tates must carefully evaluate the risks of substantially shifting to natural gas against the benefits of ramping up renewable energy sources and energy efficiency.”[[24]](#footnote-24)

One of the big questions about the CPP is this: How much more progress over and

above the status quo will it bring about? Bloomberg, for instance, estimates by the end of this year the US will have reached half of the EPA’s CO2 reduction goals. In other words, the EPA rule appears, in their estimation, to add little to existing momentum already underway without the rule.[[25]](#footnote-25)

The Union of Concerned Scientists confirms that most states have already or will be (with current policies) on track to comply with the CPP, which raises the question of how much the rules can take credit for. USC found:

“• At least 31 states are on track to be more than halfway toward meeting their 2022 targets thanks to existing commitments to clean energy.

• At least 21 states are on track to surpass their 2022 emissions reduction targets, including 3 states expected to sue the EPA.

• At least 16 states are on track to achieve their 2030 targets based on existing clean energy commitments.”[[26]](#footnote-26)

Finally, a comparison between the European Union and United States suggests the EPA’s targets are quite modest relative to those being pursued in Europe. The European Union is working to reduce CO2 emissions “by 40 percent over 1990 levels” by 2030. The US benchmark is 32 percent below 2005 levels, which equates to “a mere 13 percent reduction if measured from 1990 to 2030.”[[27]](#footnote-27)

***Treatment of Natural Gas***

Natural gas could become the primary compliance option for states under the CPP. However, according to a growing body of research on methane emissions from natural gas drilling operations and local natural gas distribution systems, the EPA could very well be severely underestimating the natural gas fuel cycle’s impact on climate change.[[28]](#footnote-28) Methane is a far more powerful greenhouse gas than carbon dioxide, with a global warming potential (GWP) that is 34 times greater than CO2 over 100 years and 86 times greater over 20 years.[[29]](#footnote-29) Furthermore, peer-reviewed estimates of methane leakage from natural gas systems suggest leakage of methane from shale gas over its life-cycle of extraction, processing, reansport, and use may be 3.6% to 7.9% of its production.[[30]](#footnote-30) More recent reports suggest that actual leakage rates could be even higher.[[31]](#footnote-31)

Moreover, the EPA rule foresees increasing demand for natural gas over the compliance period. On the other hand, the EPA has proposed rules for curbing methane emissions at shale gas wells. The agency estimates that reductions in methane could be as high as 95%, which may cut overall methane emissions from these wells. Again, uncertainty prevails as to the ultimate impact of the rule on climate change because state-level responses and the results of EPA methane rules remain unclear.

The proposed carbon rule published in June 2014 had a glaring loophole. Essentially, existing natural gas plants, covered by the rule, could have been replaced by new natural gas plants, not covered by the rule, which would have most likely resulted in much higher carbon emissions rather than reductions in carbon emissions. The EPA proposed changes to mitigate that loophole (discussed above), but natural gas still has a lot of running room under the CPP.[[32]](#footnote-32)

The EPA will allow natural gas usage in the electric sector to increase 22 percent from 2012 to 2022 (reflecting the increase in such usage from 2011 to 2012, the largest such year over year increase in the last 20 years), then 5 percent during the implementation period (2022 to 2030), which is the average increase year-to-year from 1990 to 2012. According to the EPA, this would increase natural gas usage 55 percent from 2012 levels. The EPA assumes existing natural gas-fired power plants’ capacity factors to increase from the 40 to 50 percent level today to 75 percent by 2030.[[33]](#footnote-33) This increase is considered “business as usual” instead of an extreme increase in natural gas demand in the initial proposal.[[34]](#footnote-34)

Indeed, the increase in natural gas demand from existing natural gas-fired power plants envisioned in the rule may benefit pipeline construction and natural gas transportation companies (owners of natural gas pipelines). UBS, a Wall Street financial services firm, expects from its analysis that the rule will increase demand for pipelines and “midstream opportunities (increased transportation of natural gas through those pipelines) to deliver incremental gas to plants.”[[35]](#footnote-35)[[36]](#footnote-36)

However, the price of natural gas is still uncertain and will vary from region to region. Moreover, there is a question whether adequate pipeline capacity will exist in all regions. For instance, the Northeast has experienced high prices compared to the rest of the nation. However, MA Attorney General Maura Healey recently stated that “we [in New England] do not need increased gas capacity to meet electric reliability needs, and that electric ratepayers shouldn’t foot the bill for additional pipelines”[[37]](#footnote-37). Also, higher demand may increase natural gas prices generally.[[38]](#footnote-38) In addition, overreliance on any single fuel source can also impact energy security. But the ultimate impact of the CPP on natural gas prices will depend on whether states emphasize renewables and energy efficiency, which would curb demand for natural gas.

Depending on (or perhaps despite) the effectiveness of the EPA’s regulations for shale oil and gas wells[[39]](#footnote-39) and depending on the direction taken by state governments, the CPP may not result in curbing the rate of climate change decisively enough due to escaping methane from these wells.

***Treatment of Nuclear Power***

The EPA allows states to comply with the CPP by adding new nuclear power units or increasing the output of existing plants, which is known as “uprates.” However, it is doubtful that nuclear power can compete in the marketplace to mitigate climate change or that it will play a decisive role in the US energy mix over time. As former Nuclear Regulatory Commission (NRC) commissioner Peter Bradford recently stated:

“[Economic analysis](http://www-assets.vermontlaw.edu/Assets/iee/Power_Shift_Mark_Cooper_June_2015.PDF) shows that the cost of new reactors is far above that of other low-carbon alternatives…. Furthermore, even the cost of operating today’s reactors has risen above power market prices in the substantial parts of the United States that rely on wholesale power competition.”[[40]](#footnote-40)

Despite continued and severe financial difficulties for new construction,[[41]](#footnote-41) nuclear power is seen by the EPA as an important resource in combating climate change.[[42]](#footnote-42) This is so even though a recent report published by the US DOE showed that nuclear power, given its cost, financing difficulties, and long construction period is unlikely to have any material impact on climate change.[[43]](#footnote-43)

Under the final CPP rule, the EPA allows the five nuclear reactors currently under construction (and uprates of existing plants), as requested by the Nuclear Energy Institute (the nuclear industry’s lobbying arm), to apply towards state-level compliance with the rules.[[44]](#footnote-44)

EPA adopted this approach even though there is uncertainty about whether all five of the reactors now under construction will eventually be completed. The Nuclear Energy Institute (NEI) was not pleased that the EPA removed nuclear power from the building blocks and excluded plants that receive license extensions without increasing their output (uprated plants).[[45]](#footnote-45)

The financial troubles facing nuclear power appear difficult for the industry to overcome, despite the subsidies it receives. UBS views the treatment of nuclear power in the rule as leverage for the industry but potentially only on a temporary basis. For Example, UBS believes that the rule “… should help push EXC’s (Exelon’s) argument for a nuclear deal in Illinois to maintain the [nuclear] portfolio at least through CPP implementation in 2022…”[[46]](#footnote-46) However, that prospect seems increasingly murky after an initial rebuff from state lawmakers.

***Treatment of Renewable Energy***

The EPA does, to a certain extent, recognize the recent surge in renewable energy output, particularly wind and solar PV and the ability of these technologies to replace coal-fired and natural gas-fired power plants. However, it remains unclear how quickly wind and solar technology will expand in the US given the uncertain policy climate at the federal level. On the other hand, every government globally in recent reports has underestimated the growth of wind and solar power.[[47]](#footnote-47)

Beyond this development, both wind and solar have reached or are reaching costs competitive with conventional power plants of late and this trend is expected to continue.[[48]](#footnote-48) Likewise, by some estimates, solar PV (unlike nuclear and coal-fired power plants) will not require subsidies in most places on the globe by 2017.[[49]](#footnote-49)[[50]](#footnote-50) In other words, the EPA may be grossly underestimating renewables potential, particularly as wind and solar are becoming competitive with natural gas, and in some regions already are. The only real inhibitor of accelerated deployment of renewables is state and federal politics.

The EPA does acknowledge greater potential for wind and solar in the CPP. The agency’s thinking evolved from its initial proposed rule, increasing the potential for renewables to reach 28 percent of generating capacity instead of 22 percent under the final rule. The EPA cites dropping costs and market dynamics in its move to highlight renewables as an important compliance tool for states to consider.[[51]](#footnote-51) The EPA also assumes renewables can replace both coal and/or natural gas-fired power, unlike assuming only natural gas could replace coal in the 2014 proposal.[[52]](#footnote-52) Existing renewable resources may not be applied towards compliance with the carbon-reduction requirements.[[53]](#footnote-53)

***Treatment of Energy Efficiency***

The EPA initially added energy efficiency in its draft proposal. It removed this option from the Best System of Emission Reduction (BSER) in the final rule because it was convinced that it could not legally support it under the parameters of the Clean Air Act.[[54]](#footnote-54) But the agency still considers it a critical component for compliance from an emissions and cost perspective. To bolster this option, the EPA, as stated, includes energy efficiency in low-income areas in its Clean Energy Incentive Program. However, the EPA assumes a level of an annual reduction in kilowatt-hour sales of 1 percent by 2020 for state efficiency programs to be reasonable,[[55]](#footnote-55) far below the best programs in the country.[[56]](#footnote-56) (More on energy efficiency in the next section.)

**A True Plan: The Strength of a Direct, Technology-Based Approach to Addressing Climate Change and Other Critical Societal Issues**

The greatest gains in addressing the numerous issues presented by our current electric power system – climate, water consumption, vast amounts of pollutants that threaten public health, excessive costs of controlling that pollution, massive costs of building new coal-fired and nuclear power plants –may well have been the direct investment in renewables and energy efficiency under the President’s stimulus package.[[57]](#footnote-57) Another example is the German Energy Transition, which is essentially a conventional power replacement policy – first nuclear power then fossil fuels.[[58]](#footnote-58)

A financially viable national plan in the US that prioritizes actual clean power to generate electricity would:

* Establish energy efficiency, renewables (primarily wind and solar PV), energy storage, and distributed power as the preferred generation technologies, the primary purpose of which would be to replace conventional (coal, nuclear, and natural gas) modes of power generation, jettisoning the all-of-the-above rubric.
* Address critical social, financial, economic, natural resource and public health challenges posed by our current power system, not just carbon.
* Establish a long-term commitment of federal financial and human resources to achieve a transition to a sustainable electric grid, in a well-coordinated effort within the federal government and between the federal government and state governments.
* Establish a framework for public transparency and discourse on a sustained basis.

The issue is not if -- but when-- the United States will fully embrace these technologies and the idea of a sustainable electric grid. It is happening already, albeit in a largely uncoordinated fashion. Energy policy as it relates to the electric sector has essentially been handed over to the states. The federal government is providing research dollars, assistance with startups and intermittent tax incentives, but there remains a vacuum in terms of a focused national energy policy.

The Civil Society Institute looked into the feasibility of attaining 80% renewables by 2050, keeping in mind cost and reliability issues. (In a few years, this may come across as a modest goal. The renewables and energy storage sectors are taking off much more rapidly than was initially projected.) CSI asked Synapse Energy Economics, a Boston-based energy consulting firm, to provide data and outcomes of reaching this goal.[[59]](#footnote-59)

**Findings of an 80% Renewables by 2050 Scenario**

Utility companies and their allies continue to hammer on the cost and reliability issues of variable wind and solar resources despite the fact that costs are declining and there is no indication of major grid disruptions with increasingly more variable resources on the electric grid.[[60]](#footnote-60) In other words, the cost issue has been answered. Reliability is a challenge, as more variable resources are added to the electric grid, but not an insurmountable challenge.

*Costs*

Costs can be analyzed in a number of ways. Opponents of renewable energy point to subsidies for solar and wind as somehow skewing the market, ignoring the fact that coal, natural gas, oil and nuclear power have enjoyed subsidies for decades and could for years to come. Synapse removed tax credits from CSI’s scenario, dealing, as much as possible, with the direct costs of generation technology, in part due to the uncertainty of the subsidies’ continuation, but also noting Wall Street analysts who predict solar and wind to soon become competitive in many regions of the country, especially if fossil fuel and nuclear subsidies are also removed. The costs of the various generation technologies are based on Spring 2015 project costs to the extent practicable.

Synapse also included the avoided costs of reduced carbon emissions over time, since climate change exacts a high cost on society. These types of costs are known as externalities. The impact of climate change is being seen now in the form of increased frequency of severe storms, massive wildfires out west, accelerating glacial melt, extended droughts and their associated costs.[[61]](#footnote-61)

The tables below show the results of the Synapse analysis on costs of an 80% renewables scenario. It is now a cost-effective option for Americans. Including the savings related to curtailing carbon emissions by nearly 90% (below), it becomes abundantly clear the direction we must now take as a country.

Synapse ran two scenarios. The results of the first scenario depict the costs/savings of moving towards a sustainable electric sector, assuming that 40% of light-duty vehicles would be fully electric or hybrids by 2050. This scenario is referred to as TSEV (transition scenario/electric vehicle). The results of the TSEV are shown in the first table below. Numbers without parentheses depict a cost over business as usual.[[62]](#footnote-62) Numbers with parentheses depict costs (i.e. savings) below business as usual.

As the reader can see in the TSEV scenario, the costs of the electric sector are $162 billion above business as usual – but over a 35-year period, a modest increase. However, there is a $360 billion of overall savings when reduced use of gasoline[[63]](#footnote-63) is included and an overall $1.8 trillion in savings when avoided carbon emissions[[64]](#footnote-64) are added to the gasoline savings.

**Net Direct Costs and CO2 Damages in the Transition Scenario Including**

**Electric Vehicles (billion 2013$)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 2020 | 2030 | 2040 | 2050 | NPV (3%) |
|  Conventional Gen. | ($12) | ($73) | ($130) | ($170) |  |
|  Renewable Gen. | $2.5  | $54  | $104  | $85  |  |
|  Efficiency | $10  | $35  | $51  | $58  |  |
|  Storage | $0.0  | ($1.1) | $6.3  | $17  |  |
|  Transmission | $0.2  | $2.7  | $4.8  | $7.0  |  |
|  Env. Controls | ($4.3) | ($7.2) | $0.0  | $0.0  |  |
|  Nat. Gas Infrastructure | ($1.3) | ($3.5) | ($5.6) | ($6.5) |  |
| Subtotal | ($5.1) | $7.1  | $33  | ($6.9) | $160  |
|  Gasoline Savings | ($3.0) | ($14) | ($46) | ($100) |  |
| Subtotal | ($8.1) | ($6.9) | ($13) | ($110) | ($360) |
|  CO2 Damages | ($9.7) | ($69) | ($130) | ($160) |  |
| Grand Total | ($18) | ($76) | ($140) | ($270) | ($1,800) |

*Figures may not sum due to rounding.*

Synapse also developed a Transition Scenario (referred to as TS) excluding the vehicle sector. This scenario shows a savings of $62 billion by 2050 compared to the Reference Case (business as usual), without including savings from CO2 emission reductions. Overall savings increase to $1.5 trillion when the savings from reduced carbon emissions are included.

In both scenarios, there are substantial savings in avoided retrofits of pollution control equipment primarily since coal-fired power is completely phased out and in avoided natural gas pipeline construction due to the substantial decrease in natural gas demand. Savings in conventional generation are due to both coal-fired and nuclear plant retirements.[[65]](#footnote-65)

The bottom line is a transition to renewables and efficiency, with complementing technology, is cost-effective for the public and technologically feasible.

Net Direct Costs and CO2 Damages in TS (billion 2013$)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 2020 | 2030 | 2040 | 2050 | NPV (3%) |
|  Conventional Gen. | ($13) | ($76) | ($130) | ($180) |  |
|  Renewable Gen. | $2.2  | $52  | $91  | $58  |  |
|  Efficiency | $10  | $35  | $51  | $58  |  |
|  Storage | $0.0 | ($1.3) | $5.3  | $12  |  |
|  Transmission | $0.1  | $2.5  | $4.0  | $4.6  |  |
|  Environmental Controls | ($4.3) | ($7.2) | $0.0  | $0.0  |  |
|  Natural Gas Infrastructure | ($1.3) | ($3.5) | ($5.6) | ($6.5) |  |
| Subtotal | ($6.2) | $1.2  | $12  | ($49) | ($62) |
|  CO2 Damages | ($10) | ($70) | ($130) | ($160) |  |
| Grand Total | ($16) | ($69) | ($120) | ($210) | ($1,500) |

*Figures may not sum due to rounding.*

Moreover, as shown the table below, there are substantial reductions in carbon emissions far above those estimated in EPA’s Clean Power Plan.

CO2 Emissions in the Two Scenarios and with EV Reductions



Note that the dotted boxes in the chart on the right represent the CO2 emissions

offset by gasoline savings over the same time period

*Reliability*

Synapse used the ReEDS model developed by the National Renewable Energy Lab (NREL). The model takes into account reserve margins (how much power is needed for summer peak demand, etc) and balances electric demand and energy capacity in 134 nationwide control areas, in two-year increments. It also takes into account demand during times of the day and seasons (such as summer peak demand). Synapse modeling demonstrated that reliability is maintained throughout the study period.

*Other Perks of a National Sustainable Energy Policy*

Under a much more aggressive, but feasible, plan than the CCP, coal-fired power can be phased out by 2040. Virtually all nuclear capacity can be phased out by 2050. Below is the energy mix from today to 2050 under an 80% renewables scenario by 2050.

**The Electric Generation Mix in the Synapse Scenarios**



Note: RC is reference case; TS is transition scenario; TSEV is transition scenario with electric vehicles,

and the second grouping above is 2030 and the third is 2050

Natural gas demand in the sector also declines from 2010 levels. In the Transition Scenario natural gas use falls 19%. In the Transition Electric Vehicle Scenario it declines slightly less, by 9%, due to the shift from gasoline powers to electric vehicles, but the uptick in natural gas use is offset by the decreased use of gasoline. Natural gas use increases 86% in the “business as usual” Reference Case.

 Coal and Gas Use in the Three Scenarios



 RC is reference case; TS is transition scenario; TSEV is transition scenario with electric vehicles

Drought and overuse are making water a priority issue in various regions in the country. Shifting investment to renewables and efficiency in the electric sector also dramatically reduces water withdrawals (water taken, whether or not it is returned to the body of water) and consumption (water taken and not returned to the body of water) in the sector. Water withdrawals drop over 95% from 2010 levels in both the Transition Scenario and the Transition Scenario Electric Vehicles. Consumption drops over 80% in both scenarios.

Cooling Water Withdrawals in the Three Scenarios



Natural gas is, of course, used for purposes other than generating electricity. However, the Synapse scenarios demonstrate what methane leakage rates could look like by reducing natural gas demand in the sector over time. The following chart shows reductions in methane leakage rates assuming 1% and 10% leakage rates respectively at shale gas wells, on a 20-year and 100-year basis in millions of equivalent tons of CO2 over the course of the study period.

 Methane Leakage Avoided in the TS Assuming 1% and 10% Leakage Rates

**

1%%%

10%

 2020 2030 2040 2050

*Energy Efficiency*

The cornerstone of any energy policy should be making residences and businesses more energy efficient. The Synapse transition scenarios assume that every state in the country could ramp up to 2.1% of reductions in annual kilowatt sales by 2020 and maintain that until 2050. The assumption is also that greater efficiency over time will cost more (see cost table above) but that electricity demand will decrease significantly, falling 19% below 2010 levels in the Transition Scenario and 9% below 2010 levels in the Transition Scenario Electric Vehicles, rather than increasing dramatically in the Reference Case (Business as Usual).

This may be a conservative assumption as the American Council for an Energy Efficient Economy (ACEEE) recently concluded that electricity demand could be reduced by 50% below 2012 levels.[[66]](#footnote-66)

Electricity Use in the Two Scenarios

 

TS

TSEV

RC

**Conclusion**

As noted, the outcomes of the EPA’s carbon rule are highly uncertain. It will depend on the politics of each state, as the rule lends great flexibility to state governments. Nonetheless, the Obama Administration should be applauded for taking this action, as constrained as it might be, in a political context laced with misinformation and influence peddling designed to maintain the status quo in the electric power sector. Indeed, the Clean Air Act has its limitations in terms of scope and effectiveness in meeting the climate change challenge. The Administration may have also constrained itself by embracing an all-of-the-above energy strategy early in its first term, a policy it still favors today. The rule and the EPA’s comments with respect to the various electric power resources available to the states seem to reflect that policy as well.

A much more economically and environmentally sound approach would be to create a well-coordinated national effort to phase-out conventional power generation and phase-in an electric grid dominated by energy efficiency and renewables. This approach, a replacement policy, would be the foundation of a true clean power plan.

The reality is that we are only at the beginning of what is a technological revolution in the energy sector. The potential is just being tapped. What we need to do now is embrace and nurture it, not allow the inertia of misinformation, influence peddling, and intellectual stagnation championed by entrenched energy interests, who are hanging on to obsolete technology and business models, to dominate public discourse. The “All-of-the-Above” strategy is a manifestation of this PR campaign.

1. http://energytransition.de [↑](#footnote-ref-1)
2. By sustainable electric power sector, we mean an electric grid that is anchored in energy efficiency investments and powered by renewables (distributed and otherwise), with an emphasis on energy storage and demand response, the evolution of which eliminates coal-fired and nuclear power and greatly limits/eliminates natural gas-fired power within the next 35 years. [↑](#footnote-ref-2)
3. Brad Plummer, “How Obama’s Clean Power Plan Actually Works – A Step-By-Step-Guide.” Vox, August 15, 2015. <http://www.vox.com/2015/8/4/9096903/clean-power-plan-explained> [↑](#footnote-ref-3)
4. Plummer, August 15 2015. [↑](#footnote-ref-4)
5. “Clean Power Plan: Key Topics and Issues.” US EPA Fact Sheet, <http://www.epa.gov/airquality/cpp/cpp-key-topics.pdf> [↑](#footnote-ref-5)
6. “Incorporating RE and Demand-Side EE Into State Plan Demonstrations. A Technical Support Document: Carbon Emission Guidelines for Existing Stationary Sources.” US EPA, July 31, 2015. <http://epa.gov/airquality/cpp/tsd-cpp-incorporating-re-ee.pdf> [↑](#footnote-ref-6)
7. Gavin Bade, “Devil’s in the Details: What’s in EPA’s Final Clean Power Plan.” Utility Dive, August 5, 2015. <http://www.utilitydive.com/news/devils-in-the-details-whats-in-the-epas-final-clean-power-plan/403493/> [↑](#footnote-ref-7)
8. “US Solar and Alternative Energy: Distilling the Essence of the Clean Power Plant.” UBS, August 11, 2015. <https://neo.ubs.com/shared/d1lLjrWjcCf0PY/> [↑](#footnote-ref-8)
9. “Four Ways the Clean Power Plan Limits the Rush to Natural Gas.” Union of Concerned Scientists, August 7, 2015. <http://blog.ucsusa.org/four-ways-the-final-clean-power-plan-limits-the-rush-to-natural-gas-839> [↑](#footnote-ref-9)
10. “Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units.” US EPA (Final Clean Power Plan Rule), August 3, 2015. <http://www2.epa.gov/cleanpowerplan/clean-power-plan-existing-power-plants> [↑](#footnote-ref-10)
11. 40 CFR Parts 60, 62, and 78 Federal Plan Requirements for Greenhouse Gas Emissions From Electric Utility Generating Units Constructed on or Before January 8, 2014; Model Trading Rules; Amendments to Framework Regulations; Proposed Rule. <http://www.gpo.gov/fdsys/pkg/FR-2015-10-23/pdf/2015-22848.pdf> [↑](#footnote-ref-11)
12. “EPA Finalizes Historic Greenhouse Gas Emission Reduction Program.” Latham & Watkins. Climate Alert White Paper, August 18, 2015. <https://www.lw.com/thoughtLeadership/epa-finalizes-greenhouse-gas-reduction-program> [↑](#footnote-ref-12)
13. US EPA Fact Sheet. [↑](#footnote-ref-13)
14. “24 States Sue Obama Over Clean Power Plan.” EcoWatch, October 24, 2015. <http://ecowatch.com/2015/10/24/clean-power-plan-lawsuits/> [↑](#footnote-ref-14)
15. See “365 Companies and Investors Announce Support for EPA’s Clean Power Plan.” Ceres, July 31, 2015. <http://www.ceres.org/press/press-releases/365-companies-and-investors-announce-support-for-epa2019s-clean-power-plan> and “Fuzzy Lines in Battle Over Clean Power Plan.” EnergyBiz, August 18, 2015. <http://www.energybiz.com/article/15/08/fuzzy-lines-battle-over-clean-power-plan?utm_source=2015_08_19&utm_medium=eNL&utm_campaign=EB_DAILY&utm_content=30764> [↑](#footnote-ref-15)
16. David Roberts, “What Impact Will Obama’s Clean Power Plan Have? It Depends.” Vox, August 3, 2015. <http://www.vox.com/2015/8/3/9090607/5-factors-clean-power-plan-impact> [↑](#footnote-ref-16)
17. Brad Plummer, August 5, 2015. [↑](#footnote-ref-17)
18. “Wind Energy Wins Big Under Clean Power Plan.” Green Tech Media, August 25, 2015. <http://www.greentechmedia.com/articles/read/wind-power-wins-big-under-the-clean-power-plan> [↑](#footnote-ref-18)
19. See “Energy Efficiency in the Clean Power Plan: Take One.” ACEEE, August 12, 2015. <http://aceee.org/blog/2015/08/energy-efficiency-clean-power-plan> and US EPA Fact Sheet. [↑](#footnote-ref-19)
20. [↑](#footnote-ref-20)
21. David Roberts, August 3, 2015. [↑](#footnote-ref-21)
22. Michael A. Levi is the David M. Rubenstein senior fellow for energy and the environment at the Council on Foreign Relations (CFR), director of the Maurice R. Greenberg Center for Geoeconomic Studies, and director of the CFR program on energy security and climate change. He is an expert on climate change, energy security, arms control, and nuclear terrorism. <http://www.cfr.org/experts/energy-geoeconomics/michael-a-levi/b11890> [↑](#footnote-ref-22)
23. Michael Levi, “Five Takeaways on the EPA’s Clean Power Plan.” Council on Foreign Relations, August 3, 2015. <http://blogs.cfr.org/levi/2015/08/03/five-takeaways-on-the-epas-clean-power-plan/> [↑](#footnote-ref-23)
24. “Natural Gas vs. Renewable Energy: States Face Crucial Decisions.” Union of Concerned Scientists. <http://www.ucsusa.org/our-work/global-warming/reduce-emissions/what-is-the-clean-power-plan#bf-toc-2> [↑](#footnote-ref-24)
25. Bloomberg cited in “Why Obama’s Epic Climate Plan Isn’t Such a Big Deal.” Politico, August 2015. <http://www.politico.com/agenda/story/2015/08/why-obamas-epic-climate-plan-isnt-such-a-big-deal-000183> [↑](#footnote-ref-25)
26. “States of Progress Update: Existing Clean Energy Commitments Put Most States in Strong Position to Meet EPA’s Final Clean Power Plan.” Union of Concerned Scientists, August 13, 2015. <http://www.ucsusa.org/sites/default/files/attach/2015/08/States-of-Progress-Update-Slidedeck.pdf> [↑](#footnote-ref-26)
27. “Obama Clean Power Plan Welcomed – But Won’t Avoid Dangerous Warming.” The Guardian, August 4, 2015. <http://www.theguardian.com/environment/2015/aug/04/obama-clean-power-plan-welcomed-but-wont-avoid-dangerous-warming> [↑](#footnote-ref-27)
28. The following sources were provided to Civil Society Institute by Synapse Energy Economics: Emissions from Shale Gas Wells: “Extensive Regional Atmospheric Hydrocarbon Pollution in the Southwestern United States. PNAS, October 14, 2003. <http://www.pnas.org/content/100/21/11975.full>, “Hydrocarbon Emissions Characterization in the Colorado Front Range: A Pilot Study.” Journal of Geophysical Research, 2012. <http://onlinelibrary.wiley.com/doi/10.1029/2011JD016360/pdf>, “Anthropogenic Emissions of Methane in the United States.” Proceedings of the National Academy of Sciences, 2013. <http://calgem.lbl.gov/Miller-2013-PNAS-US-CH4-Emissions-9J5D3GH72.pdf>, “Methane Emissions Estimate from Airborne Measurements Over a Western United States Natural Gas Field.” Geophysical Research Letters, 2013. <http://www.achd.net/shale/pubs/Karion_et-al_2013_Methane.pdf>, “Toward a Better Understanding and Quantification of Methane Emissions from Shale Gas Development.” PNAS, April 29, 2014. [http://www.pnas.org/content/111/17/6237.full.pdf+html](http://www.pnas.org/content/111/17/6237.full.pdf%2Bhtml), “Remote Sensing of Fugitive Methane Emissions from Oil and Gas Production in North American Tight Geologic Formations.” AGU Publications, October 6, 2014. <http://onlinelibrary.wiley.com/doi/10.1002/2014EF000265/pdf>. Distribution System Studies: “Mapping urban pipeline leaks: Methane Leaks Across Boston.” Environmental Pollution, 201. <http://www.ourenergypolicy.org/mapping-urban-pipeline-leaks-methane-leaks-across-boston/>, “Natural Gas Pipeline Leaks Across Washington, DC.” Environmental Science and Technology, 2014. <http://sites.biology.duke.edu/jackson/est2014.pdf> [↑](#footnote-ref-28)
29. *IPCC Warns Methane Traps Much More Heat than We Thought.*  Joe Romm. Clean Technica. <http://cleantechnica.com/2013/10/04/ipcc-warns-methane-traps-much-heat-thought/>

See Also: IPCC Fifth Assessment Report (AR5). http://www.climatechange2013.org/images/uploads/WGIAR5\_WGI-12Doc2b\_FinalDraft\_All.pdf [↑](#footnote-ref-29)
30. *A Bridge to Nowhere: Methane Emissions and the Greenhouse Gas Footprint of Natural Gas.* Robert W. Howarth. Energy Science & Engineering. April 2014. http://www.eeb.cornell.edu/howarth/publications/Howarth\_2014\_ESE\_methane\_emissions.pdf [↑](#footnote-ref-30)
31. *Methane Emissions and Climatic Warming Risk from Hydraulic Fracturing and Shale Gas Development:Implications for policy.* Robert W. Howarth. Energy and Emission Control Technologies. October 8, 2015. http://www.eeb.cornell.edu/howarth/publications/f\_EECT-61539-perspectives-on-air-emissions-of-methane-and-climatic-warmin\_100815\_27470.pdf [↑](#footnote-ref-31)
32. Union of Concerned Scientists, August 7, 2015. [↑](#footnote-ref-32)
33. “Greenhouse Gas Mitigation Measures: Carbon Mitigation Measures for Existing Power Plants, Technical Support Document.” US EPA, August 3, 2015. <http://epa.gov/airquality/cpp/tsd-cpp-ghg-mitigation-measures.pdf> [↑](#footnote-ref-33)
34. Gavin Bade, August 5, 2015. [↑](#footnote-ref-34)
35. UBS, August 11, 2015. [↑](#footnote-ref-35)
36. This means that ramping up output from existing combined-cycle natural gas plants will increase pipeline construction and bolster the finances of firms that arrange for the transportation of natural gas through those pipelines [↑](#footnote-ref-36)
37. “Mass. AG sees no need for new natural gas pipelines”. The Boston Globe. November, 18 2015. https://www.bostonglobe.com/business/2015/11/18/healey-study-natural-gas-pipelines-sees-pros-and-cons/gPaGdvJyH8PWGnkUddgSfN/story.html [↑](#footnote-ref-37)
38. “Final Report: Implications for EPA’s ‘Clean Power Plan’.” Synapse Energy Economics on behalf of NASUCA, November 14, 2014. http://nasuca.org/nwp/wp-content/uploads/2013/11/NASUCA-111d-final-report-20141114-2.pdf [↑](#footnote-ref-38)
39. Oil and Natural Gas Pollution Standards. US EPA. <http://www.epa.gov/airquality/oilandgas/> [↑](#footnote-ref-39)
40. “What the EPA’s Plan Means for Nuclear Energy.” Bulletin of the Atomic Scientists, September 24, 2015. http://thebulletin.org/what-epa’s-clean-power-plan-means-nuclear-energy8763#.VgSdbrOtsbU.twitter [↑](#footnote-ref-40)
41. “Nuclear Industry Darkened by Delays, Cost Overruns at Vogtle and Summer Facilities.” Utility Dive, August 24, 2015. <http://www.utilitydive.com/news/nuclear-industry-darkened-by-delays-cost-overruns-at-vogtle-summer-facil/404418/> [↑](#footnote-ref-41)
42. US EPA Fact Sheet. http://www2.epa.gov/sites/production/files/2015-11/documents/fs-cpp-nuclear.pdf? [↑](#footnote-ref-42)
43. “New EIA Analysis Shows Nukes Don’t Help Reduce Carbon in EPA’s Clean Power Plan.” Safeenergy.org, June 3, 2015. <http://safeenergy.org/2015/06/03/new-eia-analysis-shows-nukes/> [↑](#footnote-ref-43)
44. “NEI Comments on EPA’s Clean Power Plan.” NEI Fact Sheet, August 3, 2015. <http://www.nei.org/News-Media/Media-Room/News-Releases/NEI-Comments-on-EPA-s-Clean-Power-Plan> [↑](#footnote-ref-44)
45. NEI Fact Sheet, August 3, 2015. [↑](#footnote-ref-45)
46. UBS, August 11, 2013. [↑](#footnote-ref-46)
47. “Energiewende – The German Energy Revolution.” Presentation by Ruben Bach of the International Renewable Energy Agency. Energy Storage 2015. Hamburg, Germany, February 4-5, 2015. [↑](#footnote-ref-47)
48. See “Wind Energy Reaches Grid Parity – Without Subsidies.” Utility Dive, April 7, 2014. <http://www.utilitydive.com/news/wind-energy-reaches-grid-paritywithout-subsidies/248313/>, <http://cleantechnica.com/2015/01/14/deutsche-bank-predicts-solar-grid-parity-80-global-market-2017/>, “Rooftop Solar Energy Will Reach or Exceed Grid Parity in More Than Half of US States by 2017, Says UCS.” Daily Kos, September 15, 2015. [http://www.dailykos.com/story/2014/09/15/1329813/-Rooftop-solar-energy-will-reach-or-exceed-grid-parity-in-more-than-half-of-states-by-2017-says-UCS#](http://www.dailykos.com/story/2014/09/15/1329813/-Rooftop-solar-energy-will-reach-or-exceed-grid-parity-in-more-than-half-of-states-by-2017-says-UCS), and “US Wind Energy Selling At Record Low Price of 2.5 Cents Per Kilowatt-Hour.” Renewable Energy World, August 9, 2015. <http://www.renewableenergyworld.com/articles/2015/08/us-wind-energy-selling-at-record-low-price-of-2-5-cents-per-kwh.html> [↑](#footnote-ref-48)
49. It is important to note that the competitiveness of wind and solar is not only dependent upon their own subsidies, but also the subsidies afforded to other forms of energy. Continued subsidies for fossil fuels keep the costs of these fuels artificially low, making it harder for solar and wind to compete if their subsidies are removed. [↑](#footnote-ref-49)
50. “Deutsche Bank Predicts Solar Grid Parity in 80% of Global Market by 2017.” Cleantechnica, January 14, 2015. <http://cleantechnica.com/2015/01/14/deutsche-bank-predicts-solar-grid-parity-80-global-market-2017/> [↑](#footnote-ref-50)
51. UBS, August 11, 2013. [↑](#footnote-ref-51)
52. “EPA Expands Role of Renewables in Clean Power Plan.” Union of Concerned Scientists, August 7, 2011. <http://blog.ucsusa.org/role-of-renewable-energy-final-clean-power-plan-838> [↑](#footnote-ref-52)
53. US EPA Fact Sheet. [↑](#footnote-ref-53)
54. US EPA Fact Sheet. [↑](#footnote-ref-54)
55. US EPA, July 31, 2015. [↑](#footnote-ref-55)
56. Tim Wolf et al., “Unleashing Energy Efficiency: The Best Way to Comply with EPA’s Clean Power Plan.” Public Utilities,

October 2014. <http://synapse-energy.com/project/energy-efficiency-era-climate-change> and Galen Barbose et al, “The Future

of Utility-Customer Funded Energy Efficiency Programs in the United States.” Lawrence Berkeley National Lab, 2013.

<http://emp.lbl.gov/publications/future-utility-customer-funded-energy-efficiency-programs-united-states-projected-spend> [↑](#footnote-ref-56)
57. Politico, August 2015. [↑](#footnote-ref-57)
58. “4 Myths About the German Energy Transition.” Civil Society Institute, 2014. [↑](#footnote-ref-58)
59. For a description of methodology and assumptions go to (web site)? [↑](#footnote-ref-59)
60. Germany serves as an example. The country’s electric grid is more reliable than most EU countries, despite a relatively high penetration of solar PV and wind resources. In 2012, Germany’s grid reliability ranked 3rd overall in the EU. (Overview of Grid Reliablity in EU.Renewables Interna­tional: http://www.renewablesinternational.net/overview-of-grid-reiability-in-eu/150/537/75716/) [↑](#footnote-ref-60)
61. “The Current and Future Consequences of Global Change.” NASA. http://climate.nasa.gov/effects [↑](#footnote-ref-61)
62. The savings are in comparison to the Reference Case (business as usual) developed by Synapse based on DOE’s Annual Energy Outlook (AEO). [↑](#footnote-ref-62)
63. Synapse calculates the reduced use of gasoline and gasoline prices in the following way: “To estimate the gasoline savings, we start with the annual electricity load (GWh) from the EVs (see Section 3.1). We convert to VMT assuming an average EV efficiency of 0.3 kWh per mile. We then estimate avoided gallons of gasoline using the average efficiencies targeted in the current U.S. Corporate Average Fuel Economy standards. These rates rise from 33 miles per gallon in 2015 to 47 in 2025, and we hold the rate constant after that.

We multiply avoided gallons in each year of the study period by the forecasted wholesale price of gasoline, as forecasted by the EIA. In 2013 dollars, this rate rises from $2.63 per gallon in 2015 to $4.02 in 2050. We use the wholesale price of gasoline, because only the wholesale cost (generation cost) of the electricity for the EVs is included in the TSEV.” [↑](#footnote-ref-63)
64. Synapse calculates the cost of carbon emissions in the following way: “We estimate global damages from CO2 using data from the U.S. government’s Interagency Working Group (IWG) on the Social Cost of Carbon (IWG, 2013). Government agencies use these estimates in cost-benefit analyses of proposed regulations on energy, transportation, environmental protection, and related issues (GAO, 2014). In 2013, the IWG estimated the cost in 2010 at $32 per ton of CO2, and in 2050 at $71 per ton, both in 2007 dollars per metric ton of CO2).” [↑](#footnote-ref-64)
65. Synapse used US DOE and private sector data (namely, Black & Veatch, Navigant, EPPI, Sargent & Lundy on behalf of EPA and CHP data prepared on behalf of the Natural Gas Association) to develop the construction and O&M costs of the various generating and storage technologies and for pollution control retrofits. [↑](#footnote-ref-65)
66. “The Long-Term Energy Efficiency Potential: What the Evidence Suggests.” ACEEE, January 11, 2012.

<http://www.aceee.org/research-report/e121> [↑](#footnote-ref-66)