BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Electric Transmission Incentives Policy Under Section 219 of the Federal Power Act	))))	Docket No. RM20-10-000

INITIAL COMMENTS OF
THE RAILROAD ELECTRIFICATION COUNCIL

I. INTRODUCTION

Pursuant to the Notice of Proposed Rulemaking issued in this docket on March 20, 2020,[1] by the Federal Energy Regulatory Commission ("FERC" or "Commission"), the Rail Electrification Council ("REC" or "Council") is pleased to submit these comments. The Council is a diverse coalition of electrical manufacturers, technology companies, and other stakeholders that seek to enhance the strength and efficiency of two of our most critical infrastructure networks – the North American high voltage electric transmission grid and the international, national, and regional networks of North American railroads. While being historically and operationally different and planned as part of separate supply chains, the interaction of freight railroads and the grid represents a major opportunity -- often a missed opportunity -- to anticipate greater electrification of our economy and greater utilization of brownfields rights-of-way to site energy delivery facilities for the benefit of consumers and the environment. The Commission can use this proceeding to foster change that will lower electric rates and create new pathways to major clean energy resources. The need to expand, integrate, and modernize the high-voltage grid in the United States will be forcefully argued by many parties in this proceeding, and we concur with that objective. The time has come for the Commission to proactively incentivize transmission planners and developers to seek out and support opportunities to site transmission along existing rights-of-way as a way of helping achieve that important goal, streamline the siting process, and help minimize environmental and aesthetic impacts.

[1] *Notice of Proposed Rulemaking on Electric Transmission Incentives Policy Under Section 219 of the Federal Power Act*, 170 FERC ¶ 61,204 (2020).

II. INTRODUCING THE RAIL ELECTRIFICATION COUNCIL

The Council was established under the auspices of the National Electrical Manufacturers Association ("NEMA") in April 2020 as a non-profit organization, to address several concerns about the need to improve critical energy and transportation infrastructure, promote jobs, reduce emissions, address climate change, and prepare for an economy that will be more driven by electric power in the decades to come. Membership in the Council is open to all interested companies, organizations, and individuals. The Council will undertake its education and advocacy mission before state and federal policy makers, industry participants, entrepreneurs, and concerned citizens in the months to come. It offers its ideas and its resources to the Commission, now and in the future.

III. COMMENTS

A. Background and the Council's Interest

The Council compliments the Commission for its renewed interest in strengthening the transmission grid. We fully realize that the Commission authority over the siting of electric transmission is extremely limited, especially when compared to its authority to review, certificate, and set rates and conditions for natural gas pipelines under the Natural Gas Act. Moreover, it does not regulate railroads. The Commission can nevertheless help effectuate a more integrated and extensive high voltage grid that would afford greater access to remote renewable energy resources, promote more powerful regional and national wholesale power markets, and enhance the environment by supplying cleaner energy to modes of transportation, including railroads, as soon as the economics and public policy permit.[2] In fact, the Commission's staff has recently reported to the U.S. Senate and U.S. House of Representatives regarding the role of transportation rights-of-way in siting longitudinal energy delivery facilities makes this Comment doubly relevant.[3]

[2] For a full exposition of our vision, see The Rail Electrification Council, *The Value of Rail Electrification* (2020). (*See* Attachment A)

[3] In its latest Appropriations Act (January 2020), Congress directed FERC to report on "the barriers and opportunities for high voltage transmission, including over the nation's transportation corridors. The report shall examine the reliability and resilience benefits, permitting barriers, and any barriers in state or federal policy or markets. Page 480,

We look forward to the results of that study,

The Commission's rules and policies can be structured so that transmission owning or operating companies charging the Commission-approved rates are not only made whole, but are incented to optimize their systems and services. In our view, the Commission's Federal Power Act ("FPA") authority, especially FPA Section 219(b), can clearly be used in a way that helps accelerate transmission development, overcome certain state and local opposition to facilities siting, and avoid some of the important environmental impacts of greenfield facilities development. There are important benefits worth encouraging. Transmission providers should be incentivized to incur the capital and non-capital costs of leasing rights-of-way as a means of overcoming the challenges of siting facilities. The Council therefore encourages the Commission to use its FPA ratemaking or other authority in the siting and land-use area just as it would offer an inducement to employ advanced technology or make certain investment decisions. In that regard, a significant solution to the difficulties in siting infrastructure would come in the form of railroad rights-of-way.

Today, the supply chains that deliver goods and services to North Americans are under tremendous pressure to modernize economically, operationally, and technologically. The REC wants you to know that we are determined to help meet the transformational changes that these pressures will produce. Our work in pursuit of a robust grid and electrified transportation is predicated on the following:

- Demand for electricity, especially in the transportation sector, will increase dramatically in the next two or three decades. This "electrification" requires the strengthening of the infrastructures that will produce power, deliver it, and consume it in manufacturing and transportation processes.
- Consumer demand, state energy policies, and declining costs increasingly favor renewable forms of energy and technology. The best resources can only be delivered to major markets by a more integrated transmission and storage grid. Railroads bisect the largest concentration of these resources in the continental U.S. and Canada.

P.L. 116-94: https://www.govinfo.gov/content/pkg/CPRT-116HPRT38679/pdf/CPRT-116HPRT38679.pdf .The report is not publicly available at the time of this filing.

- The electric power and railroad industries are critical infrastructure networks that can be planned and developed to work more closely together, be co-located, and collaborate on climate and energy reliability solutions.
- Legacy railroad systems are striving for greater asset utilization and efficiency to enhance intermodal freight and passenger transportation. Conversion to grid power, battery systems, and electric motors that are stronger and more energy efficient than diesel, is inevitable in our view but it will be expensive and may need incentives and perhaps subsidies to accelerate developments in both the networks at issue.
- Railroad rights-of-way represent a golden opportunity to facilitate the development of a "macro" electric grid of HVDC lines that would support more efficient bulk power markets and serve state environmental policy goals. However, utilization of the rail system assets to advance such energy goals is often ignored, even by grid advocates.
- Railroad electrification also represents a large potential expansion of utility electricity loads and an opportunity to develop and manufacture electric technologies and facilities that will animate the transportation industry of the future.

B. Incentives For Use of Brownfields

As the Commission recognizes, transmission planning is difficult. FERC has struggled with this for at least two decades. Transmission planning and development is becoming even more challenging, notwithstanding the strides made under Order No. 1000. The success record of proposed multi-state or inter-market transmission projects is poor, despite the growing interest, if not consensus, about the need for major transmission expansion and modernization.[4] Proposed transmission projects are vulnerable to jurisdictional disputes, policy disagreements and divergent practices among states and between regional transmission organizations, and divergent siting requirements. Even successful new transmission projects which promise to contribute significantly to grid integration, reliability, liquid wholesale power markets, and a clean energy future face

[4] An indication of the increasing importance of potential interregional transmission for the future of renewable energy is the "Macro-Grid Initiative." https://cleanenergygrid.org/macro-grid-initiative-launches-expand-upgrade-americas-transmission-network/

regulatory processes and public opposition that will typically delay implementation for a decade or longer. These inefficiencies will prove costly for consumers and the general economy.

Siting a transmission line may be foiled for a variety of reasons, good and bad. Facilities siting is the single most intractable barrier to transmission project development. Congress has struggled to address the problem, with little success, through "backstop siting," regional compacts, and use of the federal eminent domain authority of power marketing agencies. However, we point out that transmission can be greatly facilitated where it is proposed to be constructed on private property and across brownfields – i.e., land already developed for another industrial or ground-disturbing purpose. There are many potential kinds of available brownfields that may be suitable for co-development, railroads and highways among them. Brownfields are not always longitudinal in nature or capable of supporting network infrastructure installations like fiber optic cable, pipelines, or electric transmission. Railroad systems can. Brownfields offer opportunities to construct infrastructure without major additional environmental impacts. In a nutshell, the historical rail system in North America represents such a brownfield opportunity. Moreover, railroad networks often bisect the major potential renewable energy resources in the U.S. and Canada. In the Council's view, the potential to alleviate the siting problems that transmission development faces by encouraging access to these rights-of- way is largely untapped, with notable exceptions.[5]

Incentives are admittedly not the total solution to the array of impediments transmission faces. However, they can provide surgical solutions in key cases, help planners think ahead, and signal a more positive and creative transmission strategy from the Commission. The Council therefore requests that the Commission consider adoption of a performance- or benefit-based incentive tied to the commitment to utilize brownfield space to site transmission. Non-monetary incentives can also help overcome the obstacles to siting projects. Such non-monetary incentives (or disincentives) are also implicitly present in the Commission's policies for planning transmission additions and for managing interconnection of new resources. All stakeholders in the transmission of electricity should be induced by Commission policy to take actions that support the optimum development

[5] Cite Soo Green HVDC Link (See presentation at Attachment B)

and use of the grid, including entities the Commission does not directly regulate. Without such creative action, siting will otherwise remain largely a state-by-state, landowner-by-landowner issue that will thwart public policy goals and defeat major interregional projects even where a project has been found to have economic or reliability or public policy merits and benefits.

The Council acknowledges that not all rail rights-of-way will support transmission installation and that electricity can pose certain safety or control problems if installed improperly. Indeed, the dimensions of railroad rights-of-way are not entirely understood even by the railroads themselves, given the pattern of land sales and abandonments that have occurred over time. That said, the Council does not believe that these limitations or concerns justify simply ignoring a major opportunity to help ensure a more robust and environmentally-friendly transmission grid in the relatively near future. In fact, we strongly recommend that FERC adopt a proactive policy of encouraging use of environmentally benign brownfields by means of its incentives rules.[6] By establishing an *ex ante* performance or benefit-based incentive up front, utilities and developers will begin to consider brownfield options more seriously. The Commission's inducements to use such brownfields can be conditioned on a form of benefit sharing that will present these opportunities in a fresh way.

We believe that railroad companies can be encouraged to consider monetizing access to their rights of way and to participate in advancing the public's interest in a strong grid, a role no less important now than when railroads drove the integration of the U.S. economy in the Nineteenth and Twentieth Centuries.

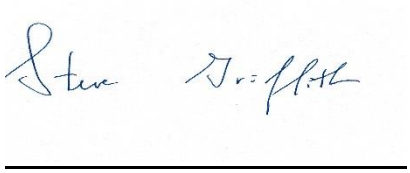
CONCLUSION

The Council therefore respectfully requests that the Commission adopt as part of its Final Rule a rate incentive that would become effective upon completion of projects located primarily on railroad or other brownfields rights of way or such other non-monetary inducements that encourage integration of railroad rights-of-way into regional transmission planning processes. By doing so, the Commission would be employing its ratemaking and

[6] The Council attaches to this Comment a recent presentation by Aaron Bloom of the Energy Systems Integration Group, which makes a powerful case for the utilization of longitudinal networks like railroads for electric grid integration (S*ee* Attachment C)

planning authorities to foster a real solution to the problems associated with siting of major interregional or inter-market electric transmission facilities. The process of obtaining rights-of-way, licenses, and permits for major projects to be located in multiple state and local jurisdictions, each of which have significant authority to reject or condition the project differently and often without regard for regional or national interests, can deter investment, delay grid integration, and ultimately inhibit access to clean energy resources. The Council would prefer the Commission examine how brownfield siting can support the goals of Order No. 1000 and thus help unleash the potential of a truly national (and North American) bulk power market. Rail electrification and railroad support for grid facilities can become a key enhancement to the interstate commerce in electricity as well as freight, while also satisfying state and local economic and environmental concerns.

Respectfully submitted,



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Attachment A

The Value of Rail Electrification

James Hoecker, Husch Blackwell & Steve Griffith, NEMA
Discussion paper for Rail Electrification Council

Introduction

Evaluation of the potential benefits of modernizing basic infrastructure will involve not only engineering and related considerations but also developments in areas of public policy and perception, economic efficiency, new technology, and changing supply chain issues in related industries. Electrification of the transportation sector is today focused primarily on electric highway vehicles and reflects trends in other parts of industry. Electricity usage is expected to penetrate new markets in the coming two or three decades, driven by new technologies and productive energy efficiency strategies, mitigation of climate change and health concerns, the changing mix of electric generation resources, including from low-cost natural gas and the declining cost of renewable resources, the need to replace and upgrade infrastructure, and emerging regional energy markets.

Rail electrification and modernization will be a function primarily of two network industries – the railways and the electric power system. However, these core industries are generally planned, operated, and regulated in separate silos. If integrated more effectively, these industries would offer important benefits to freight shippers and consumers, electricity consumers, and North American economies.

Background

The conversion of freight rail transportation from steam to electricity began in the United States at the turn of the 20th century. Electrification of major rail lines such as the Milwaukee Road was common up through World War II. Electric freight rail was comprised of many different systems in different geographical areas, but the practicality of that concept was not in doubt. There were (5) drivers for rail electrification in this initial era of steam powered engines --

1. Tunnels: Early railroad electrifications took place in long tunnels where congestion and pollution became more prevalent.
2. Mountains: Tunnel electrifications paved the way for larger projects and longer installations where electric power proved to be an advantage on steep inclines

3. Passenger Terminals: Electric multiple unit passenger trains that could operate in both directions eliminated the switching moves required by steam engines
4. Short lines: Successful installations on a number of short line railroads
5. Smoke abatement: Policy decisions by local governments lead to electric installations

By the mid-20th century, steam engines had been replaced by more efficient electric locomotives and diesel-electric locomotives. U.S. railroad companies transitioned to diesel over electric locomotives because of diesel's lower up-front costs. Railroad operators in many other industrialized countries switched to electric locomotives partly because the railroads were owned by the governments of those countries that could afford the required infrastructure. In the U.S., railroads have always been a regulated privately-owned industry. This presented U.S. railroad companies with challenges when financing electrification upgrades. As a result, the U.S. today lags behind many other nations, such as Europe and China, with respect to electrification of major railroad lines

Today's Challenges for Two Industries

The network of Class 1 (long line freight) railroads and Class 2 (short line) railroads, and their associated facilities has been a critical backbone of interstate commerce for more than 150 years. Railroad companies often own substantial established rights of way. Freight rail transportation is nevertheless only one-tenth the size of highway truck transportation. Its market share appears to be declining and its rolling stock is aging. The transport of coal by rail, destined primarily for electric generation plants, has been among the principal sources of revenue for railroads. Moreover, locomotives are predominantly powered by fossil fuels (diesel) in conjunction with electric traction motors (which are regenerated within diesel locomotive). Not surprisingly, railroad companies are seldom counted among supporters of climate change mitigation or development of clean energy resources.

Like electric utilities, the railroads are today facing some new realities that they must inevitably determine how to meet. Likewise, there are new opportunities that await decisions. Declining coal shipments, fossil fuel emissions and climate change concerns, rising demand for renewable resources often located along rail systems, and competitive pressures from other forms of transportation (which are electrifying) are among the challenges and opportunities that rail executives face.

When Congress reinvigorated the industry in 1980 by reducing federal regulation, it made rail transport more flexible and competitive relative to the new interstate highway system. The industry is therefore better equipped to meet new challenges. For example, the emissions profile of rail transportation gives it a head start. Today's railroads contribute far less greenhouse gas and other pollutants than other modes of freight transportation. Moreover, the current fuel efficiency of trains is undeniable. The ratio of rail fuel efficiency to the fuel use of trucks moving the same freight, typically measured in tons of freight moved a distance (ton-miles) per gallon of fuel, is between 3:1 and 4:1. This advantage belies the fact that freight transport by rail often depend on trucking at either end of the "haul." The strength of diesel engines is well-known and the cost of replacing them domestically (25,000 units) would be in the neighborhood of $150 billion, not to mention the investment in facilities required to deliver grid power or battery power. This suggests that full electrification of Class 1 freight lines is years away. Moreover, to the extend railroads move in that direction (as we believe they should), they will need to ensure safe operations, revenue-neutrality over the long haul, and benefits for both the companies and public policy.

The case for electrification is based in part on the potential economic efficiency of electric drives as the motive force of freight rail, as well as on environmental and public policy considerations. The delivered cost of electricity from the grid (assuming the massive investment in new delivery infrastructure) would be significantly lower than electricity from a diesel engine (which drives the traction motors), especially if low-cost renewable resources are integrated more heavily into the grid. Electric engines, perhaps augmented by battery storage or hydrogen-based power, can reduce fuel costs overall, even when accounting for the generation of that power at a plant some distance away. The advantages of electric drives also relate to lower maintenance and operation costs, reductions in fueling time, increased acceleration to allow more trains ("sprinter" service) on same tracks, and the creation of railroads as foundational customers of remote renewable power sources. Finally, the importance of the rail network to national security has been recognized by the military's designation of 36,000 miles of rail as the Strategic Rail Corridor Network ("STRACNET") for movement of military equipment among 170 installations.

As other major sectors of the economy become electrified, the advantages of rail electrification may become even more obvious. This is also a transformative time for the electricity industry and the bulk power grid upon which it depends. The transmission grid dates from the turn of the 20th century but has been truly integrated regionally in only the past 50 years or so. Much of today's electric transmission system remains a patchwork of service

territories. Many facilities have exceeded their useful lives and sometimes rely on electro-mechanical controls. That may be changing in profound ways. Emerging regional and national power markets and the push by states and consumers to access remotely located renewable resources have increased pressure to build more transmission, including major HVDC facilities. However, the electric system is regulated largely by the several states with respect to siting and permitting transmission facilities, in addition to federal rate and environmental regulation. These requirements make planning and development of the kind of cross-border or interregional transmission that is required for a vibrant energy market a difficult, expensive, and frequently unsuccessful process.

While these two infrastructure networks — railroads and electricity transmission — carry critical goods and services across multiple states and into adjacent foreign countries, they are planned and operated differently, and their owners and operators seldom communicate or collaborate in pursuit of economic efficiency or environmental benefits. Nevertheless, the changing dynamics of the energy landscape pose opportunities and challenges to both industries. Now is a propitious time to consider how rail electrification opportunities and more coordinated planning and operation can benefit both. For example, the electric transmission industry has a known interest in utilizing rail rights of way to route its high-voltage lines, although rail safety and other concerns have made such arrangements difficult if not impossible to achieve. Existing railroads are uniquely positioned to provide strategic access to new clean energy resources if railroad rights-of-way (ROW) can be utilized. Moreover, new ROW revenues could help finance rail electrification. It must be acknowledged that electrifying Class 1 (and to some extent Class 2) freight railroads is an expensive proposition, whether done with catenary systems or third rail technology -- up to $3 million per double track mile. Electrifying rail parks offers more favorable cost-benefit ratios. However, the magnitude of the long-term benefits to regional and national economies makes this an objective that should be explored soon,

Analysts also agree that long haul transportation can be more efficient and less expensive by train than by truck. The physics of steel rolling on steel is much more effective from an energy transfer perspective than that of rubber on concrete. Trains are more efficient aerodynamically than trucks and a cleaner more robust electrified railroad system could replace substantial amounts of truck traffic, easing congestion and pollution in urban areas. Intermodal arrangements have helped utilize both rail and trucking capacity more efficiently. However, railroads remain a vastly underutilized asset. In comparison to diesel alternatives, electric railways offer operational advantages—substantially better energy efficiency, lower emissions,

and lower operating costs. Electric locomotives have quicker acceleration, lower fuel cost, and fewer CO_2 emissions; electric locomotives are lighter (creating less wear on rail beds), are more powerful, and more responsive and reliable than diesels. Looking forward, they may offer energy storage and flexible dispatch potential for the electric grid.

The Benefits of Rail Electrification

The transportation sector represents the single largest user of non-electrical energy; accounting for 25% of total U.S. energy use. Economists and analysts are coming to recognize that the transportation sector (principally EVs and trucks) will become increasingly electrified in the next quarter century. This means 70GW of new demand by 2030 and up to 130 GW more by 2050. Under current market and public policy trends, this electrification will entail greater production of renewable energy and a marked decline in the use of fossil fuels. Because renewable resources are location-constrained — the best resources are in the plains regions where there are fewer customers — there will be a concomitant demand for additional build-out of the transmission grid. Because electrification of highway transportation will also increase substantially, railroads have an additional competitive challenge. The primary benefits associated with an electrified rail system can therefore be best categorized as follows: a lower total cost of ownership, job creation, additional revenue sources, and environmental impacts.

Lower Total Cost of Ownership: While up-front prices of diesel fuel currently are low, the long-term trend is for those prices to increase. Conversely, electricity prices are falling especially with the increasing use of renewable energy sources such as solar. Electric-powered trains are also more efficient than those powered by diesel. As an example, diesel-powered trains transfer about 30-35% of the energy generated by combustion to its wheels, whereas supplying electricity directly from an overhead line transfers about 95%. Electric trains can accelerate faster and stay at top speeds longer.

Job Creation: The transition to electrified transportation will lead to new industries and job opportunities. Specifically, it could spur new jobs in charging infrastructure engineering, battery manufacturing, software development, and machine learning appealing to labor unions. Part of the rail industry's current advantage is a huge employee to ton-mile ratio. In order to meet the demand for new jobs, the public sector, industry, and educational institutions will have to devote

necessary resources to worker education and training. Major questions persist about the returns that rail companies can expect from the changes that are suggested in this paper. On the transmission side, developers and utilities are expected to continue to spend $20-40 billion annually for the foreseeable future to modernize and integrate the grid.

Additional revenue sources: The historical rail system is an ideal connector between location-constrained renewable resources that are increasingly in demand and major power markets. Railroad rights-of-way could be employed to site linear electric transmission infrastructure, providing a source for fresh revenue. These revenues could be used to spur railway electrification. Battery powered trains also have the capability to sell excess energy back into the grid. This could also be supported by regenerative breaking (as the trains slow down the wheels drive the generators) putting additional energy back into the system.

Environmental benefits: Reducing or eliminating diesel-powered locomotives can reduce air pollution including soot, volatile organic compounds, nitrogen oxides, and sulfur oxides, all of which affect public health as well as the environment. This is especially important as many railroads pass through congested urban areas. It would also reduce noise levels in cities. Switching from diesel to electricity would also address the challenge of replacing petroleum-based liquid transportation fuels with cleaner alternatives as we look to lower total greenhouse gas emissions and to open another front against climate change.

A Path Forward

Policy innovation: Railroad electrification is a long-term project. Such an investment nationally will be considerable. Currently, neither railroads nor their regulators have a strategy for electrification except for commuter lines or speculative high-speed rail lines. Despite their importance to the economy, major rail companies are not active in climate change, smart grid, or national energy policy conversations. Within the U.S., most railroads and electric utility infrastructure are privately owned and operated. While this can make it more difficult to secure financing for major infrastructure investments, the lack of coherent national policy may be a more important impediment. For both rail and transmission infrastructure, innovative policies are needed to spur this discussion.

Technology innovation: The electric grid can be tapped for wayside and crossing signals, switch heaters, trackside cameras, transponders for freight tracking, and climate control

for refrigerated containers and boxcars. Engines and freight railcars can become power generators through regenerative braking and even PV rooftop panels. A more flexible, innovative, digitalized railroad network holds enormous market potential for electric power, technological inventions like 5G, major battery installation, control and monitoring systems, environmental and safety Standards, cables, converters and new conductors, trackside equipment, catenary systems, and methods of hydrogen propulsion. The two industries described above are ripe for collaboration and innovation.

Public-Private Partnerships could become viable solutions for funding an electrified rail network by using a combination of federal, state, private sector, and possibly regional sources. The PPP model has had some success for Class 2 and commuter rail in regions across the country. Freight railway electrification will positively benefit a variety of other industries. For the agriculture sector, rail electrification could represent cost savings and efficiency in transporting food to market. Agriculture goods usually represent a much smaller portion of freight rail and with the increased capacity of electric rail that electrified railways could provide, rail shipments could become much timelier and more frequent than they are today.

For electric manufacturing and technology firms, more extensive electrical applications would mean a significant new market and new products. For electricity producers (conventional or renewable), rail electrification would mean new load and support for generation plant development. For railroads themselves, electrification could reduce congestion, create new jobs, and make operations more competitive with highway freight transport. For public policy makers, it would translate into cleaner energy (and fulfillment of state renewable energy requirements), lower emissions, and constructive contribution to climate mitigation.

Electric generators and transmission providers should also play a role in supporting the electrification of railways. Utilities have been among freight rail's largest customers, primarily for the delivery of coal to power plants and hauling away coal ash. They are now becoming major developers and purchasers of renewable energy projects. As utilities become less dependent on coal, the revenues of freight rail will come under increasing pressure. The extent to which greater reliance on new resources like wind and solar, as well as batteries and other distributed resources, will compensate the power industry monetarily or for a potential challenges to reliability from loss of base load plants, remains to be seen. Likewise, unless the railroads take these changes and opportunities into account and critically reevaluate their business model,

they will find the energy and public policy environments increasingly challenging in the years to come.

Conclusion

America is transitioning to a transportation future that is increasingly electrified. While vehicle electrification is at the forefront of these discussions, an electrified rail infrastructure also has the potential to efficiently and reliably transport freight and/or passengers while also benefitting the overall environment.

The NEMA Rail Electrification Council intends to explore these opportunities and seek energy and transportation policies and practices that provide consumer benefits to the North American economies. The Council will promote the adoption of electricity as the principal motive power of domestic railroad (freight and/or passengers) transportation and as an enabler of electric grid integration and innovation. The Council is open to both NEMA Members and non-Members; to join, contact Steve.Griffith@nema.org.

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Attachment B

A New Transmission Model to Deliver a Clean Energy Future

Direct Connect

Rail Electrification Council
June 4, 2020

A New Transmission Model to Deliver a Clean Energy Future

The United States has abundant wind and solar energy resources. But today's power grid – bottlenecked with transmission constraints – cannot deliver enough renewable energy to meet growing customer demand, limiting renewable energy growth and slowing the transition to a clean energy future.

Direct Connect

Direct Connect Development's Rail Co-located Transmission Model

Direct Connect is pioneering a new model to build High Voltage Direct Current (**HVDC**) transmission underground along railroad corridors to deliver clean energy to market.

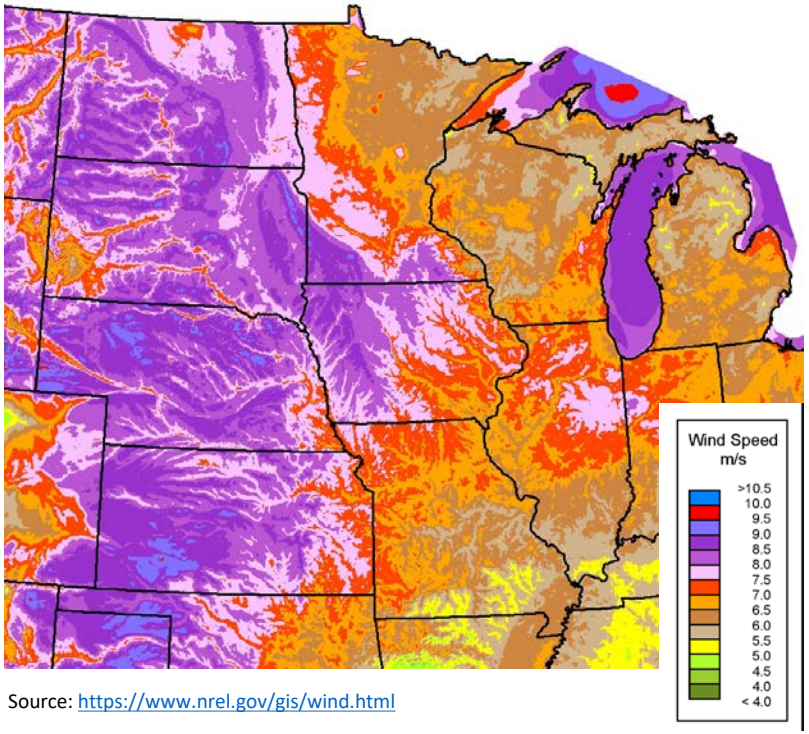
Our flagship *SOO Green HVDC Link* project will connect midwestern and eastern U.S. power markets, unlocking new sources of renewable energy and creating the first link in a new national HVDC transmission network needed to meet America's growing demand for affordable, zero-carbon energy.

Direct Connect's underground transmission lines ship bulk renewable energy along secure rail corridors to deliver a clean energy future

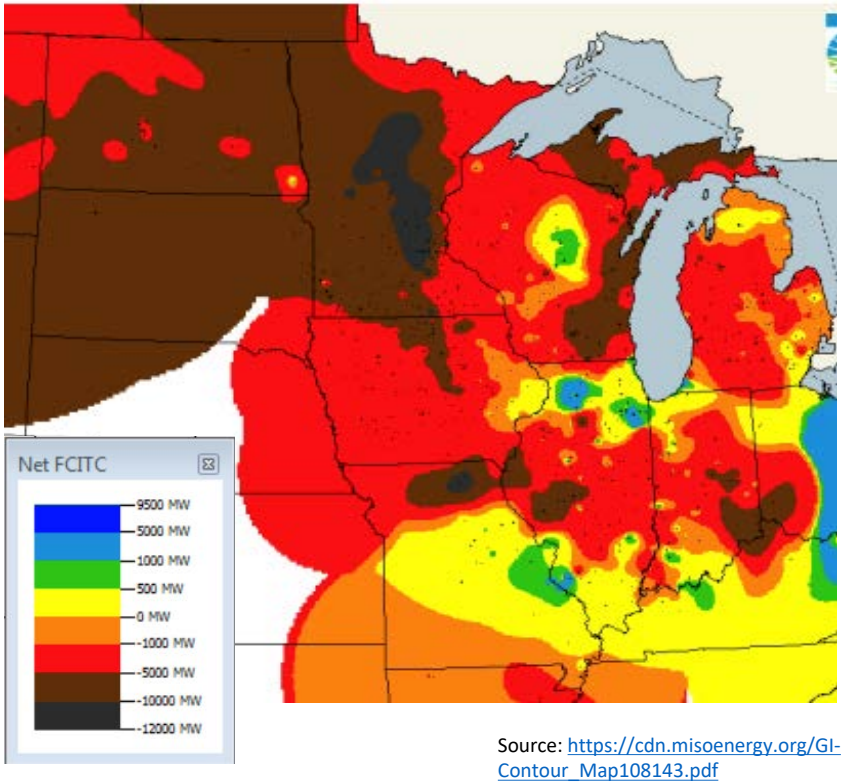
SOO Green HVDC Link: Project Overview

- SOO Green HVDC Link is a 350-mile 2,100 megawatt underground HVDC transmission line running along railroad right-of-way from Iowa to Illinois
- The $2.5 Billion project is privately financed and **will not require any public subsidies or ratepayer investment** – *those who use the transmission pay for the transmission*
- SOO Green is backed by Copenhagen Infrastructure Partners, Siemens and Jingoli Power, with a strategic partnership with Canadian Pacific Railway to follow its SOO Line from north central Iowa to northeastern Illinois
- SOO Green aims to begin operations in 2024

The Renewable Energy-rich MISO Region is Transmission Constrained



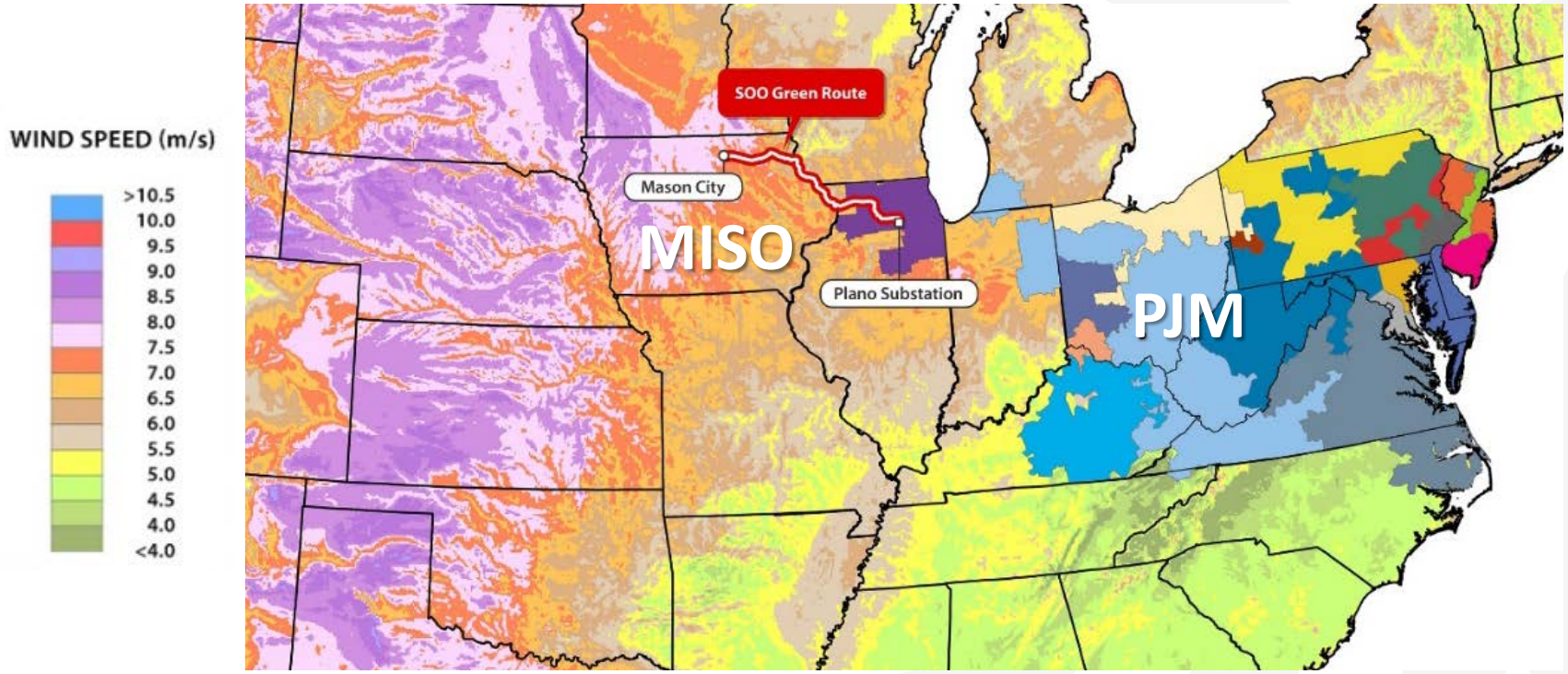
Source: https://www.nrel.gov/gis/wind.html



Source: https://cdn.misoenergy.org/GI-Contour_Map108143.pdf

- MISO's best large-scale wind generation sites are increasingly transmission constrained
- Queued projects face interconnection costs in some cases exceeding $1000/kW
- Operating projects face congestion and curtailment risk

A New Model for Inter-Regional Transmission



- SOO Green will be the first major transmission project to connect the midwestern energy market (operated by MISO, the Midcontinent Independent System Operator) to the eastern market (operated by PJM Interconnection)
- A purely market-based solution, SOO Green will deliver low-cost, reliable midwestern clean energy to municipal, utility, university and commercial customers in PJM

SOO Green: Delivering Economic and Environmental Benefits

12,400 New Construction Jobs

SOO Green will create more than 12,400 in Illinois and Iowa construction jobs, with all work performed under Project Labor Agreements

$3.5 Billion in New Investment

SOO Green will generate more than $3.5 billion in economic output in Illinois and Iowa, including more than $800 million in wages during construction and more than $400 million in manufacturing wages

$3.75 Billion in Ratepayer Savings

By delivering 2,000 megawatts of low-cost renewable energy to northern Illinois, SOO Green will save ratepayers $3.75 billion over 20-years

100%

Achieving Clean Energy Goals

SOO Green will help states affordably achieve a 100% clean energy future by delivering the renewable energy needed to decarbonize the power grid

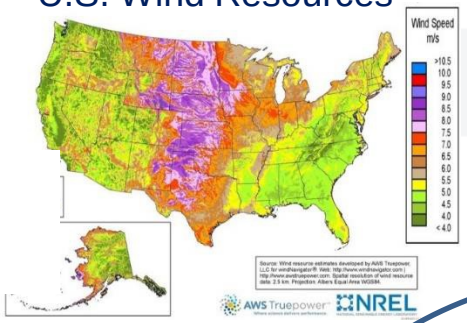
Cleaner Air & Water Savings

SOO Green reduces air pollutants (carbon dioxide, sulfur dioxide, nitrogen oxide, mercury) and water use by offsetting coal and natural gas generation

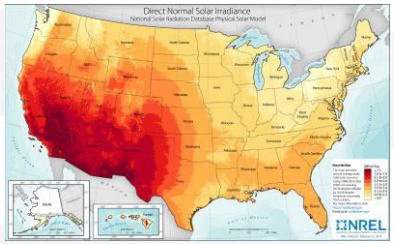
Direct Connect

Transmission Infrastructure is Needed to Bring Renewable Energy to Market

U.S. Wind Resources

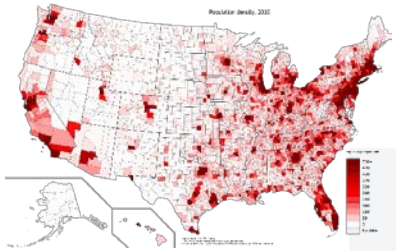


U.S. Solar Resources

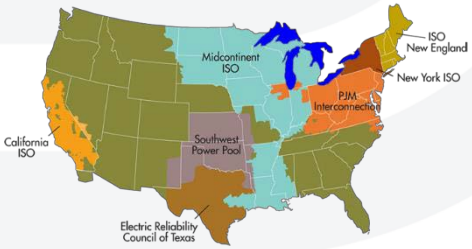


U.S. Class 1 Railways

U.S. Population Density



U.S. RTOs



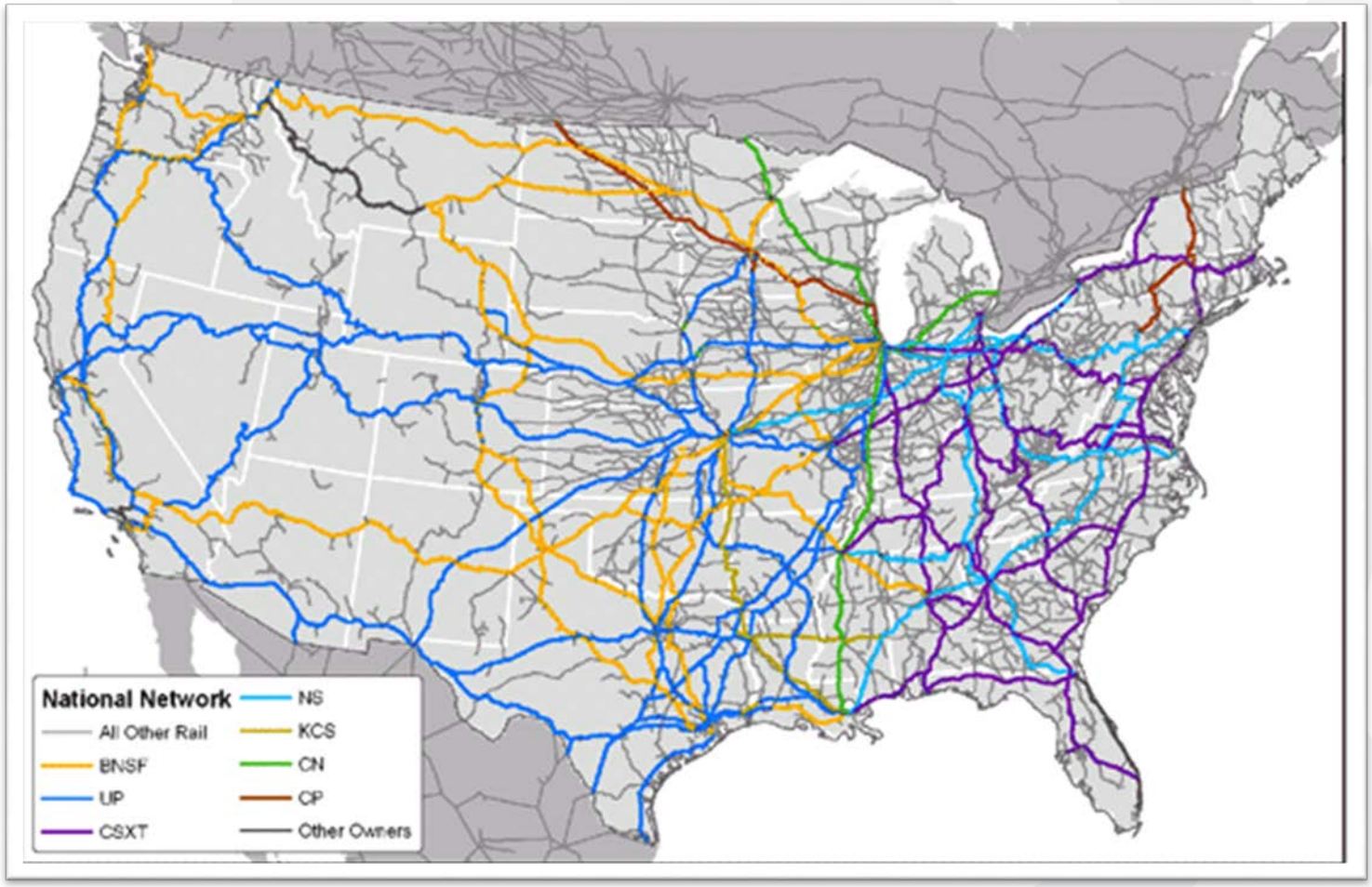
- Zero-carbon utility-scale wind and solar generation are now the lowest cost forms of new power generation
- The most robust U.S. wind and solar resources are generally far from population and load centers
- Electric transmission is the major bottleneck to high penetration of renewable energy
- Greenfield overhead high voltage transmission development is increasingly difficult to site and permit

The U.S. railway network links critical electric power resources and major load centers

Direct Connect

SOO Green: The First Link on the U.S. HVDC Macrogrid

Direct Connect's rail co-location model will change the way transmission is planned and sited in the U.S.



***"Logic will get you from A to B. Imagination will take you everywhere."* – Albert Einstein**

Renewable Energy-by-Rail: A Better Model

Rail corridors provide unique opportunities to link low-cost renewable energy to utility and commercial customers in population centers. Our co-located underground transmission model, which we've developed with CP over the past 10 years, is replicable and compatible with safe railroad operations.

Direct Connect's Rail Co-location Model:

- Avoids the use of eminent domain and need for private land
- Minimizes environmental impacts through underground installation
- Eliminates visual & avian impacts from overhead transmission facilities
- Enables new wind and solar energy development where it's most efficient to build and operate
- Delivers clean energy over long-distances using modern HVDC technology
- Enhances grid reliability & resiliency
- Burial in secure, policed railroad right-of-way provides grid security

Underground Cable Installation

Direct Connect

Rail Co-location Reduces Routing and Permitting Risk

Installing transmission cables underground along railroad right-of-way and boring under sensitive environmental areas avoids use of eminent domain and the contentious siting and permitting issues that have hindered above ground transmission development.

SOO Green's Underground Cable

Overhead Towers

The underground rail co-located model utilizes two cables, each five inches in diameter, occupying only three feet of railroad ROW at a five-foot depth

Direct Connect

Modernizing the Grid with Advanced HVDC Technology

SOO Green will use state-of-the-art Voltage Sourced Converter (**VSC**) stations built by Siemens and Cross Link Polyethylene Cables (**XLPE**) to bring transmission into the digital age

Siemens 2000 MW Voltage Sourced Converter Station Technology

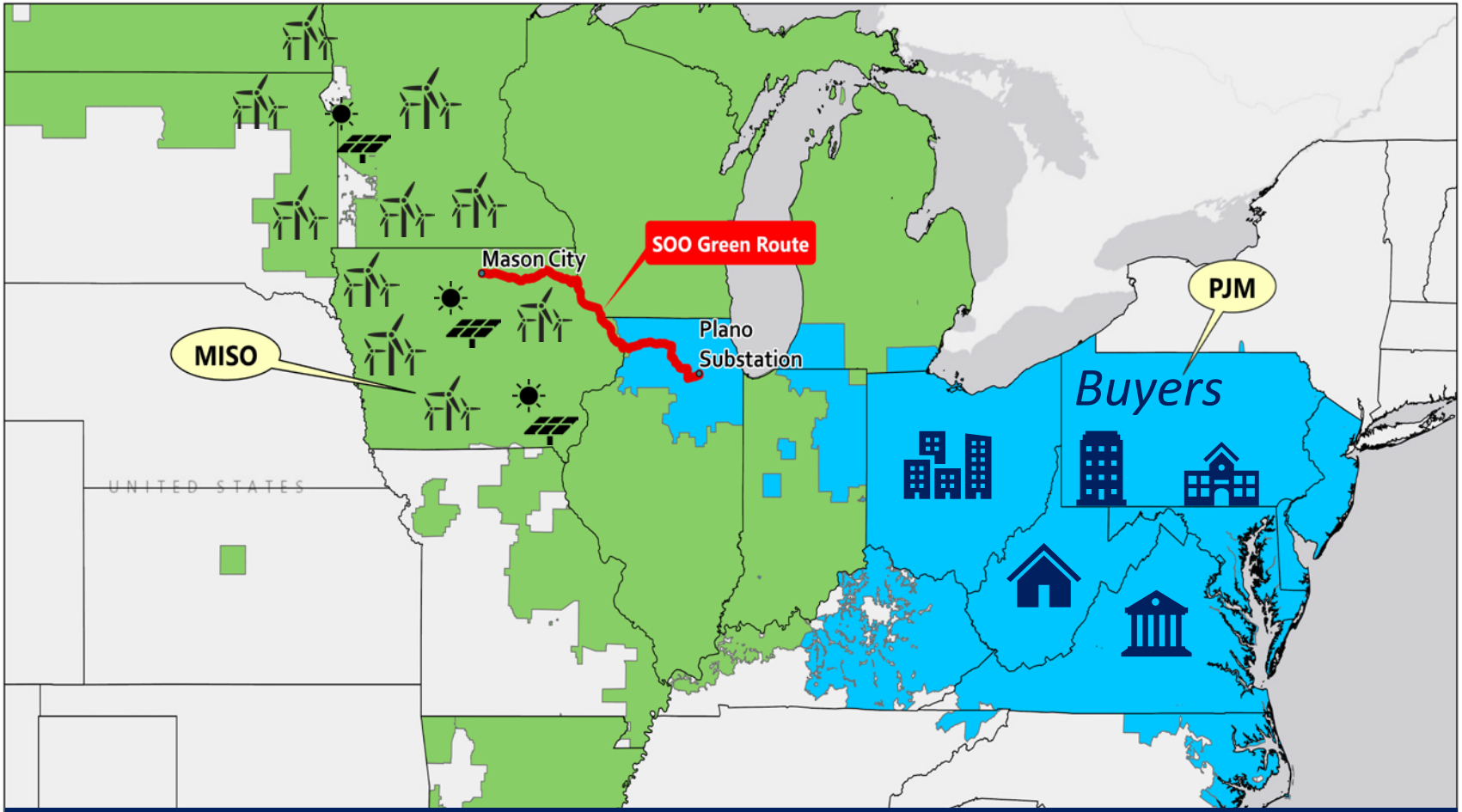
- VSCs boost grid reliability by providing extremely responsive utility-scale reactive power, black start and other ancillary services historically provided by centralized fossil-fueled generators
- VSCs strengthen grid resiliency by accurately controlling power dispatch, avoiding cascading outages and improving power quality via dynamic voltage, frequency and reactive power control
- XLPE cables enable long-distance delivery of renewable energy with little line loss and allow for simpler and less expensive installation with high-power transfer capability

Development Opportunities Adjacent to HVDC Converters

- Cloud companies seek locations with low-cost, reliable, renewable power for siting data centers
- Data centers are slated to grow in size (150 MW)
- SOO Green provides direct access to large-scale, low-cost renewables with high power quality using reliable and ultra-responsive modern HVDC technology
- A **microgrid**, fed directly by the SOO Green converter station, is a natural development opportunity at SOO Green terminals
- **Data centers** and high-tech infrastructure can utilize dark fiber trunk line to be co-located along HVDC transmission, providing network resilience
- SOO Green can obtain local entitlements to facilitate microgrid, data centers and **technology park** development with shared security infrastructure

SOO Green will supply high quality, highly reliable renewable energy for microgrid, data center and other technology applications

SOO Green will Improve Buyer Access to Renewable Energy



SOO Green will provide direct access for PJM Renewable Energy Buyers to an untapped portfolio of low-cost, large-scale renewable generation

Direct Connect

SOO Green Offers RE Products and Services Not Available Today

- SOO Green provides Renewable Energy (**RE**) Buyers in PJM direct access to large-scale and low-cost RE generation
- SOO Green delivers a diverse portfolio of MISO generation in PJM, substituting for VPPA model and its risks
- SOO Green generation profile enables a variety of RE products, including firmed and shaped generation
    - SOO Green *can match power delivery with customers' energy usage* in real time, solving for the variability of RE
    - RE flowing on SOO Green is controllable, schedulable and deliverable

SOO Green will launch an online Open Solicitation in Summer 2020 to allocate transmission capacity and match generation supply with growing demand for renewable energy

Development Team

Trey Ward (Founder & CEO) has worked around the globe as an attorney on a variety of business, project development and policy matters. He formed the first-of-its-kind partnership with a Class I railway, CP, to co-locate HVDC transmission along rail.

Joe DeVito (President) brings over 30 years of experience in the US power industry that includes wholesale electricity markets and the formation of ISOs/RTOs across the U.S. He has developed $3Bn of wind, solar and battery storage projects.

Brian Lammers (Executive Vice President) has more than 20 years of power generation development, origination and finance experience. He has developed more than 3GW of utility-scale wind and solar generation.

Steve Frenkel (Vice President) has more than 20 years energy policy, finance, and business development experience, including technology and business model innovation. His senior roles include leading energy policy for the State of Illinois.

Neil Jones (Vice President) has over 17 years of project management experience in renewable energy, linear and telecommunications projects and has led the development of over 3GW of wind generation and over 300 miles of high voltage transmission.

Raj Rajan (Vice President) has more than 35 years of experience in environmental impact management, with over 15 years in development, generation and corporate procurement of renewables from biogas to solar and wind power.

Direct Connect

Direct Connect Development Co, LLC has been established to develop the SOO Green HVDC Link and other transmission projects on a nationwide basis

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Thank you!

SOOGreenRR.com

Direct Connect

Attachment C

Railroads and Electricity

Aaron Bloom
Energy Systems Integration Group

ESIG
ENERGY SYSTEMS
INTEGRATION GROUP

ESIG

ENERGY SYSTEMS INTEGRATION GROUP

Energy Systems Integration Group is a non-profit educational association that provides workshops, resources and education on the evolving electricity and energy systems.

ESIG supports engineers, researchers, technologists, policymakers and the public with the transformation of energy systems in a way that is economic, reliable, sustainable, thoughtful and collaborative.

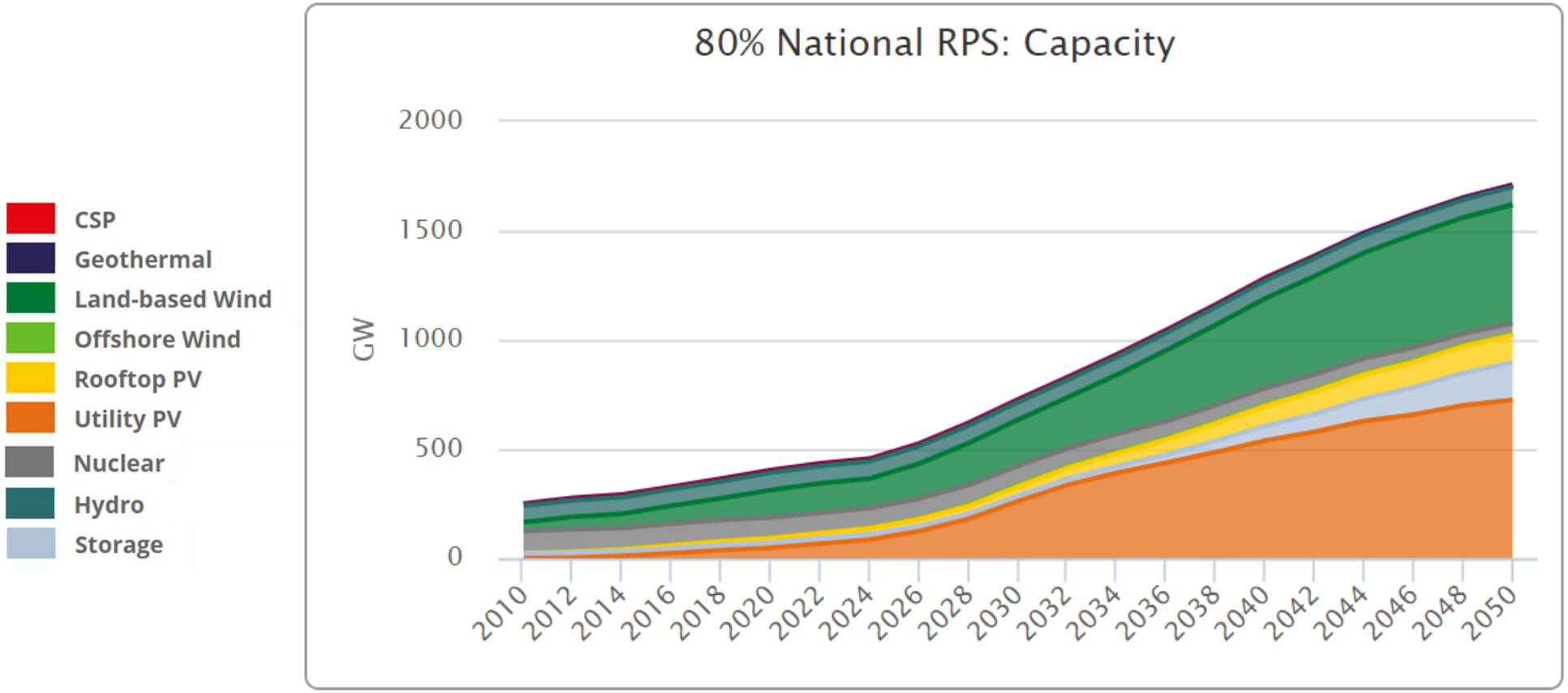
Consumers and policy makers want clean electricity

Utilities have a problem: the public wants 100% renewable energy, and quick

The industry is groping for ways to talk the public down.

By David Roberts | @drvox | david@vox.com | Updated Oct 11, 2018, 9:19am EDT

This will take lots of Renewable Energy



https://www.nrel.gov/analysis/standard-scenarios.html

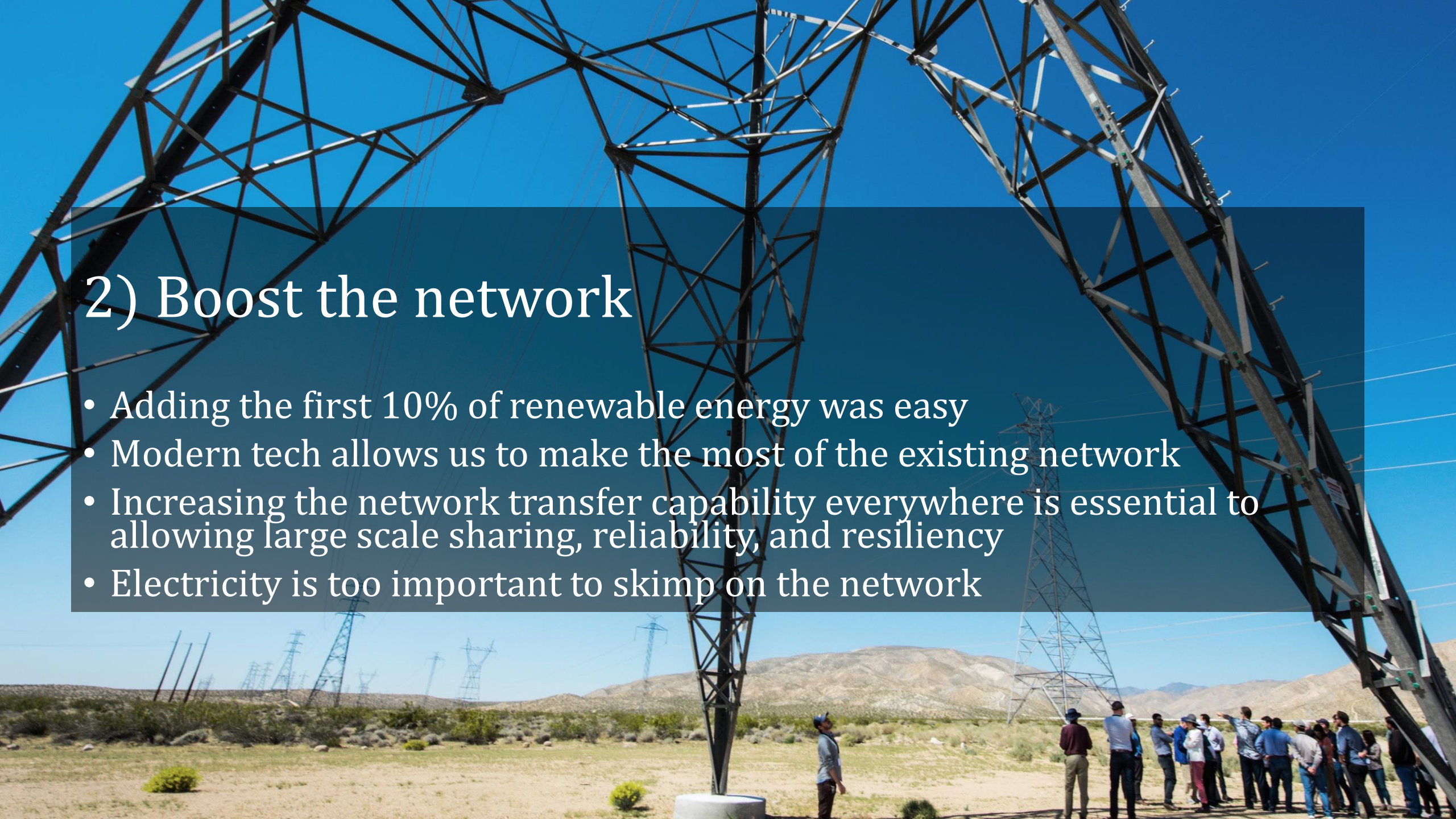
Engineers can make it work.

Hi, we’re difficult!

Here’s what we can do

1) Build everywhere

- Diversity is critical to giving everyone a role in the future
- It helps with cost allocation
- Reduces variability at all time scales
- Our power system needs an overhaul due to age, let’s build the right new stuff
- Grid scale and distributed scale resource have complementary characteristics

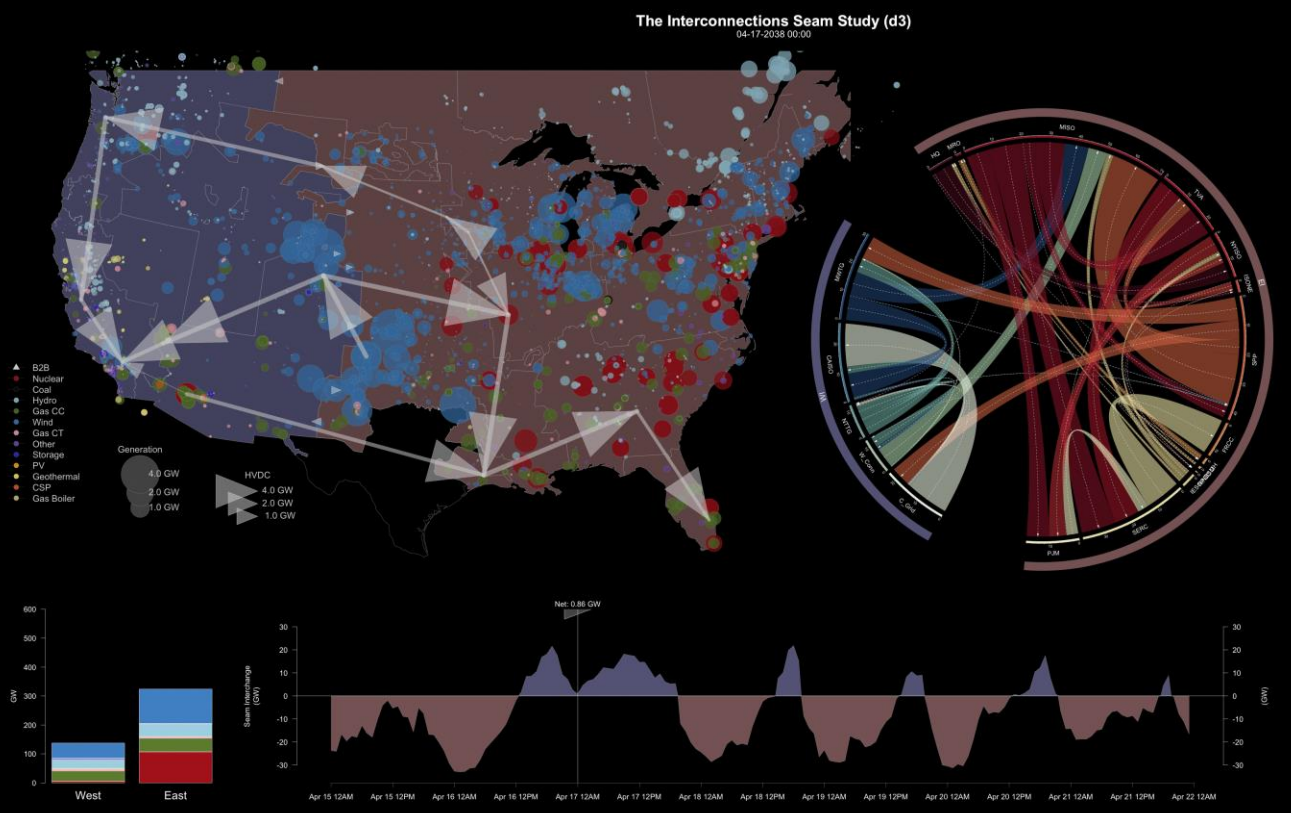


2) Boost the network

- Adding the first 10% of renewable energy was easy
- Modern tech allows us to make the most of the existing network
- Increasing the network transfer capability everywhere is essential to allowing large scale sharing, reliability, and resiliency
- Electricity is too important to skimp on the network

3) Join the interconnections

- Electricity is the only commodity without a national supply chain
- Managing the seasons and large scale distributed generation can't be done with storage alone
- Even California needs to import avocados sometimes



https://www.terrawatts.com/seams-transgridx-2018.pdf

4) Scale hybrid power plants

- Renewables are no longer simple consumers of reliability services
- With a little software and a little storage they can operate like the perfect generator
- Hybrids don’t have to be co-located; we can make thermostats, EVs, and grid scale plants work intelligently in tandem or isolation

5) Share

- The economy needs to spend trillions on modernizing the electric grid, and even more if we want to decarbonize all energy
- Everyone can benefit, and we will all need to pay something
- Our differences are the key to our success; by finding complementary goals and resource profiles we can be more efficient and competitive
- Work with regulators on common sense cost allocation

Google:

"ESIG Toward 100%"

Contact me:

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