A NATIONAL ELECTRICAL SUPERHIGHWAY:

How Extra-high Voltage Transmission Can Enable National Energy Security and Environmental Goals

ANBARIC HOLDING

By Edward N. Krapels

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About Anbaric Holding

The Principal behind Anbaric Holding, LLC – Edward N. Krapels -- has incubated a number of companies in various energy arenas, starting with the world-wide consultancy, Energy Security Analysis, Inc. (see www.ESAI.com). As a consultant, Mr. Krapels spent decades advising international oil companies and governments on global oil affairs. In the late 1990s, Mr. Krapels began a series of risk management projects culminating in the publication of an influential series of risk management monographs published by Risk (one on crude oil, one on natural gas, one on electricity). In that capacity, Mr. Krapels acted as a risk management advisor to a number of prominent energy producing, energy consuming, and utility companies, as well as the PJM Interconnection and the New York Independent System Operator.

In recent years, Mr. Krapels has been a Principal in the development of a number of business in the electricity arena of the United States. He was a founding member of Atlantic Energy Partners, LLC, the developer of the Neptune Regional Transmission System, a 660MW, $600 million high voltage, direct current transmission link between the 160,000MW PJM system and Long Island. Neptune now routinely transmits 20 percent of the electricity used in Long Island.

In 2005, under the Anbaric Holding LLC banner (see www.AnbaricPower.com), Mr. Krapels teamed up with Edward M. Stern and others to found Hudson Transmission Partners, whose Hudson HVDC Transmission Project (“Hudson HVDC”) was selected for development by the New York Power Authority in 2005. The Hudson HVDC project will transmission 660MW between northern New Jersey and downtown Manhattan. This innovative and complex project will meet a substantial portion of new York City’s future energy requirements in an economic and environmentally beneficial manner. The project is expected to be in service in mid-2011.

In 2006, Mr. Krapels and Mr. Stern again teamed up to create the New England Independent Transmission Company (NEITC), a new entrant into the small circle of entities in New England that develop high voltage, environmentally acceptable transmission projects. NEITC has proposed the Green Line, a 1200MW HVDC project between northern Maine, Boston, and the Cape that will provide a massive, new superhighway for the renewable potential in Maine and the Canadian Maritimes. If accepted, the Green Line could be in service in 2013.

In 2008, Mr. Krapels and three investment firms – the Energy Investors Funds, the Starwood Infrastructure Fund, and JH Whitney – moved to enlarge the environmentally-oriented transmission incubation effort by launching work on the “Transmission Class of 2008 and 2009,” a series of potential projects that share certain characteristics – technology, regional orientation, and size. Mr. Krapels and his investors believe the class of 2008 contains a number of projects that will substantially enhance the access of renewables to urban markets.

In 2008, Mr. Krapels also teamed up with the former Chief Operating Officer of PJM – Ms. Audrey Zibelman – to found Viridity LLC, which is developing a capability to integrate demand response and smart grid technology to develop “Smart Energy Campuses” for universities and others whose properties have campus-like characteristics. Viridity expects the first Smart Energy Campus applications to be launched in late 2008.

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Executive Summary

In the next twenty years, in spite of the resistance to new infrastructure development, the United States will need an intensive effort to expand its currently underdeveloped transmission system. One hundred years ago, local needs drove what we expected from the transmission system; fifty years ago, regional needs began to be taken into account; now national goals have taken priority but the grid is inadequate to achieve them.

Sound energy policy requires periodic assessments of the needs of consumers and of society as a whole, the demands that we must place on our energy infrastructure and how we move forward, given where we are today. While much has been written about the needs of the transmission system, this White Paper provides a holistic assessment based on American society's needs from broad regional and national perspectives, and explores how we will have to adapt the existing transmission system to help achieve these broad policy objectives.

The White Paper advocates the development of an interstate extra high voltage transmission system (EHV). In these pages, we will refer to EHV as transmission lines of 500 and 765 kV. In a few areas (notably, New England and New York), EHV systems may not be feasible but the same analysis of the need will be applied to expanding their 345 kV and high voltage direct current (HVDC) systems. Through adoption of a nationwide EHV strategy, the transmission grid can be used not only to address regional reliability needs but also to promote the national policy initiatives we review in this White Paper.

❶ Expectations of the Nation's Electric Power Grid

In spite of widespread resistance to new infrastructure development, the United States must massively expand its underdeveloped interstate high voltage transmission system in the next 20 years to achieve three national objectives:

1. ***Improve reliability of the electricity grid***: As a direct result of heightened concerns over the integrity of the transmission system, new federal reliability standards require further investment in the national transmission system.
2. ***Reduce transmission's environmental footprint and the amount of carbon dioxide emitted by the power sector.*** Current state-level objectives call for reduction of as much as 20 percent (and even more in the following twenty years).
3. ***Contain the power sector's dependence on imported liquefied natural gas (LNG).*** Because we have probably reached the peak of sustainable natural gas production in North America, most of the incremental gas used in the U.S. will have to be imported as LNG.

These objectives mark an important change in American energy policy. In the past two decades, most policy attention has been focused on developing competitive wholesale energy markets. By and large, that effort has succeeded, with workably competitive markets in oil, natural gas and wholesale electric trade.

In recent years, however, a consensus has emerged in favor of taking steps to combat climate change and reduce our environmental footprint. One way to work toward this goal is to convert more of America's electric generating fleet to natural gas, with fewer emissions than coal, which now fuels roughly half of the United States' electricity. This conversion has been underway since the 1990s, but it has put significant pressure on domestic and Canadian gas resources, quadrupling the price of gas and inevitably the delivered cost of electricity.

How, then, can we reduce the U.S. power sector's contributions to climate change without massively increasing our dependence on imported LNG? Clearly, one way is to implement much more aggressive electricity demand conservation programs. Demand for electricity nationwide has been increasing between 1 and 2 percent annually. With aggressive conservation measures, that growth may be slowed. For example, in the next twenty years, high-tech devices may make enormous contributions to Demand Response – the practice of helping consumers learn to control their consumption. Part of Demand Response is simply educational, but more sophisticated new approaches include "smart meters" – electric meters that help consumers make very targeted choices about such issues as when to run their dishwashers and clothes dryers. By shifting load to off-peak times when generation capacity often goes unused, electric utilities can delay their need to build new generation. Nevertheless, as population increases and affluent Americans continue to prefer, *inter alia*, widescreen plasma televisions to traditional models, reversing demand growth is unlikely

On the supply side, however, the United States has four large potential sources of domestically produced low carbon input fuels (aside from natural gas) for electricity generation:

1. Renewables: wind, geothermal, solar and biomass;
2. Run-of-the-river hydroelectric facilities;
3. Nuclear;
4. Clean coal technologies (CCT), and carbon storage and sequestration.

These resources are almost always remotely located. Given that only transmission enables these clean, remote resources to reach urban markets, a substantial expansion of the U.S. EHV transmission system will be needed. In recent years, the Federal Energy Regulatory Commission (FERC) has imposed a series of rulemakings requiring most transmission systems to be open to wholesale competition and development by new entities. Nevertheless, on a national level, EHV transmission investment remains inadequate.

Gradually, people are recognizing that the expansion of the transmission system is an essential component of the solution to several big problems that we as a society are attempting to solve. While there has recently been a national call for the development of transmission, there has not been a specific call for what type of transmission should be encouraged. The recent push to build transmission has largely been triggered by the blackout of 2003 and the concerns over the general condition of the grid.

Years of underinvestment resulted in the need to increase transmission investment across the broad simply to promote the overall reliability of the system. But as our societal challenges change, so too must the solution. Fundamentally, not all transmission is created equal. Local transmission provides local benefits, regional transmission provides regional benefits and EHV transmission provides inter-regional and national benefits. We now need to promote EHV expansion if we are to shift the fuel diversity in the United States to more and more low- and non-carbon emitting generation sources.

The need for more EHV transmission raises an additional, equally daunting, challenge: participants in the electric sector have long been embroiled in often bitter disputes about who pays for transmission. EHV transmission lines provide the capability to move power across utility service area boundaries, state boundaries and RTO boundaries. The challenges associated with the allocation of the costs of such projects run the risk of discouraging the development of the right transmission solutions.

Questions regarding the appropriate level of transmission infrastructure are typically raised early in the planning process.[1] One of the challenges associated with regional planning is the scope

[1] In areas with RTOs, this function rests with the RTO, often in collaboration with the transmission owners.

of the solution sought. For many, the desired approach is to view transmission upgrades in a minimalist fashion and to minimize the investment's magnitude. With this rationale, a transmission solution will only be as strong as the expectations placed on it.

Because EHV systems are designed to transport large quantities of energy, they are by definition intended to be used to move power across large geographic areas, often spanning multiple utility or even regional transmission organization (RTO) planning areas. As such, the development of these facilities requires planners to look beyond the traditional utility or RTO boundaries and to look toward inter-regional/national solutions. Recently the Southwest Power Pool, Midwest Independent System Operator (Midwest ISO), the PJM Regional Transmission Organization (PJM RTO), Tennessee Valley Authority and the Department of Energy announced that they would hold a stakeholder meeting to discuss the development of a coordinated system plan for the areas. The result was the Joint Coordinated System Plan initiative. This development has the potential to allow the industry to take a giant leap forward in terms of how it designs the system and how it establishes expectations of what the nation's grid can deliver.

❷ The American Transmission System: Transition to Superhighways

History of Transmission Investment

To understand the challenges facing today's transmission grid, one must reflect on how the system developed. Transmission began as a means of taking locally supplied generation across town. As utilities invested in larger, often shared, generation resources, the transmission system again evolved to transport energy across the state or within the region. While significant inroads have been made by many utilities and RTOs to promote regional planning, very little has been done to develop a true interstate system that provides national benefits.

Superficially, the electric system is similar to the network of highways that knit states together. As seen in Figure 1, it is a large system with thousands of miles of cables and wires. Transmission is the class of line that typically takes massive quantities of power from a generation source to a substation, where the power is then divided out into distribution lines that carry smaller quantities of energy from the substation to homes and businesses. The lines visible in Figure 1 are transmission lines from 500 kV and above, the voltage levels that constitute the kind of electricity superhighway that we will discuss in these pages.[2]

[2] These kV ratings are essentially capacity designations: the higher the number (theoretically up to 1000 kV, though not in the United States, where 765 kV represents our limit), the greater the carrying capacity of the line. Think of 230kV lines as basic 4-lane roads, 345 kV as four lane interstates, 500 and 765kV as six and eight lane superhighways.

As is evident from the gaps in Figure 1, no master plan directed the development of the North American EHV electricity grid. Since Thomas Edison first developed a light bulb with practical commercial prospects, the complex of poles, towers and wires that takes electricity to consumers emerged out of mostly uncoordinated efforts by thousands of independent businesses. The result: a loosely integrated EHV system developed to focus on local needs rather than national needs and synergies.

Figure 1: US Transmission Superhighways (Lines of 500 kV and above, with 500 kV in red and 765 kV in blue)

As demonstrated by recent history, when inadequate transmission facilities cause or exacerbate blackouts, the cost of that inadequacy is substantial. But much *more* substantial is the ongoing, everyday impact of high electricity prices in areas that are considered congested – where there is not adequate transmission to carry enough power to sustain a highly populated area, causing prices to rise.

In a perfect system, all markets would be able to receive the cheapest energy from a diverse pool of fuel sources all the time. While perfection is not achievable, it is prudent based on what we know today to rethink how the system should be planned from a national perspective. Given our desire to increase the diversity of our fuel portfolio and to ensure that we are maximizing the system's overall efficiency, we need to move away from a project-by-project approach to infrastructure development. Because not all transmission is created equally, the benefits of EHV investments need to be much more seriously considered.

Transmission: New Views on the Integration of EHV transmission to the Grid

Today, control over the development of additional interstate transmission capacity is shared among federal agencies, state regulators, RTOs, electric transmission providers, and independent developers of such projects. At the federal level, FERC has strongly supported the emergence of open access to the transmission system both for those who desire to transact energy trades through the system, and for those who want to add to it. Thanks largely to FERC's efforts, the pace of transmission construction has picked up in recent years.[3] While the pace of transmission upgrades has risen, the growth of EHV alternatives has lagged that of lower voltage upgrades.

The analysis below distinguishes the role of EHV transmission versus the role of lower voltage – local or regional – transmission. Lower voltage transmission (of less than 100 kV) is primarily dedicated to serving local needs and enhancing the delivery and support of the area's distribution systems. Voltage classes above 100 kV and less than 300 kV tend to support more sub-regional or regional needs. Voltage classes above 300 kV, depending on the area, are driven by regional and inter-regional needs. It is this infrastructure -- and more specifically the 500 kV and 765 kV parts of it -- that will serve as the foundation of an interstate transmission system.

In analyzing the benefits of EHV transmission versus lower voltage transmission, generators typically argue that transmission is a substitute for generation. Indeed, in some applications, transmission does compete with generation. For example, in New York City, where building a power plant is prohibitively costly, remote power plants connected to the city with dedicated transmission lines may well be cheaper than in-city generation, and in competitive markets they may become the preferred solution.

The real value of transmission, however, is enabling and improving competitive markets for an array of generation resources, and these benefits often outweigh the cost of specific transmission projects. In this view, transmission should not be financed by immediate and direct beneficiaries because all users of the system ultimately benefit. Instead, the bulk of its cost should be socialized.

Those who believe that transmission is an essential facilitator of climate change solutions now have a primary mission for the Grid that extends far beyond the narrow analysis of the beneficiaries of a specific project. They would argue that – so far – the EHV grid has been built with little regard for ensuring an efficient, optimal design. Given the remote locations of the nation's best

[3] See Energy Security Analysis, Inc., *Meeting U.S. Transmission Needs,* (Washington, D.C.: Edison Electric Institute, 2005), http://www.eei.org/industry_issues/energy_infrastructure/transmission/meeting_trans_needs.pdf.

wind, biomass, clean coal, and hydro resources, it is necessary to build out the EHV grid well beyond its current footprint to integrate these resources as a large portion of the nation's electricity supply in order to meet an emerging national need to reduce carbon emissions.

These are the contending views on transmission's purpose and the primary mission of the EHV grid. Under the old paradigm, new transmission pitted those who needed resources against those who had them. Under the new paradigm of a national EHV superhighway, we all need to work together to build a more perfect, electrical, union.

Closing the Gap: From Existing Transmission Policy Toward An Interstate Model

If there were agreement that grid expansion is necessary, how do we get from where we are today to practical, well-chosen transmission projects?

Well-chosen projects have to emerge from a complex dialogue about the proper allocation of transmission costs between national, regional, state and local regulators. More than a decade of power industry restructuring has seen an important evolution in federal and regional transmission cost allocation policy. This policy template, however, has gradually been overshadowed by its own deficiencies, as well as by increased concerns about climate change. In its place, both state and federal regulators have been increasingly willing to accept that the costs of certain transmission projects should be socialized.

The line of demarcation between lines shoes cost may be socialized and those which may not be will largely drive the nature of transmission solutions in a given area. In PJM, for example, lines at and above 500kV are socialized, so when a state analyzes the need for a project through its state siting process, it will evaluate not only the needs and benefits of that line but also its cost allocation treatment. If, for example, a line is proposed at 345 kV in Pennsylvania, the state will likely ask why a 500 or 765 solution was not selected since the latter's costs would have been socialized and the former's localized.

Other drivers of how to allocate transmission costs include considerations and assumptions used by the planning entity in evaluating a given project's need. For example, a five year planning horizon might lead to one solution, a 15-year horizon a different, and perhaps better solution.

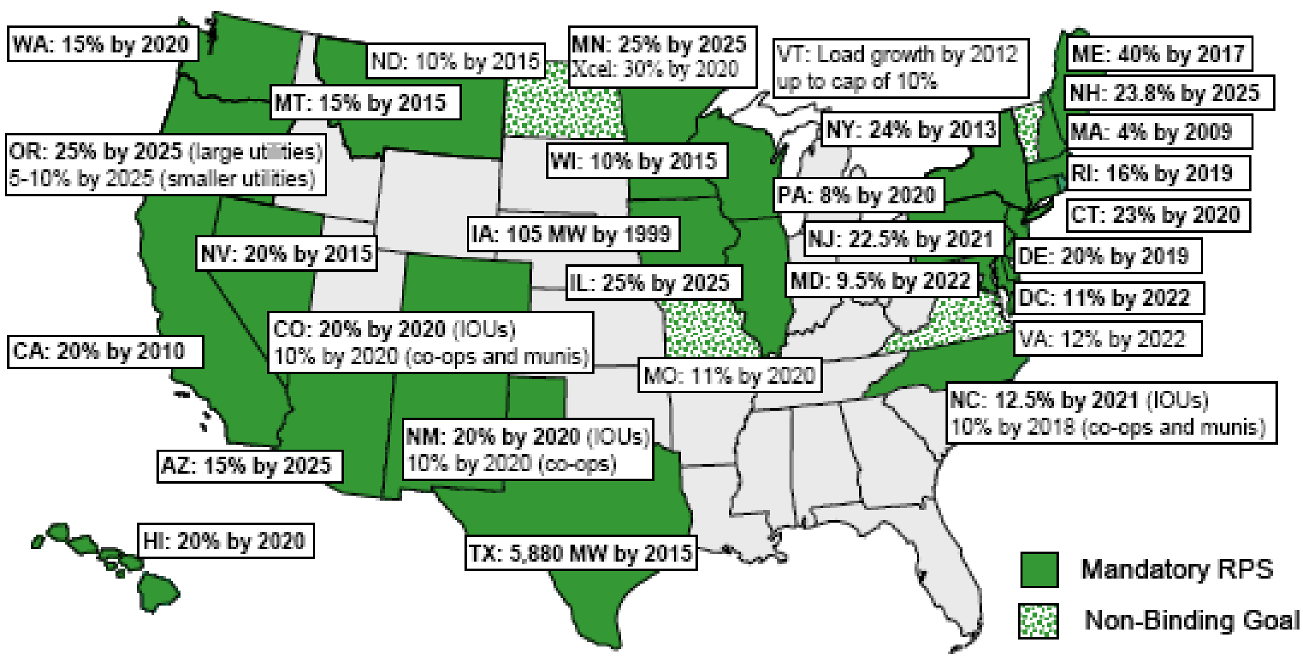
Now, environmental and portfolio diversity considerations need to be added to the analysis. Transmission projects need to be evaluated not just in terms of their need from a reliability perspective, but also from the perspective of the contribution they can make to meeting our environmental objectives, as we discuss below.

❸ The New American Transmission System

The Grid Is The Enabler Of Programs To Combat Climate Change

In the past few years, the need for the United States to take action to reduce its carbon emissions has increasingly been accepted by and integrated into the energy and environmental planning of a growing number of cities and states. Many cities have announced "green" and "renewable" programs.[4] In 1983, Iowa became the first state to implement a renewable portfolio standard (RPS) when it required state utilities to purchase 105 MW of their energy from renewable sources. Since then, more than half of the states and the District of Columbia have imposed RPS requirements and such requirements are on the legislative agendas in many other states. Figure 2 shows the states that currently have RPS regulations, and the renewable energy percentage targets of each.

Figure 2: Lawrence Berkeley National Laboratory, Renewables Portfolio Standards in the United States, April 2008, page 3.



[4] 745 organizations, including cities, for example, are part of the EPA Green Power Partners program. See http://www.epa.gov/greenpower/partners/gpp_partners2.htm.

RPS requirements differ between states in several respects, but until the federal government imposes RPS requirements, state RPS goals will remain the major driver in the accelerated development of renewable resources in the United States.[5]

In 2006, renewable energy generating capacity – including hydroelectric capacity -- accounted for 94 gigawatts (GWs), 10 percent of total electricity generation.[6] Where that number will be in 2026 depends, in large part, on what we do about transmission in the next few years. From New England to California, more states are implementing or considering policies to impose renewable portfolio standards and other regulations to reduce carbon emissions from the power sector. With these initiatives, the affected states will need to substantially increase the development of renewable energy. As a result, more forecasts show that the amount of electric energy that will be supplied by renewables should skyrocket, ***if*** the renewables can be brought to market.

The U.S. Energy Information Administration (EIA) is responsible for developing annual forecasts of how the nation will meet its electricity requirements. In its 2007 "base case" projections (which assume no major new initiatives) for 2030, the EIA envisions an increase in electricity generating capacity of 292 GW (current capacity is 1,000 GW). In this case, the EIA projects that coal-fired plants will account for 54 percent, natural gas plants 36 percent, nuclear plants 4 percent, and renewable facilities only 6 percent of that growth.[7] That 6 percent would constitute only about 18 GW of new renewable capacity[8].

[5] The differences include but are not limited to (a) the percentage of energy that load serving entities (LSEs) must provide from renewable resources, (b) the date by which that goal must be achieved,(c) resource types that qualify as "renewable", (d) limits on location of the renewable resource (procurement outside of the state or pool), and (e) the percentage of procurements that must come from a specified type of renewable energy production. Some states make a distinction between tiers or classes of renewable resources with specific percentage targets in each tier or class. In Pennsylvania, for example, the "Alternative Energy Portfolio Standards Act" allows waste coal and integrated combined coal gasification technologies to qualify as "Tier 2" alternative resources. New Jersey and Connecticut also make a distinction between types of renewable resources. In New Jersey, wind, solar, and geothermal resources are considered Class 1 resources, while resource recovery facilities and hydroelectric facilities under 30 MW and considered Class 2 renewable resources. Connecticut makes a class distinction between types of biomass that is tied to NOx emission rates. Some states, such as New Jersey, specifically exclude types of fuels: municipal solid waste, tires, and sewage sludge do not qualify as renewable in New Jersey. Other states set specific targets for certain resource types. Colorado, Nevada, and Pennsylvania have set targets for solar generation, while Minnesota requires that one percent of its renewable energy come from biomass.

[6] From the Energy Information Administration's *2007 Annual Energy Outlook*, page 153.

[7] U.S. Energy Information Administration, *Annual Energy Outlook 2007*, page 83.

[8] In the EIA base case scenario, demand for natural gas in the United States increases from 22 to 26.2 trillion cubic feet. Gas demand in the electric power sector grows from 5.8 trillion cubic feet in 2005 to a peak of 7.2 trillion cubic feet in 2020. Virtually all of the growth in domestic natural gas consumption would be supplied by LNG imports, which the EIA projects will increase from 1.4 TCF in 2005 to 4.5 TCF in 2030. Also, in these projections, the amount of carbon dioxide emitted by the U.S. energy sector increases from 5.945 billion metric tons in 2005 to 7.95 billion metric tons in 2030. (page 101). So, instead of capping or reducing carbon emissions, the official forecaster of the U.S. federal government envisions that the power sector's carbon emissions will increase by 33 percent.

An efficient EHV transmission grid will be the critical component to close this widening gap between renewables objectives and performance. Today, planning processes used by many RTOs tend to favor "a need" (based on mostly technical reliability assessments) and give market participants time to propose transmission projects to meet those needs. The result: lower voltage, less efficient solutions are chosen over EHV upgrades that would provide sustainable, efficient long-term energy solutions. Even worse from an RPS standpoint, in most regions, the "path of least resistance" for meeting electricity capacity requirements is to commission gas-fired power plants to be built as the need arises or incremental transmission investment that amounts to minimal transmission investment.

Enabling Large Scale Renewables to Play a More Prominent Role at a National Level

A useful resource like wind needs to be deployed on a massive scale in the United States. In spite of the EIA's relatively modest base case forecast for U.S. wind development, it is clear that RPS and other environmental objectives are pushing for more wind resources. According to a joint study involving AWEA, U.S. Department of Energy (DOE), and National Renewable Energy Laboratory (NREL), wind could provide up to 20 percent, or approximately 350 GW, of the nation's electricity.[9] A 2008 update of that study concluded that "a 20% Wind Scenario in 2030, while ambitious, could be feasible if the significant challenges identified in this report are overcome."[10]

Such an increase in wind capacity would represent a capital investment of hundreds of billions of dollars, investments made using largely domestic resources (from wind turbines to towers to local sites and labor). For even a small increment of this investment in wind to be made, however, transmission must be built to connect the wind energy to market. Our nation's wind resources tend to be where the people are not, so there will be no substantial wind development without EHV transmission development.

Figure 3 maps the geography of wind, according to the National Renewable Energy Laboratory, a division of the DOE. Wind development potential is rated on a scale of 1 to 7. Class 1 areas are considered to have poor development potential; Class 7 areas are considered to have superb development potential. Wind speed is the key differentiator in the cost of wind energy production. Projects located in Class 5 areas or higher are considered to be cost-competitive. The map indicates that, on a state-by-state basis, North Dakota, South Dakota, Texas, Kansas, and Montana are the five highest ranked states in terms of energy production from wind. Within states like California and Maine, there are also excellent wind opportunities. In all cases, a substantial amount of

[9] See U.S. Department of Energy, "Securing Our Greatest Homeland Energy Resource," July 2006, http://www1.eere.energy.gov/office_eere/pdfs/windhydro_fs.pdf.

[10] U.S. Department of Energy, 20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply, May 2008, page 1.

transmission development will be required to bring the energy to market. The question is whether transmission development will be sufficiently well coordinated to meet environmental targets.

Figure 3: Composite Wind Resource Map

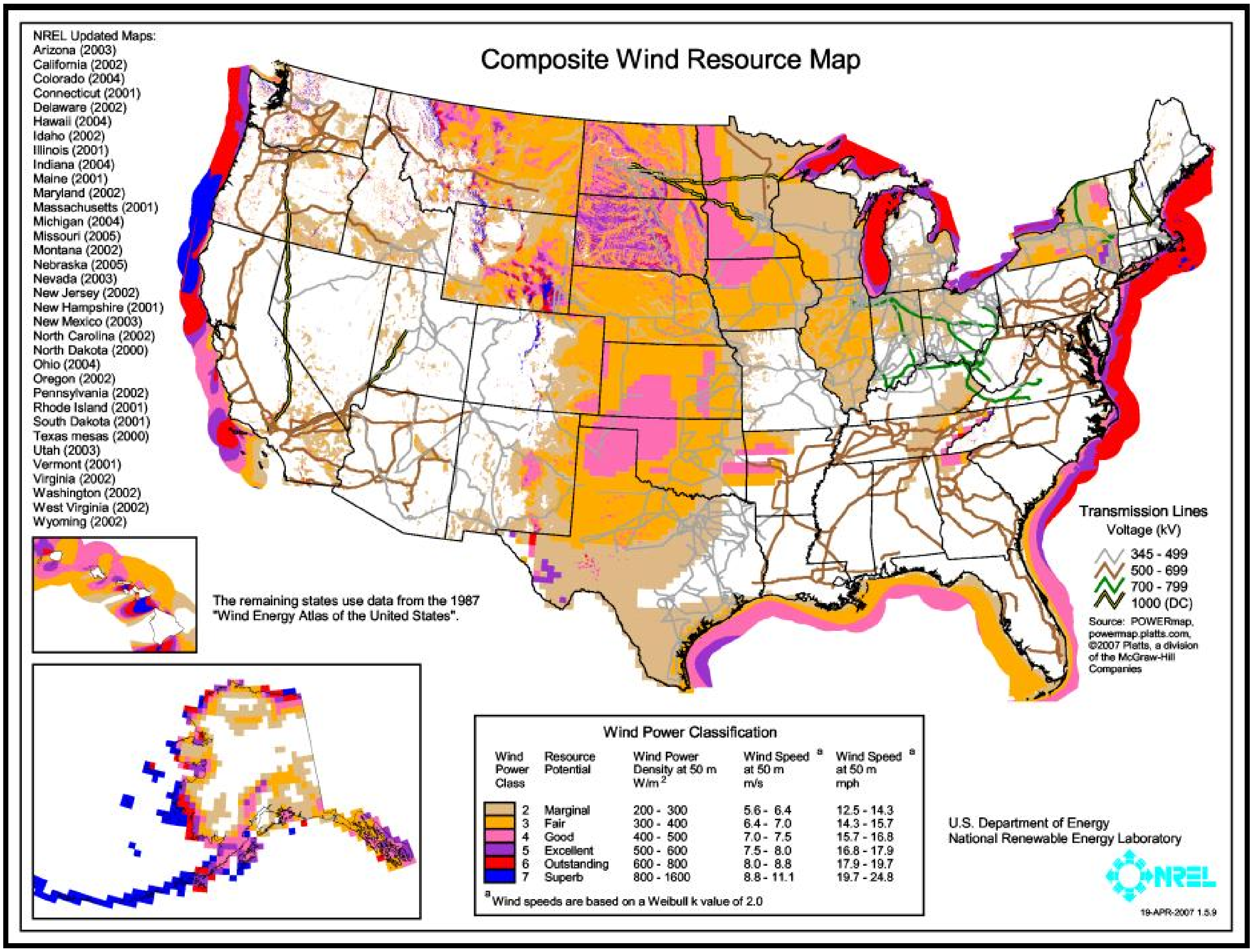
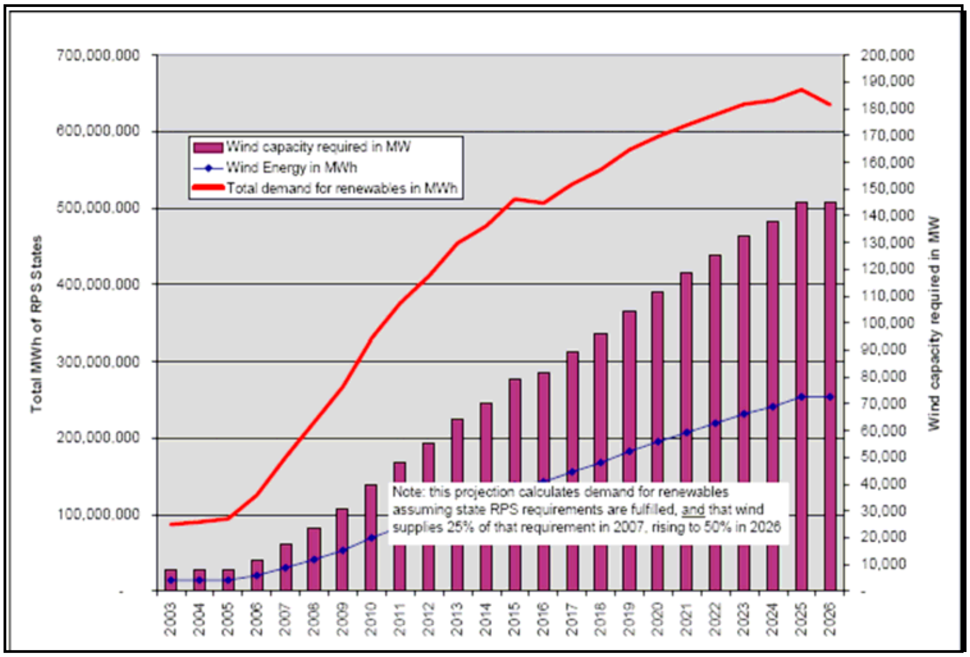


Figure 4 presents an analysis of the effects of state-level RPS objectives, subject to assumptions about the percentage of renewable energy to be provided by wind. In 2006, wind constituted 10 GW of the 18 GW of non-hydro renewable capacity. The U.S. electric power industry generated 94 million MWhs of renewable energy in 2005, of which wind generated approximately 15 percent. Figure 4 indicates the increase in desired generation of renewables as a result of compliance with RPS regulations, and desired wind generation if the fraction of wind increases from 15 percent of total renewables to 50 percent. In a nutshell, this calculation shows that wind generation capacity would increase from 10 GW today to 140 GW in 2026. While this is a simplification – in fact, biomass, geothermal, solar and other renewables make a very substantial contribution – it does indicate the extremely large requirement RPS objectives impose on the country's most abundant sustainable renewable resource: wind.

Figure 4: One Scenario of How Much Wind Generating Capacity Would Be Required to Meet RPS Requirements



In many parts of the United States, however, conflicting state and ISO regulations are currently impeding transmission development aimed at bringing renewables to market. Development rules worked out with great difficulty over the past decade – designed primarily to maintain reliability and promote competitive wholesale markets – often do not help to develop EHV transmission for renewables.

It is in the single-state ISOs, that, to date, we have seen the most progressive transmission development policies specifically aimed at bringing large quantities of renewables to market. For example, in the Tehachapi Mountains of Southern California, there is an estimated 5,000 MW of potential wind generating capacity. Situated between the Mohave Desert and the Central Valley, the area is a potential gold mine for wind developers who would supply California the renewable energy needed to meet a state requirement. The requirement stipulates that 20 percent of customers' energy come from renewable resources by 2010. The problem: wind is miles from where the energy it would generate is needed, and the only transmission lines in the region are 69 kV. To gain access to the resources, the California Public Utilities Commission (CPUC), the agency behind the 20 percent renewable requirement, directed Southern California Edison (SCE) to create a transmission configuration that would allow all potential wind energy in the region to get to market. The Tehachapi Mountains are in SCE's control area.

In April 2007, after years of effort by California regulators, the ISO and utilities, FERC approved CAISO's proposal to establish a new class of transmission facilities -- associated with large-scale renewable energy developments in "locationally constrained" resource areas. In effect, FERC agreed to allow ratepayers to fund transmission lines that do not meet traditional reliability or economic tests to achieve a different policy goal of encouraging development of renewable resources. While the upfront funding from ratepayers ultimately would be reimbursed as generators connect to the trunk line, this funding would occur regardless of whether enough generators eventually connect – a utility ratemaking version of "if you build it (and pay for it) they will come."

FERC's order approving the renewable trunk line concept explicitly invites proposals with similar objectives from other entities and regions.[11]

In Texas, impetus for a very large investment in wind capacity comes from the State's infrastructure-friendly planning and transmission cost allocation policies. However, Texas plans to go further. In enacting increases to the state's RPS requirements, the Texas legislature required the Public Utility Commission of Texas (PUCT) to designate Competitive Renewable Energy Zones (CREZ) areas in Texas with high-quality renewable resources that require transmission to allow access to load centers. The law further authorized the PUCT to order utilities to construct transmission between the CREZ and load centers to meet the Texas RPS requirements. Importantly, under the law and PUCT regulations, transmission proposed for CREZ automatically meets 'used and useful' and prudence ratemaking criteria.

The Texas policies also attracted new entrants to the transmission development business. In February 2007, AEP and MidAmerican formed a joint venture (Electric Transmission Texas LLC) to build more than 1,000 miles of CREZ-related transmission. Later in May, FPL Energy's subsidiary,

Case Study PJM:

One of the critical issues facing the PJM Interconnection – the largest power market in the United Sates -- is the Mid-Atlantic States' growing dependence on electricity fired by natural gas. The issue for PJM East is that the price of natural gas – on an annual average basis – has averaged and is expected in the future to average much more than $7/MMBTU, while the price of the coal widely used in the Midwest (a.k.a. PJM West) is between $2 and $3/MMBTU.

Historically, even though coal plants have had a higher capital cost than gas-fired plants, the low energy price that resulted from burning $2.00/MMBTU coal at a 10,000 Btu/kWh heat rate made the plants an economical part of the baseload. For example, the American Electric Power market area (in PJM West) has almost 35,000 MW of generation, more than 60 percent of which is fired by coal. The Public Service Electric and Gas market area (in the New Jersey part of PJM East) has 13,000 MW of capacity, more than 50 percent of which is fired by natural gas. In the New York metro area, the issue is even starker. Because it is so difficult to build new generation in the metro area, it is still home to a substantial number of oil plants that are the least efficient at producing electricity, with a commensurately disastrous effect on New York City's electricity prices.

The effect of these differences in the generation portfolios has been very apparent in energy prices. From January 2005 to January 2007, the price of energy in the AEP zone

continued on next page…

[11] See Federal Energy Regulatory Commission, "Order Granting Petition for Declaratory Order, Docket EL07-33, 119 FERC ¶ 61,061.

Lone Star Transmission LLC, filed an application with the PUCT to construct, own and operate transmission facilities in Texas, including the proposed DFW Express, a 180 to 200 mile HVDC line from CREZs in West Texas to the Dallas/Fort Worth area. As in the California renewable trunk line mechanism, the Texas CREZ mechanism provides an explicit inclusion of criteria other than reliability and economics into the transmission planning process. The effort reflects state initiatives that despite best intentions remains focused on moving power within a state, rather than within broad geographic regions on a national scale.

In conclusion, California and Texas appear to be in the forefront of jurisdictions where Public Utility Commissions and ISOs have accepted the principle that large-scale renewable development is impossible without large-scale EHV transmission development. These single-state markets have been dedicated both to restructuring the electricity business to bring competition to the wholesale sector, and to embracing the reality that renewables require transmission. While there have traditionally been some cost-allocation disputes within these states, and there will certainly still be challenges in siting specific portions of transmission lines, the decision by the public utility commissions to socialize costs of major transmission lines to all state ratepayers appears to have been politically acceptable.

Case Study PJM continued…

averaged around $40/MWh, in the PSEG zone around $60/MWh, and in New York around $80/MWh. Given that the PSEG and New York City zonal annual loads are approximately 50 million MWh, the $20/MWh differences in energy prices between the neighboring zones amounts to a $1 billion per year premium, paid by the ratepayers in the higher-priced zone, year after year. If we compare New York City with AEP, the differences in the rates shouldered by electricity customers is $2 billion per year.

The combined upstate New Jersey, New York City, Long Island and Southwest Connecticut (or the "NY-NJ-CT Metro Area") is the center of one of the most dynamic regional economies in the world – and at $900 billion also one of the largest in the world – with boundaries that extend well beyond New York City's borders. For that very reason, there is enormous traffic of goods and people that flows freely between New Jersey, New York and Connecticut. Commerce spills over state borders to the benefit of all. One of the few things that does not flow freely, however, is electricity. The legacy of 100 years of electricity industry development is that there is a very limited amount of electric transmission into the Metro Area. As a result, the Metro Area is extremely dependent on power plants that run on imported oil or increasingly scarce and expensive (and in the future, also imported liquefied) natural gas.

Transmission to Promote Reliability and Diversity of Supply

Access to renewables is one component of a larger policy interest: maintaining a diverse portfolio of electricity generating sources. That goal is innately sensible. Nevertheless, it is surprising how rules and regulations of electric markets have had the unintended consequence of discouraging diversity in generating portfolios. The reason is simple. Under rules aimed at providing competition in the wholesale power markets, most investors would rather build plants that recoup the investment in a few years than facilities (including transmission) that take decades to recoup investment costs. Our preoccupation with developing competitive power markets within confined regions, in other words, has not created a fertile climate for long-range, strategic investments in either large wind farms or in baseload coal and nuclear plants, or large EHV transmission projects that can serve as platforms for promoting diversity in generating portfolios.

EHV transmission is unique in terms of the benefits it brings to the system as a whole. Simply put, higher voltages are capable of moving greater amount of power through the system in a more efficient manner than their lower voltage counterparts. Making the analogy that is often made in the industry today, the EHV system provides the functional equivalent of an interstate highway system, allowing for more efficient transport of energy. While on a highway system we talk about savings in terms of time and gasoline consumption, on an interstate transmission system we talk in terms of the need for less infrastructure, line loss savings and reduction of CO^2 emissions.

In a recently released study by AEP and ITC where the two companies considered the feasibility of extending the 765 kV system in PJM to Midwest ISO into Michigan, the companies estimated that the annual loss savings associated with this project would be 250 MW. Translating these savings to dollars, the annual savings in losses along would be over $40 million, along with significant CO^2 reductions. Consider the economic benefits if such a system were built on a national scale.

❹ Closing Transmission Gaps

> *"We need a true nationwide transmission version of our interstate highway system; a grid of extra-high voltage backbone transmission lines reaching out to remote resources and overlaying, reinforcing, and tying together the existing grid in each interconnection to an extent never before seen,"*
>
> — FERC Commissioner Suedeen Kelly[12]

If we are to accomplish America's new energy missions -- to combat climate change while containing dependence on insecure imported natural gas – we need, in Commissioner Kelly's words "a true nationwide version of our interstate highway system." For most of the United States, and from the perspective of maximizing the potential contributions of renewable and low carbon energy sources, the most efficient structure would be an extra high voltage system that resembles the conceptual proposal put forward by the AWEA and AEP. This proposal envisions a 765 kV system that would extend from PJM (in the east) into the Plains and Rocky Mountain states, Texas and the Southwest, the Northwest and California (see figure 5).[13]

The AWEA/AEP analysis indicates that this system could "enable significantly greater wind energy penetration levels by providing an additional 200-400 GW of bulk transmission capacity. The total capital investment is estimated at approximately $60 billion (2007 dollars). While it is by no means the total solution, this initiative illustrates the opportunities that exist, and what might be possible with adequate cooperation, collaboration, and coordination – the '3Cs'."[14] It is also worth noting that such a system not only harvests renewable resources, it also significantly reduces power flows on the underlying system, much the same way a highway would lighten the load on the routes that existed before the development of the highway system. The result is the development of a truly efficient bulk power delivery system.

Advancing Policy To Pave a National Solution

Today's infrastructure needs to become innovative to capture the vast renewable resources that the country has available, which requires leadership and strong policy initiatives. At the federal level, through legislative and regulatory changes, the Congress and FERC can do much more to empower EHV transmission. The Department of Energy potentially can do more, but in the absence of a federal commitment to specific energy policy goals, its transmission mandate is restricted to dealing with reliability – which the existing rules adequately protect – and excessive

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[12] See Federal Energy Regulatory Commission, "Order On Rehearing And Compliance Filing," Docket ER06-18-007 and 008, July 23, 2007.

[13] See AWEA web site (http://www.awea.org/) for "Interstate Transmission Vision for Wind Integration."

[14] "Interstate Transmission Vision for Wind Integration," p. 2.

congestion – a concept that is innately flawed (as it deals only with energy and not with capacity pricing) and for which there is little enthusiasm among state regulators.

As we look for ways to close the gap between the limitations of the existing transmission system and the one that it can become through EHV development at a national level, we can enable targeted development that will result in the timely development of a national transmission superhighway. As this happens, EHV transmission will emerge as a powerful catalyst to a new energy outlook, one in which we not only mitigate the energy security problems we otherwise will exacerbate, but also meet our critical environmental objectives.

Figure 5: The Conceptual EHV Proposal of AEP and AWEA