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California entering decade of disruption, as power system shifts dramatically

New Next 10 reports detail challenges and opportunities facing State's grid from the growth of EVs, CCAs and DERs

SAN FRANCISCO — With California's grid facing an era of rapid change as access to renewable energy grows, three new reports from the nonprofit, nonpartisan think tank Next 10 examine key issues involving the state's power system. The reports take a deep dive into how the grid might be challenged or helped by the rise of electric vehicles; the increase in distributed energy resources, such as rooftop solar panels; and the growth of community choice aggregation, which allows cities and counties to join together to purchase electricity on behalf of their community members.

"These innovations are all key elements in California's efforts to transition to clean, renewable energy that is both reliable and affordable," said F. Noel Perry, businessman and founder of Next 10. "As the state adds more variable renewable energy to the grid, these resources – electric vehicles, distributed energy resources and community choice aggregators – represent a challenge to the traditional energy management system but also provide opportunities for us to manage a more efficient and cleaner grid. There are a lot of complex issues for Californians — especially policymakers — to consider as we work toward a clean energy future."

Electric Vehicles

Together with the state's shift toward low-carbon generation of electricity, electrifying transportation is a key pathway for California's clean energy strategy.

California currently has about 369,000 plug-in electric passenger vehicles (PEVs). In order to reach Gov. Jerry Brown's goal of 5 million PEVs by 2030, sales need to grow significantly. Also on the horizon: electric medium- and heavy-duty vehicles, and the prospect of private vehicle ownership being lowered by fleets of electric, self-driving PEVs.

The California grid is well placed to handle rapid growth in PEVs but advance planning and smart policy can ease the transition for the state's power system, according to Next

10's report [Electric Vehicles and the California Grid](#), by Anand R. Gopal and Julia Szinai of Lawrence Berkeley National Laboratory.

Among the report's key takeaways:

- **Energy demand is only modestly increasing as PEV sales surge**
 - The California Energy Commission forecasts that 3.9 million PEVs would add about 15,500 GWh of charging demand, equivalent to just about five percent of California's current total annual energy load.
 - A Chevy Bolt driven 50 miles a day uses the same amount of electricity as an air conditioner cooling a 3-bedroom home for three hours.
- **Transportation trends towards automation and increased usage of mobility services like ride-hailing could rapidly expand the share of electric vehicles on the road, further increasing electricity demand.**
 - The estimated share of total light-duty vehicle miles traveled from ride-hailing vehicles could double from 10 percent to 20 percent between 2018 and 2020, based on projections from ride-hailing companies.
 - If regulators choose to require that these fleets move toward PEVs, this could have significant impacts for infrastructure and charging needs. Only about one percent of total Uber and Lyft trip miles in California are made in electric vehicles (as of Q3 2017).
- **The growth of electric vehicles in California will require upgrades to the energy system, but the costs are likely to be low compared to the benefits.**
 - In areas with high concentrations of PEVs, the distribution system is likely to be the first part of the grid to require upgrades and management as a result of PEV growth. At an aggregate distribution system level, an analysis found that annual PEV-related distribution costs through 2030 are estimated at about only one percent of the distribution revenue requirement of California's three investor-owned utilities and the Sacramento Municipal Utility District combined.
 - Meanwhile, the authors' analysis shows that if California were to move to smart charging of the 5 million electric vehicles targeted by Governor Brown's goal, it could help reduce the amount of curtailed renewable energy by 50 percent in 2025.
 - According to the California Public Utilities Commission, flexible EV charging can generate resource cost savings of \$100-200 million per year for the power system, compared to unmanaged EV charging.
- **New management strategies can help optimize potential benefits and minimize potential risks of more PEVs needing more electricity, but are challenging to implement.**
 - Managed charging programs — such as time-of use charging, which shifts charging to off-peak hours — could lessen stress on the grid, lower operating costs, and help integrate intermittent renewable energy.
 - Smart charging — which allows active electric vehicle charging to be turned on or off to coincide with times of low wholesale prices or high

renewable generation — can curb incremental system operating costs and reduce renewable energy curtailment.

- Such programs require well-designed, behaviorally aware incentives to entice large numbers of PEV owners to participate in them.
- Hence, even though electric vehicle batteries could provide a source of energy storage to the grid, in practice this would be complex and costly. Stationary battery storage could be used to provide distribution system support, load-shifting, and ancillary services.

“If California wants to meet its zero-emission vehicle goals while keeping electricity affordable and reliable, it’s worth considering some policy levers that can help,” Anand Gopal, author to the brief, said. “In addition to encouraging further electrification of the transportation sector and supporting the development of associated charging infrastructure, policymakers can look at ensuring that autonomous vehicles and mobility-on-demand services don’t increase GHG emissions. Other potential strategies include expanding time-of-use rate programs and supporting smart charging to optimize benefits that electric vehicles can provide to the grid.”

Distributed Energy Resources

Distributed energy resources are small technologies — including rooftop solar, energy storage, microgrids, load control, energy efficiency, and communication and control technologies — that produce, store, manage, and reduce the use of energy. They are small enough to be “distributed” all around the grid, close to customers and away from centrally located power plants.

“There’s a lot of buzz around distributed energy resources (DERs), which have rapidly growing capabilities and falling costs,” said Bentham Paulos of PaulosAnalytics, who produced [The Growth of Distributed Energy: Implications for California](#) for Next 10. “While they can help make the grid more reliable, resilient, and equitable, DERs represent a potential shift from the status quo of central control and ownership. As many decisions are made by individual customers, regulators and utilities are ceding some control of the system, requiring new flexibility and a new set of incentives. If DERs are going to reach their full potential, their value must be recognized and properly rewarded.”

California has already adopted virtually every policy conceived to encourage DERs, the brief notes, and is a leader in deployment, as well. For example:

- 90 percent of the nation’s small-scale energy storage and nearly half of all U.S. large-scale storage is in California.
- California has over 800,000 customers with rooftop solar systems, totaling over 6,500 MW of capacity. The state has been adding 100,000 systems annually.
- In May 2018, the California Energy Commission added rooftop solar as a building code requirement, which could lead to an additional 75,000 installations per year.

- Smart grid investment is trending nationally and in California to help automate distribution system controls. Last year, nearly \$2 billion was invested nationally, with California utilities having invested nearly \$250 million.
- As of early 2017, there were 36 operating microgrids in California, with an additional 80 under construction or planned. Altogether, these microgrids will provide over 650MW of peak capacity to the grid.
- More than 220 MW of fuel cell systems have been installed in close to 200 California cities.

California is also a leader in energy efficiency programs, including building codes, appliance standards, and ratepayer-funded utility programs with investor-owned utilities investing more than \$700 million annually in programs. Over the course of decades, these have reduced energy demand, saved customers money, reduced the need for investment and infrastructure, and cut pollution. But while California is a leader in energy efficiency, it is lagging behind in using flexible power demand to provide services to the grid, known as “demand response.”

“Distributed energy resources represent an economic opportunity for California, with tremendous growth potential,” said Perry. “California companies lead in energy efficiency, energy storage, energy software, and rooftop solar.

Community Choice Aggregation

Communities across California are forming Community Choice Aggregators (CCAs) at a rapid rate since 2010, with over half of them starting within the last two years. County and city governments administer CCAs as local alternatives to investor-owned utilities (IOUs).

Next 10’s report [The Growth of Community Choice Aggregation: Impacts to California’s Grid](#), written by JR DeShazo, Julien Gattaciecce, and Kelly Trumbull of UCLA’s Luskin Center for Innovation, finds that if current growth trends continue, CCAs may serve a majority of California’s power consumers within the next 10 years, transforming California’s retail electricity sector.

According to the report, the rise of CCAs has both direct and indirect positive effects on overall renewable energy consumed in California, helping contribute to the state meeting its 2030 RPS targets approximately ten years in advance.

Even with such an important impact on the penetration of renewable energies, CCAs’ effects on the grid have been negligible so far. This is in part because when a CCA starts, it handles the needs of existing electric customers, and often gets power from existing power plants.

In the long term, though, CCAs’ impact on the grid depends on their energy procurement strategies and their local investments.

“The public and local nature of CCAs positions them to implement local energy programs that will help to reduce or shift energy consumption, benefiting the grid as well as their customers,” DeShazo said. The report finds that some CCAs have been especially innovative in responding to customers’ preferences by offering programs that focus on efficiency, rooftop solar, electric vehicles, and demand response.

Among the report’s other findings:

- CCAs are offering customers electricity with renewable energy content ranging from 37 percent to 100 percent, with an average of 52 percent.
- IOUs are offering renewable content between 32 percent and 44 percent. They estimate a renewable content that exceeds 50 percent by 2020.
- CCAs rely more on short-term and out-of-state renewable energy contracts, compared to IOUs, due in part to the fact that they are relatively new entities. It’s unclear if this pattern will persist as CCAs continue to mature.
- CCAs compensate their rooftop solar customers for energy generated in excess of their consumption at rates up to three times higher than IOUs.
- Some CCAs have demonstrated more success at engaging hard-to-reach customer groups in energy efficiency, compared to their IOU counterparts. For example, MCE’s multi-family energy efficiency program is more cost-effective than the comparable PG&E’s program.

Next 10’s briefs on the grid and distributed energy generation, community choice aggregation, and electric vehicles are the third, fourth and fifth entries in a five-brief series on the grid. The first two reports — on [grid regionalization](#) and a [primer on California’s electricity system](#) — were released earlier this month. All five briefs can be found at www.next10.org.

About Next 10

Next 10 (next10.org) is an independent, nonpartisan organization that educates, engages and empowers Californians to improve the state’s future. With a focus on the intersection of the economy, the environment, and quality of life, Next 10 employs research from leading experts on complex state issues and creates a portfolio of nonpartisan educational materials to foster a deeper understanding of the critical issues affecting our state.