Briefing held **JULY 2021**

One Pager

For more details about this briefing: ccst.us/expert-briefings

Technologies for **RENEWABLE ENERGY STORAGE**

Stanford University's decarbonization strategy includes three large water tanks for thermal energy storage at their Central Energy Facility. | Google Earth. Maps Data: © 2021 Google.

SUMMARY

- Increasing California's capacity for large-scale and long-term storage of variable renewable energy (e.g. solar and wind) is critical to accelerating California's goal to procure 100% of electricity from carbon-neutral sources by 2045.
- Increased energy storage capacity in California can also help to decarbonize other energy end uses (e.g. transportation or building heating), increase grid resilience, and accelerate the retirement of high-emission power plants that impact health.

Scaling up Renewable Energy **IN CALIFORNIA**

Senate Bill 100 (de Leon, 2018) requires California to procure 100% of all electricity from carbon-neutral resources by 2045. However, many carbon-neutral renewable energy sources (e.g. solar and wind) are variable, and electricity production cannot be controlled by grid operators.

As a consequence, there is frequently a mismatch between renewable energy production and demand. When renewable energy production is less than demand, the gap is usually filled with electricity produced from natural gas "peaker" plants. When renewable energy production is greater than demand, it is curtailed and any surplus unused.

Large-scale and long-term storage of surplus renewable energy would help reduce reliance on natural gas plants and ensure California achieves its goal of a reliable, carbon-neutral electric grid. Doing so would reduce anthropogenic carbon emissions—a leading cause of climate change—at a scale that is globally significant.

Examples of Ways to Store **SURPLUS RENEWABLE ENERGY**

BATTERIES
Batteries are charged to chemically store energy and then used to generate electricity when needed.

COMPRESSED AIR
Air is compressed to high pressure for storage and then used to run turbines to generate electricity.

PUMPED HYDROPOWER
Water is pumped uphill to a reservoir for storage and then allowed to flow downhill and run turbines to generate electricity.

GREEN HYDROGEN
Hydrogen gas is produced from the electrolysis of water using renewable energy for storage and then available for many end uses including regeneration of electricity.

THERMAL
Water or other materials are heated, chilled, or pumped underground for storage and then later available for building heating or other uses.

Stronger with Science for 30 Years

CCST
California Council on Science & Technology

About the
CCST Disaster Resilience Initiative:

Ongoing, complex, and intersecting disasters—including climate change, extreme heat, power outages, and the COVID-19 pandemic—are radically disrupting the ways in which Californians live and work. CCST is committed to delivering science and technology advice to improve our resilience to disasters, reduce harm, and improve the lives of all Californians.

SELECT EXPERTS

The following experts can advise on renewable energy storage technologies:

JANEA SCOTT (Moderator)
Senior Counselor to the Assistant Secretary for Land and Minerals
U.S. Department of the Interior
janea_scott@ios.doi.gov
Expertise: renewable energy policy

NOEL M BAKHTIAN, PhD
Exec. Director, Energy Storage Center
Berkeley Lab
noel@lbl.gov
Expertise: emerging energy storage technologies

JOAN CASEY, PhD
Asst. Prof., Environmental Health Sciences
Columbia Mailman School of Public Health
jac2250@columbia.edu
Office: (212) 304-5502
Expertise: environmental health, environmental justice, and sustainability

ROBERT D CORMIA
Chemistry Faculty, Foothill College
Cormiarobert@fhda.edu
Office: (650) 949-7456
Expertise: implementation of energy storage to meet decarbonization goals

SARAH KURTZ, PHD
Professor, School of Engineering
UC Merced
skurtz@ucmerced.edu
Office: (303) 881-5085
Expertise: pathways for scaling up renewable energy storage

Contact:
CCST Deputy Director:
Sarah.Brady@ccst.us

Benefits of
RENEWABLE ENERGY STORAGE IN CALIFORNIA

(BLM / Tom Brewster Photography)

(BLM / Tom Brewster Photography)

Photos: Solar and wind renewable energy resources.

Storing
RENEWABLE ENERGY

Energy storage technologies allow the State to capture surplus renewable electricity production for use when the sun is not shining, or the wind is not blowing. Increasing energy storage capacity will reduce the need for fossil sources of electricity and will reduce the total solar and wind resources needed to ensure a reliable, zero-carbon grid.

Reducing the
CARBON FOOTPRINT

Increased renewable energy storage can not only help to decarbonize electricity production but can also help to decarbonize other energy end uses including transportation and building heating and cooling. College campuses across the state are working to increase thermal energy storage capacity to heat and cool buildings without relying on natural gas boilers and other fossil sources.

Improved Grid
RESILIENCE

Microgrids that provide local storage of renewable energy can help provide campuses or local communities with a reliable source of carbon-free electricity in the event of grid disruptions such as rolling blackouts or public safety power shutoffs (PSPS). Local storage can help increase resilience to disasters while reducing the need for fossil-fuel driven backup generators.

Co-Benefits to
IMPACTED COMMUNITIES

Communities near natural gas peaker plants are exposed to the air pollution they produce. The resulting high occurrence of poor health outcomes raises concerns of equity and environmental justice. New renewable energy storage resources can be sited to optimize the balance between improving grid reliability and retiring natural gas peaker plants that cause the greatest harm to human health.

STRONGER WITH SCIENCE FOR 30 YEARS

CCST
CALIFORNIA COUNCIL ON SCIENCE & TECHNOLOGY

Making California's policies stronger with science and technology since 1988.

Learn more: www.ccst.us

Follow us: CCSTorg @CCSTorg