

Transmission Planning for 100% Clean Electricity

A FACT SHEET FROM ESIG

The widespread adoption of clean energy goals by many U.S. states and businesses is underway, spurred by accelerating commitments to combat climate change and the growing cost-competitiveness of renewable resources. In January 2021, the Biden administration adopted ambitious decarbonization plans for 100 percent clean electricity by 2035 and net-zero emissions across the economy by 2050. Expanded transmission infrastructure is crucial to enable rapid, affordable decarbonization.

Achieving Reduced Costs and Increased Reliability of a Decarbonized Power System

Without strategic, targeted investment in a new transmission infrastructure—a macro grid—the continued development of wind and solar will likely be slower and more expensive, and may be insufficient to meet ambitious decarbonization goals.

RENEWABLE GENERATION IS LOCATED FAR FROM URBAN CENTERS

The increased electrification of the U.S. economy as decarbonization proceeds will substantially increase electricity demand, with many studies showing that U.S. generating capacity will need to double. However, many of the richest wind and solar resources are located far from urban load centers.

TODAY'S TRANSMISSION PLANNING IS UNCOORDINATED

No single entity in the United States has the responsibility or authority to direct the building of transmission infrastructure that serves national policy goals, determine where new generation will be constructed, or allocate the costs of transmission expansion. Studies show that when resource and transmission planning is optimized on a national scale, the costs of decarbonizing the electricity system are lower, as power can be shared between regions with different patterns of electricity generation and customer loads.

EXPANDED TRANSMISSION INFRASTRUCTURE WILL REDUCE COSTS AND INCREASE RELIABILITY

Interregional transmission will dramatically lower the cost of achieving 100 percent clean electricity by reducing the amount of wind, solar, storage that must be built. The construction of a U.S. macro grid is estimated to save \$1 trillion in reaching the nation's decarbonization goals.

The sharing of electricity between regions will also increase power system reliability. Geographical diversity already contributes to smoothing the output of variable renewable energy across daily, seasonal, and annual time scales. For example, transmission has helped to balance seasonal needs by connecting northern winter-peaking loads and generation with southern summer-peaking loads and generation for decades. A nationwide transmission system will ramp up regions' ability to give and take depending on their capacity

and their needs. It will also allow grid owners and operators to optimize high-quality renewable resources without overbuilding or building in areas with mediocre wind and solar resources.

Without the addition of significant multi-regional transmission, system planners will need to overbuild local renewable resources in order to manage weather patterns and meet demand, resulting in extreme curtailment of local wind and solar resources during non-peak periods and a high price tag.

Design of a National Macro Grid

ESIG developed a conceptual design for a national macro grid that will allow the sharing of renewable energy between regions, making the decarbonization of the electricity system more rapid, reliable, and affordable (Figure 1). ESIG has the following three recommendations.

UNDERTAKE NATIONAL TRANSMISSION PLANNING

A national transmission planning authority is needed to maintain the broad perspective necessary to serve the needs of all regions of the United States for reliable, affordable, and rapid decarbonization. This authority will develop the initial set of conceptual and engineering power system analyses in consultation with a broad suite of stakeholders and experts including regional, state, local, and utility transmission planners; grid operators; generators; energy service providers; and nongovernmental organizations.

Longer term, the national transmission planning authority will facilitate the construction of successive stages of the macro grid and play an ongoing role of adapting and updating macro grid plans for evolving technological, economic, and policy changes.

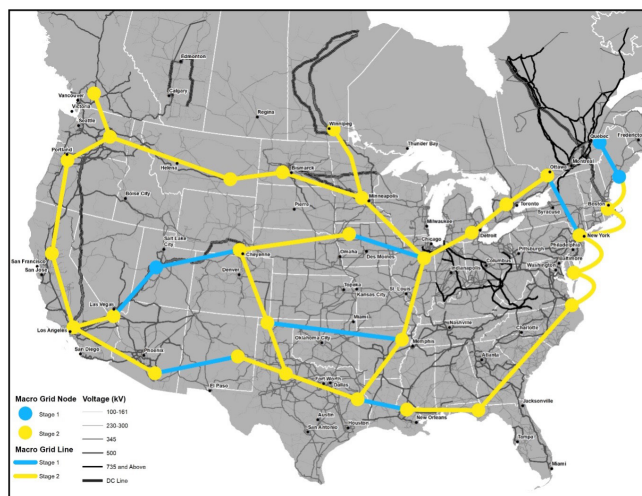


Figure 1. ESIG's conceptual design for a U.S. macro grid superimposed on the existing electricity transmission system.

IDENTIFY RENEWABLE ENERGY ZONES

The second component of the ESIG macro grid concept is the identification of renewable energy zones that can support major levels of wind or solar development concentrated in favorable locations with the availability of rapid, large-scale transmission facilities and interconnection capacity (Figure 2). Proactive transmission planning to these zones, with appropriate cost allocation and cost recovery mechanisms, is key to unlocking massive levels of renewable generation.

Some wind and solar has already been developed in many of these high-capability regions, but it must increase by at least a factor of five, scaling from 0.2 terawatt today to at least 1 terawatt to meet even the 2035 clean electricity goals.

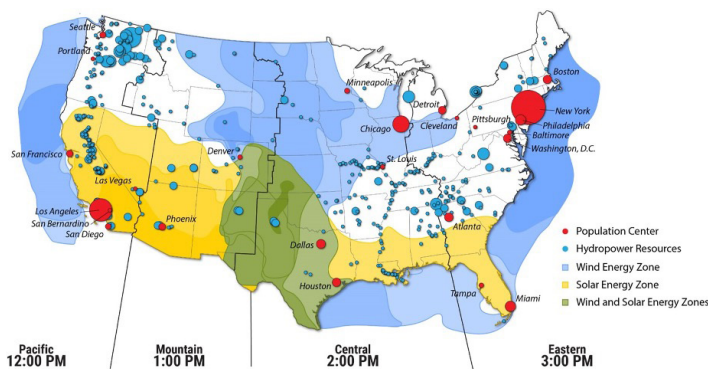


Figure 2. Renewable energy zones that must be connected by a nationwide transmission system to support a rapid, reliable, and affordable transition to a clean energy economy.

DESIGN AND CONSTRUCT THE MACRO GRID

The third component of the ESIG macro grid concept designs and begins construction of a network of multi-regional high-voltage transmission that unites the country's power systems and allows the sharing of renewable resources among regions of the United States. This endeavor will require long-term commitment on the part of national and state policymakers, planners, regulators, transmission owners, entities that provide financing, and others.

The U.S. macro grid will:

- **Connect regions** with diverse load patterns and wind and solar characteristics, and connect renewable energy zones to urban centers.
- **Have the smallest possible cost and footprint**, for example, by maximizing the use of existing transmission, highway, and railway rights-of-way.
- **Take advantage of today's surplus transmission capability**, thereby reducing the need to construct entirely new substation facilities. This integration of the macro grid into existing and planned transmission systems serving regional needs will require unprecedented coordination—political as well as technological.
- **Be both tightly integrated and able to separate safely** when necessary to protect regions from a widespread cascading collapse in the event of an attack or operational failure.

Next Steps

To design and build large-scale transmission to interconnect regions and resources will take time and require agreement and support from many groups across the country. But immediate action is imperative if the United States is to meet its decarbonization goals. The next steps are to:

- **Articulate the decarbonization vision and convene the major players.** The Biden administration should quickly convene governors, state public utility commissions, the Federal Energy Regulatory Commission (FERC), the North American Electric Reliability Corporation (NERC), the Department of Energy, independent system operators and regional transmission operators, municipal utilities, cooperatives, investor-owned utilities, and many sectors of customers and stakeholders to rise to this challenge.
- **Designate an authority.** A national transmission planning authority must be designated and endowed with the responsibility to conduct national-level planning in coordination with regional planning authorities. Consideration should be given to whether existing authorities such as the Department of Energy's National Electric Transmission Congestion Study could support the needs of a national transmission planning authority or whether new planning authorities are necessary.
- **Leverage national capabilities and industry expertise.** The capabilities of the Department of Energy, national laboratories, power administrations, the Federal Energy Regulatory Commission, and the Department of the Interior should be coordinated to facilitate the industry's design and construction of a national macro grid.
- **Provide seed funding for new transmission planning and financing.** Just as in the 1950s, federal funding supported the planning and construction of the national highway system that transformed the U.S. transportation system, federal leadership and funding is critical to kick off the new generation of power system planning and investment that will harness American ingenuity and realize our goals for a clean energy, carbon-free future.

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