

MANAGING THE EVOLVING GRID

DRAFT FOR BOARD APPROVAL

Climate change policy is driving innovation across the economy and ushering in new ways to grow and evolve the electric system. All eyes are on us as state policies and programs lead to reductions in greenhouse gas emissions.

1.4°F

amount Earth's average temperature has risen over the past century¹

5%

growth of carbon dioxide emissions nationwide from 1990-2012¹

32%

of greenhouse gas emissions in the U.S. in 2012 were from electricity production¹

Mandates:

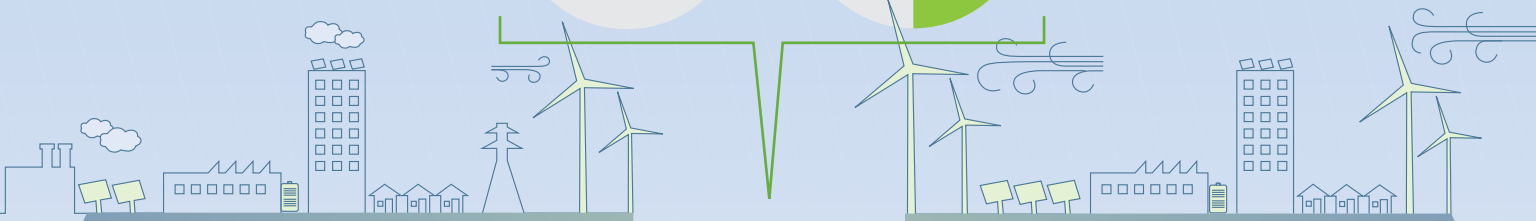
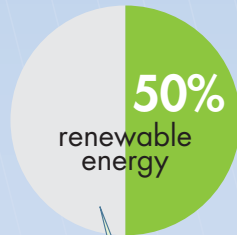
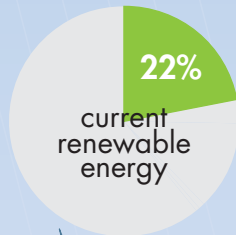
CA Renewable Portfolio Standard: **33%** renewable energy by 2020

U.S. Environmental Protection Agency's Clean Power Plan: **30%** reduction in carbon dioxide levels from existing power plants by 2030

California's goal by 2030

Resource mix

The ISO needs a resource mix that can react quickly to adjust electricity production to meet the sharp changes in demand.



Challenges

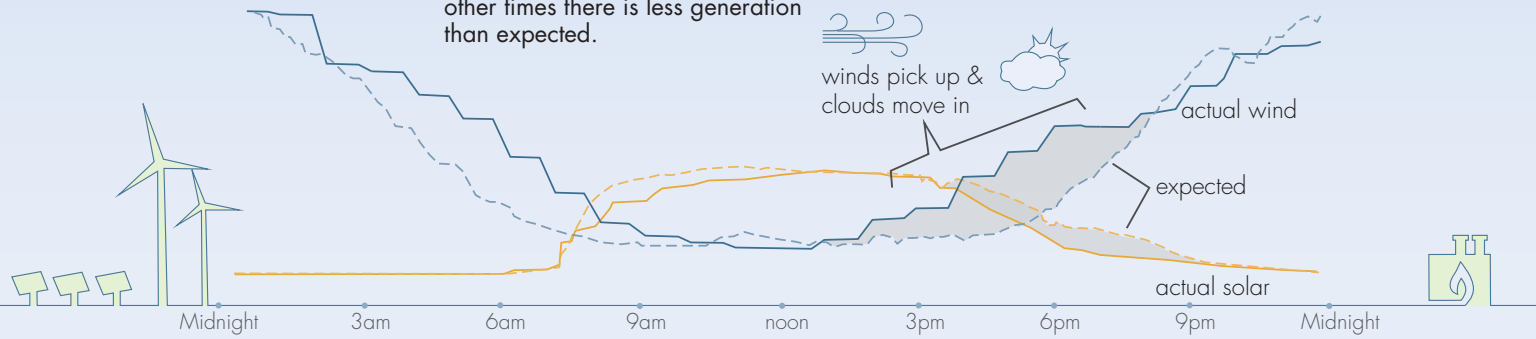
- can't turn it on and off as needed
- varies with weather & time of day
- infrastructure cost

INCREASING RENEWABLES ON THE GRID

Benefits

- cleaner air — less carbon emissions
- reduced environmental impact
- creates jobs

The ISO forecasts daily how much renewable generation will be available to meet user demand. Sometimes there is more, and other times there is less generation than expected.



Role of conventional generation

Conventional power plants are used to quickly ramp up or down to match demand.

Since it can take several hours for these plants to start up, they remain at least at a minimum operating level to maintain grid reliability when there is less renewable generation available to serve demand.

This minimum generation, when added to the available renewable generation, can result in **overgeneration**.



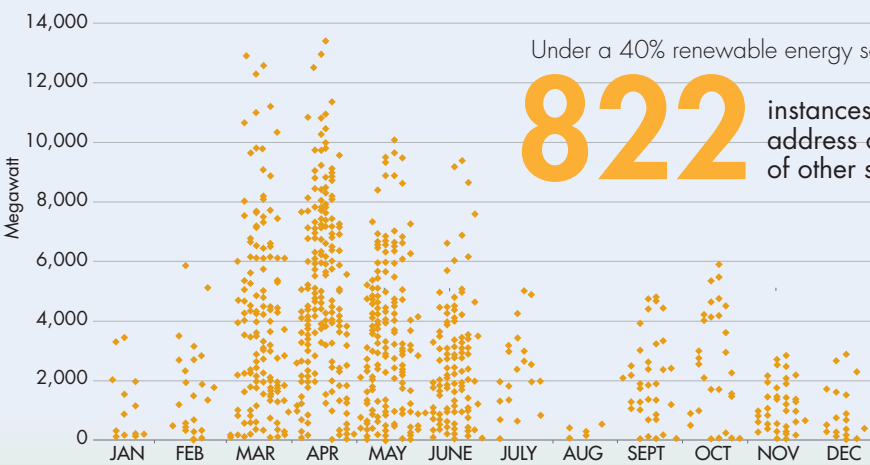
What is overgeneration

when more electricity is being generated than can be used



Managing overgeneration:

Generation must be reduced to match demand, but it's not as simple as it may seem.



Under a 40% renewable energy scenario, the ISO estimates

822

instances of renewable curtailment to address overgeneration in the absence of other solutions

Curtailing renewable power plants impacts our ability to achieve the

33% and 50%

renewable energy goals.

TO INTEGRATE RENEWABLES & ENSURE RELIABILITY

Encourage low carbon energy solutions such as **energy storage**, **demand response** and **expanded energy efficiency standards**.

Facilitate **renewable generation contribution** to grid reliability.

Leverage the **electrification of the transportation** system to reduce greenhouse gas emissions and help **consume surplus energy** when renewable generation output is high.

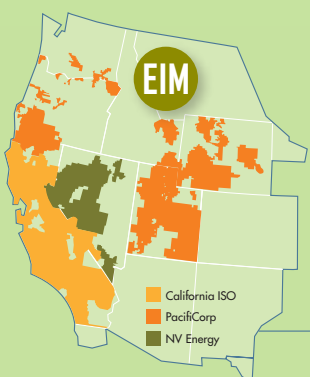
Provide **incentives for consumers** to adjust energy use in response to changes in supply and demand.

WHAT NEEDS TO HAPPEN

Encourage **development of more flexible generation resources** that can adjust to constantly changing system conditions.

Increase **regional collaboration** to expand the **diversity of resources** and to leverage opportunities for **infrastructure and operations efficiencies**.

This is our vision of what must happen to ensure grid reliability and efficiency while leading the transition to a low carbon grid.



¹ www.epa.gov/climatechange