

Transformative Power of...

Energy Storage

Diane I. Fellman, Esq.

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Notes

- ❖ This presentation was prepared by a private individual formerly employed by the California Public Utilities Commission (CPUC). It does not necessarily represent the views of the CPUC, its Commissioners, or any other agency of the State of California as well as the California Independent System Operator (CAISO). The CPUC, the State of California, the CAISO, its employees, contractors, and subcontractors make no warrant, express or implied, and assume no legal liability for the information in this presentation. It has not been approved or disapproved by any of these entities, nor have they passed upon the accuracy or adequacy of the information in it.
- ❖ The Reference Slides at the end of the deck contain links to examples of storage policies; procurement documents, including RFO protocols and *pro forma* contracts as well as updates on current California policy developments. They are marked with the book icon.
- ❖ The slides used in this presentation are reproduced by permission from Strategen Consulting with whom Ms. Fellman has been engaged in developing a template for global deployment of energy storage policies and technologies in emerging economies.



For further information, visit www.stratagen.com



Energy Storage: Power System Gamechanger



Photo credit; General Electric

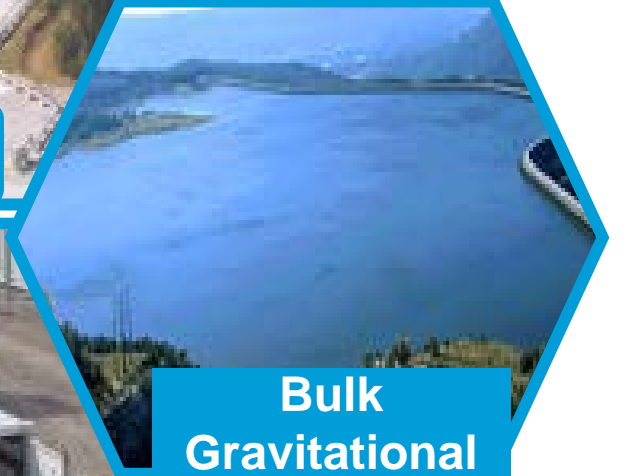
Whether “the grid” is a village micro-grid or a national grid or the globe



Energy Storage is a Broad Asset Class



Bulk Mechanical



Bulk Gravitational



Mechanical



Transportation

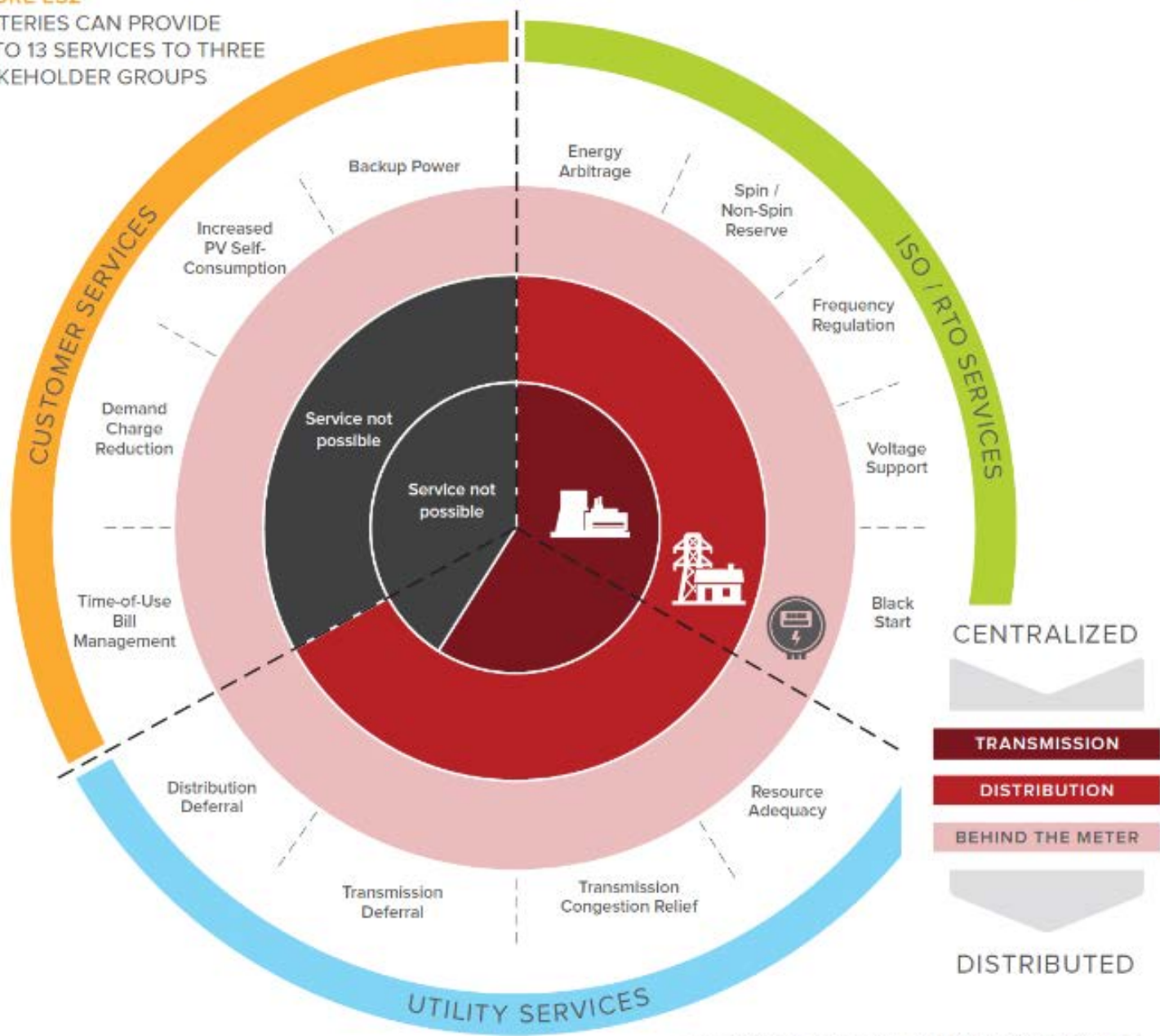


Electro-Chemical



Thermal

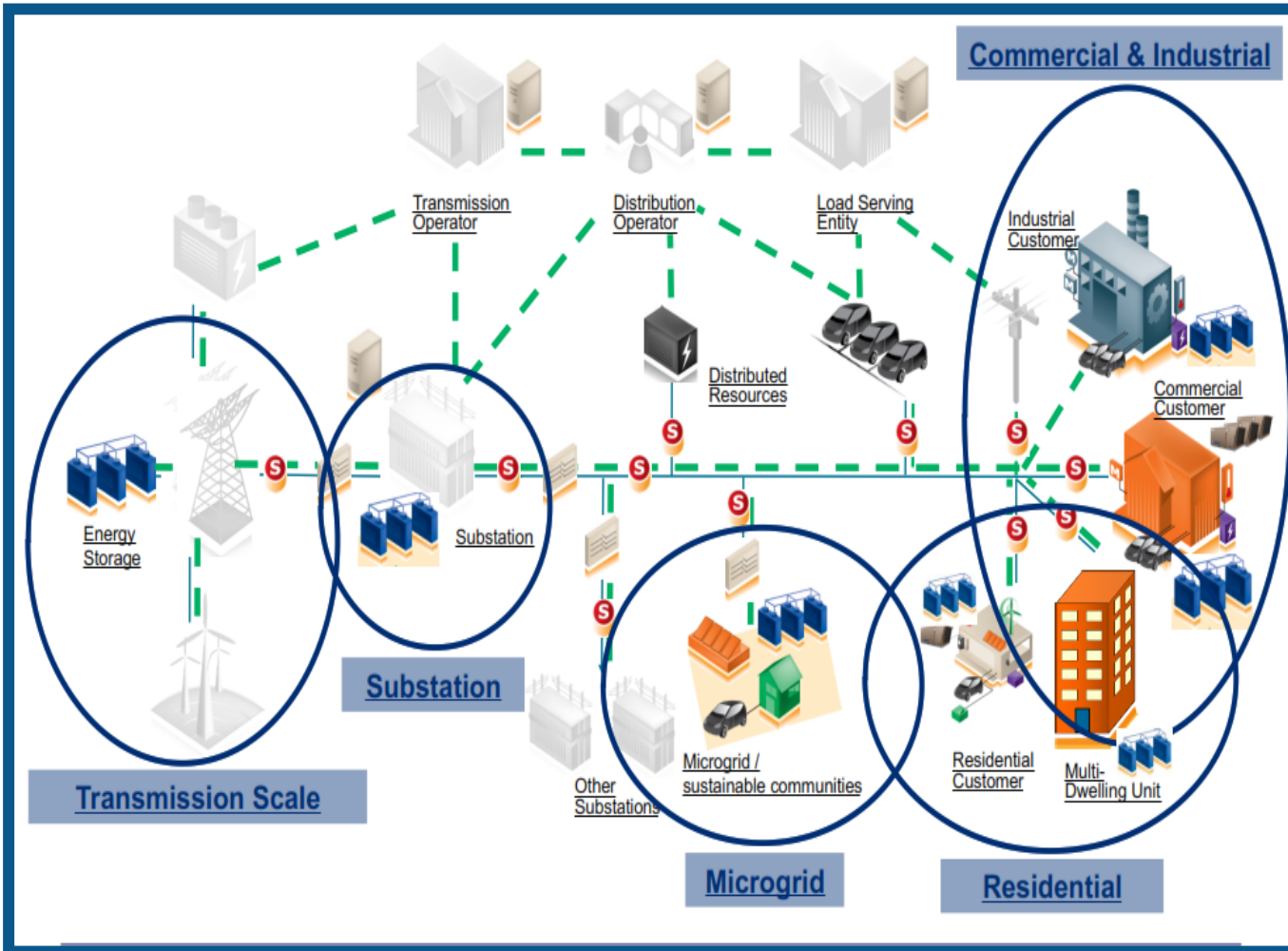
FIGURE ES2
 BATTERIES CAN PROVIDE
 UP TO 13 SERVICES TO THREE
 STAKEHOLDER GROUPS



Energy storage is the ultimate grid resiliency and reliability tool, enabling greater system efficiency and existing resource optimization



Where does storage best serve the grid?

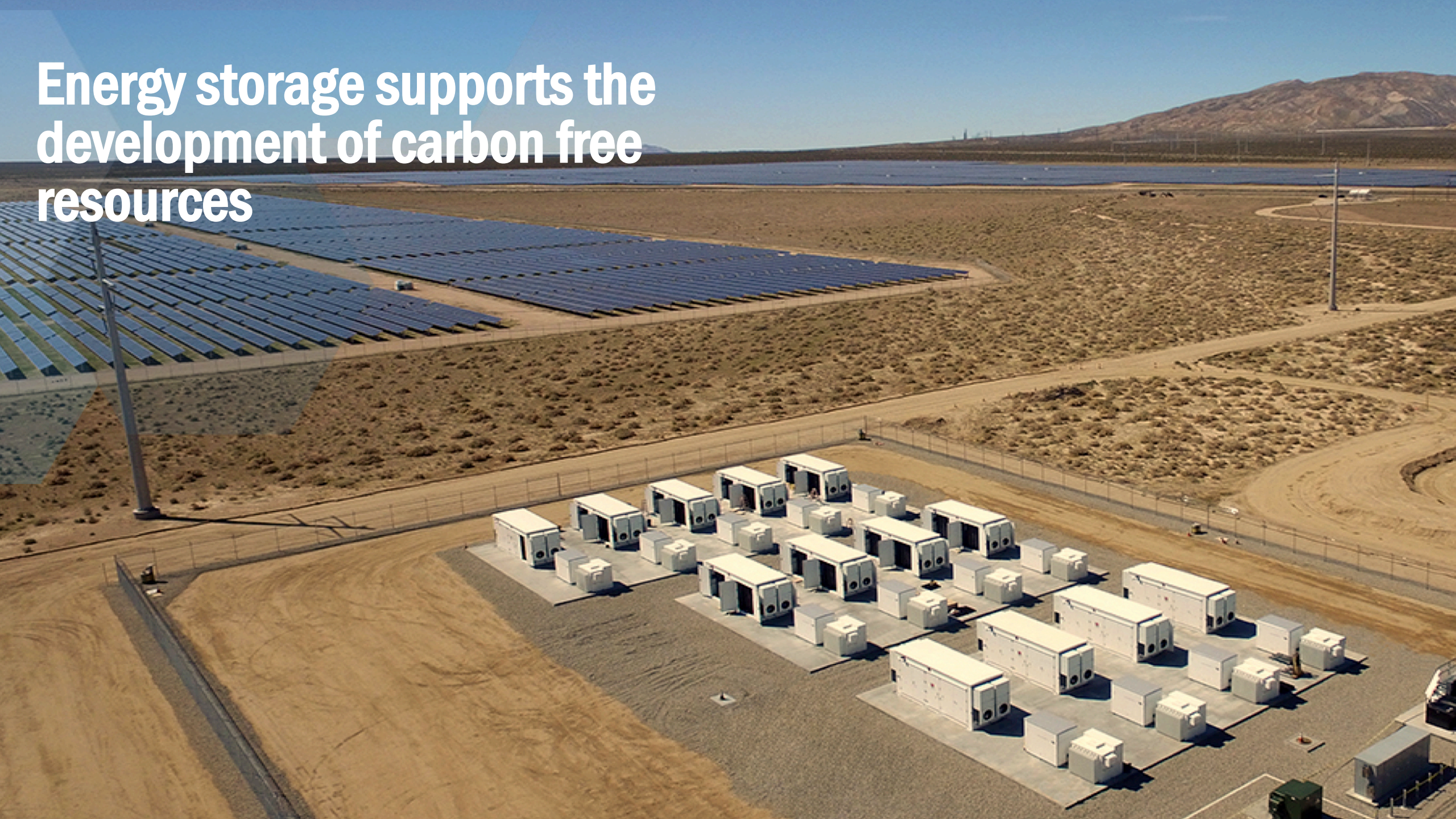


Source: Pacific Gas & Electric Company

<i>Domain</i>	<i>Services</i>
Customer	TOU bill management
	Demand charge management
	Increased consumption of on-site generation
	Back-up power
	DR Program Participation
Distribution	Distribution capacity/deferral
	Reliability (back-tie) services
	Voltage support
	Resiliency/microgrid/islanding
Transmission	Transmission deferral
	Black start
	Voltage Support
	Inertia
	Primary frequency response
Wholesale Market	Frequency regulation
	Imbalance energy
	Spinning Reserves
	Non-spinning reserves
	Flexible Ramping Product
Resource Adequacy	System RA capacity
	Local RA capacity
	Flexible RA capacity

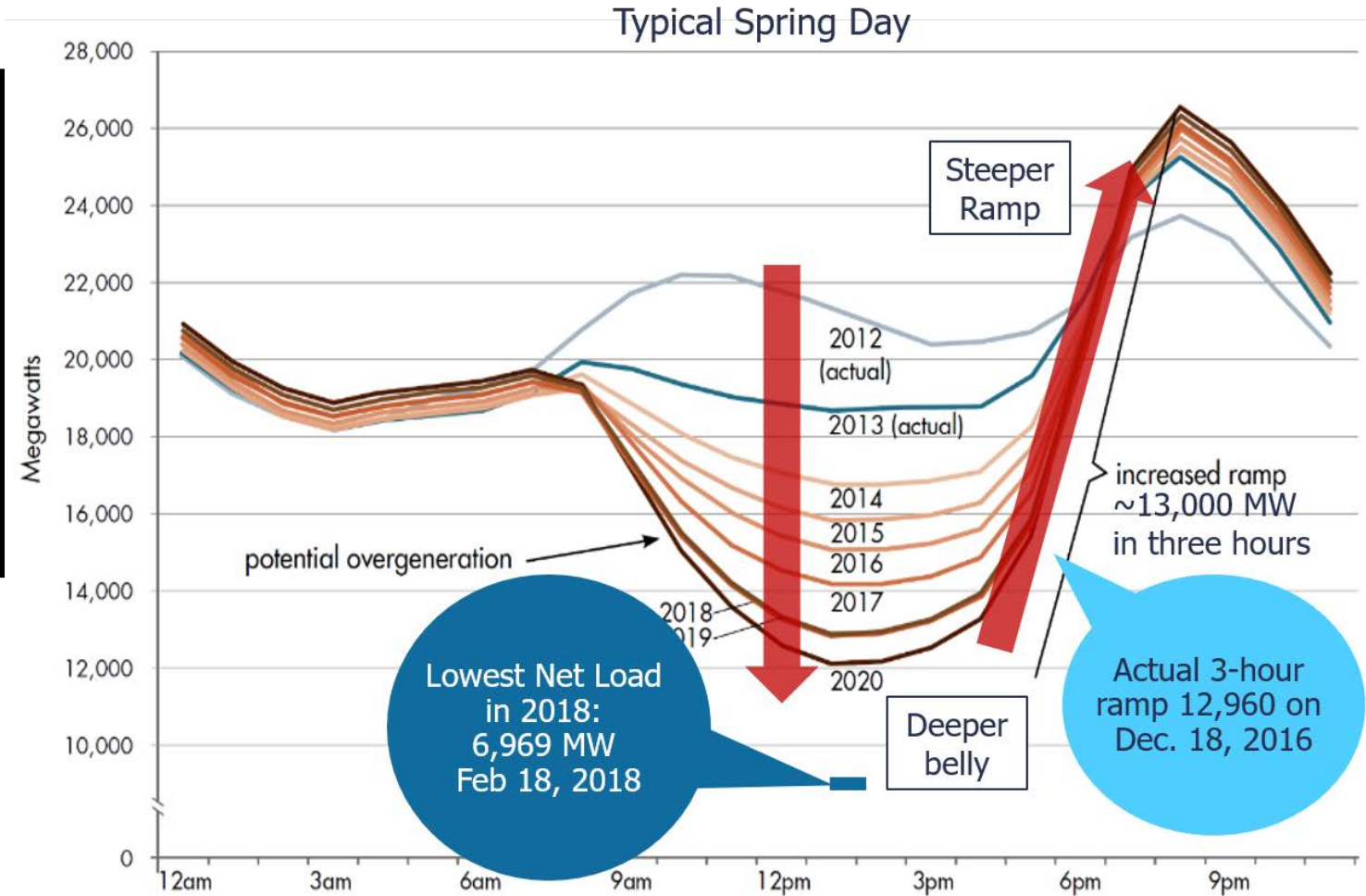
Source: California Public Utilities Commission

Energy storage supports the development of carbon free resources



Integrating renewables into existing grids is challenging:

Storage-enabled grids are the platform for building renewables

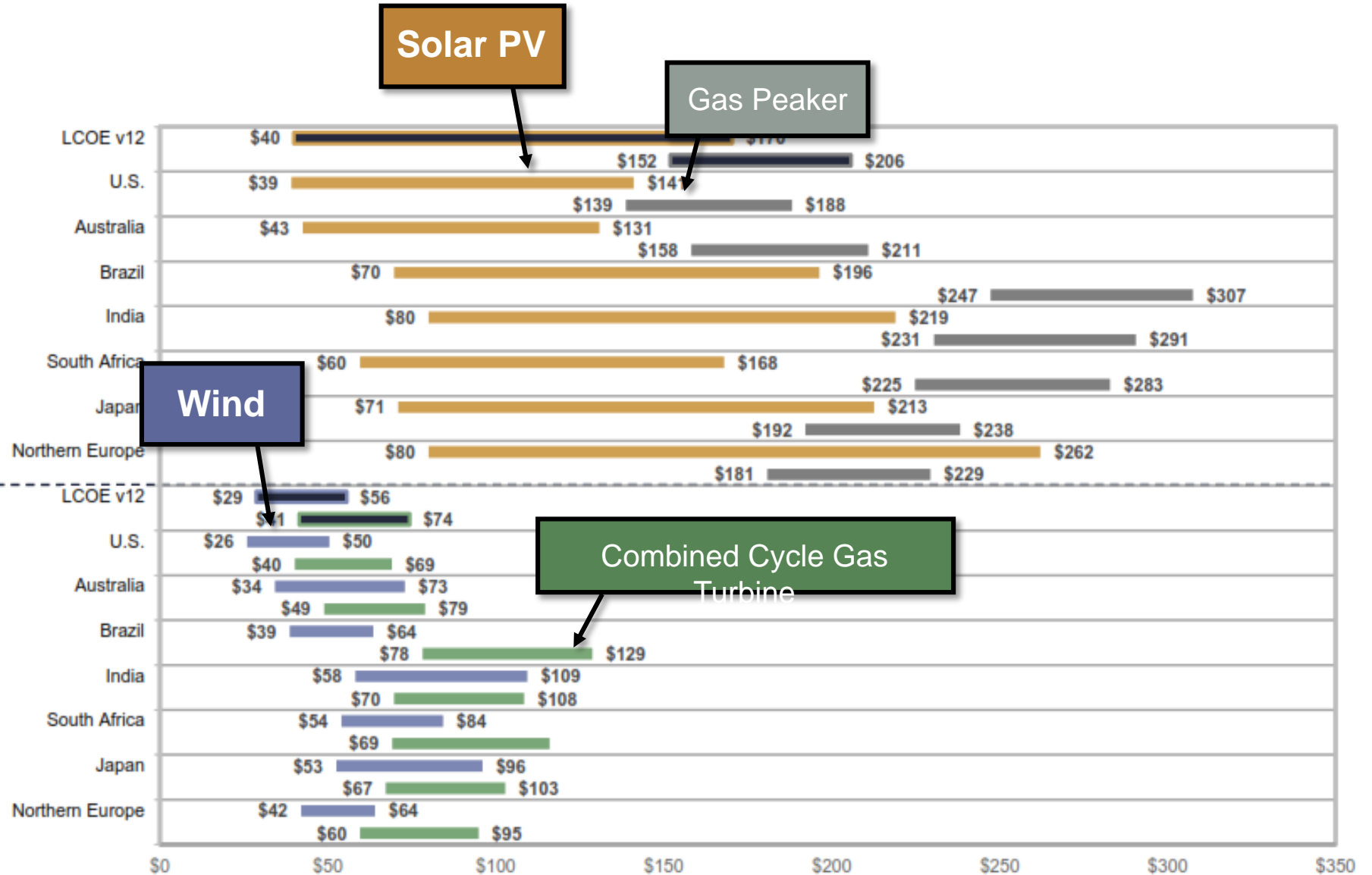


Ex: California's net load, forecasted and actual 2016 & 2018

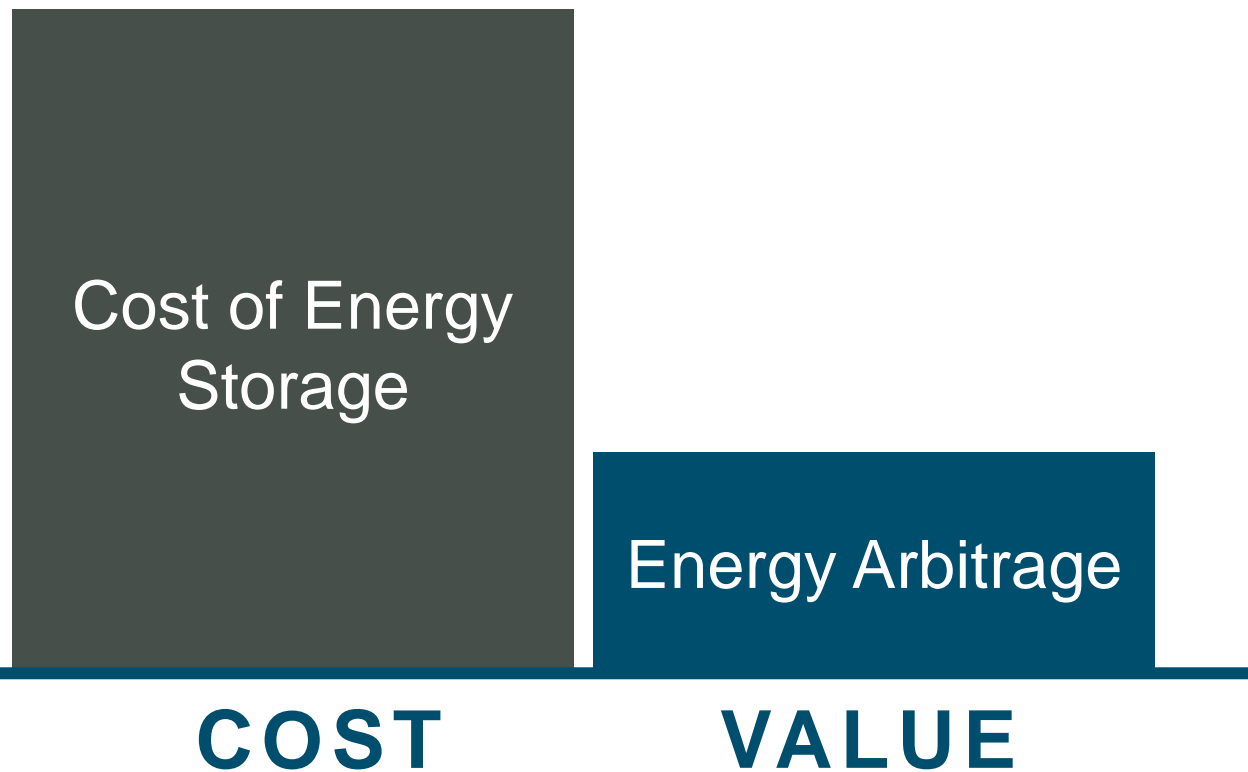
Wind and Solar are now cheaper than fossil generation

Solar PV⁽²⁾
versus
Gas Peaker⁽³⁾

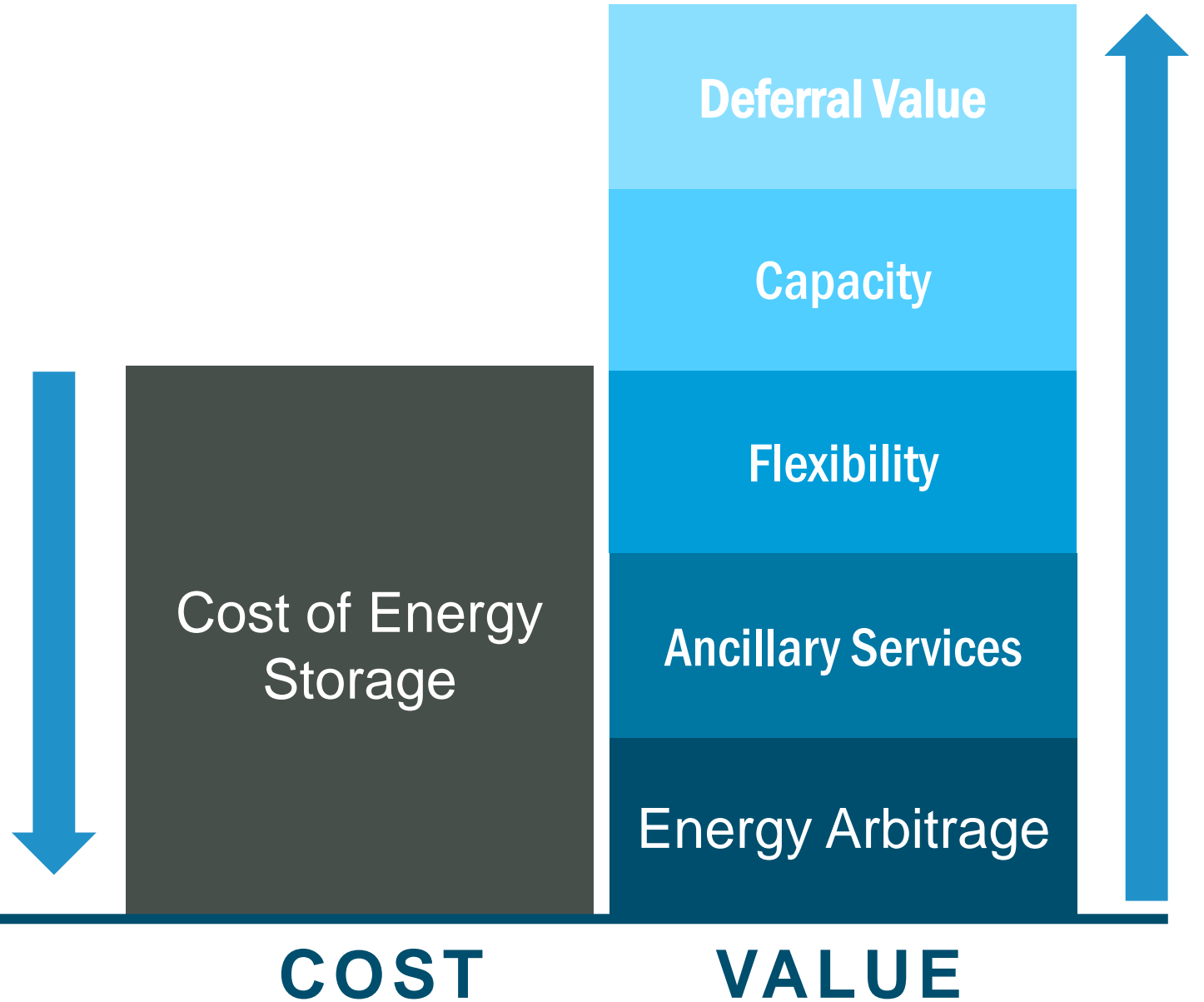
Wind⁽⁴⁾
versus
Combined Cycle
Gas Turbine⁽⁵⁾



Why would anyone want to buy energy storage when it is so costly?



Regulatory innovation enables recognition of the value storage can provide and accelerates technology costs reduction



**The value provided by energy storage is obscured
in an artificially siloed market structure ...**

Generation

Transmission

Distribution

Load

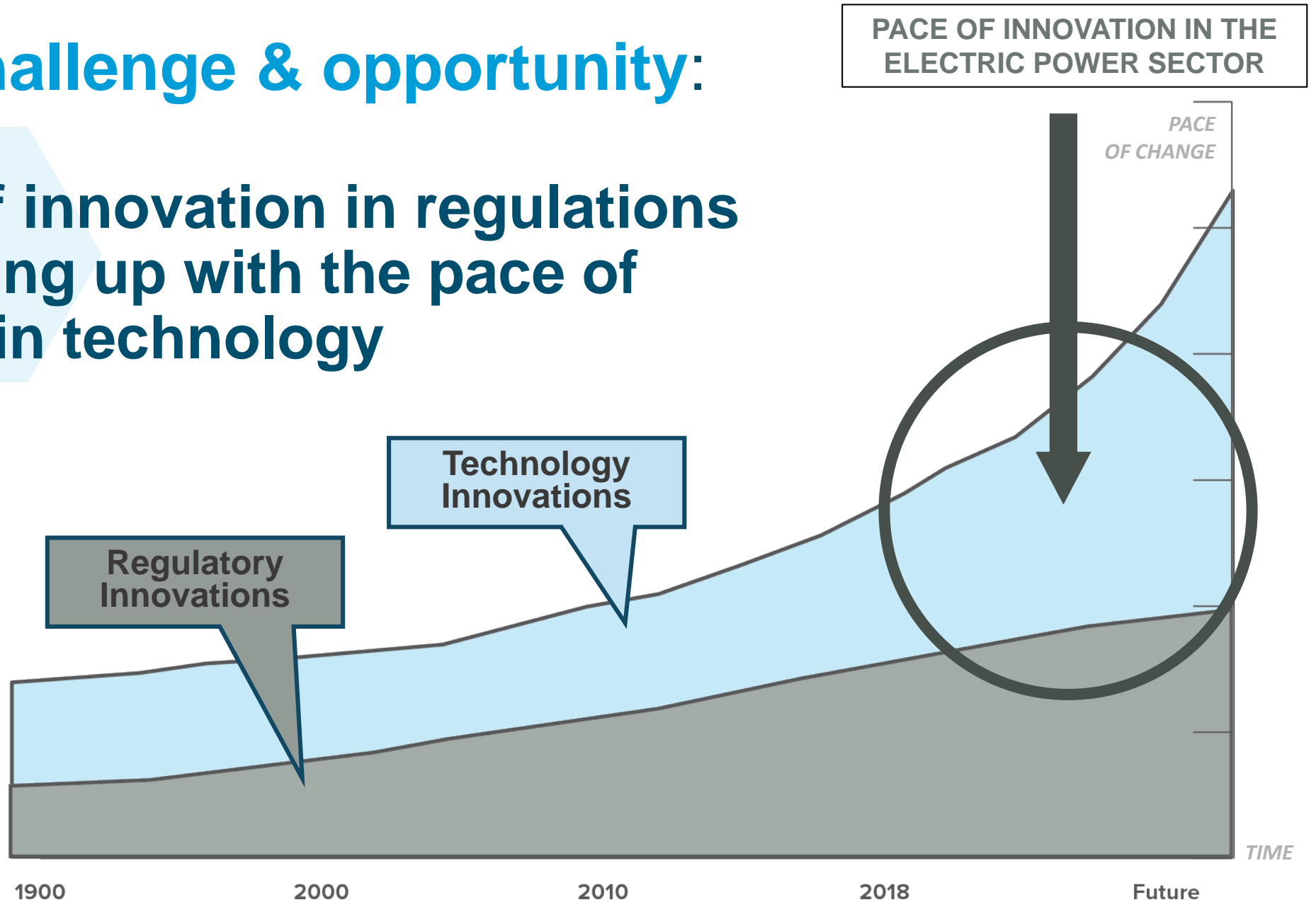
**...that is also extremely
risk averse.**

**New Paradigm:
Valuing and
procuring for
net benefits—
NOT just cost**



Today's challenge & opportunity:

The pace of innovation in regulations is not keeping up with the pace of innovation in technology



TIME

Appropriate market signals are necessary to scale up & accelerate progress



Market design



Capital +
Infrastructure
Investment



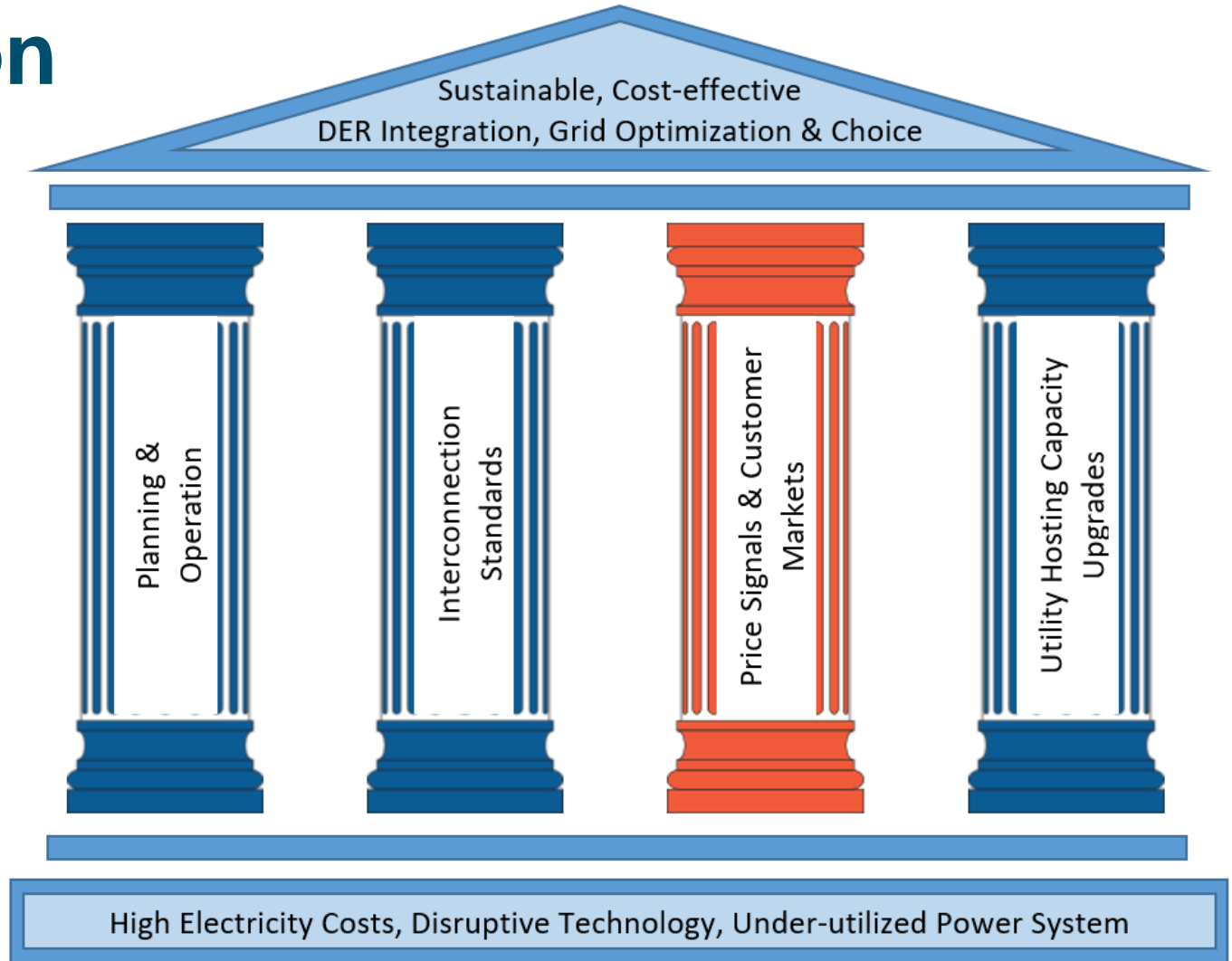
Progress + Impact
(and more innovation)

Grid Transformation Requires Several Pillars for Reform



Unlock potential through regulatory innovation

- Awareness
- Leadership
- Benefit Analysis Tools
- New Rules & Regulations



Policies for Storage Success

Statutes Mandates

- **Legislation**
- **Mandated Procurement**
- **Technology Neutral & Diversity of Size**
- **Priority over fossil fuels for grid resiliency**

Incentives Processes

- **Mini-grids**
- **Interconnection**
- **Wholesale Market: Price Signals**
- **Rate design: Time of Use; Net Metering**

Expanded Revenue

- **Long-term Contracting**
- **Multiple Use Applications: Storage/Solar**
- **Ancillary Services and Load Shifting**
- **Integrate Renewables**

Thank you!

Contact:

Diane Fellman

diane.fellman@yahoo.com

+1(415)601-2025

Reference Slides

**California Case Study:
Templates for Storage Policy Implementation**

Storage Procurement: Platform



Principles to justify storage

- Optimization of the grid (peak reduction, reliability, deferment of transmission & distribution)
- Integration of renewable energy
- Reduction of greenhouse gases (replace natural gas for generation)



Targets set for storage procurement with designated amounts ()

- Legislation
- Regulation ([Targets](#))



Regulatory proceedings provide the avenue for storage development

- Technology neutral
- Divided between utility scale and distributed energy resources (on site)



California Public Utilities Commission Storage Webpage: [Regulatory History, Proceedings, Orders & Decisions](#)

Legislation Examples: [Assembly Bill \(AB\) 2514](#) ; [AB 2868](#); [Senate Bill 801](#) ;

[CPUC proceeding: Rulemaking 15-03-011](#)

Examples of Procurement Protocols for Storage



Pacific Gas & Electric	<u>Energy Storage Program</u> & <u>2018 Local Area Energy Storage RFO</u>
Southern California Edison	<u>Aliso Canyon Energy Storage 2 RFO</u> & <u>Energy Storage & Distribution Deferral</u>
San Diego Gas & Electric	<u>Preferred Resources Solicitation (Storage)</u> & <u>Distribution Reliability Seeking Storage</u>
Community Choice Power	<u>Renewables + Storage Power Purchase Agreement</u> <u>Request for Proposals</u>

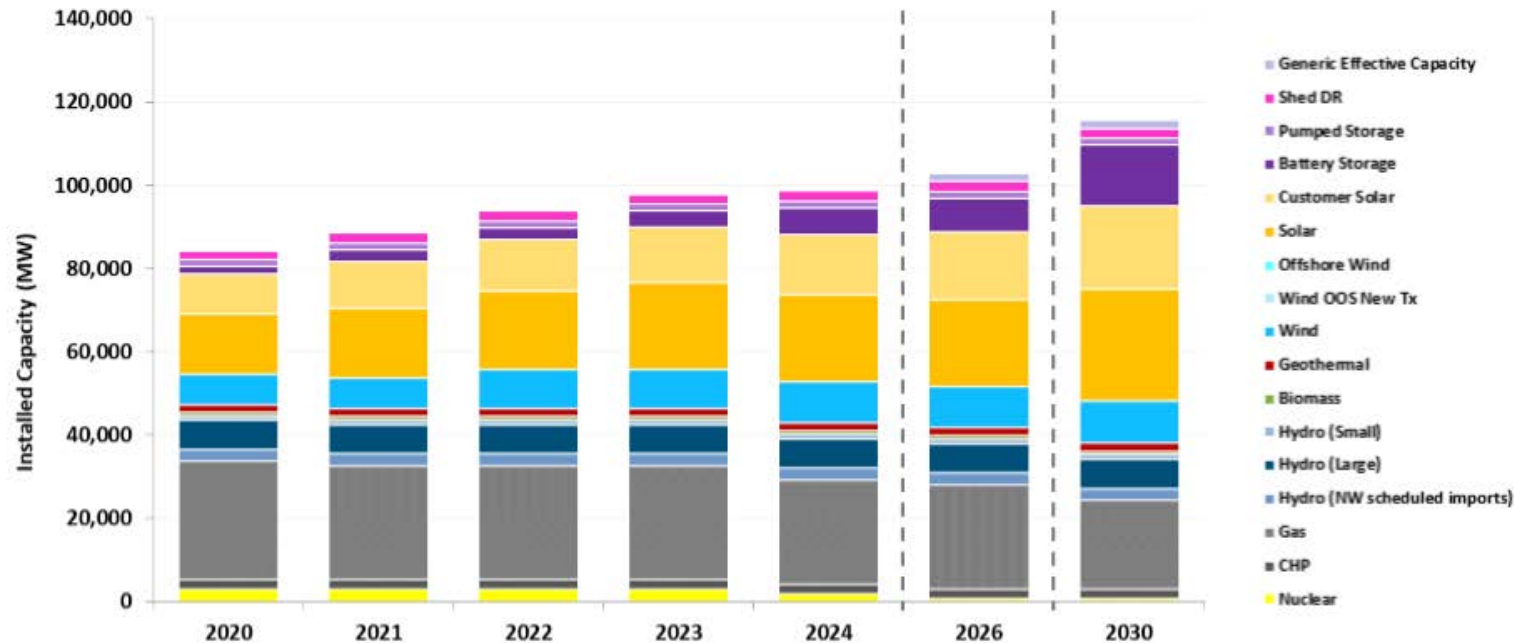


**In the links
there are
templates
for....**

- ✓ **Request for Offers (RFOs)**
- ✓ **Timelines**
- ✓ ***Pro forma* contracts**
- ✓ **Workbooks**
- ✓ **Technical specifications**
- ✓ **Frequently Asked Questions (FAQs)**

2019 California Integrated Resource Plan (IRP)

2019 IRP Proposed Reference System Portfolio, Total Resources, with 2 GW Generic Effective Capacity Added in 2026, aka "46 MMT Alternate"



The IRP 2019 "base case" for 2030 resources includes **11,000 MWs of storage** of all types to meet **reliability** goals and to **reduce greenhouse gas** emissions below the target level for the state.



Incentives: Self Generation Incentive Program

Objective

- Reduce GHG
- Demand Reduction
- Increased System Reliability
 - Improved transmission and distribution system utilization
 - Increase penetration of distributed energy resources (DER)

Mechanism

- Incentives
 - \$USD 500,000 collected to date
 - Ratepayer funded
 - Step down in value
 - Based on subscribers in queue
 - Annual budget
 - 80% to storage
(13% to residential < 10 kW)
- Technologies: Storage +
 - Wind, waste heat to power, biogas, pressure reduction turbines, fuel cells, small generation



[CPUC SGIP website](#)

2017 SGIP Handbook, [click here](#).

Utility SGIP websites: [PG&E](#) [SCE](#) [SDG&E](#) [SoCal](#)

Administration website: <https://www.selfgenca.com/>

CPUC Rule 21 Interconnection Standards

Objective

- Streamline interconnection of technologies at the distribution* level
 - CPUC governs interconnection of all third party resources to the grid
- Study issues relating to export of storage to the grid
- Impact of storage on timing and cost allocation for grid upgrades
 - Infrastructure deferment potential

*CAISO governs wholesale transmission system

Mechanism

- Utility tariff: CPUC process
- Timeframe to review applications
 - Fee schedules and impact studies
- Allocation of interconnection costs
- Technical operating parameters
 - Certification
 - Testing criteria
 - Inverter requirements
 - Metering and monitoring
- Dispute resolution mechanisms
- Continuing Implementation
 - Next phase: 2019-2020

Note: Solar rooftop with net energy metering is exempted

Rule 21: CPUC References



- **Rule 21** Interconnection General Information Page
- IOU Rule 21
 - PG&E
 - SCE
 - SDG&E
- Process
 - Initial Issues: 2014 Report
 - Current Issues: Rulemaking 17-07-007 CPUC web page
 - Rulemaking 17-07-007 (proceeding link)
 - Order Instituting Rulemaking (OIR) 17-07-007
 - Phase 1:
 - Phase 2

Rule 21: References

Working Groups(2)



- Working Group 1: Urgent and/or Quickly Resolved Issues including Smart Inverters
 - Transmission Cluster Studies
 - Complex Metering
 - Material Modifications in 1) Interconnection Applications or 2) Existing Facilities
 - Telemetry
 - Activation of Latent Smart Inverters
 - Smart Inverter Aggregator Forms and Agreements
 - Income Tax Component of Contribution
- Working Group 2: Integration Capacity Analysis (ICA) and Streamlining
- *Pro forma* distributed energy resource aggregation agreements between suppliers and companies;
 - Incorporation of the ICA into Rule 21 to inform siting decisions
 - Streamlining the Fast Track interconnection process for projects that are proposed below the integration capacity at a particular point on the system
 - Facilitate automation of the interconnection process
- Working Group 3: Planning, Construction, and Billing of Distribution Upgrades
- Working Group 4: Application Processing and Review Issues
- Working Group 5: Smart Inverter Issues
- Working Group 6: Safety and Environmental Issues
- Working Group 7: Rate Setting Issues
- Working Group 8: Small and multi-jurisdictional utility rules

Rule 21: Reference(3)



Interconnection Discussion Forum

The CPUC Energy Division has established an Interconnection Discussion Forum (on the [Rule 21 webpage above](#)) to provide an information venue for utilities, developers to meet the following objectives:

Material is available on the following topics:

- [PV + Storage](#)
- [EPRI Solar + Storage Interconnection](#)
- [Smart Inverter and Reactive Power Priority](#)
- [Joint IOU Interconnection Process Common Deficiencies and Best Practices](#)
- [Rules 2 15 16 21 \(Interconnection Rules\)](#)
- [Interconnection Timeline greater than 1 MW](#)
- [Interconnection Timeline less than 1 MW](#)
- [Joint IOU Interconnection Process Common Deficiencies and Best Practices](#)

Storage and the Grid: CAISO*

- **Storage as a Transmission-Connected Asset**

Beyond capacity for local area reliability identified in the transmission plan

- Provide regulated & competitive Cost of Service transmission services
- Market-based services to access market revenue streams
- Benefit ratepayers by lowering costs and providing greater flexibility

*California Independent System Operator

- **Wholesale Market participation**

Enhance ability of ISO connected and distribution-[connected resources to participate in the wholesale market to help lower carbon emissions and provide operational benefits

- Non-generation resources
- Bidding requirements
- Demand response Enhancements
- Multiple-Use Application



[Storage as transmission asset](#) : [\(Issue paper\)](#) [\(1/24/19 Presentation\)](#)

Storage participation in the wholesale markets: [Energy Storage and Distributed Resources](#)

Storage Safety Standards

- **Safety is an important factor in the deployment of energy storage**
 - Recent incidents such as fires have triggered extensive investigations
 - Recommended practices are evolving
- **Both federal, state and local governments have created requirements**
 - Underwriters Lab (UL) is creating standards for installation that are being adopted in building codes
 - US national research laboratories are leading the way



- [Safety Best Practices for Installation of Energy Storage](#)
- [Batteries & Solar: Installation requirements](#)



Additional California References

Storage (California Energy Commission)

- Microgrid [research](#)
- Innovative battery technology [research](#)
- [Tracking progress](#) for all California utilities
 - Investor-owned
 - Municipal
- [2019 Building Energy Efficiency Standards](#)
 - [Fact Sheet](#)

Climate

- Fourth statewide Climate Change [assessment](#)
- California's [climate change research](#) to develop adaptation plans

Microgrids

- New proceeding to create policy framework for commercialization of microgrids ([R.19-09-009](#))
- [Senate Bill 1339](#) sets stage

Public Safety Power Shutoffs

- [Power de-energization](#) is occurring in California during certain weather conditions to prevent wildfires
- The state's energy regulators, fire division and office of emergency services is coordinating with the utilities to examine
- This is quite controversial
- Storage is being called upon by Governor Newsom to provide system support for citizens in his [roadmap](#) to fight wildfires and assure there is clean and reliable power in California

California Statistics

- ❖ Population: 39,500,000 (1st in US)
- ❖ Area: 163,696 sq. mi.
- ❖ 5th Largest Global Economy
- ❖ Diversity of Natural Resources
- ❖ Statewide peak demand: ~ 60,713 MW



California Resource Mix

