National Transmission Planning Study

The Biden Administration has set a goal to achieve 100% carbon free electricity nationally by 2035. The Department of Energy's Office of Electricity is undertaking a national transmission planning study to better inform the administration on the characteristics the future power grid would likely need to meet this goal. Accomplishing this goal will require a major expansion of the power grid, the plans for which are ultimately determined by state and regional stakeholders. This study is therefore intended to complement, and not replace, existing regional transmission planning processes. This effort will only be successful with the involvement and support of state and regional planners; planning for carbon-free electricity is challenging and ambitious, and we are inviting interested parties to share their expertise.

The Office of Electricity has engaged the National Renewable Energy Laboratory (NREL) and the Pacific Northwest National Laboratory (PNNL) to perform the transmission expansion planning study using their modeling expertise. The laboratories will work with stakeholders to help identify viable future grid realization pathways to a large-scale transmission system buildout that would accomplish clean energy goals.

As a first step in this effort, stakeholders—including transmission owners, operators, regional transmission planning entities, regional reliability councils—will be engaged to help define new scenarios to be analyzed to reach grid decarbonization goals cost effectively and under new high-stress conditions. Scenario characteristics to be considered are transmission topology (national macrogrid, interconnection-wide expansion, and intra-balancing area options), transmission technology and cost, distribution demand drivers (electrification, distributed energy resources, etc.), and generation drivers (renewable siting constraints, storage costs, thermal fleet assumptions, etc.).

Transmission Planning Methods

Grid investment decisions need to consider a range of potential scenarios relating to technology adoption, electrification of loads and transportation, availability of alternative fuels, etc. The likelihood of any given scenario materializing will be driven by policy and regulatory changes, technology innovation, extreme weather, and climate change scenarios, among other things. In light of these uncertainties and the cost associated with transmission investments, it is important to ensure that viable least-regret investment decisions are identified as part of the planning process. These least-regret investments, regardless of the variables that may impact the future system and infrastructure, can help to set a baseline for infrastructure progress. The identification of least-regret investment options needs to include or be aware of the following elements:

1. Present and future transmission congestion issues already identified by regional stakeholders
2. Existing transmission buildout plans
3. Generation in the interconnection queue
4. Generation planned to be retired over the years
5. Major load regions within interconnections, considering existing load, load growth and new electrification projects, DER growth projections
6. Regions of high renewable potential in areas of existing transmission pathways and in more remote regions
7. Classification of offshore resource potential and transmission needed to bring resources onshore
8. Analyses that match high-demand regions to high-resource regions and estimate transmission needs

9. Existing transmission contracts to accurately represent available capacity in the near and longer terms.

Analyses to identify these investments will include an evaluation of energy, capacity, and reserve needs, ensuring investments maintain or improve existing reliability levels. In addition, system resilience must be considered, particularly an analysis of extreme weather and contingency situations associated with proposed and existing transmission and generation resources and weather-driven load. It is imperative to work with stakeholders to refine the assessments of transmission needs and potential for renewable resources to be developed in identified regions.

Two different but related approaches will be taken to consider least-regret investments and a combination of both approaches may shed important insights and identify more optimal solutions. These two approaches are a top-down approach from a large-scale, country-wide viewpoint and a bottom-up approach that takes a local viewpoint of the same question.

The top-down approach would consider load, generation resources, and existing transmission in aggregate at the country or interconnection scale. It would consider load requirements and generation and transmission needs to meet those requirements in a broad, regional sense, being less specific to granular local details. It would likely be limited to high-voltage, large-throughput transmission pathways. This would present a high-level transmission needs analysis.

The bottom-up assessment would evaluate load, generation resources, and existing transmission locally at each region level (at a to-be-determined granularity, e.g., balancing authority level, state level, etc.), seeking to match load with resource and transmission buildout at this level while also considering imports and exports from nearby regions. This effort will rely heavily on input from regional stakeholders. This would then be rolled up across all regions in an interconnection to represent a country-scale picture.

In addition to the aforementioned measures and methods to derive least-regret investment plans, efforts should be made to consider all available tools and technologies to maximize available transmission capacity. Where possible, regulatory and policy changes should be instituted to encourage deployment of such tools and technologies. Some examples include: 1) dynamic line ratings; 2) line and voltage upgrades; 3) modular power flow control technologies, etc. Further, existing contractual limitations should be considered, some of which may artificially limit available transmission capacity. Regulatory changes should permit contracted capacity to be available when needed by those who contract for it, but also available for broader use when not otherwise required.

Next Steps

The DOE Office of Electricity requests that all transmission planning stakeholders who wish to participate in this study **please identify one point of contact for the study** and forward the relevant contact information to DOE staff. The anticipated time commitment for each point of contact will be 1-8 hours a month, depending on the desired level of participation. Assigned DOE staff for this project are Dr. Adria Brooks (adria.brooks@hq.doe.gov) and Mr. Hamody Hindi (hamody.hindi@hq.doe.gov).