Deep Dive

Advancements in DER Technologies

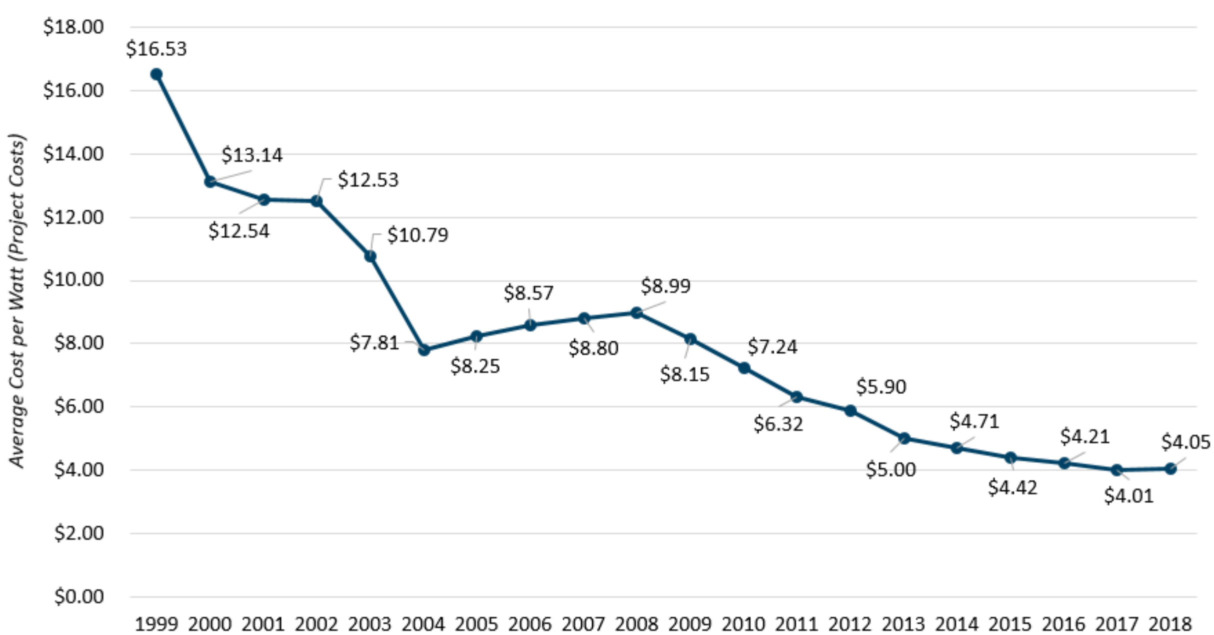
Over the last decade, there have been significant advancements in DER technologies, along with dramatic decreases in costs.

Distributed Generation

Distributed generation resources are interconnected on the distribution grid and may either be deployed by the utility in front of the meter or "behind the meter" at a customer site. Common distributed generation resources include diesel and propane generators and renewable resources such as solar photovoltaic (PV) systems, combined heat and power systems, biodigesters, and small-scale hydro. Renewable distributed generation systems can often provide significant resilience value during extended grid outages.

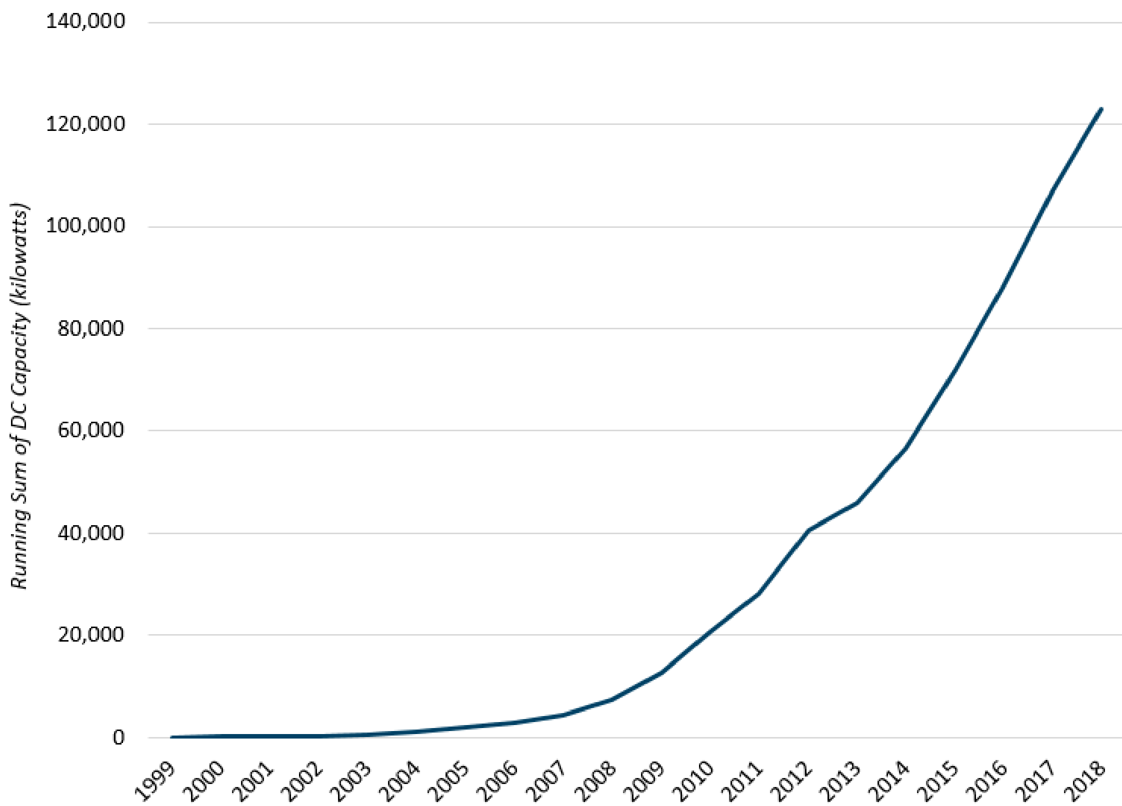
Solar PV systems have been installed on a limited basis for several decades in Oregon, but a rapid decline in the installation costs over the last 20 years has accelerated PV deployments. The Oregon Department of Energy's Solar Dashboard illustrates the dramatic cost decline of installed residential solar systems in Oregon since 1999.

Figure 1: Oregon Residential System Cost per Watt by Year (Data from Oregon Solar Dashboard)



The Solar Dashboard also tracks the corresponding increased deployment of distributed solar PV systems in Oregon as the installed price of the technology has fallen. The graph below illustrates the cumulative installed capacity of distributed residential and commercial solar PV installations in Oregon since 1999.

Figure 2: Running Total of Commercial and Residential Sector Installed DC Capacity in Oregon (Data from Oregon Solar Dashboard)



Increased deployment of renewable distributed generation projects—if able to be islanded from the grid—can improve local energy resilience by providing on-site electricity for long durations. Oregon's bulk energy systems will be severely affected during a CSZ earthquake, so local communities may not receive liquid fuel deliveries, and access to the electric and natural gas transmission systems could be down for many months.

Load Controls

At the same time that costs for solar PV systems have fallen and adoption rates have increased, there has been significant development around new technologies to enable grid-connected loads, such as smart thermostats and grid-connected electric water heaters.

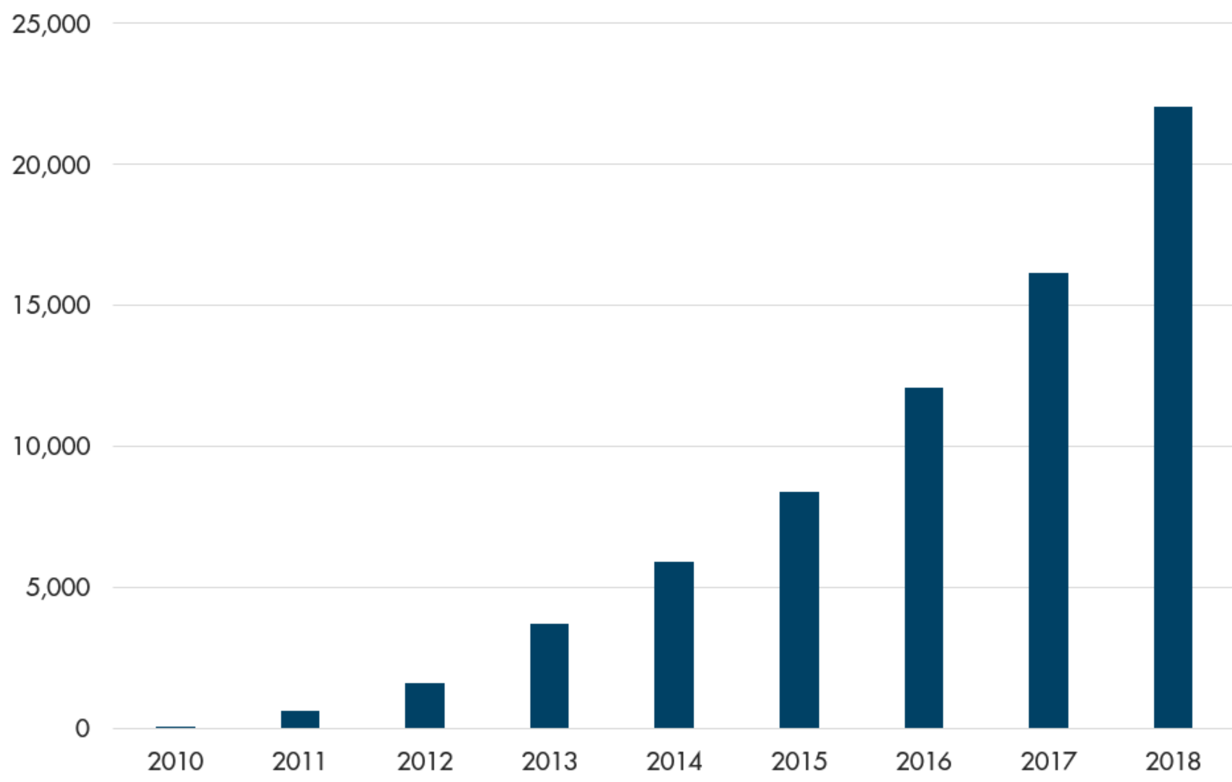
These load control technologies can leverage the deployment of smart meters that provide two-way communications between end-users and the utility. The meters allow a utility to gather more granular, real-time data on load patterns. This creates new opportunities for a utility to develop innovative mechanisms to make loads more responsive to grid needs, either through remote access direct load control or through incentives to end-users to modify demand.

Advanced control systems enable utilities to more seamlessly integrate sources of distributed generation onto their distribution systems, while also providing for dynamic remote functionality (e.g., switching specific loads on or off) that could prove valuable following a major grid disruption.

Electric Vehicles

The adoption of electric vehicles in Oregon has accelerated in recent years; this growth is forecasted to continue over the next decade. The following graph shows the rapid increase in the adoption of EVs since the year 2010.[1]

Figure 3: Oregon Total EV Registrations by Year



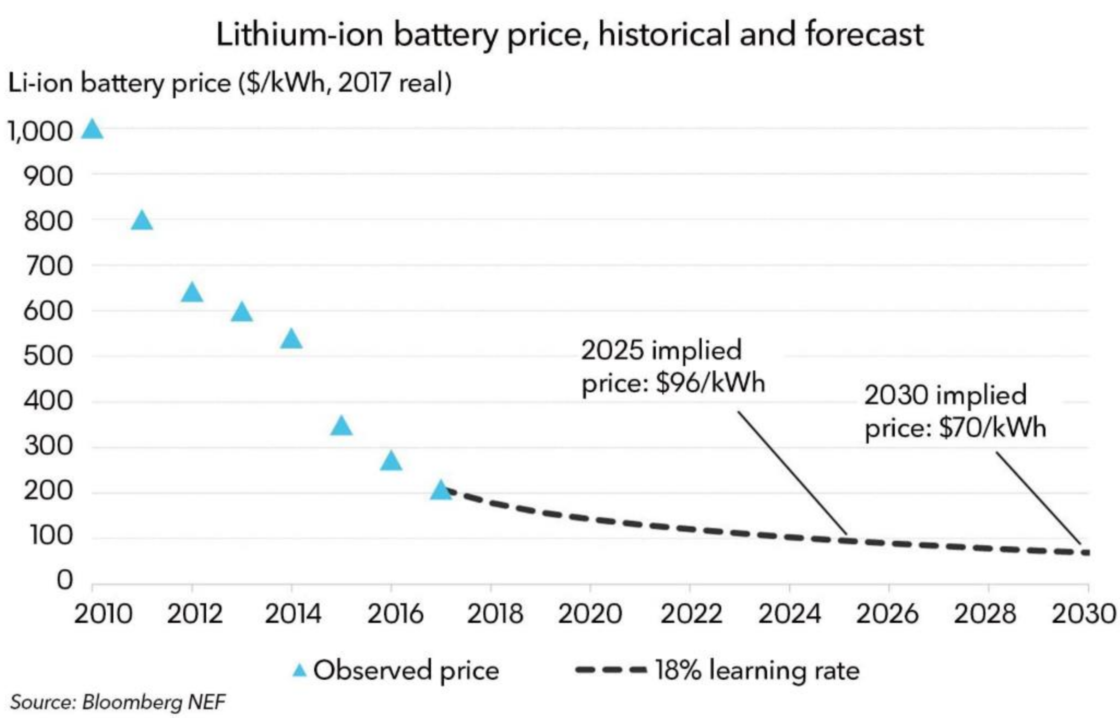
As a type of DER, EVs can provide some significant benefits. For the utility, there is the potential to develop mechanisms for optimized EV charging that meets the customer’s needs, while also delivering benefits to the grid, like shifting loads during peak times. For end-users, improved energy resilience is among the many benefits of EV adoption. Unlike with traditional liquid fueled vehicles, end-users have the potential to recharge EVs with locally-generated electricity from distributed generation sources (a particularly valuable benefit if an event has caused severe disruptions to the liquid fuel delivery system). EVs could then have the capability to charge other devices, such as cell phones.

Battery Storage

Given the variable output of some types of renewables, like solar PV, it is valuable to have the ability to store excess electricity production on-site for use at a later time. In the northwest, utility battery storage projects are already improving local resilience. Two examples include the Glacier battery storage project[2] developed by Puget Sound Energy and the Grid Edge Demonstration project developed by the Eugene Water and Electric Board.

According to Bloomberg New Energy Finance, the cost for lithium ion batteries has fallen steeply from approximately $1,000 per kilowatt hour in 2010 to $200 or less per kWh in 2018. The latest data from 2019 show a continued reduction in costs, with Bloomberg finding an additional 35 percent reduction in costs over the last year.[3] Bloomberg expects prices will continue falling through the next decade to less than $100/kWh.[4]

Figure 3: Lithium-ion Battery Price, Historical and Forecast (Bloomberg)



The deployment of battery storage systems creates opportunities for a utility or end-use customers to optimize the use of generation from distributed resources. This could provide a significant resilience benefit following a major grid disruption. For example, a fire station that deploys a microgrid incorporating a diesel generator, rooftop solar, and a battery system could better manage its on-site diesel fuel use and its solar output to maintain back-up power for a longer duration.

Optimization Systems

There have also been significant advancements in the development of technology and software systems, commonly referred to as Distributed Energy Resource Management Systems (or DERMS), that enable owners to manage DERs. These systems can help optimize the use of DER technologies to maximize economic value, provide grid services, or maximize the amount of energy stored on site to improve resilience for end-use customers by increasing the duration of the back-up power that DERs provide. The systems can also automate when the DERs will disconnect, and island themselves from the grid based on pre-defined conditions.

Standards Development

The Institute of Electrical and Electronics Engineers (IEEE) supports the development of national standards, including standard IEEE 1547 for inverters used in DER/grid interconnection. The 2018 update to IEEE 1547-2018, *IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces,*[5] *improved the ability of smart inverters to support grid functions*. The 2018 standards update lagged behind the market, so most inverters available on the market already comply with the new standards. Additional efforts are underway to develop uniform standards around other DER functionality, such as communication protocols to enable interoperability between a variety of end-use appliances and the electric grid.[6]

References

[1] Data provided by the Oregon Department of Motor Vehicles in March 2019 was compiled by the Oregon Department of Energy for this graph.

[2] https://www.pse.com/pages/smart-grid/glacier-demo-project

[3] https://about.bnef.com/blog/battery-powers-latest-plunge-costs-threatens-coal-gas/

[4] Bloomberg New Energy Finance. *New Energy Outlook 2018*. https://about.bnef.com/new-energy-outlook/#toc-download

[5] https://standards.ieee.org/standard/1547-2018.html

[6] Electric Power Research Institute (EPRI), "Introduction to the ANSI/CTA-2045 Standard." https://www.epri.com/#/pages/product/000000003002004020/?lang=en-US

OREGON DEPARTMENT OF ENERGY

This Deep Dive is part of the *Oregon Guidebook for Local Energy Resilience: For Small and Medium Utilities*, first published in June 2019.

www.oregon.gov/energy | askenergy@oregon.gov | 503-378-4040