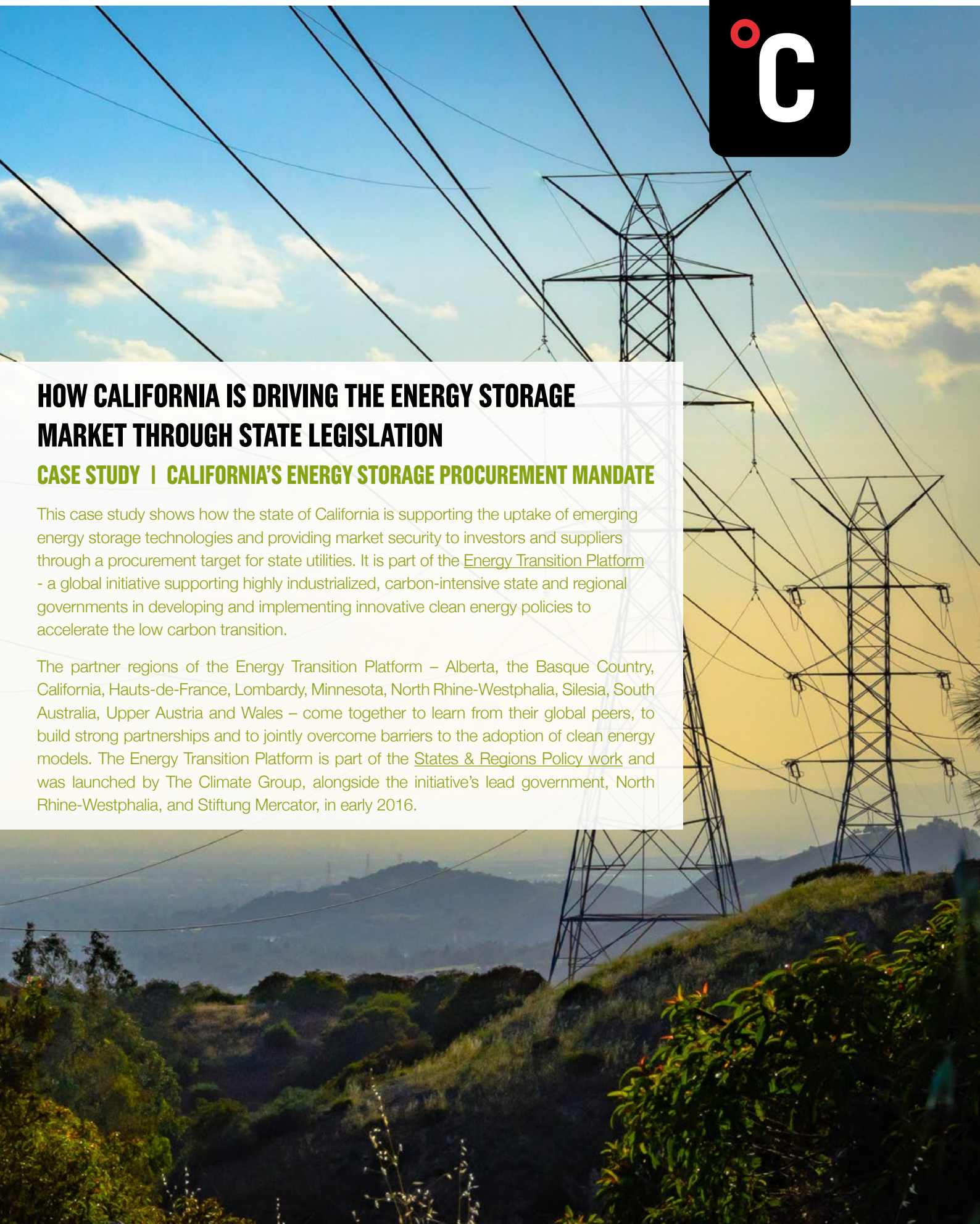
STATES & REGIONS



HOW CALIFORNIA IS DRIVING THE ENERGY STORAGE MARKET THROUGH STATE LEGISLATION

CASE STUDY | CALIFORNIA'S ENERGY STORAGE PROCUREMENT MANDATE

This case study shows how the state of California is supporting the uptake of emerging energy storage technologies and providing market security to investors and suppliers through a procurement target for state utilities. It is part of the Energy Transition Platform - a global initiative supporting highly industrialized, carbon-intensive state and regional governments in developing and implementing innovative clean energy policies to accelerate the low carbon transition.

The partner regions of the Energy Transition Platform – Alberta, the Basque Country, California, Hauts-de-France, Lombardy, Minnesota, North Rhine-Westphalia, Silesia, South Australia, Upper Austria and Wales – come together to learn from their global peers, to build strong partnerships and to jointly overcome barriers to the adoption of clean energy models. The Energy Transition Platform is part of the States & Regions Policy work and was launched by The Climate Group, alongside the initiative's lead government, North Rhine-Westphalia, and Stiftung Mercator, in early 2016.

"AS CALIFORNIA AIMS TO FURTHER REDUCE GREENHOUSE GAS EMISSIONS AND - BY 2030 - GET 50% OF ITS ELECTRICITY FROM RENEWABLE SOURCES, FLEXIBLE RESOURCES SUCH AS ENERGY STORAGE WILL BE IMPORTANT TO BALANCE THE POWER GRID."

- Robert B. Weisenmiller, Chair, California Energy Commission

SUPPORTING ENERGY STORAGE FOR AN OPTIMIZED AND DECARBONIZED GRID

The rapid uptake of renewable energy - a crucial aspect of the energy transition - has important consequences on grid management. Energy storage is key to maximize the benefits of renewables and ensure that their integration leads to a reliable and affordable electricity supply.

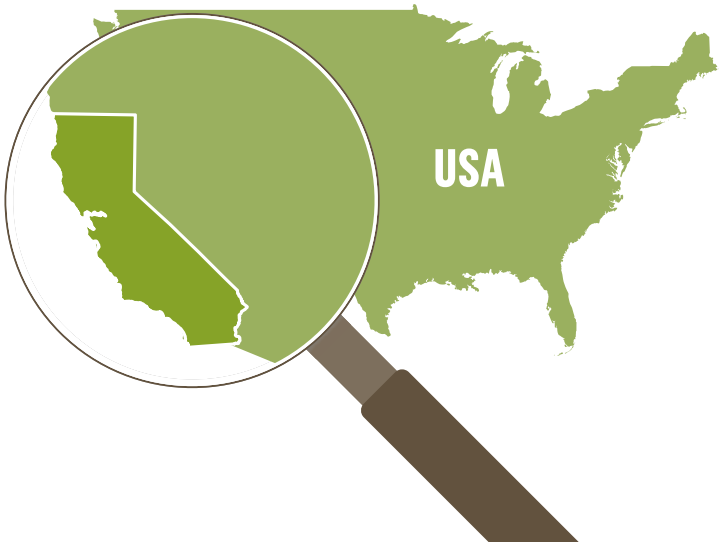
As costs plummet and performance improves, the energy storage market is expected to boom in the coming decades. According to the International Renewable Energy Agency (IRENA), battery storage alone could increase from around 1 gigawatt (GW) today to 250 GW by 2030.

With its innovative and ambitious policies, California is a global leader in the development and deployment of energy storage. The state currently has over 4.2 GW of installed storage capacity - 96% of which is pumped hydroelectric. Although significant, it is still far short of the 13 GW needed to meet daily peak electricity demand.

In October 2013, the California Public Utilities Commission (CPUC) adopted a **1,325 megawatts (MW) procurement mandate for electricity storage by 2020**, with targets increasing every two years between 2016 and 2020. An additional four laws were adopted in 2016 to increase and help reach this initial goal.

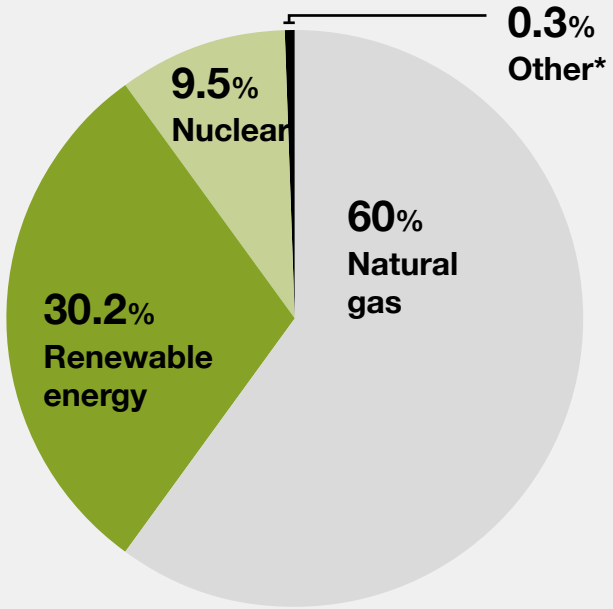
California's energy storage policies were presented in an online Peer Forum of the Energy Transition Platform in February 2017 by Kevin Barker, John Mathias and Mike Gravely of the California Energy Commission.

SPOTLIGHT ON CALIFORNIA



GOVERNOR	EDMUND G. BROWN JR (DEMOCRATIC PARTY)
STATE LEGISLATURE	DEMOCRATIC PARTY MAJORITY IN THE STATE SENATE AND STATE ASSEMBLY
GDP	US$2.5 TRILLION (2015)
POPULATION	39,300,000 (2016)

ELECTRICITY GENERATION MIX (2015)[1]



*** Including oil and coal**

1 http://www.energy.ca.gov/almanac/electricity_data/electric_generation_capacity.html

ENERGY STORAGE PROCUREMENT MANDATE: CALIFORNIA HAS ADOPTED AN AMBITIOUS ENERGY STORAGE PROCUREMENT MANDATE FOR INVESTOR OWNED UTILITIES (IOUS) TO INSTALL 1,325 MW OF STORAGE BEFORE 2024 – THEREBY PROVIDING LONG-TERM DEMAND AND SECURITY TO THE GROWING ENERGY STORAGE MARKET.

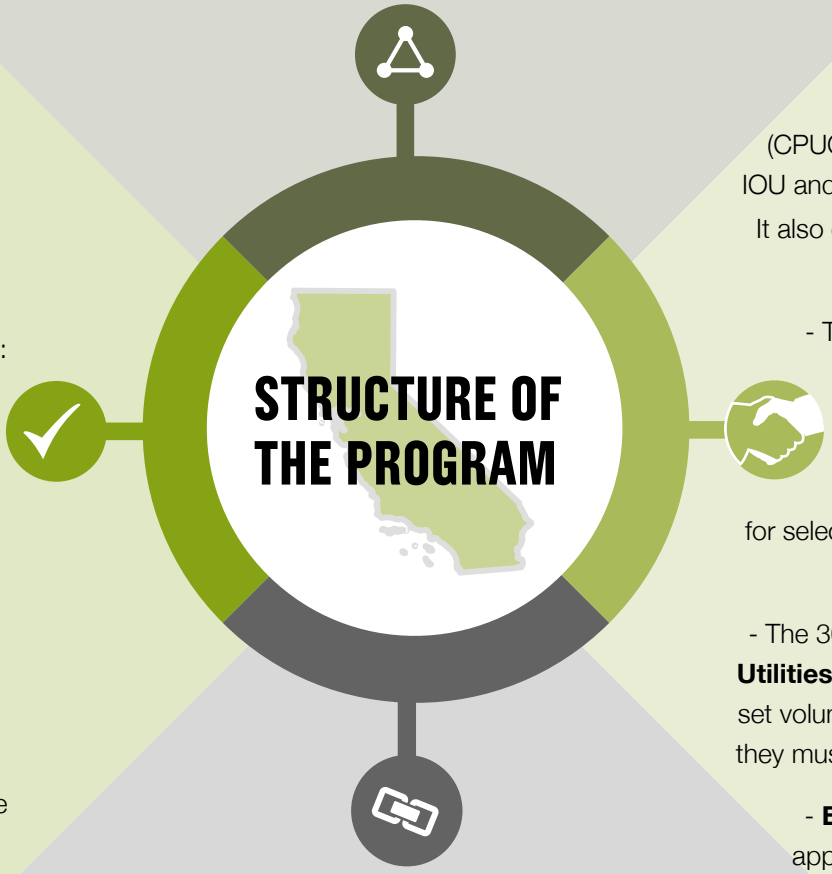
LEGISLATIVE FRAMEWORK

In October 2013, the CPUC adopted a **1,325 MW energy storage procurement mandate** applying to the state's three IOUs. The target is divided between transmission connected, distribution level and customer-sited storage and includes a large number of chemical, mechanical and thermal technologies. However, hydroelectric storage projects larger than 50 MW are not eligible.

In September 2016, the state adopted four new bills to streamline the market and accelerate storage uptake: i) creation of an **independent body to resolve interconnection disputes**, ii) **addition of a supplementary 500 MW target**, iii) expression of support to **long duration bulk storage**[2], and iv) expansion of the **funding incentives for customer-sited storage**.

BENEFITS

- Decarbonization of the grid and support for California's Renewable Portfolio Standard through the efficient **integration of renewable energy**.
- **Optimization of the grid**: improvement of reliability, security and affordability of the electricity supply.
- **Long-term vision** providing security to investors and suppliers.
- **Transformation and diversification of the energy storage market**: support to emerging technologies, smaller scale projects and disruptive suppliers (e.g. start-ups).



STAKEHOLDERS

- The **California Public Utilities Commission** (CPUC) sets the targets for each IOU and each round of solicitation. It also ensures the eligibility of the selected projects.

- The three **Investor Owned Utilities** (IOUs) received storage procurement targets based on their size and are responsible for selecting and financing storage projects.

- The 30 smaller **Publicly Owned Utilities** (POUs) are encouraged to set voluntary storage targets which they must review every three years.

- **Energy storage suppliers** apply to the IOUs' competitive solicitations (Request for Offers (RFOs)).

PROCESS

- **Timeline**: energy storage projects must be installed and operational after January 1, 2010, and **no later than December 31, 2024**.
- **Procurement**: the utilities must hold **competitive solicitations** - in the form of RFOs - at least once every two years. The first round started in December 2014, followed by three more rounds in 2016, 2018 and 2020, with larger capacity targets each time.
- **Selection process**: for each round, the mandated utilities must select the best performing and most cost-efficient projects and **get approval from the CPUC**. Project approval is granted based on the net cost to ratepayers, as well as compliance with the threefold objective of grid optimization, renewable energy integration and emissions reduction.

2 Mainly pumped hydroelectric storage

CLIMATE ACTION TARGETS

BY 2020

Reduce GHG emissions to 1990 levels

BY 2030

GHG reduction (1990 levels)

BY 2050

GHG reduction (1990 levels)

Renewable Portfolio Standard

BY 2020

Electricity consumption from renewables

BY 2030

Electricity consumption from renewables

Supported by the Climate Change Scoping Plan (updated in May 2014). The plan identifies approaches to channel low carbon investments and recommends policies to reduce emissions from various sectors such as energy and transport.

CALIFORNIA'S ENERGY STORAGE PROCUREMENT MANDATE

WHAT IS THE POLICY AIMING TO SOLVE?

The **share of renewable energy in the Californian mix has been growing exponentially** in the last few years – solar photovoltaic, for example, has skyrocketed from just 3 GWh in 2008 to 12,571 GWh in 2015.[3] This growth has a significant impact on the **imbalance between peak demand and renewable energy production** (as peak demand usually occurs after sunset, while solar production peaks around midday). This gap can be met either through baseline generation (usually thermal power) or through energy storage – the low carbon alternative.

The uptake of energy storage is also a way to mitigate the **risks linked to infrastructure failure**. In 2012 and 2015, two leakage incidents in a nuclear power plant and a gas facility led to partial shut-downs, leaving whole areas of California at risk of forced power outages. Following the second incident, the CPUC ordered Southern California Edison - the owning utility - to install energy storage to mitigate future power failures. Within the next six months, over 100 MW of energy storage were installed.

The procurement mandate aims to improve the security, reliability and affordability of electricity supply, while also helping to achieve California's renewables and climate targets.

HOW IS IT INNOVATIVE?

The Californian mandate was the **first of its kind worldwide**. Not only is the set target very ambitious – it is now close to 2 GW with the addition of 500 MW in 2016 – but the approach also goes beyond traditional storage incentives by mandating utilities to install set capacities.

In addition, the mandate creates a **new, long-term market for diverse storage technologies and suppliers**. The CPUC chose to make large-scale hydro storage ineligible to ensure the target is met through a variety of smaller projects. This is fostering emerging technologies and creating market opportunities for new storage solution providers.

HOW LONG DID IT TAKE TO IMPLEMENT?

The process of establishing the mandate took **about three years**. In September 2010, the Californian Governor signed Assembly Bill 2514, directing the CPUC to open a proceeding to adopt – if appropriate – targets for utilities to procure viable, cost-effective energy storage. Between 2012 and 2013, the CPUC ran a series of workshops to evaluate cost and benefits of energy storage, use cases, procurement options and cost effectiveness. The targets were adopted in October 2013.

The mandate is being implemented through four rounds of solicitations every two years between 2014 and 2020. All 1,325 MW of storage must be installed by 2024.

3 http://www.energy.ca.gov/almanac/electricity_data/electric_generation_capacity.html

"THERE'S BEEN MORE PROGRESS ON THE PERFORMANCE AND COST OF BATTERIES IN THE LAST FIVE YEARS THAN IN THE PREVIOUS 25. NEW TECHNOLOGIES PERFORM BETTER, LAST LONGER AND ARE MUCH MORE ATTRACTIVE TO INVESTORS."

- Mike Gravely, Research Program Manager, California Energy Commission

HOW IS THE PROGRAM FINANCED?

The mandated utilities must cover the costs of their selected storage projects, which has led to concerns over the issue of **cost recovery**. This issue was resolved in part by allowing **flexibility** in the types of energy storage projects procured and in the procurement timeframe, and in part by employing a variety of **cost recovery mechanisms**, such as distribution and transmission rates, generation charges, and the CPUC's cost allocation mechanism (CAM).[4] To make sure that electricity prices remain affordable, the utilities must justify each selected project to the CPUC and ensure that it is the most cost-effective.

California also provides **strong R&D support** to energy storage, with about US$100 million per year dedicated to research & development in electricity generation, and another US$100 million for alternative and renewable fuels and advanced transportation technologies,[5] funded through vehicle and boat license fees. These significant resources are crucial to research and support the scale-up of new storage technologies such as flywheel, vehicle-to-grid and compressed air storage.

WHAT WERE THE MAJOR CHALLENGES TO DESIGNING AND IMPLEMENTING THE POLICY AND HOW WERE THEY OVERCOME?

Significant challenges that arose during the design phase included:

- Determining the amount of the storage target;
- setting the procurement schedule;
- potential future adjustments to targets;
- flexibility in types of storage projects allowed;
- ownership of storage projects;
- cost-effectiveness; and,
- confidentiality provisions.

These issues were discussed throughout the series of public workshops held by the CPUC over a period of two years. The CPUC also solicited comments from stakeholders and incorporated these into its final decision.

A major impediment to implementing the policy has been interconnection issues between storage facilities and the grid. Assembly Bill 2861, adopted in September 2016, created an independent body to resolve these disputes within 60 days.[6]

A procurement target should be significant enough to drive the market, but not too large as to incur unreasonable costs on ratepayers.

POLICY TIP

RESULTS TO DATE

So far, the mandated utilities have procured **488 MW of energy storage** – but a limited capacity has been installed. However, solicitations started in December 2014, with another eight years to go for the operationalization of storage projects. As the mandate is still at the beginning of its implementation period, most projects are in the planning or contracting phases. The four additional bills adopted in September 2016 are expected to help streamline and accelerate the uptake of storage.

To date, energy storage in California represents about 86% of non-residential storage in the US, 36% of utility storage and 31% of residential storage.[7]

4 The CAM is a regulatory process for allocating capacity costs of utility procurement across all benefitting customers. Find more information here.
5 Vehicle to grid storage is one of the most promising technologies in California
6 https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160AB2861
7 http://www.utilitydive.com/news/a-storage-bubble-high-investment-in-nascent-industry-sows-fears-of-a-batte/432121/

A region-wide storage procurement target is usually more cost-effective than mandating a percentage of on-site storage for each new renewables project – it provides the opportunity of building storage at the most favorable location and lowest cost.

LESSON LEARNED

WHAT ARE THE KEY REQUIREMENTS TO REPLICATE THE POLICY MODEL?

Following the electricity crisis in the early 2000s, California installed **smart meters** in most commercial and residential buildings. They provide high quality, real time data on load profile and inform hourly energy storage needs. Alternative ad hoc consumption monitoring is a costlier solution which also impacts data quality. A **comprehensive roll-out of smart meters** could be a very important first step when replicating the Californian model.

In addition, having a strong **R&D support structure** is crucial in helping to develop emerging technologies and to improve the performance and cost-effectiveness of storage systems.

The Californian model has already inspired other states: in 2015, the US state of Oregon adopted a similar bill, requiring its two main electricity providers to operationalize a minimum of 5 megawatt-hours (MWh) of energy storage by 2020. Massachusetts is currently working on its own procurement targets, which are scheduled to take effect in 2020.

DIFFERENT STORAGE TECHNOLOGIES FOR DIFFERENT USE CASES[8]

California's procurement mandate includes a wide range of technologies, such as lithium-ion, zinc-air, thermal, flywheel and compressed air storage. Each technology has power rating[9] and discharge time[10] specificities which makes them most adequate to different uses. For example, lithium-ion batteries typically have a discharge time of a couple of hours and relatively small power ratings, which means they are used for **customer/industry** and **distribution support**, while compressed air storage has a higher discharge time (more than 10 hours) and higher power rating (above 10 MW), making it more appropriate for **transmission support and bulk storage**.

8 More information on battery technologies can be found here http://www.sandia.gov/ess/publication/doeepri-electricity-storage-handbook/
9 The power rating is the rate at which the storage equipment can discharge energy
10 The discharge time is the amount of time that the storage plant can discharge at its rated power without being recharged

CONNECT WITH CALIFORNIA

Alana Sanchez, International Relations Senior Advisor, California Energy Commission, alana.sanchez@energy.ca.gov

California Energy Commission: energy.ca.gov @CalEnergy

CONNECT WITH US IF YOU WANT TO KNOW MORE ABOUT OUR ENERGY TRANSITION PLATFORM

Anne-Sophie Dörnbrack: StatesandRegions@TheClimateGroup.org

THE CLIMATE GROUP

Europe | London | +44 (0)20 7960 2970 **China** | Beijing | Hong Kong | +86 (0) 10 64403639 | **India** | New Delhi | +91 11 4200 3342 | **North America** | New York City | +1 (646) 233 0550

T: +44 (0)20 7960 2970 | F: +44 (0)20 7960 2971 THECLIMATEGROUP.ORG | TWITTER.COM/CLIMATEGROUP

Funded by STIFTUNG MERCATOR

Supported by lead government

Ministerium für Klimaschutz, Umwelt, Landwirtschaft, Natur- und Verbraucherschutz des Landes Nordrhein-Westfalen