



Clean Energy in 2030: The Customer of the Future



Looking Back from the Future

It is June 21, 2030, the longest day of the year, and it is going to be a scorcher. Fifteen years ago, Southern California Edison might have had to turn to peaker power plants that run on fossil fuels to keep customers cool on long, hot days.¹ Today, however, the power grid is running safely, reliably, and efficiently, bolstered by customers' widespread adoption of clean energy technologies.

California has met the 2030 environmental goal to reduce greenhouse gases to 40 percent below 1990 levels, and is on its way to reducing greenhouse gases to 80 percent below 1990 levels² by 2050. This year, 50 percent of California's energy portfolio comes from renewable resources, and even more renewable energy is produced on the distribution network, mainly from rooftop solar panels.

Over the last twenty years, there has been a dramatic change in how customers use and interact with the electric grid. Customers in the 2010s had very little choice in how they consumed electricity, and very few customers had the opportunity to participate as electricity producers. Today, however, "prosumers" who might have solar panels on their rooftops are compensated fairly for their contributions to the grid, and also pay their fair share for their use of the grid, both to buy and sell energy. Customers who access battery storage systems can control their costs by storing energy from the grid during lower-cost hours and then using this energy during more expensive, peak hours. These energy decisions allow customers to actively contribute to California's cleaner air and reduced greenhouse gas emissions.

Back in the 2010s, few customers owned plug-in electric vehicles, and transportation contributed 37 percent of the greenhouse gases in California³. Now, there are now millions of electric vehicles on California's roads, including a growing number of shared autonomous vehicles. Expanded access to charging infrastructure for plug-in electric vehicles removed charging access as a barrier to adoption.

¹ Peaker plants are gas-powered generators that are used at times of peak need to put additional energy into the communities where they are located.

² SB32, The California Global Warming Solutions Act of 2006: Emissions limit, https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB32, Approved and filed September 8, 2016

AB 197, State Air Resources Board: greenhouse gases: regulations. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB197, Approved and filed, September 8, 2016

³ <https://www.arb.ca.gov/cc/inventory/data/data.htm>

Putting Energy in Customers' Hands

In 2030: New and evolving clean energy technologies have set the stage for the customer-centric grid of today. These technologies are collectively known as distributed energy resources or DERs. They include energy efficiency, demand response, electric vehicles, renewable energy and energy storage. All of SCE's customers have an opportunity to use DERs, and their participation reduces California's carbon footprint and can save them money. Nearly 2 million customers are driving electric vehicles.

Anthony is a homeowner in a Zero Net Energy housing development in Fontana, California, which was built in partnership with SCE back in 2015. He and his son, Eli will be out all day, so he has made an energy choice; instead of using his rooftop solar panels to cool his home, he has programmed his smart energy management system to sell the solar energy he generates back onto the grid. His solar power is valuable to the grid because his home is located in an area where this energy can be used to power other homes. Anthony's solar energy provider has aggregated his solar energy with that of other owners of rooftop solar panels, and SCE is managing the grid to optimize this power. Anthony will rely on the energy-efficient design of his home to keep it cool while he is out. His home features increased wall and attic insulation, high-efficiency lighting and an electric water heater.



Jessica is the quality control manager at Acme Industries. Jessica pulls in to Acme's parking lot, which is equipped with electric vehicle chargers, installed in coordination with SCE's Charge Ready program. She plugs in, opting into the demand response program. Her car might stop charging temporarily later in the day, when there is extreme demand on the grid, but it will be fully charged by the time she leaves work. SCE has built and owns a space-efficient battery storage system in a shipping container in Acme's storage yard. Today, Jessica will be product testing. When the testing prompts unusual high intensity demand on the grid, the battery storage system is automatically triggered to add power, ensuring consistent voltage levels and flow. Solar panels on Acme's roof also provide renewable energy, which keeps the cost of air conditioning down, helping Acme to meet its budget goals.



Leticia lives with her daughter, Jade in an apartment in a neighborhood that is designated as a California disadvantaged community (DAC) and she qualifies for SCE's CARE discount. Leticia doesn't have a rooftop for solar panels, or own her own car, but she is also benefitting from California and SCE's grid modernization efforts. The air has been so much cleaner since the state achieved its 50 percent renewable energy goals that Jade can now enjoy school and sports without worrying about asthma attacks. And, Leticia has noticed that her electricity is much more reliable than it used to be. Since a wire replacement program upgraded neighborhood circuits from 4 kilovolts to 16 kilovolts, outages caused by weather, car accidents or service interruptions have been brief and rare.



Will is a renter and a student who lives in subsidized off-campus housing. The rent is kept affordable, in part, by proceeds generated from a community solar project that is connected to the SCE distribution grid – a partnership between the college, which wanted to add renewable resources as part of its sustainability program, and SCE, which is using local generation to defer installing more circuits to meet the increased customer need. The community solar project generates revenue for the college and provides benefits to the distribution grid. Because the cost of electricity and other utilities is included in his rent, Will benefits from the solar panels without any personal actions or investments. Will gets around town in an all-electric city bus—which is quiet and clean, allowing him to study or listen to music without the sound cranked all the way up.



⁴ Disadvantaged Community (DAC) is a designation for those California communities in the highest (worst) quartile of environmental and economic burden, as evaluated by the California EPA.

⁵ The California Alternate Rates for Energy (CARE) program offers eligible low income customers up to a 20 percent discount on their monthly electric bills. More information is available at SCE.com.

Getting There

In 2017, SCE is exploring how to increase customer choice and ease of use. New technologies, new partnerships and a new way of operating are essential. SCE advocates a thoughtful, three-step approach to reinforce and modernize the grid, create new revenue opportunities, and allocate the benefits and costs of this transformation appropriately.

1. Modernizing and Managing the Grid

A grid that was built to meet the needs of the 20th century will need to be upgraded and reinforced to meet the needs and technological advances of the 21st century. By 2030, the grid must accommodate Anthony's two-way power flows and Acme's complex power quality and system demands, have the ability to direct Anthony and Will's solar energy to meet grid demands in real time, accommodate the widespread adoption of battery storage, and provide customers like Leticia who aren't opting in to customer-owned renewable energy programs, with energy that is affordable and reliable, as well as clean.

All the while, operators must have real-time visibility into the system. This visibility is key to providing safe and reliable energy at every time of day, in every type of weather, and in the face of emergencies or accidents that could interrupt power flow. In 2015, SCE operators had to quickly reconfigure or isolate portions of distribution circuits 22,000 times in response to interruptions and maintenance. And, the system will only get more complex. By 2030, the number of required grid operations will increase exponentially. With energy coming from both traditional centralized sources and from thousands of customer devices, human operators will struggle to keep up with the speed and complexity of the grid.

To meet these challenges, utilities will expand their capabilities as distribution system operators, using enhanced system automation to manage the grid in real time.

2. Connecting Distributed Energy Resources to Markets

With increasing customer adoption of DERs, the local distribution network will become even more important in coordinating between prosumers and the grid.

By 2030, the regulatory means to allow customers to sell directly to wholesale markets, already in process in 2016,⁶ should be in place. The excess energy produced by Anthony's rooftop solar panels can be aggregated and scaled up by third-party solar providers and supplied to the grid. Anthony's clean solar power could replace energy that now comes from peaker plants.

3. Balanced Program and Fair Rules

To maintain affordability and fairness, rates should account for the fixed costs of the grid, without subsidizing DER owners at the expense of other customers. Customers who don't use the grid shouldn't have to pay for it, but prosumers like Anthony will use the grid to sell their excess energy, and to power their homes at night.

DER owners should be paid a competitive rate based on the value at the time and location of the services they deliver. In the summer, Anthony's energy is worth a lot more to the grid in the late afternoon, when heat is peaking and his neighbors are cranking up their air conditioners, than it is in the morning, when his neighborhood is cool and empty. Solar energy in landlocked Fontana has a different value to the grid than solar energy in coastal Malibu.

At the same time, programs like the ones at Will's college, which provide the benefits of community solar to customers who do not have access to personal solar panels provide opportunities to customers who might be renters, students, low income, living in disadvantaged communities, or living in multi-family homes. They can all share in the advantages of solar in energy markets where community solar can be valued as a grid asset.

⁶In June 2016, the California Independent System Operator, which controls the wholesale power market in California got permission from the Federal Energy Regulatory Commission to develop a framework to allow customers to sell directly to the wholesale market.

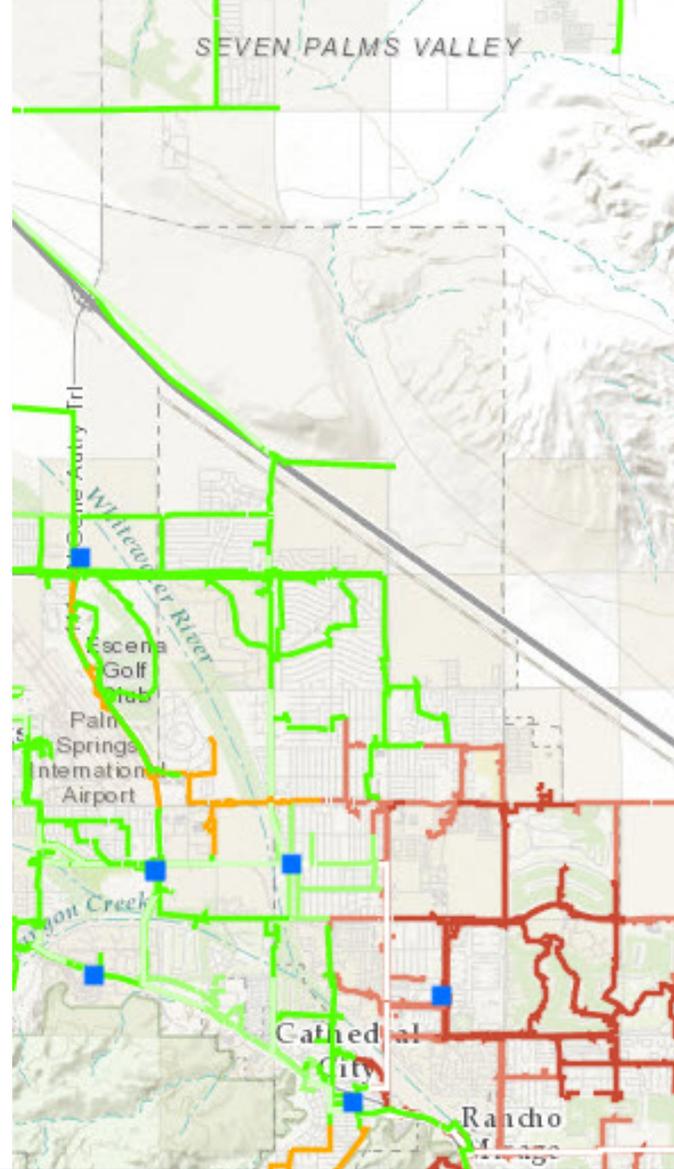
The Road Forward

The massive changes to the grid and markets required to create this future state will take time, new technologies and enhanced system architecture. But, utilities, regulators, and distributed energy providers must come together now with a sense of urgency, to build the foundation.

The year 2030 is around the corner. For SCE, it will take a significant amount of work to finish modernizing a system that includes 4,600 separate circuits and 118,834 miles of distribution and transmission lines. The entire system will need to be upgraded to be able to support bi-directional energy flows from renewable energy sources, new communication and automation devices and to service an exponential increase in electrified technology.

SCE is asking for \$2.1 billion in our 2018-2020 General Rate Case to continue improving our grid reliability while modernizing the grid through enhancements such as increased automation, upgrades to aging low-voltage circuits and substations, and enhanced, scalable computing platforms.

By 2030, Anthony, Jessica, Will and Leticia should be able to participate in an energy system that significantly reduces greenhouse gas emissions and carbon, has increased customer choice, and that continues to be safe, reliable and efficient. In turn, they will be providing their next generation a cleaner and greener future.



Mapping Out the Future

Planning documents detailing SCE's vision and the plans to get there are available on Edison.com. These include:

- 2015 **Distribution Resources Plan**
- 2016 filing of the **2018-2020 General Rate Case**
- 2016 vision white paper, **Tomorrow's Clean Energy Economy**

More information on grid modernization at SCE and electronic copies of this white paper are available at:

Edison.com/TransformingtheGrid

Searchable Distributed Energy Resource Interconnection Map (DERiM) available at:
edison.com/home/innovation/grid-modernization.html

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