Comments of Americans for a Clean Energy Grid (ACEG) to the Environmental Protection Agency on:
Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units
Docket ID No. EPA-HQ-OAR-2013-0602

VIA ELECTRONIC FILING
Gina McCarthy
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Ave NW
Washington, DC 20460
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These comments on the U.S. Environmental Protection Agency's (EPA) proposed emission guidelines for states to follow in developing plans to address greenhouse gas emissions from existing fossil fuel-fired electric generating units are submitted on behalf Americans for a Clean Energy Grid[1] (ACEG).

Summary of ACEG Comments

These comments focus on the need for this rulemaking to recognize the critical role of high-voltage transmission in making workable the most promising state and regional strategies for achieving the proposed goals for reducing carbon emissions from existing electric generating units. Although the proposed rule repeatedly acknowledges the enormous value of our nation's interconnected electricity system to customers, to the U.S. economy, and to the cost-effective implementation of environmental regulations, it does not recognize that expanding and upgrading high-voltage transmission networks can and should be an explicit element of state or regional compliance strategies[2], nor that states and utilities should be able to obtain credit against their carbon-reduction obligations when such efforts clearly enable reductions of carbon emissions to occur.

[1] Americans for a Clean Energy Grid is a project of the Energy Future Coalition.
[2] The one exception to this occurs at Fed. Reg. 34924, but curiously addresses only one of the benefits of transmission improvements: "Building block 4 focuses on improving end-use energy efficiency. Another way to reduce the utilization of, and CO2 emissions from, affected EGUs is through electricity transmission and distribution upgrades that reduce electricity losses during the delivery of electricity to end users. Just as end-use energy efficiency can reduce mass emissions from affected EGUs, so can transmission upgrades."

There has been and will be much debate about the direct recognition in this rule of strategies that take place "outside the fence" of the affected power plants. High-voltage transmission is perhaps the perfect example of why EPA must be permitted to look "outside the fence" in pursuing the necessary objectives of this rule: the transmission wires that deliver power to markets are by definition "outside the fence" of the power plants, but without them the power plants are useless. They are critical facilities for delivery of electricity whether it is generated with or without carbon emissions, and they cannot and should not be ignored in any policy that would attempt to facilitate a transition from carbon-emitting generation to clean energy. This obvious reality is the driving motive of Americans for a Clean Energy Grid; it should likewise be recognized and acted on throughout this proposed rule.

EPA recognizes in its proposal the value of the interconnected grid, and acknowledges both state policies and current industry actions which support emissions reductions, so we find it incongruous that the proposed rule completely overlooks enormously successful and widespread state and regional efforts to expand transmission networks in direct support of renewable portfolio standards and related policies. Indeed, in those states and regions where a public-policy goal of increasing the role of renewable energy has been adopted – Texas, MISO, SPP, and California are all examples (detailed later in these comments) – the strategy for meeting that goal has included building significant incremental transmission capacity. In every case, transmission investments have proven to be essential means of achieving renewable energy goals on or ahead of schedule and often while generating net economic benefits – i.e. at negative marginal cost for electricity in the affected markets.

By effectively treating the high-voltage transmission system as a fixed "constraint" within which states must achieve their assigned emissions goals, EPA has inadvertently discouraged what is arguably the most effective measure now in use by states and utilities to support renewable energy deployment, to mitigate the natural variability of renewable energy, and to achieve reduced carbon emissions from the electric sector through substitution of carbon-free energy. As it stands, the proposed rule would call for massive changes in the sources and volumes of the power on which the U.S. utterly depends, but leave unaddressed and unchanged the set of wires and connections that is barely adequate to handle today's power flows. Generation and transmission capacity are too tightly interrelated to expect major shifts in the first without concomitant change and expansion in the second, and transmission is more likely than generation to be the critical constraint in terms of timing, siting, permitting, and need for positive government action.

However, EPA should keep in mind that the barriers to transmission expansions and upgrades are not economic: transmission investments consistently deliver economic benefits far exceeding their costs, before environmental and other public policy benefits are considered. Nor do they involve outlays of taxpayer funds.

Based on this proposed rule, EPA appears unaware of the enormous and well documented challenges to building high-voltage transmission lines, especially the interstate and interregional long distance lines most critical to rapidly and cost-effectively increasing renewable energy deployment and integration[34].

[3] Fed. Reg. at 34864: "The third consideration supporting a conclusion regarding the adequacy of

There is a huge mismatch in design, permitting, and construction timelines for new transmission projects – typically ten years or more – versus those for utility scale wind and solar generating facilities – about two years on average. Therefore, the most successful and cost-effective renewable energy deployment has occurred in states where proactive steps to ensure adequate transmission capacity have *preceded* commitments to build generation. EPA's proposed rules should acknowledge the value of such steps and reward states that take them within the context of the carbon emissions policy.

Finally, ACEG submits that while there are many potential paths to achieving medium-term greenhouse gas targets (e.g. the approximately 30 percent reduction in power sector carbon emissions by 2030 in the proposed rule), there are no technically and economically feasible paths to much steeper long-term greenhouse gas targets (80 percent or more by 2050[5]) that do not rely on massive deployment of renewable energy. America has enough renewable resources to meet even these ambitious targets dozens of times over, but the richest and least expensive resources are beyond the reach and capacity of today's high-voltage power grid, and can only be made available to users through planning, siting, and construction of new or incremental high-voltage transmission lines. What's more, regional grid operators are now learning that robust high-voltage networks and other technological advances (e.g. dramatically improved forecasting tools) allow them to balance the natural variability of diverse wind and solar resources over large regions and thus integrate high levels of renewable energy without compromising reliably or increasing costs.

ACEG does not dispute that the measures identified by EPA in the proposed rule are technically feasible and capable of generating emissions reductions consistent with proposed state emissions goals for 2030. However, we strongly contend that any approach to reducing electric sector carbon emissions that does not explicitly call for expanding and modernizing high-voltage transmission networks will significantly increase compliance costs in the 2030 timeframe, and will likely make meeting longer-term carbon goals prohibitively expensive and/or technically infeasible in timeframes consistent with avoiding catastrophic impacts from climate change.

Recommendations:

ACEG and its supporters recognize that the proposed rule is a multi-faceted approach to a problem with no simple answer, and many possible partial solutions. Appropriate transmission policy steps by states and utilities can be among the most cost-effective and potent of these partial solutions and should not be ignored in the context of this rule. This rule is also merely one piece of a complex web of state and federal regulations implemented by a multiplicity of agencies with overlapping and interrelated

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the infrastructure is that pipeline and transmission planners have repeatedly demonstrated the ability to methodically relieve bottlenecks and expand capacity."

[4] Congress, the Department of Energy, and the Federal Energy Regulatory Commission have devoted significant attention to the costs of our inadequate transmission infrastructure to consumers, businesses, and the national economy. Over the past two decades, legislation has been enacted, reports and analyses completed, and numerous federal regulations issued which have improved the situation, but staggering challenges remain, notably the transmission needs of a near zero-carbon electric system.

[5] This goal is consistent with the most recent reports of the Intergovernmental Panel on Climate Change and other scientific assessment cited by EPA in the proposed rule.

authorities and jurisdictions. Moreover, the rule is proposed at a time when transmission planners and owners are already playing an unprecedented and increasingly direct role in developing a less carbon-intensive electricity system. Many states have already embraced transmission expansions and upgrades[6] as a primary and direct means of meeting renewable energy and related public policy goals. FERC Order 1000[7] requires transmission owners to participate in regional transmission planning and interregional coordination, and further that those processes consider relevant public policies like environmental regulation. Federal courts have upheld these requirements[8]. All of these circumstances argue strongly for *including* expansions and upgrades to transmission infrastructure in state plans to comply with the proposed rule.

Transmission investments which directly support renewable energy development also enjoy broad and diverse political support across the country. California and Texas have both relied on transmission expansions and upgrades to achieve ambitious renewable energy targets. Eleven Midwestern states[9] collaborated to plan and share the costs of regional transmission expansions and upgrades to enable least-cost compliance with state renewable portfolio standards. In 2014, a diverse Task Force[10] convened by the Bipartisan Policy Center's Energy Infrastructure Program identified transmission expansions and upgrades among its highest priority recommendations for our evolving electric system:

> "The U.S. electric power sector will need to make significant investments in transmission and distribution infrastructure over the next decade. In some regions, additional transmission facilities, including lines crossing state boundaries and federal lands, will be needed to bring online new renewable generation driven by both increasingly stringent state renewable portfolio standards and federal incentives. New transmission investments will also be needed in some areas to maintain reliability. Constructing these facilities entails complex decisions about siting and cost allocation."[11]

ACEG shares concerns expressed separately by the transmission industry[12] that absent changes to directly incorporate transmission planning and investment into state implementation plans, the proposed rule could have unintended and negative effects on electric reliability and on regional

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[6] States have undertaken these efforts in close cooperation with RTOs and transmission owners.

[7] *Transmission Planning and Cost Allocation by Transmission Owning and Operating Public Utilities*, Order No. 1000, FERC Stats. & Regs. ¶ 31,323, at PP 484 (2011), *order on reh'g*, Order No. 1000-A, 139 FERC ¶ 61,132, *order on reh'g*, Order No. 1000-B, 141 FERC ¶ 61,044 (2012), *aff'd sub nom. S.C. Pub. Serv. Auth.* v. *FERC*, 762 F.3d 41 (D.C. Cir. Aug. 15, 2014) ("Order No. 1000").

[8] *South Carolina Public Service Authority v. FERC*, U.S. Circuit Court of Appeals for the District of Columbia (2014).

[9] Illinois, Indiana, Iowa, Kentucky, Michigan, Missouri, Minnesota, Montana, North Dakota, South Dakota, and Wisconsin.

[10] Task Force members included former members of Congress and FERC Chairmen and representatives from: the Energy Future Coalition, the Natural Resources Defense Council, the Environmental Defense Fund, American Electric Power, Southern Company, PJM Interconnection, General Electric, EDP Renewables, Bank of America, Exelon Corporation, and the Western Interstate Energy Board.

[11] *Capitalizing on the Evolving Power Sector: Policies for a Modern and Reliable U.S. Electric Grid,* Bipartisan Policy Center, February, 2013.

[12] "Comment of WIRES on Carbon Pollution Emission Guidelines for Electric Utility Generating Units," Phillip C. Grigsby, James J. Hoecker, WIRES, December 1, 2014.

cooperation on transmission planning, cost allocation, and siting. We also want to emphasize that we strongly support each of the four building blocks included in the proposed rule, and that our recommendations do not interfere with a state's ability to pursue them: (1) heat rate improvements; (2) re-dispatch; (3) expansion of zero and low carbon generating capacity; and (4) increased demand side energy efficiency. To the contrary, transmission expansions and upgrades directly support, and indeed are a prerequisite for, building blocks 2 and 3, and enhance the value of measures under building blocks 1 and 4 by making their benefits more widely available across the system.

ACEG specifically recommends that EPA:

- Make expansions and improvements to the high-voltage grid an explicit element of the strategies states and utilities can employ in both building blocks 2 and 3 to meet their de-carbonization requirements, particularly in the context of regional integration and strategies. Without such expansions and enhancements, the potential for clean energy to be better integrated and made more fully available to the market cannot be achieved. EPA should directly recognize those facts and declare that actions to facilitate more and better transmission of clean power, transmission without which that power could not be accessed or used, will be credited under the rule.
- Require states to work directly with utility and regional transmission planners to analyze the potential for transmission expansions and upgrades to reduce the costs of meeting carbon emissions targets, and to report the results of those analyses to EPA as part of their state plans.
- Establish clear guidelines for "the process and requirements under a state plan for quantifying, monitoring, and verifying the effect of" expansions and upgrades to high-voltage transmission networks, including "treatment of interstate effects" for both state and regional approaches to compliance. ACEG recognizes the challenge of definitively quantifying the effects in tons of CO2-equivalent attributable to policies that, like building out and enhancing the high-voltage grid, have a critical but indirect effect on those emissions. In the case of transmission, one can at least be certain of the volume of electricity that flows into and out of the grid from clean versus polluting sources, and can use contract-path analysis to allocate that energy to those who are bearing its costs—including its transmission costs—so it is probably easier to quantify and attribute emission benefits achieved by specific transmission infrastructure development than it is to do so with other indirect actions such as energy-efficiency investments.
- Create positive incentives for states to incorporate transmission expansions and upgrades as part of their compliance strategies, and additional incentives for states to participate in regional and interregional transmission planning processes with binding cost allocation. ACEG does not attempt in these comments to propose a specific formula or procedure for awarding emission credits to transmission projects, but would be ready and willing to do so, working in conjunction with EPA staff and other parties, should EPA accept this recommendation.
- Create positive incentives for states to adopt expedited procedures for siting and permitting transmission lines identified in approved state implementation plans.

Background

Americans for a Clean Energy Grid (ACEG) is a project of the Energy Future Coalition that supports policies to modernize and expand the nation's electric transmission network and unlock clean energy and economic opportunities across the country. The backbone of a clean electricity system and a strong economy is a resilient and reliable transmission grid. Smart state and federal policies that improve the way the grid is developed, planned, and paid for will help it become a more robust, reliable, and secure network that supports expansion of renewable energy, competitive power markets, energy efficiency, and lower costs for consumers. ACEG draws support from a variety of stakeholders – transmission companies, utilities, environmental groups, renewable energy developers, clean energy advocates, etc. – who recognize the critical importance of a better-connected, expanded, and flexible transmission grid, particularly in providing market access for clean energy resources.

Discussion

EPA recognizes that "The Interconnected Nature of the U.S. Electricity Sector"[13] is essential to making the proposed emissions goals technically feasible and economically reasonable, and to affording states maximum flexibility to achieve them, and also that the integrated system is a prerequisite to measures taken under building blocks 2 and 3. EPA should therefore add "Expanding and Upgrading High-Voltage Transmission Networks" as an explicit strategy for purposes of goal-setting and as part of the Best System of Emissions Reduction (BSER).

EPA notes the central importance of "The Interconnected Nature of the U.S. Electricity Sector" in the explanation of the BSER in the proposed rule:

> "The U.S. electricity system is a highly interconnected, integrated system in which large numbers of EGUs using diverse fuels and generating technologies are operated in a coordinated manner to produce fungible electricity services for customers. Because electricity storage is costly and has not been widely deployed, the amounts of electricity demanded and supplied must be continuously matched, and system operators typically have flexibility to choose among multiple EGUs when selecting where to obtain the next MWh of generation needed. Coordination over short- and long-term time scales is accomplished through a variety of institutions including vertically integrated utilities, state regulatory agencies, independent system operators and regional transmission organizations (ISOs/RTOs), and market mechanisms. The electricity sector is both critical to the nation's economy and the source of more than 30 percent of U.S. greenhouse gas emissions, predominantly in the form of CO_2."[14]

We strongly agree. Interconnectivity, flexible generation, and fungible electricity services would not be possible without high-voltage transmission networks. We also know that the existing high-voltage system is limited in geographic scope, constrained in its capacity to transfer power from one region to another, and congested at times of high demand – all of which increase the cost of providing electricity

[13] Fed. Reg. at 34880.
[14] Ibid.

services to customers, limit access for new zero carbon renewable generation, reduce the availability (i.e. "capacity factor") of existing renewable generation, and constrain the ability of grid operators to dispatch lower carbon generation in place of higher carbon resources. It follows that a more robust and efficient transmission network would be more flexible, increase access and availability for low and zero carbon generation, and make the system more efficient as a whole and in separate regions and states.

EPA should therefore revise the proposed rule to explicitly add "Expanding and Upgrading High-Voltage Transmission Networks" as part of the BSER. ACEG recommends, at a minimum, that EPA include them as supportive measures under Building Blocks 2 and 3. ACEG considers that EPA could justify making high-voltage transmission measures a separate building block because doing so:

- Validates widespread and successful state and regional use of transmission investments to enable increased development and use of renewable energy generation.
- Highlights the enormous potential for transmission expansions and upgrades to reduce the cost of achieving electric sector carbon emission goals.
- Obliges EPA and states to cooperatively engage in and provide substantive input to the transmission planning process, and to incorporate relevant analytic findings and investment decisions directly into compliance plans.
- Recognizes improvements to a component of the integrated electric system not addressed by measures under any of the other building blocks.

If, however, EPA chooses not to include transmission expansions and upgrades as part of the BSER, ACEG and its supporters believe it would be wholly unacceptable for EPA to offer anything less than a detailed explanation similar to those provided under the section entitled: "Potential Emission Reduction Measures Not Used To Set Proposed Goals."[15]

States, working closely with transmission planners and transmission owners, are already using "transmission first" approaches to increase deployment of zero carbon renewable energy and reduce electric sector carbon emissions, often at negative marginal cost.

Expanding and upgrading high-voltage transmission networks is now well established as a cost effective means of increasing the deployment and availability of zero carbon renewable energy generation, in direct support of building block 3[16] of the emissions guidelines in the proposed rule. States participating in "transmission first" planning approaches to renewable energy deployment are now home to almost three quarters of wind and more than half of solar generating capacity in the U.S. – shares that will increase as planned transmission expansions are completed. Such policies have delivered these results with net economic benefits – i.e. negative marginal costs in the markets served by the transmission facilities – *before* accounting for reduced emissions or other environmental benefits. The experiences of regulators, transmission planners, and transmission owners in Texas, California, the Mid-Continent Independent System Operator (MISO), and the Southwest Power Pool (SPP) all provide powerful

[15] Fed. Reg. at 34875.
[16] Fed. Reg. at 34877: "*Building block 3*: Reducing emissions from affected EGUs in the amount that results from substituting generation at those EGUs with expanded low- or zero-carbon generation."

evidence that expanding and modernizing high-voltage transmission networks is a highly cost effective approach to reducing carbon emissions from the electricity sector.

- ***Texas Competitive Renewable Energy Zones (CREZ) Project***

  The Texas legislature established the Renewable Energy Program in 2005 and directed the Public Utilities Commission (PUC) to identify Competitive Renewable Energy Zones (CREZ): geographic areas where wind generation facilities would be constructed. In 2008, the PUC designated five CREZs for 18,500 MW of wind power and identified 3,600 circuit miles of new and upgraded transmission lines to deliver the wind energy to Texas consumers.[17] The lines were completed in 2013, and Texas now leads the nation in installed wind capacity by a wide margin, with 12,976 MW of wind installed by the third quarter of 2014 – more than twice as much as California (5,832 MW) in second place, and more than one fifth of total U.S. wind generating capacity (62,300).[18] The Electricity Reliability Council of Texas (ERCOT) predicts that over 7,000 MW of new wind capacity will be installed in Texas by the end of 2015, with another 1,300 MW projected to come online in 2016,[19] putting the state on track to exceed the CREZ goal well ahead of schedule. The CREZ transmission lines have also reduced wind curtailment[20] by more than 90 percent, from 3,782 GWh in 2009 (17.1% of potential wind generation) to just 363 GWh in 2013 (1.2% of potential wind generation), while at the same time effectively eliminating wind-related congestion between West Texas and other parts of the state.[21] ERCOT predicts the CREZ transmission lines will save ratepayers $2 billion a year, reduce carbon dioxide emissions by 16 percent and create more than $5 billion in economic development benefits for Texas – benefits far exceeding their $6.8 billion cost to ratepayers.[22]

- ***MISO Multi Value Project (MVP) Portfolio***

  In 2011, the Board of Directors for the Midcontinent Independent System Operator (MISO) approved the development of seventeen 345 kV transmission lines across nine states, to be placed in service between 2014 and 2019, at a cost of $5.2 billion. The agreement to build the portfolio was the result of a decade-long planning process that engaged state regulators, utilities, customers, environmental advocates, landowners, and many other interested parties.

  MISO's September 2014 analysis of the MVP lines found that they will enable large increases in regional renewable energy generating capacity and significant carbon emissions reductions from the

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[17] *CREZ Transmission Program Information Center*, Public Utility Commission of Texas, 2014.
[18] *U.S. Wind Industry Third Quarter 2014 Market Report: AWEA Public Version*, American Wind Energy Association, October, 2014.
[19] *ERCOT Panhandle Renewable Energy Zone Study Report,* Electric Reliability Council of Texas, 2014.
[20] Wind curtailment occurs when grid operators shut down wind turbines to prevent the power they are producing from dangerously overloading congested transmission lines. When this happens, zero marginal cost and zero carbon power from spinning wind turbines is lost until the congestion is relieved. By reducing congestion on the system, transmission expansions and upgrades reduce curtailment, making more wind available for more hours.
[21] *2013 Wind Technologies Market Report*, Ryan Wiser and Mark Bollinger, Lawrence Berkeley National Laboratory, U.S. Department of Energy, August, 2014.
[22] "Advancing Clean Energy in Texas," Public Citizen of Texas, 2014.

electric sector while generating net economic benefits, e.g. at negative marginal cost. Specifically, MISO estimates that the MVP lines will:

- Enable 43 million MWh of wind energy generation needed to meet state renewable energy mandates and goals through 2028.
- Reduce carbon emissions by 9 to 15 million tons per year through 2028.
- Generate net economic benefits of $13.1 to $49.6 billion over the next 20 to 40 years, with a benefit-to-cost ratio range of 2.6 - 3.9 to 1.
- Improve system reliability by resolving violations on approximately 650 elements for more than 6,700 system conditions and mitigating 31 system instability conditions.

- ***Southwest Power Pool (SPP)***

  SPP's first 20-Year Integrated Transmission Plan Assessment, completed in January, 2011, estimated that the nearly 1,500 miles of 345 kV lines and 11 transformers in the plan will reduce the cost of generating and supplying energy by more than five times their $1.8 billion engineering and construction cost, while simultaneously giving the region the flexibility to respond to policy initiatives like carbon regulation cost effectively and without disruptions[23]. The upgrades are expected to enable more than 3,000 MW of new wind generation in Nebraska, Kansas, Oklahoma and Texas.

- ***California Renewable Energy Transmission Initiative (RETI)***

  RETI is a statewide initiative to help identify the transmission projects needed to meet California's aggressive renewable portfolio standard of 33 percent by 2020. RETI was designed as an open, transparent, and collaborative process to encourage participation by all interested parties in facilitating the designation of transmission corridors and in the siting and permitting of both transmission and generation. RETI has assessed competitive renewable energy zones in California and neighboring states to identify resources that can meet the 2020 goal in the most cost effective and environmentally benign manner. In 2009, RETI identified more than $15.7 billion in transmission expansions and upgrades that would allow California to meet the RPS goal by 2020. Many of these lines offer additional reliability, congestion relief, and economic benefits, so their cost cannot be attributed entirely to meeting the RPS goal. Specific examples include:

  - The Sunrise Powerlink, a 500 kV line spanning more than 110 miles between San Diego and the Imperial Valley, was completed in 2012. San Diego Gas & Electric has signed contracts for more than 1,000 MW of wind and solar power from projects in the Imperial Valley that will be transmitted over the line. This power will allow SDGE to meet its obligations under California's Renewable Portfolio Standard (RPS), i.e. 33 percent renewable energy by 2020.[24]

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[23] "SPP Approves Transmission Plan for the Year 2030, Further Development of New Energy Markets," Southwest Power Pool, Press Release, January 26, 2011.
http://www.spp.org/publications/ITP20_Marketplace_Development_Approved.pdf

[24] "SDG&E Energizes Sunrise Powerlink," San Diego Gas & Electric, News Release, June 18, 2012.

- The Tehachapi Renewable Transmission Project (TRTP), approved by the California Public Utilities Commission in 2009 and expected to go into service in 2015, will provide 4,500 MW of new capacity to deliver renewable energy from the wind, solar, and geothermal-rich Tehachapi-Mohave region in southern Kern County to Southern California Edison (SCE) customers in the Los Angeles metropolitan area. SCE is building the 173 miles of new and upgraded high-voltage transmission lines for the expressed purpose of meetings its obligations under the California RPS.

Despite recent advances, barriers to transmission investments remain, and the most critically important interstate and interregional transmission lines are proceeding too slowly to meet national economic and environmental goals.

Over the past two decades, Administrations of both parties and Congress have recognized the need to remove barriers to and increase incentives for high-voltage transmission expansions and upgrades, and have taken numerous legislative and regulatory actions to address the issue. These policies have borne fruit: by 2013 investments in high-voltage transmission had recovered most of the ground lost in the 1980s and 1990s. Unfortunately, the Edison Electric Institute now predicts that transmission investments likely peaked in 2013 and will begin to decline in 2014 and beyond. Simply modernizing the existing high-voltage transmission network would require sustaining current levels of transmission investment for a decade or more; building links needed to accommodate very high levels of renewable energy would require significant additional investments.

In its landmark Order 1000 in 2011, the Federal Energy Regulatory Commission (FERC) noted that despite receiving 5,700 pages of initial and reply comments:

> "No commenter has contested the need for additional transmission facilities, and numerous examples have been provided here of transmission planning and cost allocation impediments to the development of such facilities." [25]

Recent developments in the MISO states, national leaders in planning transmission for renewable energy, provide fresh evidence that hard-won commitments to transmission expansions and upgrades cannot be taken for granted, and that further investments needed to reduce carbon emissions will require vigorous engagement from EPA:

- In the nearly three years since their Board of Directors approved the MVP Portfolio in December 2011, MISO has not made significant progress planning the next set of transmission lines, which will be needed to replace the growing amount of generating capacity the region expects to lose as coal plants retire in response to the proposed rule. MISO's estimate of anticipated coal plant retirements has more than doubled in that time, from 12.6 GW to 26.6 GW.
- Interregional coordination required under FERC Order 1000 has so far failed to advance any significant transmission solutions which cross more than one planning region. Transmission

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[25] Order No. 1000.

lines across interregional "seams" (i.e. boundaries) have the potential to deliver enormous economic and environmental value by making markets more competitive and efficient and enabling renewable energy development and delivery. MISO's Interregional Planning Stakeholder Advisory Committee (IPSAC) is still seeking agreement with its counterparts in the neighboring SPP and PJM regions on criteria and metrics to use to screen for worthy transmission projects.

Barriers to building new high-voltage lines for clean energy are not technical or economic but rather bureaucratic. Inefficient *institutions* and insufficient *policies* are the main obstacles standing in the way of critically important transmission expansions and upgrades, notably:

- Failure to assess and communicate full economic and environmental benefits of transmission projects, leading to flawed benefit-cost analyses and chronic underinvestment. Transmission planners in different regions use widely varying approaches to identifying and measuring the benefits of transmission, and many or even most potential benefits are excluded from consideration at the outset of the planning process[26]. Environmental and market benefits of zero carbon, zero marginal cost renewable resources enabled by transmission are rarely considered, and long-term benefits of transmission assets with useful lives of 50 years or more are also ignored.
- Disputes over how to allocate or share costs for new lines among ratepayers in different sub-regions of the electric grid, and whether the cost of new lines will unfairly be allocated to customers who will not benefit from them.
- Concerns over siting, including environmental and cultural impacts, compensation to landowners, and inconsistent and uncoordinated state policies on transmission line siting.
- Divided regulatory authority: FERC oversees planning and cost allocation for interstate transmission lines, while states regulate siting and permitting. (In contrast, FERC has consolidated authority to plan, allocate costs for, *and* site interstate natural gas pipelines.)

Successful state and regional efforts cited above powerfully illustrate how the incorporation of strong public policy goals can help overcome these bureaucratic and institutional obstacles to economically and environmentally beneficial transmission projects. EPA should take full advantage of this opportunity by adding "Expanding and Upgrading High Voltage Transmission Networks" as an explicit strategy states and utilities should plan and utilize under building blocks 2 and 3. EPA should also explore, in the revised rule and beyond, opportunities to engage and cooperate with other federal agencies, state regulators, transmission planners and stakeholders, barriers to collaborative approaches and how to overcome them, and the potential for improved information sharing and analytical coordination.

America's inadequate high-voltage transmission network limits renewable energy growth, drives developers to lower quality and higher cost resources, and reduces the efficiency and availability of installed renewable generation.

[26] "The Benefits of Electric Transmission: Identifying and Analyzing the Value of Investments," Judy Chang, Johannes P. Pfeifenberger, and Michael Hagerty, WIRES, July, 2013.

Lack of transmission capacity remains the primary barrier to the development of the largest and highest quality solar and wind resources in the United States. The American Wind Energy Association recently identified 15 near-term transmission projects that—if all were completed—could carry almost 60 GW of additional wind power capacity. The Solar Energy Industries Association lists 27 GW of large scale solar projects under development, and access to transmission lines and demand centers is the most important factor in their economic viability.

Insufficient transmission is driving renewable energy developers to lower quality resource locations with existing access to transmission lines. Among projects built in 2012, the average estimated quality of the wind resource at 80 meters was roughly 15 percent lower than for projects built in 1998–1999 – with most of the decline occurring since 2008. If transmission constraints were not driving developers toward lower resource quality sites, wind capacity factors would be increasing steadily, rather than stagnating as they have since 2006[27]. Given the enormous amount of renewable energy the country needs to develop to meet science-based carbon targets, and the vast supply of untapped high quality renewable resources in remote regions, transmission investments appear even more urgent.

Remote renewable resources are larger, higher quality, and less expensive than renewable resources close to load, and are the only resources capable of meeting long-term greenhouse gas emissions targets in a cost-effective and timely manner.

The National Renewable Energy Laboratory (NREL) estimates the technical potential in the United States of utility-scale PV (photovoltaic) and CSP (concentrating solar power) at approximately 80,000 GW and 37,000 GW, respectively. The total installed generating capacity on the grid today is less than 1,100 GW.[28]

NREL estimates the technical potential of distributed rooftop PV technologies at approximately 700 GW – less than 1 percent of the utility-scale resource.[29] Solar PV installations have grown rapidly in recent years, but the massive potential of U.S. solar resources will only be unlocked when transmission infrastructure is in place. The most recent data from the Solar Energy Industries Association (SEIA) estimates the cost of utility-scale solar PV at $1.69 per watt of installed capacity – less than half of the $3.74 per watt for residential systems.[30] Despite their overwhelming cost advantages, utility-scale projects account for just half of the installed PV capacity in the United States. Limited transmission networks are the primary constraint on potentially explosive large scale PV development. Utility-scale

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[27] Ryan Wiser and Mark Bollinger, *2013 Wind Technologies Market Report*, Lawrence Berkeley National Laboratory, U.S. Department of Energy, August, 2014.

[28] Energy Information Administration, Annual Energy Review, Table 8.11a Electric Net Summer Capacity: Total (All Sectors), 1949-2011 (Sum of Tables 8.11b and 8.11d; Million Kilowatts)

[29] *Renewable Electricity Futures Study (Entire Report)* National Renewable Energy Laboratory. (2012). Renewable Electricity Futures Study. Hand, M.M.; Baldwin, S.; DeMeo, E.; Reilly, J.M.; Mai, T.; Arent, D.; Porro, G.; Meshek, M.; Sandor, D. eds. 4 vols. NREL/TP-6A20-52409. Golden, CO: National Renewable Energy Laboratory. http://www.nrel.gov/analysis/re_futures/

[30] Modeled turnkey pricing for installed solar photovoltaic systems, by sector, Q2, 2014. U.S. Solar Market Insight: Q2, 2014, Solar Energy Industries Association, September, 2014.

projects are nonetheless gaining ground, accounting for the majority of new PV capacity for five straight quarters – more than residential and commercial installations combined.

Utility-scale wind power in onshore locations comprises the vast majority of both installed non-hydro renewable capacity and actual generation, primarily due to resource quality and economies of scale[31]. Larger turbines are more efficient and project costs fall when turbines are sited in large groups. Small scale wind turbines (100 kW or less) cost more than four times as much per unit of installed capacity as larger ones[32]. The National Renewable Energy Laboratory estimates that there is as much as 11,000 GW of onshore wind generation capacity potential in the U.S. onshore areas (excluding areas where such development is not feasible or likely, such as urban areas and designated wilderness and park areas), more than enough if developed to provide all U.S. energy needs at current levels of reliability.[33] Most of this potential is, however, beyond the reach of the transmission capacity in place today, and would overload that capacity if it were connected.

Offshore wind is a large, high quality resource located close to population centers, but costs about three times as much as onshore wind per unit of installed capacity. Only 6.8 GW of the 321 GW of global wind capacity installed by the end of 2013, about 2 percent, was offshore[34], and the bulk of this capacity is in Europe, where a combination of high electricity prices, limited high-voltage infrastructure, low quality onshore resources, and generous government subsidies create a much more favorable economic environment. As costs decline and technology evolves, however, this resource may become a key factor in moving to clean energy, but only if the challenges of transmitting this offshore energy onshore can be overcome

High-voltage transmission is essential to developing remote renewable resources at scales consistent with meeting long-term carbon emissions targets.

Nearly every comprehensive analysis of how to transition from our current fleet of fossil fuel power plants to an electric system primarily powered by renewable resources reaches the same conclusion: high-voltage transmission is absolutely essential. The National Renewable Energy Laboratory analyzed how to achieve very high levels of renewable electricity generation (80 to 90 percent) in the electric sector in their "Renewable Electricity Futures Study"[35] (2012), and reached the following conclusion:

> As renewable electricity generation increases, additional transmission infrastructure is required to deliver generation from cost-effective remote renewable resources to load centers, enable

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[31] 2011 Cost of Wind Energy Review, National Renewable Energy Laboratory, March 2013.
[32] Ibid.
[33] National Renewable Energy Laboratory, Estimates of Windy Land Area and Wind Energy Potential, by State, for areas >= 30% Capacity Factor at 80m, available on Energy Information Administration website under "Wind Resource Potential."
[34] Ryan Wiser and Mark Bollinger, *2013 Wind Technologies Market Report*, Lawrence Berkeley National Laboratory, U.S. Department of Energy, August, 2014.
[35] *Renewable Electricity Futures Study*, Trieu Mai, Debra Sandor, Ryan Wiser, and Thomas Schneider, National Renewable Energy Laboratory, July, 2012.

> reserve sharing over greater distances, and smooth output profiles of variable resources by enabling greater geospatial diversity.

The Massachusetts Institute of Technology's comprehensive "Future of the Electric Grid" study[36] (2011) arrived at a similar conclusion:

> One of the most important emerging challenges facing the grid is the need to incorporate more renewable generation in response to policy initiatives at both state and federal levels. Much of this capacity will rely on either solar or wind power and will accordingly produce output that is variable over time and imperfectly predictable, making it harder for system operators to match generation and load at every instant. Utilizing the best resource locations will require many renewable generators to be located far from existing load centers and will thus necessitate expansion of the transmission system, often via unusually long transmission lines. Current planning processes, cost-allocation procedures, and siting regimes will need to be changed to facilitate this expansion."

Underscoring the universal value of high-voltage networks, the European Climate Foundation identified high-voltage transmission as the key to cutting carbon emissions from Europe's electricity sector 80 percent below current levels by 2050 in their Roadmap 2050 analysis[37] (2010):

> Compared to today, all of the pathways, especially those with higher RES penetrations, require a shift in the approach to planning and operation of transmission systems. Electricity demand is no longer fixed and unchangeable. 'Smart' investments that make demand more flexible and responsive to the available supply of energy can significantly reduce system costs and implementation challenges. Expansions of transmission system capacity are a crucial and cost-effective way to take full advantage of the low-carbon resources that are available, when they are available. Inter-regional transmission must develop from a minor trading and reserve-sharing role to one that enables significant energy exchanges between regions across the year, enabling wider sharing of generation resources and minimizing curtailment. Operation of the grid must be based on greater collaboration over wider areas. To achieve this, it is paramount that planning and evaluation of transmission investments and operational decisions consider wider regional benefits than is currently the case.

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[36] *The Future of the Electric Grid: An Interdisciplinary MIT Study*, Massachusetts Institute of Technology, 2011.

[37] *Roadmap 2050: A Practical Guide to a Prosperous, Low-Carbon Europe, Technical Analysis, Executive Summary*, European Climate Foundation, April, 2010.

Grid operators are reliably and efficiently managing high levels of variable renewable energy thanks to transmission investments, improved forecasting, and other advances.

Grid operators today manage high levels of variable renewable resources much more easily than anyone predicted, and states and RTOs regularly shatter annual and single day records for renewables as a percentage of total generation without compromising system reliability:

- ERCOT, March 26, 2014, wind generation reached 10,296 MW, meeting almost 40 percent of electricity demand.
- MISO, November 23, 2012, wind generation reached 10,012 MW, meeting 25 percent of demand across a region spanning all or part of twelve states.
- Iowa received more than 27 percent of its electricity from wind in 2013, the highest percentage ever for any state over a full year, and enough electricity to power more than 1.4 million homes. On at least one occasion during 2013, the State of Iowa's electricity needs were entirely served by wind power.

Grid operators like Joe Gardner, Executive Director of Real-Time Operations for MISO, credit numerous factors for their success in managing high levels of variable resources without incident, notably:

- Geographic diversity. The wind blows at different times in different places across MISO's twelve state footprint – smoothing out the variation at any single location.
- Transmission expansions and upgrades are being approved and constructed, giving operators greater flexibility to manage all resources, and giving consumers more choices via competition.
- Better forecasting tools make it easier to accurately predict wind turbine output.
- Exchanging lessons with grid operators in different regions and countries about how to reliably integrate ever larger shares of variable renewable generation on their systems.[38]

"Smart" technologies will allow engineers to operate the grid even more efficiently. Synchrophasors monitor electrical conditions hundreds of times faster than current technologies – 30 to 120 times per second – and time-stamp every measurement to synchronize data across large regions. Grid operators can use this information to detect disturbances that would have been impossible to see in the past, allowing them to address the disturbances before they lead to serious and costly problems like severe congestion, voltage reductions, or widespread losses of power (e.g. the Northeast Blackout of 2003.) Synchrophasors installed on the U.S. high-voltage network increased nearly tenfold from just 200 in 2009 to more than 1,700 today thanks to DOE's Smart Grid Investment Grants (funded by the American Recovery and Reinvestment Act of 2009). Grid operators are still developing procedures to use this powerful new data resource, but it is certain that the information will make the grid more efficient, reliable, and capable of managing high levels of variable renewable generation.

[38] Presentation to Markets Committee of the MISO Board of Directors, Joe Gardner, February 15, 201.

FERC rules now require transmission planners and owners to play an unprecedented role in developing a less carbon-intensive electricity system, and the decisions they make will directly impact the cost and efficacy of state implementation plans to comply with the proposed rule.

As described above, states acting alone and on a regional basis within RTOs have already embraced "transmission first" approaches to meeting renewable energy requirements ahead of schedule while generating net economic benefits. In 2011, the FERC finalized Order 1000, which introduced several new transmission planning requirements highly relevant to the proposed rule:

1. All public utility transmission providers must participate in a regional transmission planning process that produces a regional transmission plan, and they must share the costs of transmission facilities identified in the regional plan.
2. All public utility transmission providers must consider transmission needs driven by public policy requirements in the local and regional transmission planning processes.
3. Neighboring transmission planning regions must improve coordination on planning for new interregional transmission facilities.

FERC highlighted state and federal energy and environmental policies and regulations as critical drivers of the need for transmission investments:

> "The need for additional transmission facilities is being driven, in large part, by changes in the generation mix. As the North American Electricity Reliability (NERC) notes in its 2009 Assessment, existing and potential environmental regulation and state renewable portfolio standards are driving significant changes in the mix of generation resources, resulting in early retirements of coal-fired generation, an increasing reliance on natural gas, and large-scale integration of renewable generation. NERC has identified approximately 131,000 megawatts of new generation planned for construction over the next ten years, with the largest fuel-type growth in gas-fired and wind generation resources. These shifts in the generation fleet increase the need for new transmission. Additionally, the existing transmission system was not built to accommodate this shifting generation fleet. Of the total miles of bulk power transmission under construction, planned, and in a conceptual stage, NERC estimates that 50 percent will be needed strictly for reliability and an additional 27 percent will be needed to integrate variable and renewable generation across North America."[39]

In upholding Order 1000's requirement that transmission planners consider relevant public policies, the U.S. Circuit Court of Appeals for the District of Columbia found "all of the challenges to the public policy mandate to be without merit."[40] EPA should follow FERC and federal courts by recognizing the critical interdependencies between transmission infrastructure and efforts to reduce carbon emissions in the power sector, requiring state compliance plans to reflect and incorporate relevant transmission planning analyses, and crediting low and zero carbon energy enabling transmission investments appropriately.

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[39] Order No. 1000.

[40] *South Carolina Public Service Authority v. FERC*, U.S. Circuit Court of Appeals for the District of Columbia (2014).

Conclusion:

Meeting the threat of climate change will require steep reductions in greenhouse gas emissions from all sectors of the economy in the coming decades, but our success in reducing electric sector emissions will likely determine our overall success. Fossil fuel fired electric generating units are by far the largest stationary sources of greenhouse gas emissions in the United States, and our ability to replace them at scale with abundant and affordable zero carbon renewable resources will depend on whether we have adequate transmission infrastructure to develop these resources and deliver them to consumers. By adopting ACEG's recommendations to include transmission expansions and upgrades as part of the BSER and to require states to work directly with transmission planners to implement the proposed rule, EPA will ensure that the combined actions of transmission planners and states are complementary and well-coordinated elements of a cost effective strategy for achieving state emission goals.

Respectfully submitted,

John W. Jimison
Managing Director
Energy Future Coalition
1750 Pennsylvania Ave., N.W., Suite 300
Washington, DC 20006
202-778-3541
jjimison@energyfuturecoalition.org

William N. White
President
Norton White Energy
28 Indian Road
Marshfield, MA 02050
781-834-7968
bill@nortonwhiteenergy.com