



WHITE PAPER

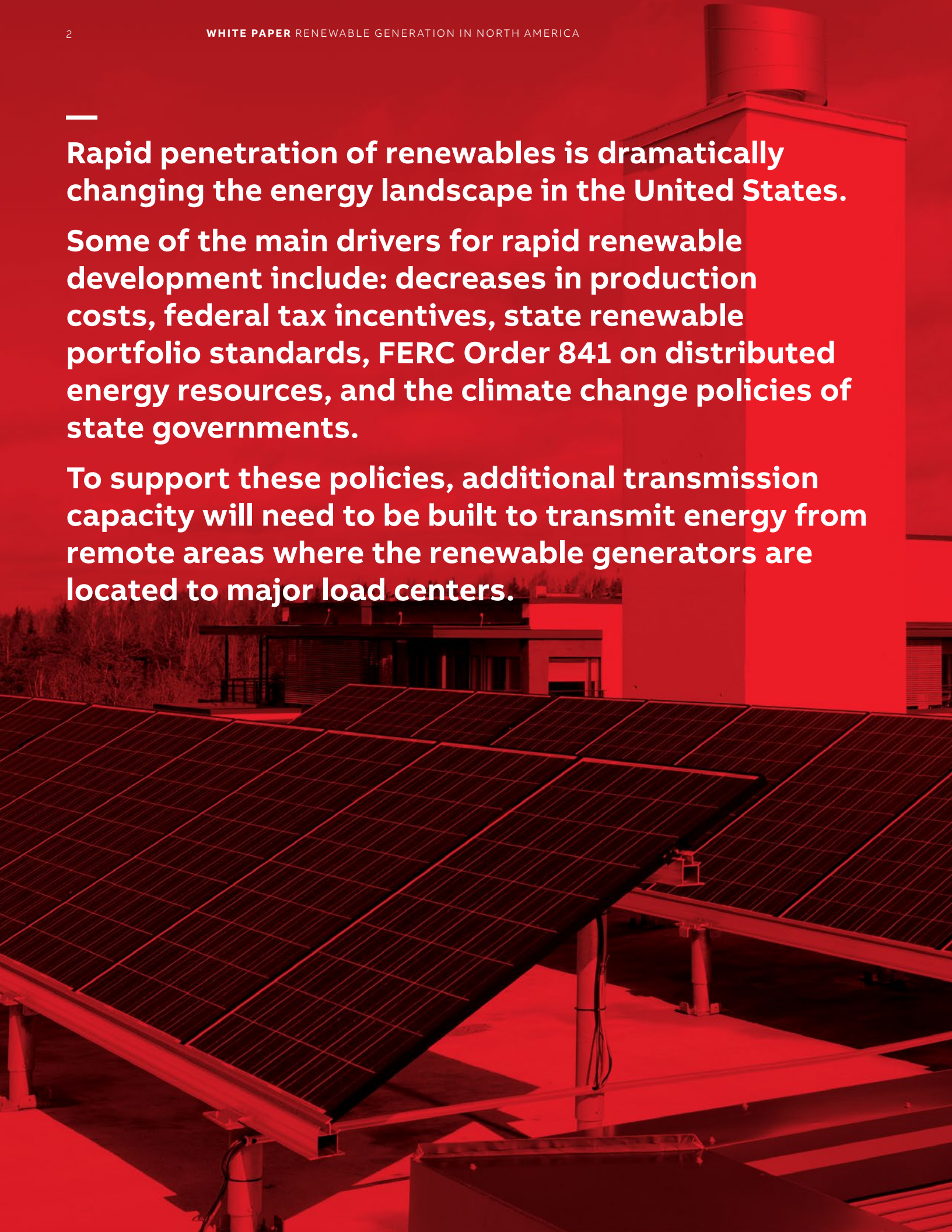
Renewable generation in North America

The importance of long-term planning
in short-term power operations

Rapid penetration of renewables is dramatically changing the energy landscape in the United States.

Some of the main drivers for rapid renewable development include: decreases in production costs, federal tax incentives, state renewable portfolio standards, FERC Order 841 on distributed energy resources, and the climate change policies of state governments.

To support these policies, additional transmission capacity will need to be built to transmit energy from remote areas where the renewable generators are located to major load centers.



The rapid growth of renewable generation and the significance of long-term planning

As illustrated in Figure 1, the next decade has a large number of proposed projects to modernize the North American transmission infrastructure. Almost 900 different lines and around 37,000 miles of infrastructure projects are proposed in North America in this time period. A past report from the Edison Electric Institute indicates that around \$48 billion worth of transmission investments are expected between 2015 and 2025.¹ Of this total, projects supporting the integration of renewable resources represent approximately \$22 billion (46%). This endeavor will require careful planning and coordination of new power generation and transmission projects, as the scope and construction span of each project can be quite different and complex.



Figure 1: Proposed transmission infrastructure projects in the next decade.²

¹ Edison Electric Institute (2015, March). "Transmission projects: At a glance." Retrieved from <http://www.eei.org/issuesandpolicy/transmission/pages/transmissionprojectsat.aspx>
² ABB Ability™ Velocity Suite (2019, January).

The timing gap between generation and transmission investments

Location and timing are two critical elements of transmission and generation investments. Rapid growth in renewable capacity is not always accompanied with rapid transmission expansions. For example, a significant overbuild of renewables before the completion of transmission lines occurred between 2007 and 2011 in West Texas. Rapid growth in solar farms and continued wind farm constructions in recent years may potentially create a similar situation in 2019.

Figure 2 illustrates the total wind generation capacity in West Texas and total transmission capacity from West Texas to other areas between 2002 and 2018. The figure shows that wind generation capacity in West Texas increased by around 6,400 MW between 2007 and 2011, while there was no significant transmission capacity addition in the same period. Therefore, transmission capacity between West Texas and major load centers in Texas was notably insufficient to bring all the electricity to these areas.

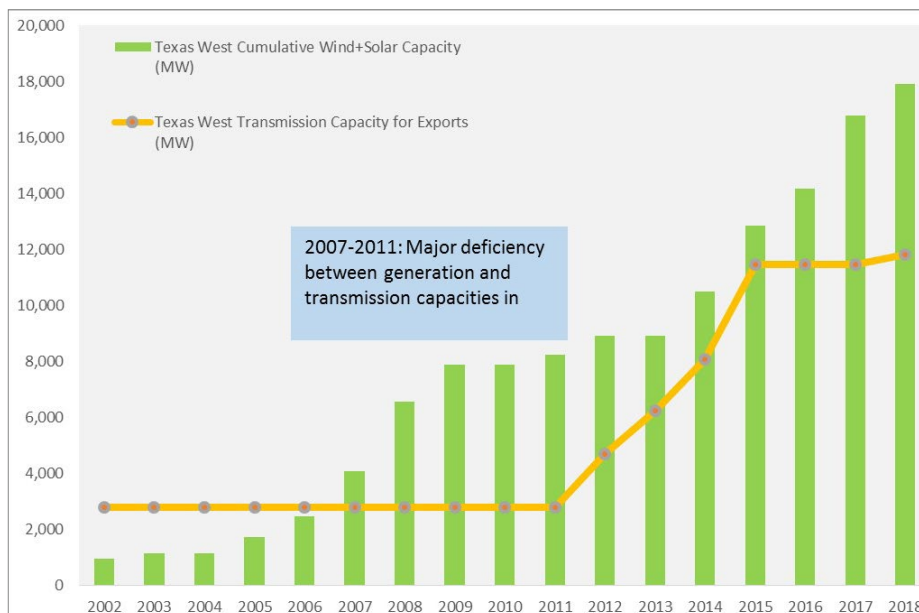


Figure 2: Total wind generation and transmission export capacity in West Texas³

This transmission capacity discrepancy in the 2007-2011 period caused real-time operational difficulties, congestion and reliability issues in the Electric Reliability Council of Texas (ERCOT) footprint. As shown in Figure 3, ERCOT had to occasionally curtail wind generation to keep the transmission network within its physical limits in 2011 and 2012. These curtailments, demand-supply imbalances in the West and negative market bids by the wind generators occasionally produced negative real-time prices in these years.

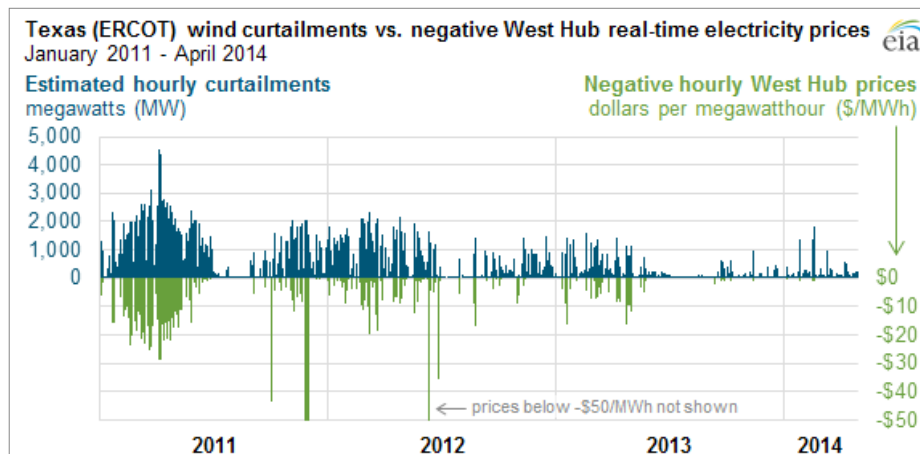


Figure 3: Wind generation curtailments and negative real-time electricity prices in ERCOT West hub⁴

Figure 3 also shows that wind generation curtailments and negative real-time prices in ERCOT have steadily dropped after 2012. This was because over 3,500 miles of transmission lines, representing 168 projects, had been completed between 2008 and 2013 (mostly in 2012 and 2013) thanks to the Texas Public Utility Commission (PUC) Competitive Renewable Energy Zones program. Major transmission capacity additions took place in 2014 and 2015, which further helped minimize the congestion issues.

⁴ U.S. Energy Information Administration (2014, June 24). "Fewer wind curtailments and negative power prices seen in Texas after major grid expansion." Retrieved from <http://www.eia.gov/todayinenergy/detail.cfm?id=16831>

The fundamental issues

Can we close this timing gap completely? The short answer is no, but regulators can better coordinate the proposed generation and transmission investments to minimize the timing gap. The fundamental issue results from the deregulation of the power industry, where transmission and generation owners can be completely different companies. Coordination between generation and transmission projects is never perfect, because these projects have different owners, scopes, capital structures and construction durations. In addition, these projects are regulated by different state and local entities and have to go through various permitting procedures.

Efforts to better coordinate the proposed projects are hindered by the differences in the scope of regulatory authorities of PUCs and independent system operators (ISOs), as well as other regulatory entities. The regulatory scope differences can often lead to the use of different data and methodologies in long-term regional planning studies. One can argue that PUCs and ISOs already cooperate in their long-term planning efforts fairly well; however, given the rapid growth of renewables, PUCs and ISOs will need to cooperate seamlessly to minimize the potential negative impacts on the power grid. This can be simpler in a state like Texas where the ISO serves only one state; however, political factors make it more complicated in other ISO footprints where several states are under the umbrella of one ISO.

Improved IT structure to increase synergy between regulatory entities

Regulatory entities can create more coordinated “joint task forces” and utilize a common database as well as use the same software solution in long-term planning studies. Seamless cooperation between regulatory entities may sound too idealistic, but it is possible. The era of big data and cloud services is here; examples include Microsoft® Azure®, which can provide rapid and secure access to a common database, and hosted software solutions such as ABB’s integrated energy solution platform, e7. This will immensely improve the cooperation and synergy between the regulatory entities. Such improvements in IT structure are likely to shorten the bureaucratic process for proposed investment approvals.

The role of planning software solutions

As mentioned above, using common planning software solutions can improve the communication and synergy between regulators overseeing the projects. Choosing the right software solution is one of the critical components of the long-term resource adequacy and transmission studies. [ABB Ability™ Capacity Expansion](#) software can produce multi-year horizon resource plans to meet long-term resource reliability requirements. These generation plans can then be integrated into [ABB Ability PROMOD®](#), a solution that incorporates extensive details in transmission grid topology and constraints, and creates economic transmission plans.

A green and bright future

There is a clear trend in the power industry: There will be significantly more renewable capacity coming online in the next decade. Better cooperation between regulatory entities and more efficient long-term plans are needed to coordinate future generation and transmission investments. This will help ensure successful integration of renewables to the power grid while increasing real-time reliability of the grid and economic efficiency of generation and transmission investments. Software solutions and cloud services will play a key role in this integration process.



abb.com/enterprise-software
info.pges@abb.com

About the authors

Erdal Kara

Erdal provides technical sales support for ABB's Capacity Expansion, Portfolio Optimization and PROMOD® software solutions. He has detailed knowledge of the CAISO tariff and FERC regulations and expertise in energy market analysis, forecasting, economic modeling and power plant valuation.

Carlos A. Romero

Carlos is responsible for product positioning, business development and the overall growth strategy for ABB's EPM product lines. He has over 20 years of experience in the design and implementation of regulatory frameworks, business strategies and solutions for generation management, smart grid commercial operations, portfolio optimization, hydro-thermal scheduling, bidding strategies and asset-centric trading operations.