January 2017

Basis for Denial of Petitions to Reconsider and Petitions to Stay the CAA section 111(d) Emission Guidelines for Greenhouse Gas Emissions and Compliance Times for Electric Utility Generating Units

Appendix 3 — Non-BSER CPP Flexibilities

U.S. Environmental Protection Agency

INTRODUCTION

The final Clean Power Plan (CPP) recognized that there are many ways that states can incorporate flexibilities into their state plans showing how sources can comply with the emission performance rates or state goals that were determined by the EPA using the best system of emission reductions (BSER). These flexibilities include both the BSER measures included in building blocks 1, 2 and 3[1] and non-BSER measures and technologies that sources may also implement. These flexibilities allow each State to take into consideration their own unique energy portfolio in designing programs to meet state goals. Since finalization of the CPP there have been some advances and updates in projects that affect these non-BSER measures and technologies. These updates and advancements are summarized in the Existing Projects section of this appendix.

Additionally, the non-BSER measures and technologies show that the final CPP allows states a large range of flexibilities because states do not need to focus solely on BSER measures. This appendix is divided into three parts.

The first section identifies a range of non-BSER measures that are being implemented today. It firsts focuses on opportunities available within a plant including: switching from coal to gas or another fuel, carbon capture and storage, efficiency improvements at gas turbines and integrated renewables. This section then looks at measures that can be taken outside of the plant including non-BSER renewables such as off-shore wind and distributed solar as well as demand side energy efficiency. The second section shows some example scenarios where non-BSER measures applied at affected EGUs can lead to a certain magnitude of reductions in greenhouse gas (GHG) emissions and that each state could achieve its goal by in-state measures. The third section demonstrates that these types of projects are not just theoretical opportunities but are in fact being employed widely across the country.

NON-BSER MEASURES AVAILABLE AT EXISTING POWER PLANTS

Fuel Switching at Coal-fired EGUs

Natural gas co-firing or complete fuel switching at coal-fired steam EGUs is becoming a more common way to reduce CO_2 emissions from these types of sources. The EPA has discussed this extensively in the final Carbon Pollution Standards with respect to new, modified or reconstructed EGUs.[2] Many existing coal-fired EGUs already have the capability to utilize natural gas co-firing as most use it to initiate start-up or heat-up of the boiler. This means that there is an existing opportunity for EGUs to utilize more natural gas and is a step that, for most, can be relatively easily taken. Co-firing with natural gas not only results in lower emissions of CO_2, but also lower production of some criteria pollutants (e.g., SO_2, PM) and hazardous air pollutants (e.g., mercury). There are companies that offer services to help retrofit coal-fired EGUs to rely more on natural gas as a primary or secondary fuel.[3]

In addition, as a result of the reduced cost of natural gas and in response to other regulatory actions (e.g., the Mercury and Air Toxics Standards (MATS)) some units have completely converted from being coal-fired to being natural gas-fired EGUs. The Department of

[1] See the final rulemaking for the CPP (80 FR 64667)
[2] See the final rulemaking for the Carbon Pollution Standards (80 FR 64513)
[3] See: "https://powergen.gepower.com/services/upgrade-and-life-extension/boiler-upgrades/natural-gas-conversions-co-firing.html"

Energy's (DOE) Energy Information Administration (EIA) found that 5.6 GW of coal-fired EGUs switched to run solely on natural gas between December 2014 and April 2016.[4] Examples of plants that have been converted from coal to natural gas include four coal-fired units at Southern Company's Ernest C. Gaston station near Wilsonville, Alabama and two coal-fired units at Appalachian Power's Clinch River Power Plan in Virginia.[5] This shows that utilities are currently taking advantage of the lower cost and the associated environmental benefits of natural gas, an approach that could also be used as a non-BSER pathway to achieving the CPP state goals.

In order for fuel switching to occur on a much larger scale, some infrastructure needs to be enhanced to support EGUs utilization of more natural gas. Over the past few years there have been projects to expand the natural gas pipeline infrastructure and to increase overall delivered capacity. Recent projects in New England include the Algonquin Incremental Market and Salem Lateral pipelines. These projects aim to increase the natural gas pipeline capacity to accommodate the increased utilization of natural gas in New England, specifically during the winter months. In addition to increasing the capacity for the area, the projects will support the Salem Harbor Power Plant which is being converted from a coal-fired to a natural gas-fired EGU and is due to be in service in mid-2017.[6]

These examples of coal-to-natural gas conversions and development of improved natural gas delivery infrastructure show that increased natural gas utilization can extend the operating life of some coal-fired units and allow facility owners and operators to take advantage of the historic low cost of natural gas. This in turn allows for a decrease in CO_2 emissions.

In addition to EGUs switching from coal to natural gas, some units are embracing more unique opportunities for switching fuels. One project in the planning and construction stage is the Sheldon Station in Hallam, Nebraska. The project involves repowering one of the coal units at the power plant to run on hydrogen produced at a nearby industrial facility, Monolith Materials. The Monolith Materials facility would use natural gas to produce carbon black and hydrogen. The hydrogen would be sent to the nearby Sheldon Station to fuel the repowered unit, thus avoiding any CO_2 emissions in the production of electricity.[7] This type of integration with an industrial process is one that serves as another example of how cooperation between industrial facilities and the power sector can lead to environmental benefit.

Carbon Capture and Storage at Coal-fired EGUs

Carbon Capture and Storage (CCS) is a technology that has been successfully implemented at multiple projects around the world during the past decades. CCS can either be included as part of a new plant or it can be retrofitted on an existing plant. Currently there are 38 large-scale CCS projects either in operation or under construction.[8] These include CCS projects

[4] U.S. EIA, July 2016. *EIA electricity generator data show power industry response to EPA mercury limits*. "http://www.eia.gov/todayinenergy/detail.php?id=26972#"
[5] See: "http://www.power-eng.com/articles/print/volume-119/issue-6/features/coal-to-gas-plant-conversions-in-the-u-s.html"
[6] U.S. EIA, December 2016. *New England natural gas pipeline capacity increases for the first time since 2010*. "http://www.eia.gov/todayinenergy/detail.php?id=29032"
[7] Nebraska Public Power District, April 2015. *Nebraska Public Power District to implement innovative solution, curbs carbon emissions while growing economy.* "http://www.nppd.com/2015/nebraska-public-power-district-implement-innovative-solution-curbs-carbon-emissions-growing-economy/"
[8] Global CCS Institute, 2016. *The Global Status of CCS: 2016 Summary Report,* Australia. http://www.eenews.net/assets/2016/11/15/document_gw_01.pdf

at fossil fueled power plants and other industrial processes. In the Carbon Pollution Standards rulemaking the EPA discussed in great detail both the technology and feasibility of CCS to limit CO_2 emissions from new fossil fuel fired electricity generating units (EGUs).[9] Since finalizing the Carbon Pollution Standards and the CPP, there are at least two CCS projects on sources covered by section 111(d) that would achieve emission reductions significantly beyond those required by implementing the BSER.

The Petra Nova WA Parish project located southwest of Houston, Texas is a joint venture between NRG Energy Inc. and JX Nippon Oil & Gas Exploration. The project has completed constructed of a commercial-scale post-combustion carbon capture project at Unit #8 of NRG's WA Parish generating station. The project is designed to utilize partial CCS by capturing approximately 90 percent of the CO_2 from a 240 MW slip-stream of the 610 MW WA Parish facility (i.e., capturing approximately 35 percent of the plant's total CO_2 emissions). The project was originally envisioned as a 60 MW slip-stream demonstration and received DOE Clean Coal Power Initiative (CCPI) funding (as provided in EPAct05) on that basis. The developers later expanded the project to the larger 240 MW slip-stream because of the need to capture greater volumes of CO_2 to be used for enhanced oil recovery (EOR) operations. No additional DOE or other federal funding was obtained for the expansion from a 60 MW slip-stream to a 240 MW slip-stream. At 240 MW, the Petra Nova project will be the largest post-combustion carbon capture system installed on an existing coal-fired power plant. The project will capture approximately 1.6 million tons of CO_2 each year to be used for EOR or to be geologically sequester. The project is online as of January 10, 2017.[10] [11] [12]

Southern Company's subsidiary Mississippi Power has constructed the Kemper County Energy Facility in Kemper County, MS. This is a 582 MW Integrated Gasification Combined Cycle plant that will utilize local Mississippi lignite and includes a pre-combustion carbon capture system to reduce CO_2 emissions by approximately 65 percent. The pre-combustion solvent, Selexol™, has also been used extensively for acid gas removal (including for CO_2 removal) in various processes. In 2016 Kemper has passed many milestones including successfully creating syngas from coal at both of the project's gasifiers. The Kemper CCS project is expected to be fully online at the beginning of 2017.[13]

Another non-US project further demonstrates the feasibility of retro-fitting CCS to an existing power plant. In Canada the Boundary Dam Unit 3 CCS project operated by SaskPower continues consistent operation since the finalization of the CPP.[14] The facility continues to meet the Canadian emission regulations (which are more stringent than comparable U.S.

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[9] See the final rulemaking for the Carbon Pollution Standards (80 FR 64510) and the technical support document titled "Literature Survey of Carbon Capture Technology" in the rulemaking docket (EPA-HQ-OAR-2013-0495).

[10] See: "http://www.nrg.com/generation/projects/petra-nova/"

[11] E&E News, October 2016. *World's largest carbon capture retrofit on track to open.* "http://www.eenews.net/climatewire/2016/10/04/stories/1060043791"

[12] Mooney, Chris. Washington Post, 2017. *America's first 'clean coal' plant is now operational — and another is on the way.* "https://www.washingtonpost.com/news/energy-environment/wp/2017/01/10/americas-first-clean-coal-plant-is-now-operational-and-another-is-on-the-way/?utm_term=.69047055d77e"

[13] Mississippi Power, December 2016. *Mississippi Power issues statement regarding Kemper County energy facility schedule*. "http://mississippipowernews.com/2016/12/02/mississippi-power-issues-statement-regarding-kemper-county-energy-facility-schedule-2/"

[14] Carbon Pollution Standards Docket ID No. EPA–HQ–OAR– 2013–0603 "Basis for Denial of Petitions to Reconsider the CAA Section 111(b) Standards of Performance for Greenhouse Gas Emissions from New, Modified, and Reconstructed Fossil Fuel-Fired Electric Utility Generating Units"

requirements) and meet the needs of its CO_2 off-taker (i.e., CO_2 sold for use in EOR operations). The most recent data shows that the 12-month average (November 2015-November 2016) operation (time online) of the CCS unit was 83 percent. Since operation began in October 2014, the unit has captured over 1.25 million metric tons of CO_2.[15]

In addition to CCS at utilities in the United States and Canada, CCS is being utilized at other non-utility industrial sources. These applications further show how the CCS technology is adaptive to different facility layouts. One example project is the industrial application of CCS at the Illinois Basin Decatur Capture and Storage Project which, when complete, will be the world's first large scale bioenergy CCS project. The project is designed to capture CO_2 from a bioethanol production plant and inject the captured CO_2 for long term geologic sequestration. The project is planned to be operational in 2017.[16]

Additional information concerning CCS is included in two briefs *amici curiae* filed by independent experts in the litigation before the D.C. Circuit concerning the Carbon Pollution Standards. Those briefs, included in the docket for this action, explain that carbon capture technologies and carbon storage are mature and viable, as well as explain that carbon capture technology can be expected to continue to improve and become less expensive as it is deployed more. Brief for *Amici Curiae* Carbon Capture and Storage Scientists, Doc. #1652097, *North Dakota v. EPA*, No. 15-01381 (D.C. Cir.), and Brief for *Amici Curiae* Technological Innovation Experts, Doc. #1652263, *North Dakota v. EPA*, No. 15-01381 (D.C. Cir.).

Retrofit CCS is Broadly Available Across the U.S.

In addition to the projects cited above, companies have pursued projects in other areas of the United States (but have not followed through on them in part because of the lack of regulatory drivers). Other projects that have previously progressed to a point where construction could have commenced but for economic and policy drivers. For instance, AEP had pursued a project designed to capture 90% of the CO_2 from a 235 MW slipstream at Mountaineer coal plant in West Virginia. Early work on that project included a 20 MW pilot (which received no federal funding) and front end engineering and design for the larger project. AEP explained that they did not continue beyond this step until, "economic and policy conditions create a viable path forward." They further elaborated that, "as a regulated utility it is impossible to gain regulatory approval to recover our share of the costs for validating and deploying the technology without federal requirements to reduce greenhouse gas emissions already in place. The uncertainty also makes it difficult to attract partners to help fund the industry share,"[17] One study concluded that up to 60 GWs of coal-fired generation might be amenable to CCS.[18] (Approximately 20% of the

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[15] SaskPower Report November 2016 posted at "http://www.saskpower.com/about-us/blog/bd3-status-update-november-2016/"

[16] This project is just one example of the CCS projects expected to come online in 2017. A full list of projects can be found in the following reference: International Energy Agency, 2016. *20 Years of Carbon Capture and Storage: Accelerating Future Deployment*, France. "https://www.iea.org/publications/freepublications/publication/20YearsofCarbonCaptureandStorage_WEB.pdf"

[17] AEP, July 2011. *AEP Places Carbon Capture Commercialization On Hold, Citing Uncertain Status Of Climate Policy, Weak Economy*. "https://www.aep.com/newsroom/newsreleases/?id=1704"

[18]Zhai, Haibu, Yang Ou, and Edward S. Rubin. May 2015. *Opportunities for Decarbonizing Existing U.S. Coal-Fired Power Plants via CO2 Capture, Utilization and Storage*. http://www.cmu.edu/epp/iecm/rubin/PDF%20files/2015/Pages%20from%20Zhai_Rubin_CCUSretrofits_ES&T_2015.pdf

coal-fired fleet). As the next section details, opportunities to store captured CO_2 are widely available across the country.

Availability of Geologic Sequestration

Geologic sequestration is feasible in different types of geologic formations including deep saline formations (formations with high salinity formation fluids) or in oil and gas formations, such as where injected CO_2 increases oil production efficiency through a process referred to as EOR. Additionally, formations such as un-mineable coal seams also offer the potential for geologic storage. In the Carbon Pollution Standards rulemaking, the EPA discussed in great detail the geographic availability of geologic sequestration.[19] Since finalizing the Carbon Pollution Standards and the CPP, the DOE has published additional information that continues to show that geologic sequestration is available throughout most of the United States and provides updated estimates on potential capacity.

The figure below depicts the geographic extent of potential geologic sequestration in deep saline formations, oil and gas reservoirs, and un-mineable coal seams, as identified by the DOE, National Energy Technology Laboratory (NETL), Carbon Utilization and Storage Atlas, Fifth Edition (2015). The figure also shows the locations of counties where active CO_2 EOR operations are occurring, based on data reported to the EPA Greenhouse Gas Reporting Program (40 CFR Part 98, subpart UU, Injection of Carbon Dioxide, 2011-2015 data). Also shown is the area within 100 kilometers from potential geologic sequestration formations.[20] Existing CO_2 pipelines are shown on the map, along with the locations of planned pipelines, or pipeline projects that are being considered. As shown in the figure, there are 39 states for which potential onshore and offshore deep saline formation storage resources have been identified. EOR operations are currently being conducted in 12 states. An additional 17 states have geology that may be amenable to EOR operations. There are 20 states within 100 kilometers of an active EOR location and 13 states have operating CO_2 pipelines.

[19] See the final rulemaking for the Carbon Pollution Standards (80 FR 64510) and the technical support document titled "Geographic Availability" in the rulemaking docket (EPA-HQ-OAR-2013-0495).
[20] The distance of 100 kilometers reflects assumptions in DOE-NETL cost estimates. See "Carbon Dioxide and Transport and Storage Costs in NETL Studies", DOE/NETL-2014/1653 (May 2014). Available at: https://www.netl.doe.gov/File%20Library/Research/Energy%20Analysis/Publications/QGESS_CO2T-S_Rev3_20140514.pdf.

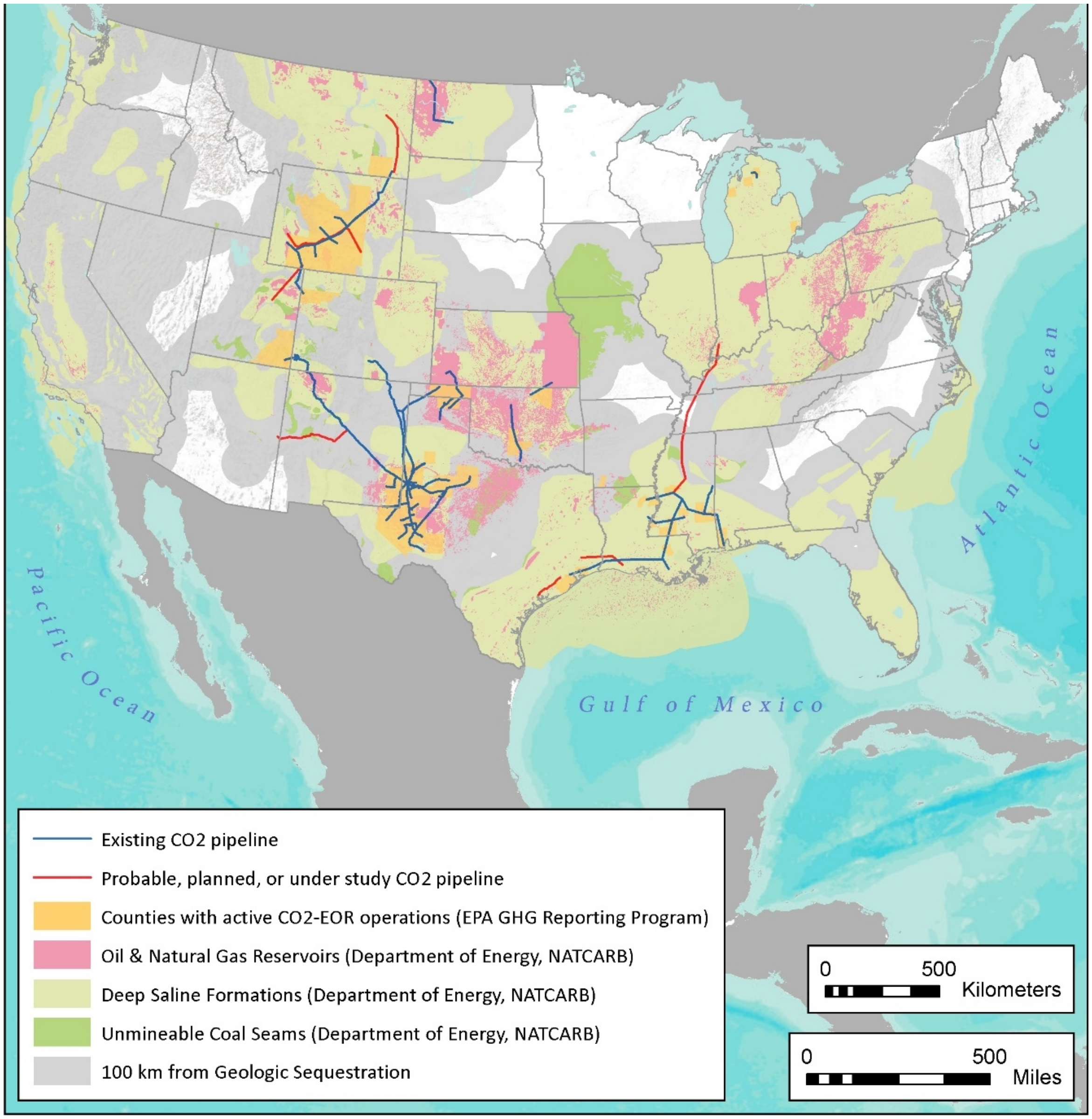

Figure 1: Geologic Sequestration in the Continental United States

DOE estimates are compiled by the National Carbon Sequestration Database and Geographic Information System and published in a Carbon Utilization and Storage Atlas. The latest version of the Atlas, published in August 2015, includes the most current and best available estimates of potential storage capacity determined by a methodology applied consistently across all seven of the DOE Regional Carbon Sequestration Partnerships.[21] The Atlas shows storage potential of approximately 2,420 billion metric tons to more than 21,299 billion metric tons of CO_2 in the United States from deep saline formations, oil and gas reservoirs, and un-mineable coal seams. This includes estimates for onshore storage and offshore storage in federal waters. Deep saline formations offer the largest geologic

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[21] NETL, *Regional Carbon Sequestration Partnerships (RCSP) Initiative*, http://www.netl.doe.gov/research/coal/carbon-storage/carbon-storage-infrastructure/rcsp

sequestration potential; DOE estimates that areas of the United States with appropriate geology have a sequestration potential of at least 2,182 billion metric tons of CO_2 in deep saline formations. The table below shows total CO_2 storage resource by state based on analysis by DOE-NETL.

Table 1:Total CO_2 Storage Resource (DOE-NETL)[22]

	Million Metric Tons*	
State	**Low Estimate**	**High Estimate**
Alabama	122,200	694,160
Alaska	8,640	19,750
Arizona	110	1,150
Arkansas	6,070	63,700
California	33,890	423,700
Colorado	35,280	357,340
Connecticut	not assessed by DOE-NETL	not assessed by DOE-NETL
Delaware	40	40
District of Columbia	not assessed by DOE-NETL	not assessed by DOE-NETL
Florida	102,650	554,950
Georgia	145,340	159,050
Hawaii	not assessed by DOE-NETL	not assessed by DOE-NETL
Idaho	40	390
Illinois	21,230	216,280
Indiana	38,250	128,760
Iowa	0	10
Kansas	10,880	86,340
Kentucky	15,910	113,610
Louisiana	162,780	2,102,430
Maine	0	0
Maryland	1,860	1,930
Massachusetts	0	0
Michigan	31,720	66,520
Minnesota	0	0
Mississippi	144,740	1,185,100
Missouri	20	300
Montana	98,690	858,150
Nebraska	23,660	111,980
Nevada	not assessed by DOE-NETL	not assessed by DOE-NETL
New Hampshire	not assessed by DOE-NETL	not assessed by DOE-NETL
New Jersey**	0	0
New Mexico	42,760	359,090
New York	4,420	4,520

[22] The United States 2015 Carbon Utilization and Storage Atlas, Fifth Edition, U.S Department of Energy, Office of Fossil Energy, National Energy Technology Laboratory (NETL). Available at: https://www.netl.doe.gov/research/coal/carbon-storage/atlasv.

North Carolina	1,340	18,390
North Dakota	72,850	237,440
Offshore Federal	490,930	6,454,000
Ohio	10,680	12,000
Oklahoma	23,120	211,650
Oregon	6,810	93,700
Pennsylvania	18,410	20,060
Rhode Island	not assessed by DOE-NETL	not assessed by DOE-NETL
South Carolina	30,100	34,180
South Dakota	3,700	12,160
Tennessee	500	4,630
Texas	479,360	4,373,250
Utah	23,950	242,130
Vermont	not assessed by DOE-NETL	not assessed by DOE-NETL
Virginia	430	2,910
Washington	36,620	496,740
West Virginia	17,490	29,610
Wisconsin	0	0
Wyoming	153,120	1,547,750
U.S. Total	**2,420,590**	**21,299,850**

* States with a "zero" value represent estimates of minimal CO_2 storage resource. States that have not yet been assessed by DOE-NETL have been identified.

**New Jersey. The Midwest Regional Carbon Sequestration Partnership prepared an initial evaluation of CO_2 storage in New Jersey in 2011 that included an assessment of storage potential in offshore continental shelf and slope. The Fourth Carbon Utilization and Storage Atlas (page 56) identified between 164,500 and 658,200 million metric tons of potential storage capacity, however the Atlas notes that offshore New Jersey resource was not included in the total deep saline formation calculation.

The Pipeline and Hazardous Materials Safety Administration reported that in 2015 there were 5,233 miles of CO_2 pipelines operating in the United States.[23] This represents a 62 percent increase in CO_2 pipeline miles since 2004. Twenty-nine companies operate CO_2 pipelines in 13 states, to support transportation of natural and anthropogenic CO_2 from source areas to CO_2 EOR locations. The demand for CO_2 to support EOR projects, and availability of new anthropogenic sources of CO_2 has provided new opportunities for CO_2 transport companies to expand the CO_2 infrastructure. Several companies have proposed several hundred miles of dedicated CO_2 pipeline in Colorado, Louisiana, Montana, New Mexico, Texas, and Wyoming. Some projects are under construction, some are in the permitting and planning stage, and some are in the evaluation and study phase.

[23] "Annual Report Mileage for Hazardous Liquid or Carbon Dioxide Systems", U.S. Pipeline and Hazardous Materials Safety Administration, December 1, 2016. Available at: http://www.phmsa.dot.gov/pipeline/library/data-stats/annual-report-mileage-for-hazardous-liquid-or-carbon-dioxide-systems.

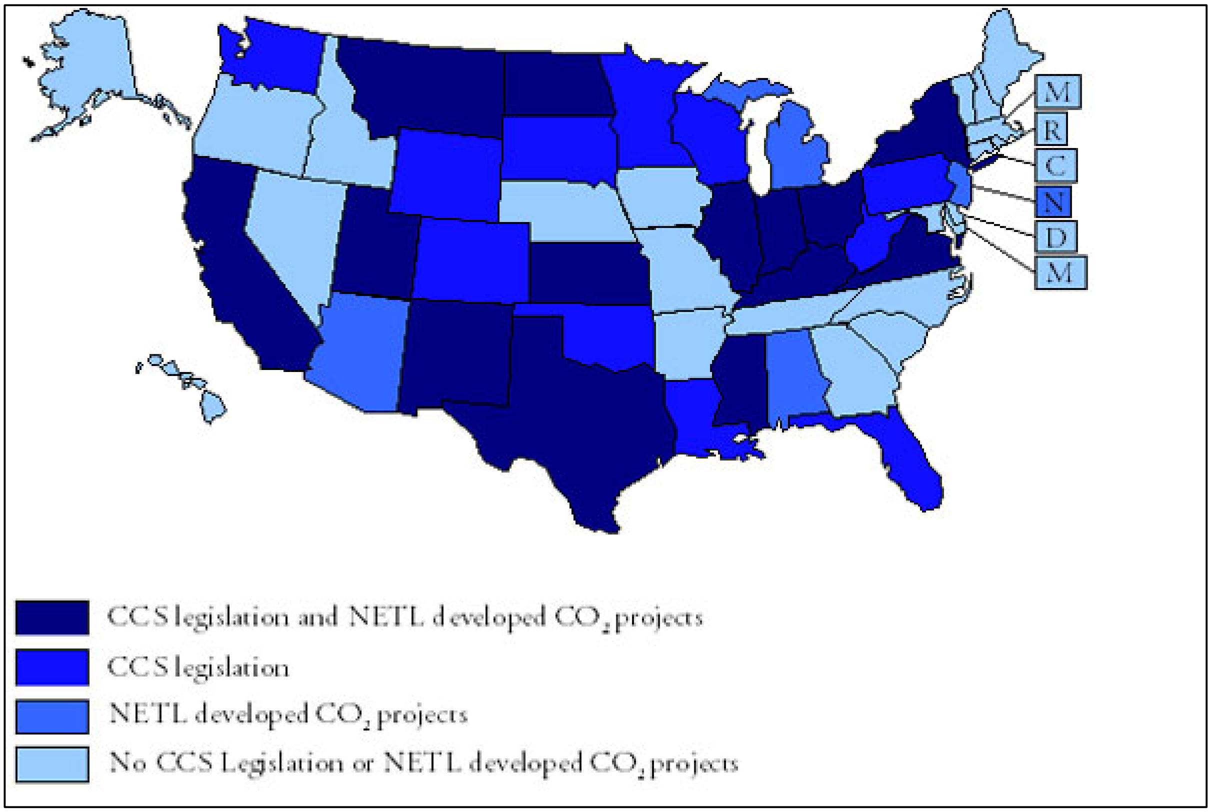

Figure 2: CCS Laws in States[24]

Many states have adopted a legal infrastructure to facilitate CCS. For example, note the following description of Intervenors ND, TX, LA, MS brief in the 111(b) case: Intervenors' brief, representing lignite interests in North Dakota, Texas, Louisiana, and Mississippi, Int. Br. at 5, 8, in fact supports the conclusion that CCS is adequately demonstrated for lignite-burning units. Intervenors note the extensive state regulatory infrastructure already in place in these states to govern CCS for lignite units, including: a North Dakota "property tax abatement for CO_2 pipelines related to lignite projects" and "sales tax exemption for lignite gasification byproducts" (which includes CO_2); Louisiana provisions governing "storage/withdrawal of carbon dioxide," "leasing state lands for the injection and storage of carbon dioxide," and "liability release provisions"; and Mississippi provisions concerning "CCS enhanced oil recovery tax treatment" and "rate recovery for CCS projects." Id. at 5-8. In Texas, the State has already adopted, *inter alia*, property tax, sales tax, and gross receipts tax exemptions for CCS; has enacted multiple programs providing "various tax exemptions, abatements, and credits" to lignite CCS projects; and has established an offshore geologic CO_2 repository. Id. at 8.

Combustion Turbine Efficiency Improvements

Heat rate or efficiency improvements at existing natural gas combined cycle (NGCC) combustion turbines is an effective way to both decrease the GHG emission rate and increase the potential output of such units. While these improvements were not included as part of the CPP

[24] National Conference of State Legislatures, "Carbon capture and storage laws in 25 states pertain to issues such as CCS incentives, CO_2 transportation, and liability and ownership of CO_2."
http://www.ncsl.org/research/energy/carbon-capture-and-storage-in-the-states.aspx

BSER, available technologies allow affected EGUs additional flexibility to reduce their CO_2 emissions and comply with State goals. For example, comment EPA-HQ-OAR-2013-0602-22971 identified several technologies that cumulatively have the potential to decrease the CO_2 emission rate of an existing NGCC unit by approximately 4%. In addition, the improvements simultaneously increase the output of the unit to allow for additional load shifting from higher CO_2 emitting EGUs. Case studies where these upgrades have been applied demonstrate that output from existing NGCC units can be increased by greater than 5 percent, with fuel use decreased by 1 to 3 percent.[25,26] Similar upgrades are available from other manufacturers as well.[27]

Renewable Energy Resource Integration and Utilization

Renewable energy on its own is a very effective electricity generating resource. In the past decade utilities have been experimenting with on-site integration of renewables and fossil fuel fired energy production as well as co-locating the two technologies. This is another unique way that states can allow for flexibilities for their affected EGUs to reduce their CO_2 emissions.

One demonstration of renewable integration is the Colorado Integrated Solar Project. The project was a hybrid of a concentrated solar power and coal plant using parabolic-trough solar technology. A parabolic trough solar field provided thermal energy to produce supplemental steam for power generation at Xcel Energy's Cameo Station's Unit 2 (approximately 2 MW equivalent) in order to decrease the overall consumption of coal, reduce emissions from the plant, improve plant efficiency, and test the commercial viability of concentrating solar integration. The plant was used for testing purposes until the coal plant was retired and the CSP plant was decommissioned.[28,29]

Another demonstration of renewable integration is the Florida Power and Light (FPL) Martin Next Generation Solar Energy Center. The project is the first hybrid solar facility in the world to connect to an existing NGCC power plant. The project has 75 MW capacity and the solar parabolic trough design uses 200,000 mirrors over 500 acres of land. Construction began at FPL's Martin Plant in Indiantown, FL in December 2008 and was completed 2010.[30,31]

Co-located renewable energy resources also provide a unique opportunity for traditional fossil fuel-fired EGUs to take advantage of intermittent renewable power generation. One proposed project is the Clean Path Energy Center project. This project includes a 680 MW NGCC and a 70 MW solar photovoltaic array. The project is designed to operate at baseload and to additionally provide peaking services.[32]

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[25] Power Engineering, July 2016. *Major Upgrade of Oregon Power Plant Completed*. "http://www.power-eng.com/articles/2016/07/major-upgrade-of-oregon-power-plant-completed.html?cmpid=enl-poe-weekly-july-26-2016&cmpid=enl_PE_Weekly_2016-07-26&eid=294698054&bid=1478248"

[26] Power Engineering, March 2016. *Making Old New Again*. "http://www.power-eng.com/articles/print/volume-120/issue-3/features/making-old-new-again.html"

[27] "http://www.energy.siemens.com/hq/en/services/fossil-power-generation"

[28] NREL "http://www.nrel.gov/csp/solarpaces/project_detail.cfm/projectID=75"

[29] XcelEnergy, 2009. *Colorado Integrated Solar Project*. "https://www.xcelenergy.com/staticfiles/xe/Corporate/Environment/09-10-204%20CameoSolarFS%5B1%5D%20V%204%20111109.pdf "

[30] "https://www.fpl.com/clean-energy/solar/energy-centers.html"

[31] "http://www.nrel.gov/csp/solarpaces/project_detail.cfm/projectID=267"

[32] http://cleanpathenergycenter.com/

Another project is Tampa Electric Company's (TECO) Big Bend Solar facility that is adjacent to Tampa Electric's Big Bend Power Station in Apollo Beach. This 23-megawatt photovoltaic (PV) array will feature more than 70,000 solar panels on 125 acres of Tampa Electric-owned land near our Big Bend Power Station. It will be the largest solar array in the Tampa Bay area. Situated on Tampa Bay, Big Bend Power Station has four coal-fired units with a combined output of more than 1,700 megawatts. A natural gas- and fuel oil-fired peaking unit was installed in 2009 to provide additional power during periods of peak demand.[33] A third project is Comanche Solar Project where Xcel Energy has agreed to purchase electricity under a 25-year power purchase agreement from the 156 MW(DC)/120 MW(AC) project (at rates that are competitive with the long-term forecast for natural gas-fired generation). The Comanche Solar Project is located next to Xcel Energy's Comanche Generating Station and is anticipated to become operational mid-summer 2016. Two other projects are the Desert Solar Energy Center and Copper mountain solar project and the EW Brown Generating Station solar project which were discussed in a final CPP memo to the docket.[34]

If integration or co-location is not an option, close proximity renewable projects may be a solution. FPL's DeSoto Energy Center is an example of a close, but not co-located, renewable/fossil project (12 miles between panels and natural gas units).[35] Additional details about renewable energy resources being in close proximity of EGUs are discussed in a TSD of the final CPP about renewable projects in close proximity, but not necessarily co-located with fossil units.[36]

Non-BSER Renewable Energy

RE was a large part of EPA's BSER in the final CPP. In addition to the RE that was included in BSER, more non-BSER projects including distributed solar photovoltaics (PV) and offshore wind have made progress in the past year. These advancements show how the RE industry is continuing to grow and advance.

Residential solar is an increasingly popular area for the public to take part in electricity generation. In 2015 total residential PV installations were roughly 2,165 MWdc and a total Residential PV Installation Forecast for 2016 of 2,661 MWdc. These trends show us that there is a growing participation of the public in distributed renewable energy projects and is a promising way for the energy sector to continue advancement. In addition to residential solar, NREL has recently shown that there is a large potential for the midscale market for solar projects including locating solar at office buildings, hotels, warehouses and universities. In total the techno-economic potential for the midscale market could reach more than 100 GW.[37]

Off-shore wind is a RE resources that has been successfully installed and implemented at various locations across the world.[38] Recently the United States has started to embrace the

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[33] http://www.tampaelectric.com/company/ourpowersystem/powergeneration/bigbendsolar/

[34] Memo titled *Memorandum Supplementing section 4.6.4 of the GHG Mitigation Measures TSD supporting the final CPP. Ownership and Co-Location* in the CPP docket (Docket ID No. EPA-HQ-OAR-2013-0602)

[35] https://www.fpl.com/clean-energy/solar/energy-centers.html

[36] TSD titled *Greenhouse Gas Mitigation Measures* in the final CPP docket (Docket ID No. EPA-HQ-OAR-2013-0602)

[37] National Renewable Energy Laboratory, September 2016. *Expanding Midscale Solar: Examining the Economic Potential, Barriers, and Opportunities at Offices, Hotels, Warehouses, and Universities.* "http://www.nrel.gov/docs/fy16osti/65938.pdf"

[38] U.S. Energy Information Administration, August 14, 2015. *First offshore wind farm in the United States begins construction*. "http://www.eia.gov/todayinenergy/detail.php?id=22512#tabs_SpotPriceSlider-1"

technology as a viable resource to be implemented off the coasts of the US. Currently as of quarter 2016 the United States has put its first offshore wind farm online at Block Island Wind Farm which is a 30 MW project.[39] [40]

Additionally, as of May 2016 DOE as identified three additional projects for completion and producing power. [41,42] First, Fishermen's Energy Atlantic City Windfarm is a 25 MW windfarm proposed to begin in 2016 where Fishermen's Energy of New Jersey will install six 4-megawatt turbines in state waters approximately three miles off the coast of Atlantic City, New Jersey. Second, Lake Erie Energy Development Corporation's Icebreaker project by Lake Erie Energy Development Corporation (LEEDCo) plans to install six 3.45-megawatt direct-drive wind turbines on Mono Bucket foundations seven miles off the coast of Cleveland in Lake Erie totaling 20.7 MW of potential generating capacity. Third, the University of Maine's New England Aqua Ventus I project is a 12 MW project where the University of Maine plans to install a pilot floating offshore wind farm with two 6-megawatt direct-drive turbines on concrete semisubmersible foundations at a test site off Monhegan Island, Maine. This project is a stepping stone for a contemplated New England Aqua Ventus II which would be a 500 MW farm consisting of eighty three 6 MW VolturnUS floating wind turbines.

Energy Efficiency Programs and Projects

The U.S. electricity sector is in the midst of major transformation through the adoption of information and communication technology (ICT). The adoption of ICT strategies as well as more traditional technology advancements in the electricity consuming devices has the potential to drive ongoing improvements in energy efficiency that will further reduce already declining projections of electricity demand growth. These savings are largely beyond those projected from past evaluations of cost-effective energy efficiency potential. A recent study by the American Council for an Energy-Efficient Economy (ACEEE) provides a midrange estimate of electricity savings from the adoption of new energy efficiency technologies and strategies (several based on new ICT deployment) equal to 22% of projected U.S. electricity sales in 2030.[43] Numerous other studies (including from The Brattle Group, Electric Power Research Institute, and the Pacific Northwest National Laboratory) have also documented substantial electricity savings potential from the deployment of strategies related to ICT, "smart grid," and the "internet of things."[44] The deployment of these technologies and strategies are expected to continue to increase energy savings from energy efficiency and put downward pressure on electricity

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[39] Environmental and Energy Study Institute (EESI), January 4, 2016. *Fact Sheet: Offshore Wind - Can the United States Catch up with Europe?*, http://www.eesi.org/papers/view/factsheet-offshore-wind-2016#5

[40] U.S. Energy Information Administration, 2016. *Annual Energy Outlook 2016- Table: Renewable Energy Generating Capacity and Generation*. "http://www.eia.gov/outlooks/aeo/pdf/0383(2016).pdf"

[41] U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy. *Offshore Wind Advanced Technology Demonstration Projects.* "http://energy.gov/eere/wind/offshore-wind-advanced-technology-demonstration-projects\"

[42] U.S. Department of Energy, Wind Energy Technologies Office, 2016. *Offshore Wind Projects – Fiscal years 2006-2016*. "http://energy.gov/sites/prod/files/2016/10/f33/Offshore-Wind-Projects-2009-2016.pdf"

[43] American Council for an Energy-Efficient Economy, September 2015. *New Horizons for Energy Efficiency: Major Opportunities to Reach Higher Electricity Savings by 2030,* Report Number U1507. "http://aceee.org/research-report/u1507"

[44] See for example: Hledik, Ryan, The Brattle Group, "How Green Is the Smart Grid," The Electricity Journal, April 2009; Electric Power Research Group, "Estimating the Costs and Benefits of the Smart Grid," 2011 Technical Report; and Pacific Northwest National Laboratory, "The Smart Grid: An Estimation of the Energy and CO2 Benefits," January 2010, PNNL-19112.

demand growth over the next several decades. Additional information on energy efficiency programs and measures can be found in the Industry Trends Appendix of this action.

Nuclear Energy

The U.S. has 60 nuclear power plants in 30 states accounting for a relatively stable 20% share of total U.S. electricity generation. In June 2016, Watts Bar Unit 2 began initial operation in Tennessee, becoming the first new reactor to come online in the United States in twenty years. Additionally, four new nuclear reactors are under construction in Georgia and South Carolina and are expected to commence initial operations by 2020. As of December 2016, there are six active applications under review by the Nuclear Regulatory Commission (NRC) for new large light-water reactors. Beyond new construction, nuclear generating capacity may be added to the system through power uprates, in which a utility will typically refuel with more enriched uranium or a higher percentage of new fuel to increase thermal output and generate more electricity. Industry have been successfully employing power uprates at nuclear plants for decades, subject to approval from the NRC.

Based on a review of EIA's Form EIA-923[45] which shows utility generation data by fuel source, from 2008 to 2015, Alabama Power, Duke Energy Carolinas, Entergy Arkansas, Georgia Power, Indiana Michigan Power, and TVA, and Union Electric Co. significantly increased their share of nuclear generation during that period.

Table 2: Energy generation from nuclear energy generation

Utility Company	2008 -- % total generation from nuclear	2015 -- % total generation from nuclear	Change[46]
Alabama Power	18	22	4
Duke Energy Carolinas	55	61	6
Entergy Arkansas	38	49	11
Georgia Power	26	34	9
Indiana Michigan Power	38	54	16
TVA	32	37	5
Union Electric Co (Ameren – MO)	19	25	6

[45] See https://www.eia.gov/electricity/data/eia923/
[46] Amounts reflect rounding

Additionally, recent statements in 2015 or 2016 IRPs about future plans have included the following:

- Duke Energy Carolinas: "In 2030, the Base Case projects that DEC will have a smaller reliance on coal and a higher reliance on gas-fired resources, nuclear, renewable resources and EE as compared to the current state."[47]
- Dominion: Plans on adding 1,452 MW nuclear in 2029.[48]
- TVA: Expects to pursue uprates of 400MW at Browns Ferry by 2023 and from 2015 to 2033: "Our results show no immediate needs for new base load plants after Watts Bar Unit 2 comes online and uprates are completed at Browns Ferry nuclear plant. Instead, we can rely on additional natural gas generation (combined cycle and combustion turbine), greater levels of cost-effective energy efficiency, and increased contributions from competitively priced renewable power. We also expect to have less coal-based generation in our energy mix than we do today, although it will continue to play an important role in the portfolio."[49]

ILLUSTRATIVE NON-BSER POTENTIAL

As previously discussed there are multiple programs or technologies beyond the three building blocks in the final CPP that states and sources can implement or install to achieve CO_2 emission reductions. The EPA has done preliminary analysis based on data used in the final CPP rulemaking to estimate the potential magnitude of reductions that some of these projects or technologies might achieve. The first set of information looks at application of CCS, natural gas fuel switching at fossil steam boilers, and demand-side energy efficiency savings. The following tables present estimated reductions of CO_2 from the 2012 baseline based upon a uniform application of the associated technology. Tables 3 and 4 show the generation share of fossil steam units and NGCC units that would be presumed to be affected EGUs under state plans based on the 2012 baseline data in the final CPP.[50]

Table 3: 2012 Baseline from CO_2 emission performance rate calculation

	National Baseline CO_2 Emissions for EGUs (tons)	National Baseline MWh of Operation for EGUs	Baseline Rate (lbs/MWh)	Generation Share
Fossil Steam	1,783,143,460	1,645,373,182	2,167	60.6%
NGCC	482,591,795	1,070,092,428	902	39.4%
Total	2,265,735,254	2,715,465,610		

[47] Duke Energy. http://www.energy.sc.gov/files/view/2015DECIRP.pdf (9/1/15) (p. 63). Adding 1,117 MW nuclear in 2024 and 1,117 MW nuclear in 2026 (Lee Nuclear Station). (pp. 56-57, 59)
[48]Dominion. April, 2016. *Dominion Virginia Power's and Dominion North Carolina Power's Report of Its Integrated Resource Plan*. "https://www.dom.com/about-us/making-energy/2016-integrated-resource-planning" (p. 111)
[49] TVA. Integrated Resource Plan 2015. "https://www.tva.com/file_source/TVA/Site%20Content/Environment/Environmental%20Stewardship/IRP/Documents/2015_irp.pdf" (p. 2, 4, 41)
[50] See the final CPP docket for the 2012 baseline (Docket ID No. EPA-HQ-OAR-2013-0602)

Table 4: Final CPP CO_2 emission performance rates and cumulative mass-based goals

	2030 CO_2 Emission Performance Rates (lbs/MWh)	2030 Mass-based CO_2 Goals (tons)	Overall Reduction from 2012 Baseline
Fossil Steam	1305	1,073,606,001	39.8%
NGCC	771	412,520,631	14.5%
Total		1,486,126,632	34.4%

Table 5 shows the different variations of on-site reductions from CCS and natural gas fuel switching at EGUs discussed in Section II of this appendix. These estimates are based upon a uniform application of technology-specific assumptions to the 2012 baseline generation and emissions data. These estimates demonstrate that considerable reductions of CO_2 from existing fossil steam boilers is technically possible, but does not consider the cost of achieving these reductions.[51]

Table 5: Potential reductions in CO_2 emissions from non-BSER technology implementation at EGUs

	Switch to 100% Natural Gas at Fossil Steam Reduction from 2012		90% CCS reduction at 20% fossil steam		Switch to 100 % natural gas at 80% of fossil steam and 90% CCS at 20% fossil steam	
	Rate (lbs/MWh)	% Reduction from 2012	Rate (lbs/MWh)	% Reduction from 2012	Rate (lbs/MWh)	% Reduction from 2012
Fossil Steam	1239	42.8%	2167 & 217	18.0%	1239 & 217	52.3%
NGCC	902	0.0%	902	0.0%	902	0.0%
Total		33.7%		14.2%		41.1%

Additionally, as discussed earlier there are many opportunities for the integration of EE programs or projects into the current energy system. Table 6 shows the possible reductions if EE is applied on a pro-rata basis to the emissions from 2012 baseline fossil steam and NGCC.

Table 6: Potential reductions in CO_2 emissions from EE pro-rata applications

	Effective Emissions Rate (lbs/MWh)	% Reduction from 2012 Baseline
Fossil Steam	2,167	12.0%
NGCC	902	12.0%
Total		12.0%

Table 7 presents the CO_2 reduction potential from the application of the non-BSER technologies at fossil steam facilities seen in Table 5 in addition to the application of demand-side energy efficiency savings across these sources in 2012 seen in Table 6.

[51] Cost to build sufficient gas pipeline infrastructure and storage to maintain reliability is not included in this exercise. These calculations are based on the 2012 baseline data included in the final rule.

Table 7: Potential reduction from non-BSER technologies at fossil steam facilities and the application of demand-side energy efficiency

	Effective Emissions Rate (lbs/MWh)	% Reduction from 2012 Baseline
Fossil Steam	1,035	58.0%
NGCC	902	12.0%
Total		48.2%

At the state level, we observe that application of the non-BSER measures above to the 2012 baseline data for each state results in an emissions estimate that is lower than the 2030 goal for nearly every state (except New Jersey and Rhode Island) seen in Table 8.

Table 8: CO2 Emissions Estimates Reflecting Application of Non-BSER Measures, by state (tons of CO_2)

State/Tribe	2012, Adjusted for Non-BSER Measures	BSER Mass-based Goal
AL	41,617,919	50,675,248
AR	20,827,275	27,014,664
AZ	22,165,153	26,879,351
CA	41,339,901	43,128,945
CO	20,091,641	26,638,491
CT	5,659,126	6,184,255
DE	3,999,670	4,197,800
FL	81,870,107	93,629,673
Fort Mojave	513,241	524,316
GA	32,623,956	41,290,758
IA	15,741,704	22,288,848
ID	1,265,594	1,329,996
IL	42,954,778	59,225,006
IN	49,210,339	67,810,396
KS	13,787,120	19,591,794
KY	39,616,507	56,239,543
LA	24,234,112	31,562,205
MA	10,397,156	10,784,211
MD	9,004,219	12,782,411
ME	1,774,856	1,847,691
MI	32,715,707	42,357,369
MN	14,796,745	20,204,331
MO	34,993,931	49,412,306
MS	18,963,164	22,543,827
MT	7,064,095	10,070,024
Navajo	13,468,202	19,333,218

NC	34,500,392	45,673,479
ND	13,022,914	18,605,030
NE	11,429,169	16,279,322
NH	3,299,279	3,561,474
NJ	15,311,292	14,788,839
NM	8,457,942	11,068,128
NV	11,361,766	12,048,264
NY	26,344,018	27,847,481
OH	48,449,863	65,722,083
OK	28,869,345	36,071,245
OR	6,518,631	7,232,970
PA	63,093,894	80,023,379
RI	3,285,791	3,137,977
SC	17,314,412	23,162,678
SD	2,384,132	3,153,350
TN	18,148,254	25,255,802
TX	142,800,363	169,230,491
UTE	1,405,425	2,016,508
UT	15,767,319	21,184,173
VA	21,826,643	24,440,368
WA	8,667,528	9,567,610
WI	18,500,444	24,933,821
WV	31,819,488	45,726,138
WY	19,775,891	28,183,339

Note: "BSER Mass-based Goal" represents the subcategory-specific standard multiplied by the 2012 generation from that subcategory.

This preliminary analysis shows that according to the data in 2012 reductions in states could be made in almost every state based on CCS and fuel switching. However, since 2012 the trends in the industry (outlined in the Power Sector Trends appendix) show that more reductions are possible with the same types of technological applications.

STATE BY STATE SUMMARY OF NON-BSER APPLICATION

This section looks at how states are advancing with the different non-BSER technologies and programs discussed in the previous section. For additional trends see the Power Sector Trends and State Trends Appendices.

Natural Gas Co-Firing and Fuel Switching

As discussed in the previous sections gas switching or co-firing is an effective way for sources to reduce CO_2 emission rates. Many states have already done this and the following table 9 reflects the MW in each state that have switched their primary fuel from coal to natural gas. The data is based on the data reported to the EPA under the Acid Rain Program between 2012 and 2016. This data shows that fuel switching at EGUs is an option to many EGUs based on many different policies and could be a viable option for future CO_2 emission reductions.

Table 9: State breakdown of coal to gas primary fuel conversions

State	MW Nameplate Capacity
AL	2,073
IL	1,680
GA	808
IN	699
IA	606
KS	332
KY	281
MI	52
MN	170
MS	750
MO	693
NE	292
NY	434
OH	51
PA	974
SC	537
WI	375
LA	611
VA	730
Total	12,148

Non-BSER Renewables

The status of RE in the United States has been consistently advancing for a larger share of the electricity generated in the United States. The Table below shows the trends since 2000 and that in 2015 installed 7,260 MWdc of solar PV in 2015, the largest annual total ever and 16% above 2014. Specifically, residential PV was once again the fastest-growing sector in U.S. solar, installing over 2 GWdc for the first time and growing 66% over 2014. Residential solar benefitted from a fourth consecutive year of >50% annual growth, with installations reaching 2,099 MWdc. On another note, non-residential [non-utility] solar was essentially flat for the third year in a row, with 1,011 MWdc of installations. A mixture of market-specific factors and scaling challenges have plagued the sector, but numerous avenues remain for resumed growth over the coming year.[52]

[52]SEIA. *2015 Solar Market Insights Report Year in Review*. "http://www.seia.org/research-resources/solar-market-insight-2015-q4"

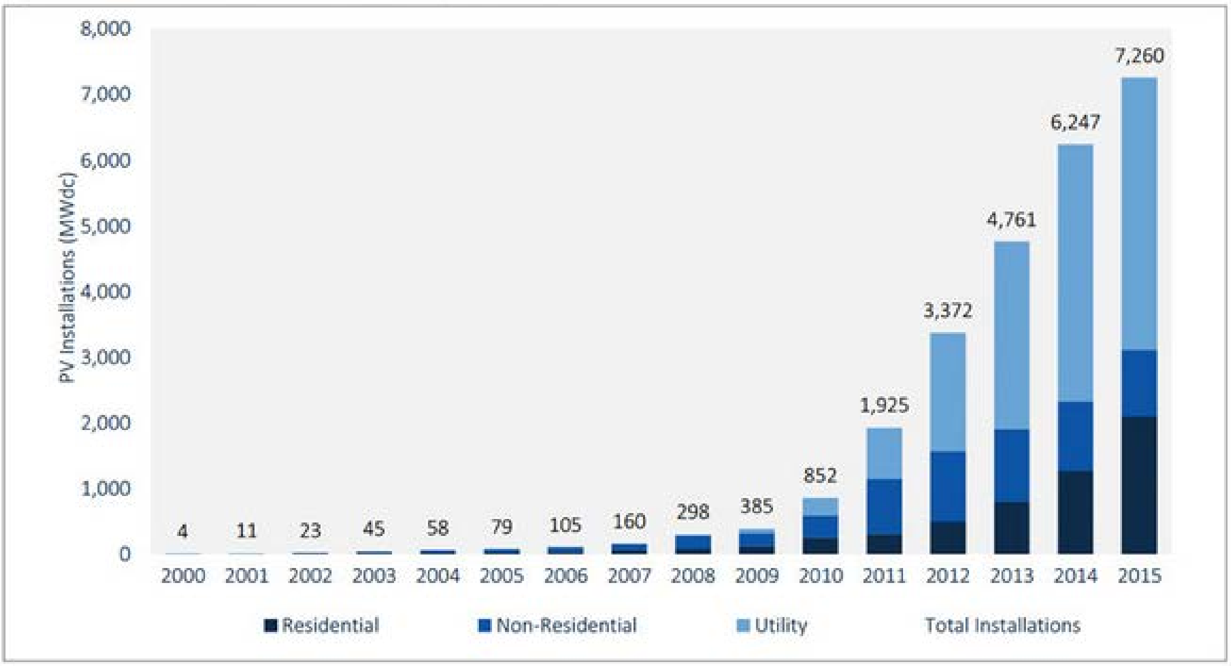

Figure 3: Total PV instillations from 2000 through 2015[53]

In 2016, for only the second time in five years, the residential PV market fell quarter-over-quarter, primarily due to a slowdown in major state markets, especially California. However, in Q3 2016, community solar added more capacity than the segment installed in all of 2015, playing a key role in supporting the second-largest quarter ever for the non-residential PV market. GTM Research forecasts that 14.1 GWdc of new PV installations will come on-line in 2016, up 88% over 2015. Utility PV is expected to account for over 70% of that new capacity.

Commercial solar demand is tapping into offsite project solutions, specifically community solar and offsite wholesale PPAs. Corporate customers have already procured more than 1.5 GWdc of offsite wholesale solar for post-2016 installation dates. By year's end, GTM Research expects more than 800 MWdc of offsite wholesale solar to come on-line, growing fourfold over 2015. Altogether, community solar is expected to add more than 200 MWdc on an annual basis in 2016. In turn, for the first time ever, more than half of annual solar PV capacity involving non-residential customers will come from offsite projects (i.e., virtual NEM, community solar and wholesale solar).

[53] 2016 Solar Market Insights Report (Various quarterly figures) http://www.seia.org/research-resources/solar-market-insight-report-2016-q4

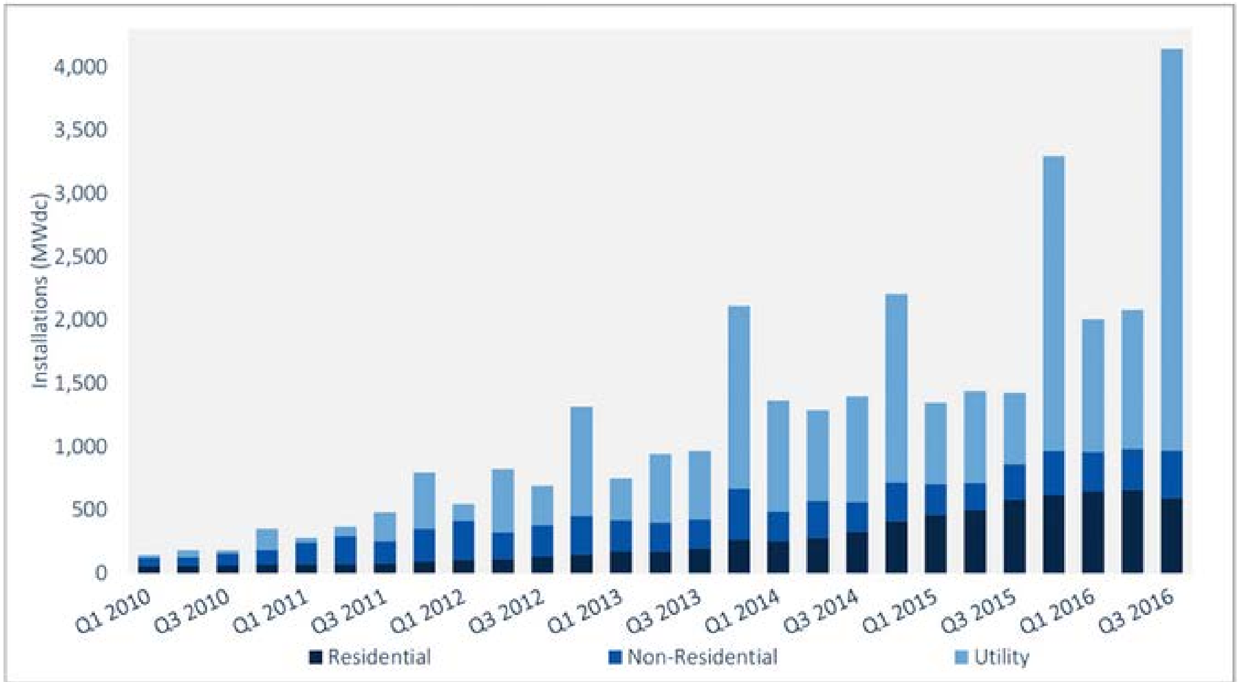

Figure 4: Annual U.S. Solar PV Instillations Q1 2010-Q3 2016 [54]

As discussed earlier there are many states that are starting to utilize offshore wind projects as a source of RE. Currently there are 15,650 MW of U.S. projects that are in various stages of development as shown in Table 10. Additionally, the U.S. Bureau of Ocean Energy Management issued offshore wind leases that could support an estimated 5,768 MW of offshore wind projects in federal waters.

Table 10:U.S. Offshore Wind Project Pipeline by State and Development Status[55]

	Operational	Approved	Major Permits Submitted	Planning (Site Control)	Planning (Early Stage)	Total Pipeline
	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)
Maine			12			12
Ohio			18			18
Oregon			25			25
Delaware				450		450
Maryland				500		500
Rhode Island	30			500		530
Hawaii					816	816
New York					987	987

[54] 2016 Solar Market Insights Report (Various quarterly figures) http://www.seia.org/research-resources/solar-market-insight-report-2016-q4
[55] NREL, *September 2015. 2014–2015 Offshore Wind Technologies Market Report*. https://energy.gov/sites/prod/files/2015/09/f26/2014-2015-offshore-wind-technologies-market-report-FINAL_1.pdf

Virginia			12	2,000		2,012
Massachusetts		468		1,900		2,368
North Carolina					3,734	3,734
New Jersey		24			4,174	4,198
Total	**30**	**492**	**67**	**5,350**	**9,711**	**15,650**

Non-BSER Energy Efficiency

Non-BSER energy efficiency development just like RE has been increasing utilization in states and energy markets. The ACEEE Energy Efficiency Scorecard report shows the status of each state and currently 26 states enforce and fund energy saving targets for energy efficiency programs. The report shows that total efficiency program spending was approximately $7.7 billion in 2015.[56] This shows that there is a commitment by states to ensure energy efficiency continues to be implemented and in addition the report shows in the tables below that there have been positive energy efficiency gains made in every state in 2015.

[56] ACEEE, September 2016. *The 2016 State Energy Efficiency Scorecard.* http://aceee.org/sites/default/files/publications/researchreports/u1606.pdf

Table 11: 2015 Net Incremental Electricity Savings by State (ACEEE The 2016 State Energy Efficiency Scorecard)

State	2015 net incremental savings (MWh)	% of 2015 retail sales	Score (7 pts.)	State	2015 net incremental savings (MWh)	% of 2015 retail sales	Score (7 pts.)
Rhode Island	222,822	2.91%	7	Arkansas	282,000	0.61%	2
Massachusetts	1,472,536	2.74%	7	New Hampshire†	64,869	0.59%	1.5
Vermont	110,642	2.01%	7	New Mexico	128,834	0.56%	1.5
California†	5,040,603	1.95%	6.5	New Jersey†	409,957	0.55%	1.5
Maine†	183,347	1.53%	5	South Carolina[5]	435,399	0.54%	1.5
Hawaii[1]	144,240	1.52%	5	Nebraska*	156,473	0.53%	1.5
Connecticut	435,740	1.48%	5	Kentucky	266,522	0.36%	1
Washington	1,275,447	1.42%	4.5	Oklahoma	190,497	0.32%	1
Arizona†	918,582	1.19%	4	Mississippi	144,401	0.29%	0.5
Michigan	1,177,277	1.16%	3.5	South Dakota	28,686	0.24%	0.5
Minnesota†	750,672	1.15%	3.5	Georgia†	315,625	0.23%	0.5
Illinois	1,553,917	1.13%	3.5	Tennessee†	185,355	0.19%	0.5
Oregon†	507,502	1.09%	3.5	West Virginia	61,349	0.19%	0.5
New York	1,559,665	1.05%	3.5	Delaware†	21,624	0.19%	0.5
Maryland	621,090	1.01%	3	Texas†	698,688	0.18%	0.5
Iowa	469,483	1.00%	3	Florida*†	262,085	0.11%	0
Ohio*†	1,353,109	0.92%	3	Wyoming*†	15,515	0.09%	0
Colorado	486,215	0.90%	3	Alabama*†	78,067	0.09%	0
Utah	254,153	0.85%	2.5	Louisiana	66,695	0.08%	0
Wisconsin	538,678	0.79%	2.5	Virginia*†	71,182	0.06%	0
Indiana[2]	768,927	0.76%	2.5	North Dakota†	1,663	0.01%	0
Nevada†	257,034	0.72%	2	Alaska*†	409	0.01%	0
Idaho[3]	159,310	0.69%	2	Kansas*†	774	0.00%	0
Montana[4]	92,923	0.66%	2	Guam	–	0.00%	0
Pennsylvania*	904,238	0.64%	2	Puerto Rico	–	–	0
North Carolina	827,508	0.62%	2	Virgin Islands	–	0.00%	0
Missouri†	494,013	0.61%	2	**US total**	**26,535,588**	**0.71%**	
District of Columbia	69,247	0.61%	2	**Median**	**255,593**	**0.61%**	

Savings data are from public service commission staff as listed in Appendix A unless noted otherwise. Sales data are from EIA Form 826 (2016c). * For these states, we did not have 2015 savings data, so we scored them on 2014 savings as reported in EIA Form 861 (2016b), unless otherwise noted. [1] 2014 savings as reported in Hawaii data request. [2] 2014 savings as reported in Indiana data request. [3] 2014 savings as reported in Idaho data request. [4] 2014 savings as reported in Montana data request. [5] 2014 savings as reported in South Carolina data request. † At least a portion of savings reported as gross. We adjusted the gross portion by a net-to-gross factor of 0.817 to make it comparable with net savings figures reported by other states.

Table 12: Electric Efficiency Program Spending Per Capita (ACEEE The 2016 State Energy Efficiency Scorecard)

State	2015 electric efficiency spending ($million)	$ per capita
Vermont	54.4	86.90
Massachusetts	557.9	82.11
Rhode Island	82.9	78.48
Connecticut	173.9	48.43
Maryland	276.8	46.08
Iowa	113.3	36.27
Washington	256.9	35.83
Oregon	142.9	35.47
California	1,378.2	35.21
Maine	42.5	31.97
Minnesota	151.5	27.59
Arkansas	76.1	25.55
Hawaii	33.3	23.28
Illinois	286.4	22.27
District of Columbia	13.9	20.62
New Jersey	177.6	19.83
Idaho	32.7	19.75
New Hampshire	25.6	19.24
New York	375.7	18.98
Michigan	188.0	18.94
Utah	55.9	18.66
Oklahoma	70.2	17.94
Pennsylvania	217.2	16.97
Indiana	111.7	16.87
Missouri	102.3	16.82
New Mexico	34.3	16.45
Colorado	87.6	16.06
Nevada	45.4	15.70
Arizona	105.0	15.38
Ohio	171.9	14.80
Wisconsin	79.8	13.83
North Carolina	113.7	11.32
Florida	218.0	10.75
Kentucky	43.2	9.77
Wyoming	5.1	8.76
Montana	9.0	8.75
South Carolina	36.5	7.45
Tennessee	48.0	7.27
Nebraska	12.9	6.80
West Virginia	12.4	6.72
Texas	181.7	6.62
South Dakota	5.3	6.17
Mississippi	17.2	5.75
Delaware	4.0	4.23
Georgia	41.5	4.06
Louisiana	13.4	2.87
Alabama	12.2	2.51
North Dakota	0.3	0.40
Virginia	0.1	0.01
Alaska	0.0	0.00
Guam	0.0	0.00
Kansas	0.0	0.00
Puerto Rico	0.0	0.00
Virgin Islands	0.0	0.00
US total	6,296.4	
Median	51.2	15.88

SUMMARY

We believe that all states have opportunities for to obtain CO_2 reductions from non-BSER measures. Most states have some form of demand-side energy efficiency program and the table below summarizes some of the demand-side measures states are currently using or developing. Table 13 demonstrates that at least 31 of the affected CPP states currently have one or more non-BSER demand-side project operating and at least another 5 of the affected CPP states have one or more non-BSER demand-side projects under development.

Table 13: Summary of State Specific Non-BSER projects

	Fuel Switching	CCS	Offshore Wind	Distributed Solar
Alabama	Yes			
Arkansas				
Arizona				More than 1.5 GW
California				More than 5 GW
Colorado				More than 0.1 GW
Connecticut				More than 0.2 GW
Delaware			Planning	
Florida				More than 0.1 GW
Georgia	Yes			
Iowa	Yes			
Idaho				
Illinois	Yes			
Indiana	Yes			More than 0.1 GW
Kansas	Yes			
Kentucky	Yes			
Louisiana	Yes			
Massachusetts			Permit Approved	More than 1.5 GW
Maryland			Planning	More than 0.1 GW
Maine			Permit Submitted	
Michigan	Yes			
Minnesota	Yes			
Missouri	Yes			
Mississippi	Yes			
Montana				
North Carolina			Planning	
North Dakota				
Nebraska	Yes			
New Hampshire				
New Jersey			Permit Approved	More than 2 GW
New Mexico				More than 0.1 GW
Nevada				More than 0.3 GW
New York	Yes			More than 0.5 GW
Ohio	Yes		Permit Submitted	More than 0.1 GW
Oklahoma				
Oregon			Permit Submitted	
Pennsylvania	Yes			More than 0.2 GW
Rhode Island			Operating	
South Carolina	Yes			
South Dakota				
Tennessee				
Texas		Yes		More than 0.3 GW
Utah				
Virgina	Yes		Permit Submitted	
Washington				
Wisconsin	Yes			

West Virginia				
Wyoming				