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# HOW UTILITIES CAN PARTICIPATE IN THE "GREEN FUTURE"

According to the U.S. Department of Energy (DOE) and numerous other governmental and private organizations and agencies, the "grid will continue to go green," and DER (distributed energy resources) will play an ever-increasing role in this journey.

An August 2022 report by DOE's National Renewable Energy Laboratory (NREL) looked at the future of the "green grid" and how it may unfold. In specific, the report focused on the goal of completely decarbonizing the electric grid by 2035.

The report examined the types of clean energy technologies and the scale and pace of deployment needed to achieve 100 percent clean electricity, or a net-zero power grid, in the United States by 2035. **Overall, NREL identified multiple pathways to 100 percent clean electricity by 2035 that would produce significant benefits**, but the exact technology mix and costs will be determined by research and development, manufacturing, and infrastructure investment decisions over the next decade.

**"There is no one single solution to transitioning the power sector to renewable and clean energy technologies," said Paul Denholm, principal investigator and lead author of the study. "There are several key challenges that we still need to understand and will need to be addressed over the next decade to enable the speed and scale of deployment necessary to achieve the 2035 goal."**

The new report came on the heels of the enactment of the landmark Inflation Reduction Act (IRA), which, in tandem with the Bipartisan Infrastructure Law (BIL), is estimated to have the most pronounced impact on the power sector, with initial analyses estimating that, as a result of the IRA and BIL, grid emissions could decline to 68 percent to 78 percent below 2005 levels by 2030.

CLEAN ENERGY

In all modeled scenarios considered by the NREL in its report, new clean energy technologies are deployed at an unprecedented scale and rate to achieve 100 percent clean electricity by 2035. As modeled, wind and solar energy provide 60 percent to 80 percent of generation in the least-cost electricity mix in 2035, and the overall generation capacity grows to roughly three times the 2020 level by 2035, including a combined two terawatts of wind and solar.

To achieve those levels would require an additional **40 to 90 gigawatts of solar on the grid per year and 70 to 150 gigawatts of wind per year** by the end of this decade under this modeled scenario. That's more than four times the current annual deployment levels for each technology.

**"The U.S. can get to 80%–90% clean electricity with technologies that are available today, although it requires a massive acceleration in deployment rates," said Brian Sergi, NREL analyst and a co-author of the study. "To get from there to 100%, there are many potentially important technologies that have not yet been deployed at scale, so there is uncertainty about the final mix of technologies that can fully decarbonize the power system. The technology mix that is ultimately achieved will depend on advances in R&D in further improving cost and performance as well as the pace and scale of investment."**

In all scenarios, significant transmission must also be added in many locations, mostly to deliver energy from wind-rich regions to major load centers in the Eastern United States. As modeled, the total transmission capacity in 2035 is one to almost three times today's capacity, **which would require between 1,400 and 10,100 miles of new high-capacity lines per year, assuming new construction starts in 2026.**

"Decarbonizing the power system is a necessary step if the worst effects of climate change are to be avoided," said Patrick Brown, NREL analyst and another co-author of the study. "The benefits of a zero-carbon grid outweigh the costs in each of the more than 100 scenarios modeled in this study, and accelerated cost declines for renewable and clean energy technologies could lead to even larger benefits."

The NREL report added that significant future research is needed to better understand the implications for power system operations, grid reliability, impacts on the distribution system, electrification and efficiency investment costs and adoption, and clean fuels production infrastructure investment costs. Requirements and limitations of resources, including land and water; supply chain and workforce requirements; and other economy-wide decarbonization considerations will also need to be considered.

## IMPLICATIONS FOR ELECTRIC UTILITIES

So what does all of this mean for electric utilities in terms of their potential involvement with DER? One of the most important is that, whether utilities become more aggressively involved in their own DER or not, their customers are continuing to move ahead in this direction on their own, looking at a number of "behind the meter" installations of technologies such as distributed solar photovoltaic (PV) systems, microgrids, demand services, aggregated generation, and other types of generation.

**So, which types of Finley clients would stand to gain the most by beginning, or continuing to explore, integrating DER in their systems? There are basically four groups: rural electric cooperatives, municipal utilities, data centers, and industrial facilities.**

## BENEFITS

**In terms of the potential benefits of integrating DER for these entities, there are numerous ones, primarily related to the general categories of reliability and economics (savings and profitability).**

### In specific, benefits include:

**1 – Incentives**
The opportunity to access state and federal incentives for implementing DER systems,

**2 – Growing Interest**
Being able to latch onto the growing interest in moving to a more decentralized electric grid.

**3 – Reduced Dependence**
Having a reduced dependence on the transmission grid.

**4 – Ride-Through Capability**
Gaining ride-through capability during voltage excursions (with some of the newer inverters).

**5 – Service Reliability**
Gaining improved overall service reliability.

In addition, with the aggregation of DER capabilities, it becomes feasible to dispatch DER for things such as system balancing, demand response, operating and contingency reserves, or to mitigate ramp rate concerns in the morning and evening.

**Use of DER may also:**

- Reduce the need for new utility generation assets and ancillary services,
- Allow utilities to avoid higher transmission costs by reducing peak demand,
- Reduce air pollution emitted by traditional fossil fuel-fed generation, and
- Assist utilities in hedging against widespread power outages.

## CHALLENGES

While there are numerous benefits to implementing DER systems, such projects do not come without challenges, which include reliability, operational, and economic challenges.

Increasing amounts of DER can change how the distribution system interacts with the transmission grid and will transform the distribution system into an active source of energy. DER providers need to understand the operability and reliability considerations for the power system as a whole. As DER penetrations increase, the effect of these resources can present certain reliability challenges that require attention. For example, grid operators may rely on some businesses to operate their onsite emergency generators to maintain reliable electricity service for all customers during hours of peak electricity use. Increased DER affects not just the flow of power, but also the behavior of the system during disturbances.

**Attention must be paid to potential reliability impacts, the time frame required to address reliability concerns, and coordination of system protection considerations for both the transmission and distribution system. This will all require improved information sharing between transmission and distribution entities.**

### SOME ADDITIONAL CHALLENGES IN SPECIFIC:

- Current electrical system models and operating tools typically do not sufficiently represent the effect of aggregated DER. These deficiencies can result in unanticipated power flows and increased demand forecast errors.

- With sufficient DER penetrations, an unexpected loss of aggregated DER can cause frequency and voltage instability.

- Variable outputs from DER can contribute to ramping and system balancing challenges for system operators.

- Existing analysis tools and models may be inadequate.

- Because DERs are typically netted with load at the distribution bus for operations and planning, there will be challenges to understand DER variability and interactions with other resources.

- Coordination of planning, installation, and operation is required for DER.

- High levels of DER with inverters can also result in a decline in short circuit current, which can make it more difficult for protection devices to detect and clear system faults.

- Too much distributed generation can create excess demand at a substation, causing reverse flow of power to the transmission grid. This can increase the chances of high voltage swings and other stresses on electric equipment.

- DERs can also end up “islanding.” In such a situation, the local feeder remains energized by DER, once the utility is no longer supplying power due to an outage or other cause.

Fortunately, entities interested in exploring DER opportunities and addressing the multiple challenges can rely on Finley for complete assistance.

Finley can provide a multitude of services typically involving modeling and analysis of potential DER additions at particular locations in the clients' electrical system. For example, Finley performs analysis and studies using electrical power system modeling and analysis tools, such as Milsoft's WindMil and ETAP, among others.

These analytic tools are utilized along with Finley's engineering expertise to evaluate various scenarios related to an addition of DER to a customer's electrical system. Modeling of DER requires a solid understanding of DER performance based on both interconnection requirements and technology-specific DER performance and control systems, which Finley can provide.

**Finley can provide information from a number of studies related to DER applications, including:**

– Feasibility studies
– Load studies
– Fault studies (fault current analysis)
– Coordination studies
– Impact on electrical system studies
– Power quality studies.

Furthermore, Finley can compile and provide professional detailed reports to clients, including information such as recommendations for changes to the electrical system and protection scheme recommendations to maximize reliability, while also considering the economic impacts of options and recommendations.

Finley can also perform "best practice" evaluations in order to confirm proper distribution interconnection parameters, with recommendations for preferred equipment and protective device selection. Recommended protective relay settings are also a typical deliverable with these types of studies. In addition, and very importantly, Finley also has comprehensive expertise in dealing with regulatory issues, compliance with standards, and navigation of state and federal energy funding programs.

**Finally, Finley can provide a multitude of local service level loading impact studies for DER applications. These include the following:**

- Distribution system primary feed and corresponding protection device analysis.
- Distribution system alternate feed scenario for similar analysis.
- Transmission level impact and back-feed scenario analysis.
- Modeling of voltage impact.
- Loading impact studies to determine solar output integration during lightly-loaded seasonal conditions.

PROFESSIONAL EXPERTISE

## ABOUT THE AUTHOR

**Dennis Wright, P.E.**

Dennis is a Professional Engineer with more than 27 years of experience in the Energy sector. His areas of expertise include high voltage substations, protection and controls, substation physical, battery energy storage systems, power plants, Smart Grid, SCADA, electric power and electric wiring.

He has held a broad range of positions over the years working with power plant automation, industrial controls, high voltage utility substation projects up to 500kV and substation automation. He spent 10 years working in one of North America's largest chemical plants; then, branched into Power & Substations with a 138kV substation project, followed immediately by turnkey design, construction, commissioning and successful startup of a $70,000,000 High Impact Polystyrene Plant in 1998.

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