

Achieving 100 Percent Clean Electricity

Key Strategies Needed to Reach California's Ambitious Goal

HIGHLIGHTS

California is a global clean energy leader. In 2018, the state set a new goal to reach 100 percent carbon-free electricity by 2045 and strengthened its existing requirement for utilities to provide electricity from renewables, increasing the target from 50 percent by 2030 to 60 percent. Achieving this bold goal will require a diverse array of solutions to reduce reliance on fossil fuels, meet climate and clean air goals, and ensure grid reliability. The Union of Concerned Scientists has outlined 10 key strategies California should deploy to reach its clean energy vision in the most reliable, cost-effective, and equitable way possible.

California is continuing its clean energy leadership in 2018 by adopting a groundbreaking new law that sets a goal of 100 percent carbon-free electricity by 2045 and raises the renewable energy requirement from 50 to 60 percent by 2030 (California Legislature 2018). The 100 percent goal can be met by both eligible renewables and other technologies that do not emit global warming pollution when electricity is generated. Clean electricity is needed to dramatically reduce global warming pollution, not only in the power sector but in transportation and buildings—both residential and commercial—as well. This bold, new clean electricity goal is ambitious and necessary to meet the state's climate targets (Brown 2018). Achieving it is within reach if California advances needed policies, rules, and programs.

The transition to 100 percent clean electricity must be done equitably. Many of California's low-income communities and communities of color have suffered disproportionately for decades from the devastating health, economic, and environmental impacts of using fossil fuels to generate electricity and to power vehicles and industrial processes. As California reduces its global warming emissions and transitions to cleaner sources of energy, the state should commit to improving air quality and prioritizing clean electricity and transportation infrastructure investments that benefit disadvantaged and underserved communities.

The Union of Concerned Scientists has outlined 10 key strategies that state legislators, regulators, and other stakeholders can follow to advance new policies, refine market rules, and adopt and expand procurement programs. These strategies will make the electricity grid more flexible while reducing reliance on fossil fuels, prioritize equitable outcomes in the clean energy transition, and ensure that California's goal of 100 percent clean electricity becomes a reality.



California has set a new goal of achieving 100 percent carbon-free electricity by 2045. To help meet this goal, the Union of Concerned Scientists has outlined 10 key strategies for stakeholders to pursue, including generating electricity from a diverse mix of renewable resources.

Technological solutions exist today to integrate higher levels of renewable energy onto the grid, thus reducing dependence on natural gas.

1. Use electricity as efficiently as possible and reduce demand at times of the day when renewable supplies are least abundant.

To ensure that California’s clean energy transition is cost-effective, electricity should be consumed as efficiently as possible. While California already has some of the most aggressive energy savings goals in the country, going forward, it will be important for energy efficiency investments to encourage savings during evening hours when renewable energy supplies are not as abundant. This will reduce dependence on natural gas generation and lower overall costs of the clean energy transition.

2. Generate renewable electricity from a diverse mix of sources.

To help spread renewable generation more evenly during the day and seasons of the year, a clean electricity grid will require a variety of renewable energy technologies with diverse production patterns. This power generation—including wind, solar, geothermal, and low-carbon bioenergy—should come from both large- and small-scale facilities located within and outside California. The more diverse the renewable energy portfolio, the smaller the requirement for other sources to fill generation gaps and balance electricity supply and demand, thus lowering the overall costs associated with managing a reliable electricity grid.

3. Plan for an orderly and equitable transition away from natural gas generation.

California uses natural gas to meet about one-third of its electricity needs, and grid operators currently depend on the flexibility of natural gas power plants to back up solar and wind generation, which fluctuates depending on weather. But technological solutions exist today to integrate much higher levels of renewable energy onto the grid, thus reducing dependence on natural gas. The state needs to develop a strategy to phase down natural gas electricity generation in an orderly, cost-effective, and equitable manner that prioritizes reductions in

natural gas generation in communities disproportionately affected by global warming and air pollution. This transition plan should reflect that some existing plants can be retired immediately, while others may need to remain online and be used increasingly sparingly to bridge the transition to 100 percent clean electricity (Wisland and Specht 2018).

4. Use renewable generation technologies to provide grid reliability services.

To keep the grid stable, electricity generation technologies must be able to rapidly reduce or increase power supplies in order to keep electricity supply and demand in balance at all times. Technologies that provide these fast-responding grid services—also called ancillary services—have traditionally been met in California using large hydropower and natural gas. But solar and wind can also provide ancillary services (Loutan et al. 2017), and adequately compensating renewables for doing so will help reduce reliance on natural gas generation to provide these essential grid services (Nelson and Wisland 2015). New policies, market rules, and contract structures are needed to create more attractive financial incentives for renewable technologies to be operated as flexibly as possible to provide fast-acting grid services that support reliability.



Utilities and others are investing in different battery technologies to help store electricity generated by renewables that are intermittent, like wind and solar. Strategically locating battery storage and distributed energy resources—like at Browns Valley north of Sacramento, CA—can also help the grid be reliable and resilient when a power plant or transmission line goes down.

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Electrifying transportation can support integrating more renewables on the grid and reducing reliance on fossil fuels by shifting load and using electricity at times that coincide with greater renewables production.

5. Invest in energy storage at various timescales and locations.

Storage devices like batteries, pumped hydropower, and compressed air can store electricity generated by renewables to meet future electricity demand and provide the fast-responding ancillary services needed to keep the grid reliable. Policies and market rules should encourage more investment in energy storage across different timescales—hours, days, seasons—to reduce California’s reliance on natural gas generation. Investments should be targeted in locations that are especially vulnerable to grid reliability challenges if a local power plant or transmission line goes offline unexpectedly, and areas where storage can improve air quality in disadvantaged communities by reducing or eliminating the need to burn natural gas for electricity generation.

6. Enable greater integration of western electricity markets.

As California takes steps to rely on larger quantities of renewable electricity, grid operators within the state will need access to a wider pool of carbon-free generation to meet electricity demand and provide essential grid services to keep the grid reliable. Participation in regional electricity markets will also lessen the need to curtail the output of renewable generation by making it easier to export excess renewable generation to areas that can use it. Greater coordination and regionalization of electricity markets in the West should preserve state authority, including matters concerning electricity procurement and planning, and should support a

transparent system to track greenhouse gas emissions throughout the region.

7. Unlock the value of distributed energy resources.

There are unique and valuable localized benefits of small-scale solar and storage installed on the distribution grid that, when installed in the right locations, save money by postponing upgrades to the distribution system or avoiding them altogether. Distributed energy resources can also make the grid more resilient when a big power plant or transmission line goes down because of extreme weather or some other type of grid emergency. California should improve approaches for identifying and quantifying the value of clean distributed energy resources on the electricity grid so that these technologies can play a bigger role in helping the state reduce reliance on fossil fuels and maintain a reliable grid.

8. Electrify cars, trucks, and buildings.

Transitioning from gasoline- and diesel-powered vehicles to ones powered by clean electricity will dramatically reduce pollution from the transportation sector, a very significant source of greenhouse gas emissions and air pollution in the state. Likewise, the furnaces and water heaters that burn natural gas in most buildings will need to be replaced by heaters that run on clean electricity. As California scales up efforts to reduce fossil fuel use in the building and transportation sectors by switching to clean electricity, these investments should be deployed to be as flexible as possible, so that they use electricity and shift load in ways that are most supportive to the integration of renewables on the grid.

9. Shift electricity demand to better coincide with renewable electricity production.

Shifting electricity consumption—known as flexible demand—to times of the day when renewable generation is high will help take advantage of clean electricity during the periods when it is available and will reduce the need for ramping up natural gas plants during other periods of the day. Key opportunities to better match electricity consumption with renewable energy production are policies and programs for electric vehicle charging, smart appliances that automatically optimize when to run, and time-varying electricity rates that incentivize electricity use when renewables are most plentiful. Policies should be designed to protect vulnerable and low-income customers who may be unable to shift their electricity consumption behavior.



Organizations such as Grid Alternatives are making renewable energy technology and job training accessible to underserved communities, a key priority for advancing California's clean energy transition.

10. Promote high-quality jobs and workforce development.

Talented and skilled workers are needed to create California's clean energy future—in infrastructure, manufacturing, software, construction, maintenance, and more. The public, private, and non-profit sectors, including educational institutions, should collaborate to train and develop the workforce needed to fuel this growth. As new business models for the clean electricity grid are developed and tested, workers should benefit from the industry's growth and be paid a fair and living wage.

California is charting a path for other states to follow to meet the urgent goal of achieving 100 percent clean electricity.

Conclusion

Advancing these key solutions will require robust and cross-sectoral communication, information sharing, investment planning, and risk-management processes. Cross-sectoral coordination and planning is becoming more important as California's electricity and transportation sectors have grown and become more diverse, and as California strives to make deeper cuts to global warming emissions throughout all parts of its economy. California is poised to chart a path that other states and nations can follow to meet the urgent and widely shared goals of achieving 100 percent clean electricity, stabilizing our climate, and improving the quality of life for all communities.

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