Now Comes the Hard Part:
Making California's Clean Energy Future a Reality

Presentation to the Business for Local Energy Symposium

Mark Ferron
Governor, California Independent System Operator
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Disclaimer

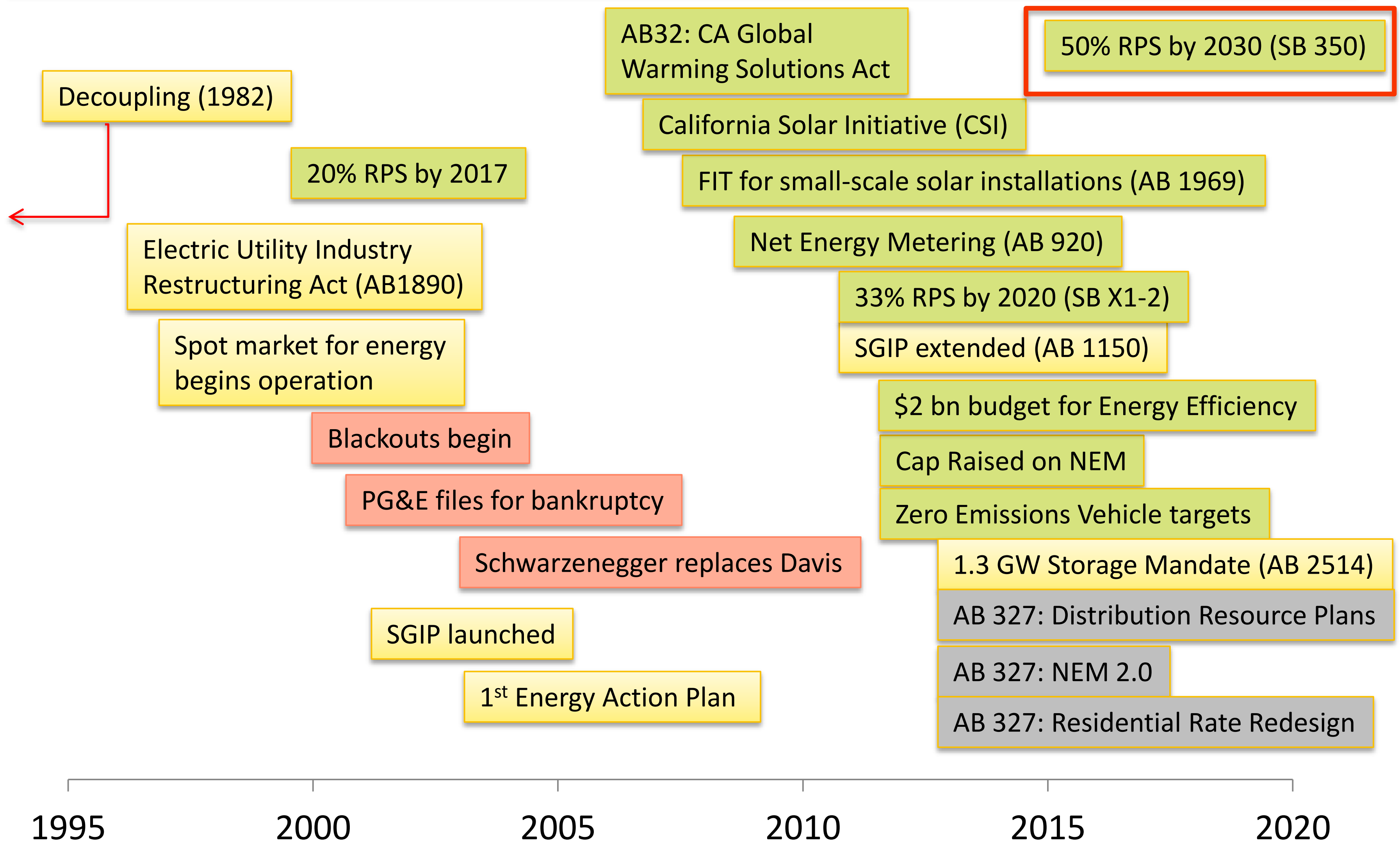
"The views presented are mine only and do not necessarily reflect the opinions of the California Independent System Operator Corporation, its Board of Governors or staff."

What is the future of the electricity industry?

SB 350: Clean Energy and Pollution Reduction Act of 2015

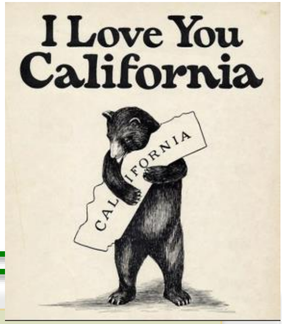
- Increase Renewable Portfolio Standard from 33% to 50% by 2030
- Double energy efficiency in buildings
- Encourage increased investments in transportation electrification, including charging infrastructure
- Begin transition for the California ISO to become a multi-state western regional transmission organization

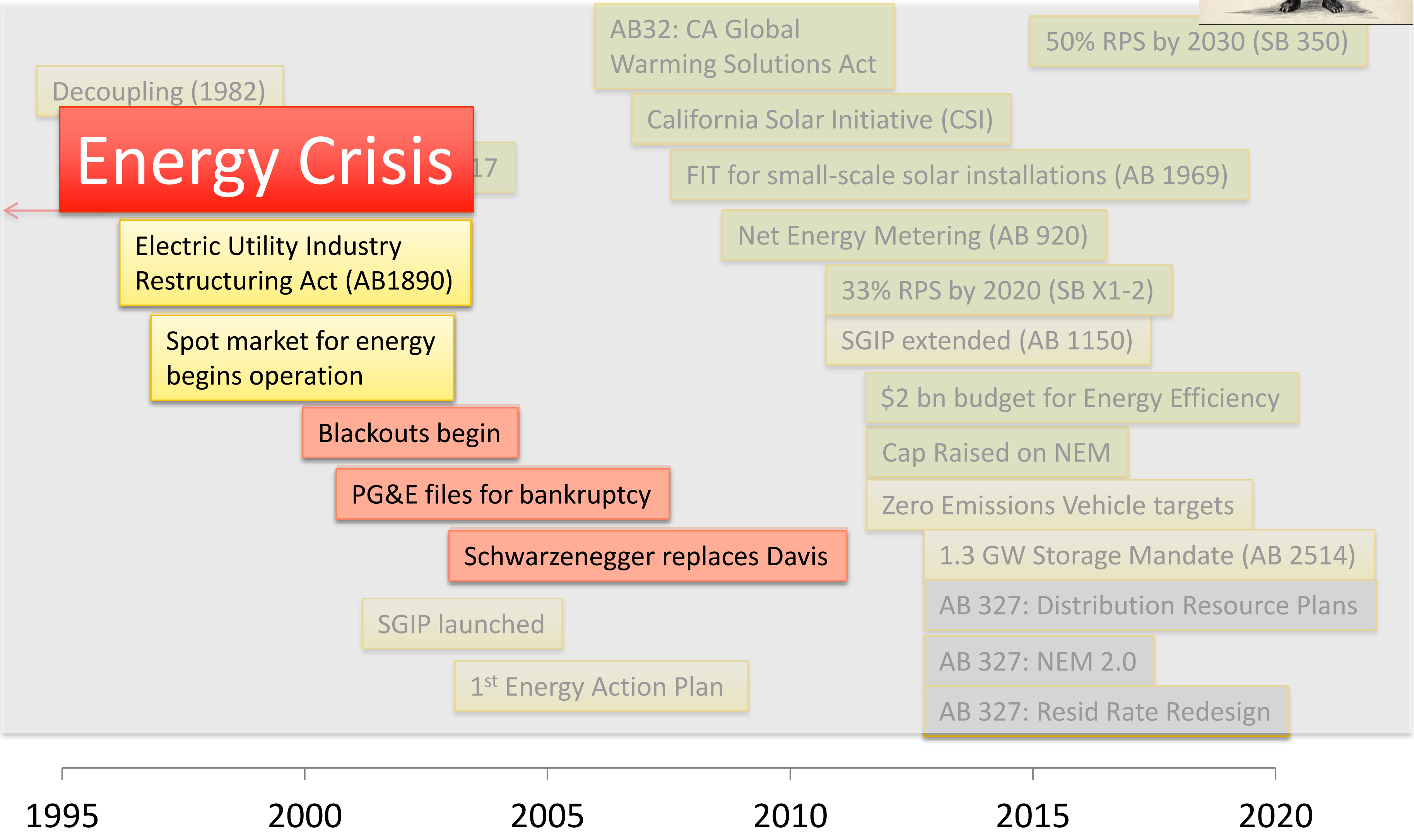
California has a long history of Energy Policy Innovation



What could possibly go wrong?

California has a long history of Energy Policy Innovation





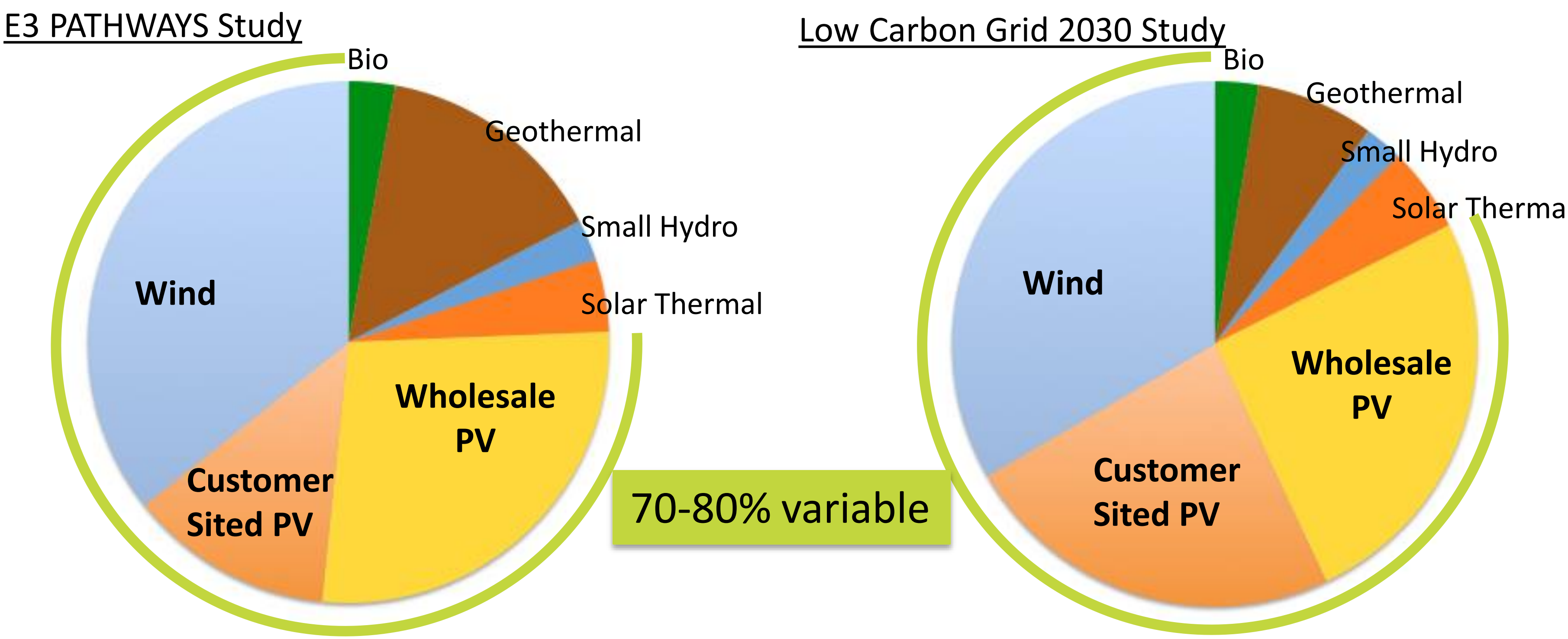
What could possibly go wrong?

Problems

1. Renewable integration challenges including over-generation
2. Greater complexity for the T&D grid
3. Investment in grid "assets" is expensive and growing
4. Institutional environment is disjointed and inflexible

50% Renewable penetration will involve substantial Variable Resources

Alternative Renewable Energy Mixes in 2030



Source: E3 PATHWAYS Study, 2014 https://ethree.com/documents/E3_PATHWAYS_GHG_Scenarios_UCDavis_CCPM_final.pdf

Source: Low Carbon Grid 2030 Study, 2014: http://lowcarbongrid2030.org/wp-content/uploads/2014/08/LCGS-Phase-I-Results-Summary-Slides.pdf

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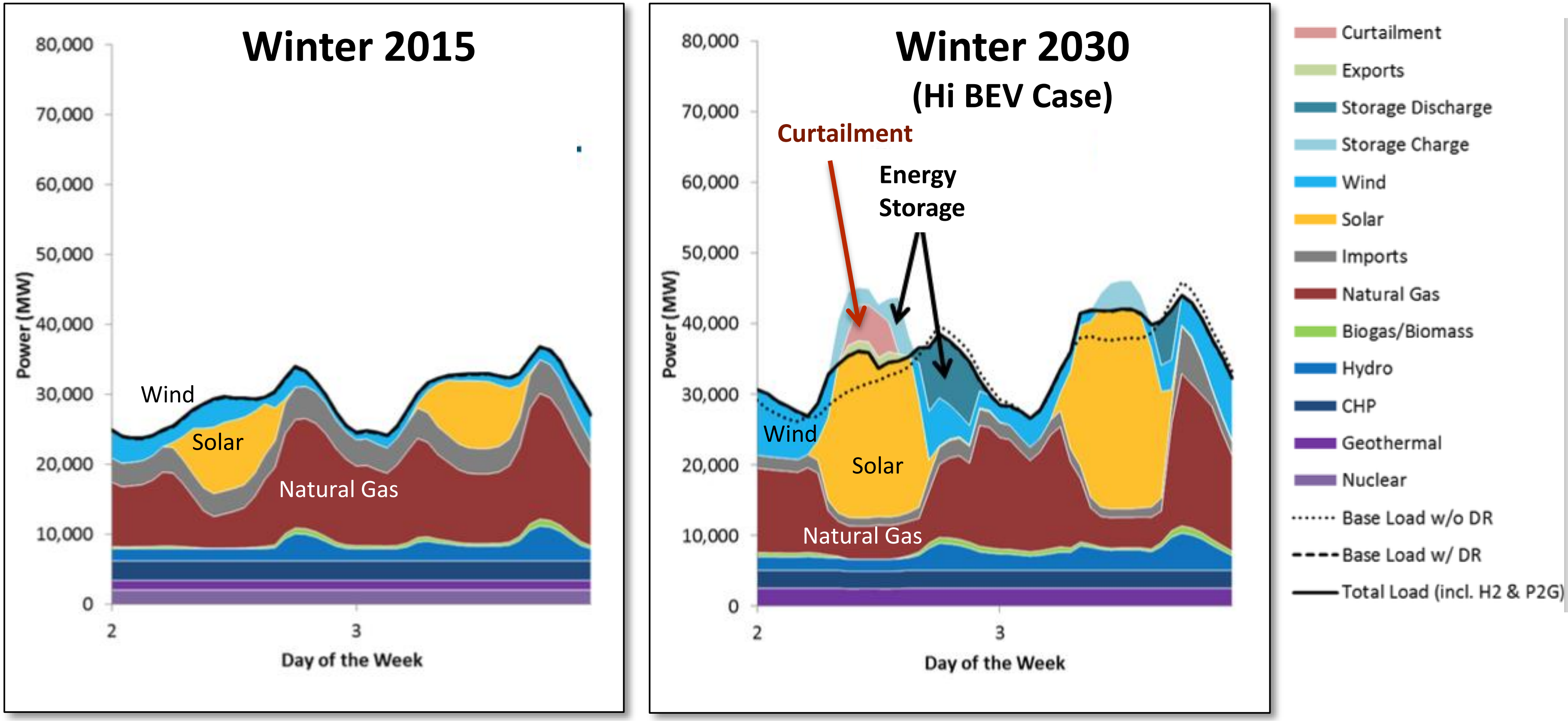
The management of a 50% Renewable portfolio is considerably more complex

Energy Dispatch Stacks



Source: E3 PATHWAYS Study, 2014
https://ethree.com/documents/E3_PATHWAYS_GHG_Scenarios_UCDavis_CCPM_final.pdf

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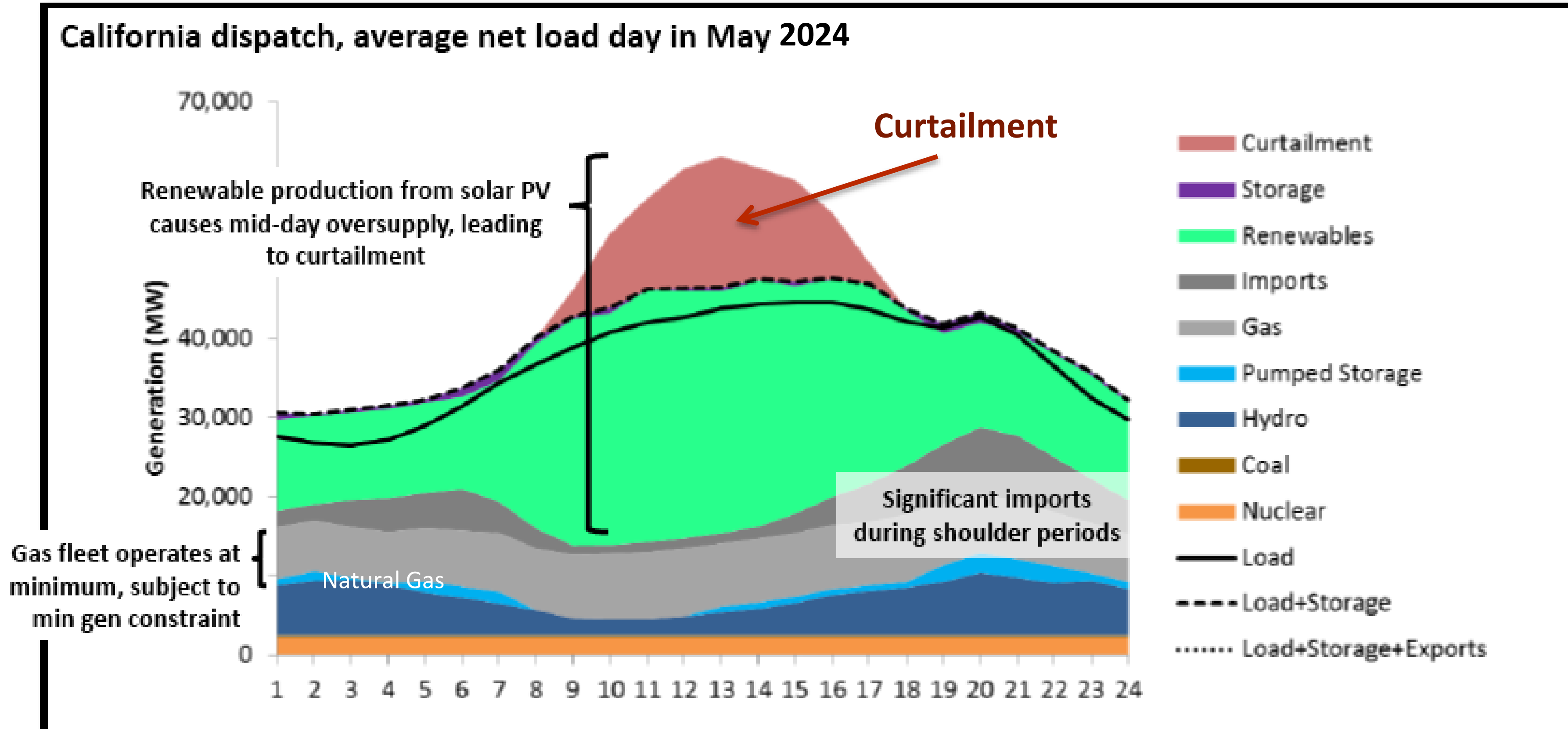
High renewable penetration may lead to substantial amounts of curtailment



Renewable Penetration: 50%
(% of load)

Renewable Curtailment: 8.7%
(% of annual renewables)

Curtailment Frequency: 20%
(% of hours per year)

Source:E3/NREL, Western Interconnection Flexibility Assessment, October 30 2015
http://westernenergyboard.org/wp-content/uploads/2015/10/10-30-15_CREPC-SPSC-WIRAB_schlag-olson_E3_flex_assessment.pdf

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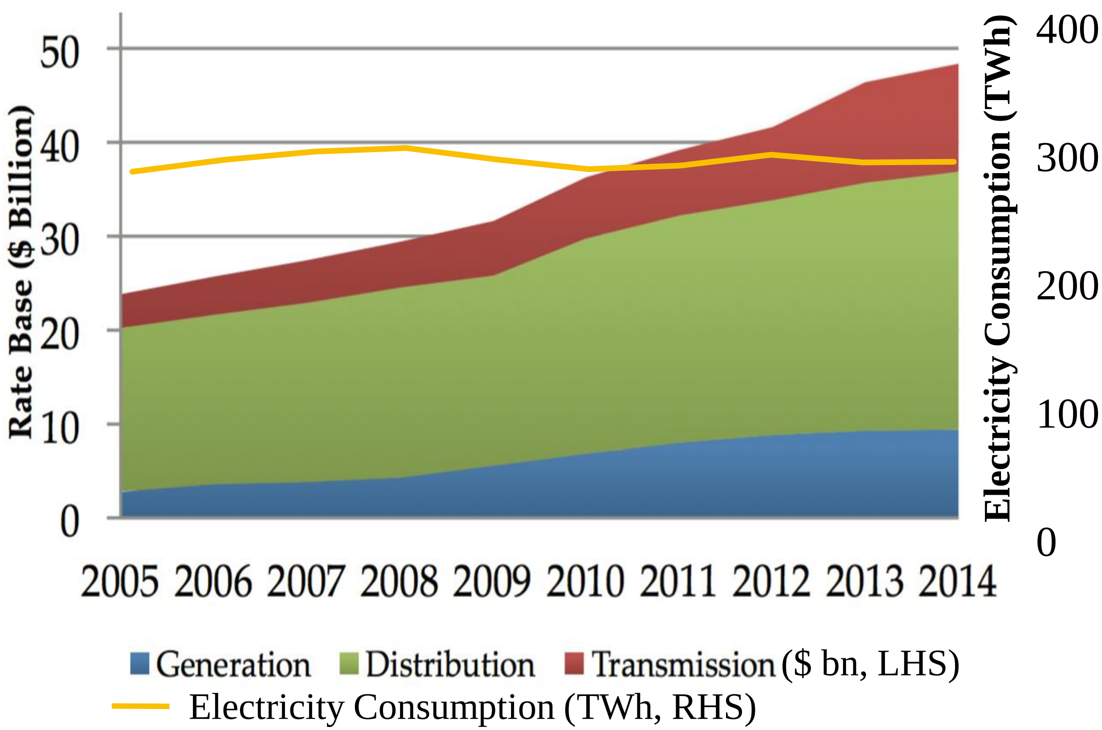
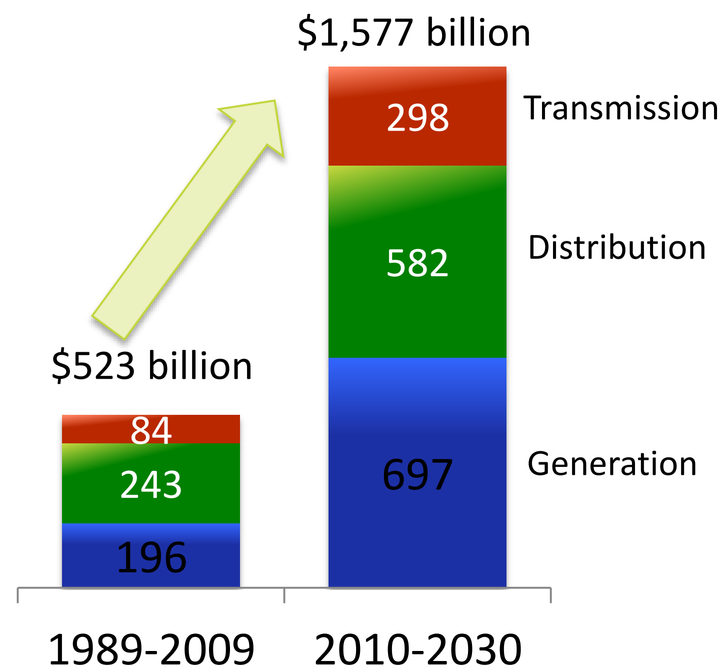
Investment in grid "assets" is expensive and growing

Historical Growth in California Utility Rate Base vs Electricity Consumption



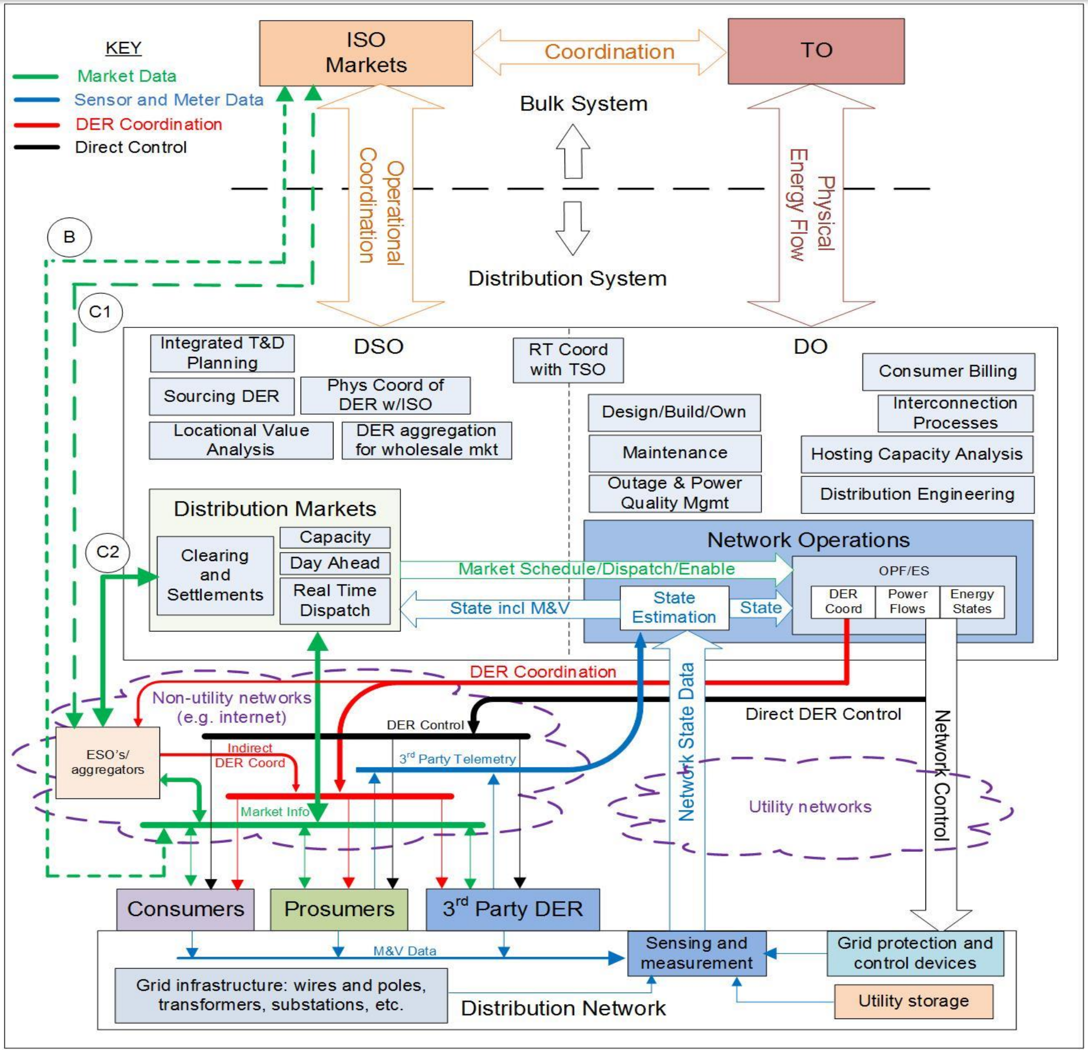
Source: CPUC, Electric and Gas Cost Utility Report, April 2015; California Energy Commission

Projected Growth in US Grid Investments



Source: "Transforming America's Power Industry: The Investment Challenge 2010 – 2030", Chupka et al., Brattle for EEI, 2008 http://www.edisonfoundation.net/iei/Documents/Transforming_Americas_Power_Industry.pdf

Much greater complexity for the Transmission & Distribution grid



Complex structure and coordinated set of interactions required between wholesale/transmission operations and distribution level operations for a high Distributed Energy Resource (DER) system.

This complex structure is already in operation and developing in several US states and countries

There are significant scaling issues that need to be addressed in a more distributed future

Source: "Distribution Systems in a High DER Future: Planning, Market Design, Operation and Oversight," Paul De Martini (Newport Consulting Group) and Lorenzo Kristov (CAISO) October 2015; https://emp.lbl.gov/future-electric-utility-regulation-series

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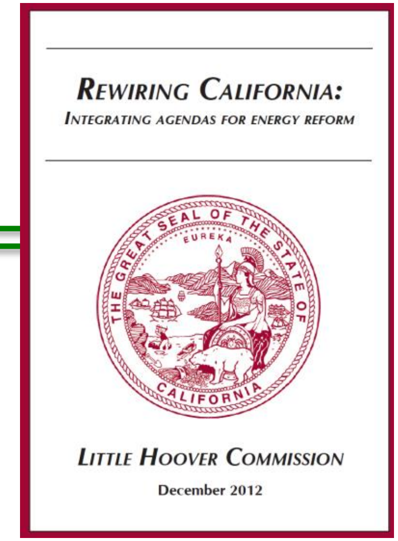
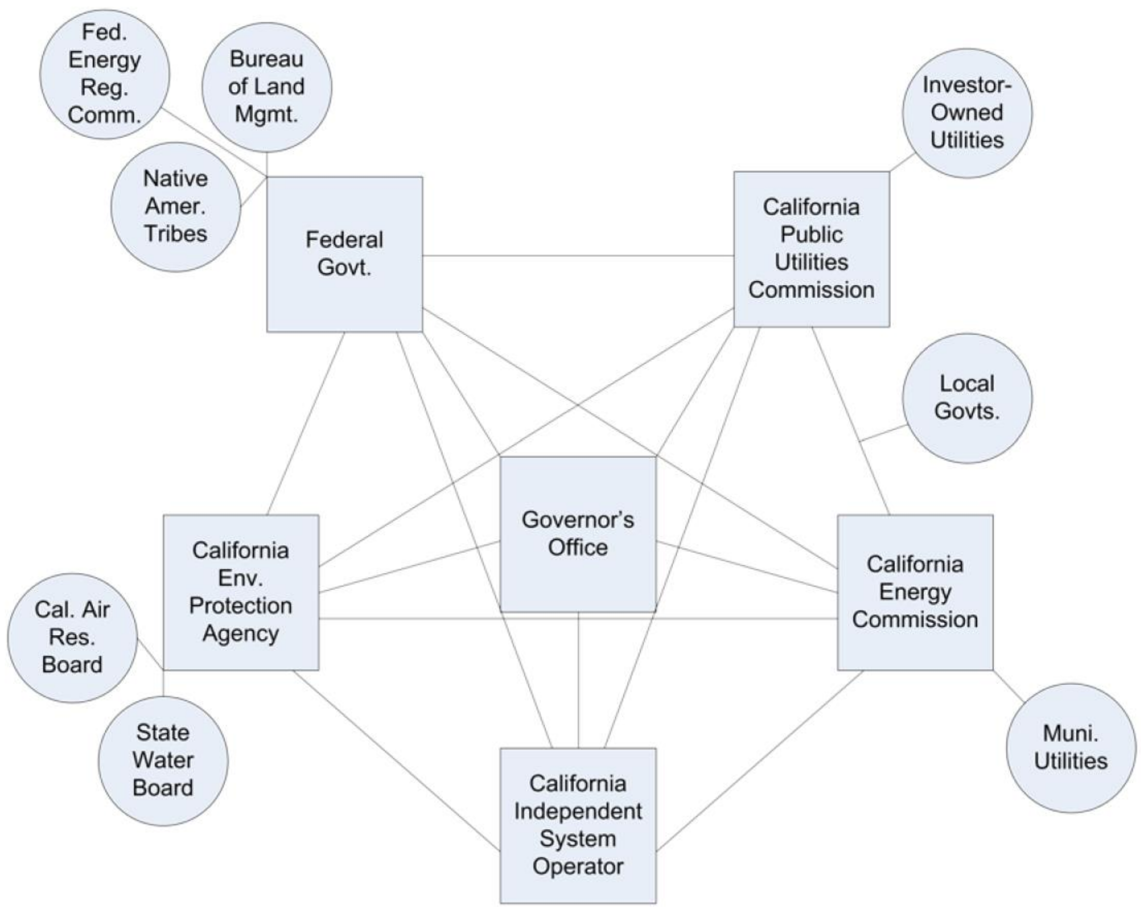
Institutional environment is disjointed and inflexible



Organizations Coordinating on Electricity in California



http://www.lhc.ca.gov/studies/214/Report214_Final%20Complete.pdf

4

Navigating the regulatory maze is daunting

*"…this proceeding will serve as a kind of "umbrella" for our work in a number of other **[37]** related proceedings, including, but not necessarily limited to, those indicated …."*

CPUC Proceedings impacted by R.16-02-007

Greenhouse Gas Proceeding for Electric Utilities	R.11-03-012
Greenhouse Gas Proceeding for Gas Utilities	R.14-03-003
Greenhouse Gas Outreach Issues	A.13-08-026; A.13-08-027; A.13-09-001; A.13-09-002; A.13-09-003
2014 Long Term Procurement Plan Proceeding	R.13-12-010
Resource Adequacy Requirements	R.14-10-010
Joint Reliability Plan	R.14-02-001
Energy Efficiency	R.13-11-005
Demand Response and Advanced Metering	R.13-09-011
Energy Savings Assistance and California Alternative Rates for Energy Programs	A.14-11-007; A.14-11-009; A.14-11-010; A.14-11-011
Low Income Programs and Budgets	A.15-02-001; A.15-02-002; A.15-02-003; A.15-02-013; A.15-02-024; A.15-02-004
Distribution Level Interconnection Rules and Regulations	R.11-09-011
Evaluation of Integrated Distributed Energy Resource Programs	R.14-10-003
Distribution Resources Plan (Rulemaking and Applications)	R.14-08-013; A.15-07-002; A.15-07-003; A.15-07-005; A.15-07-006; A.15-07-007; A.15-07-008
California Solar Initiative and Distributed Generation	R.12-11-005
Further Development of Renewables Portfolio Standard Program	R.15-02-020
Alternative-Fueled Vehicle Programs	R.13-11-007
Energy Storage	R.15-03-011
Water-Energy Nexus	R.13-12-011
Net Energy Metering	R.14-07-002

http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M158/K663/158663325.PDF

What could possibly go wrong?

Problems

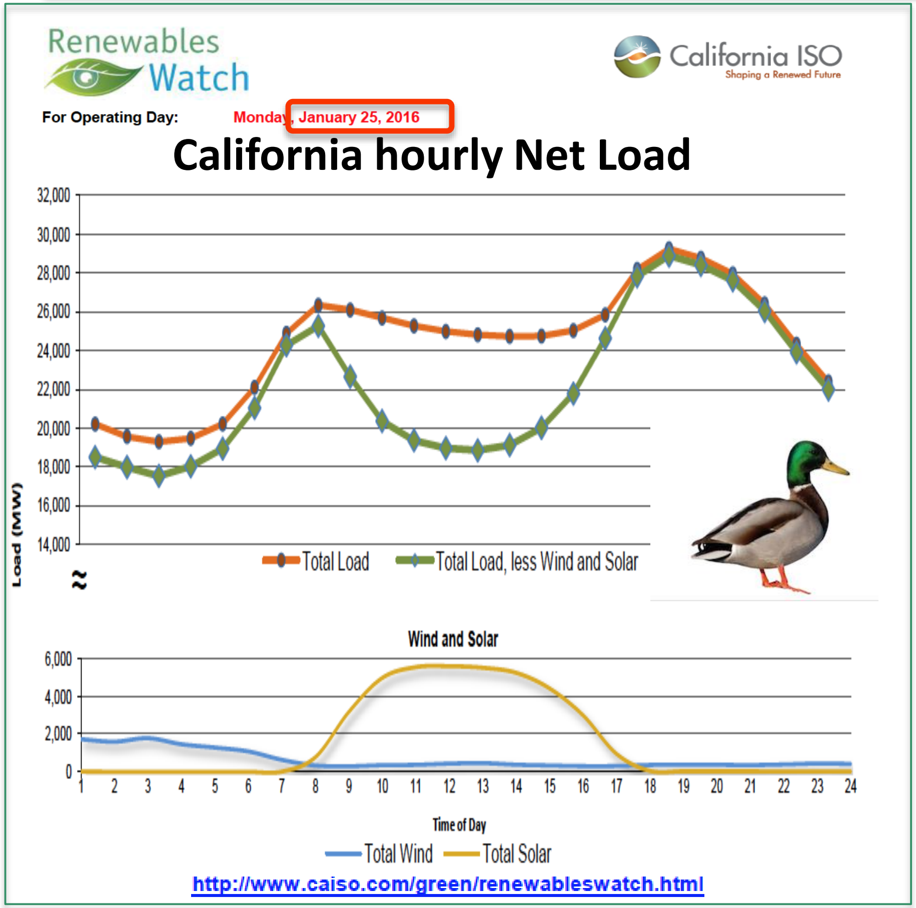
1. Renewable integration challenges including over-generation
2. Greater complexity for the T&D grid
3. Investment in grid "assets" is expensive and growing
4. Institutional environment is disjointed and inflexible

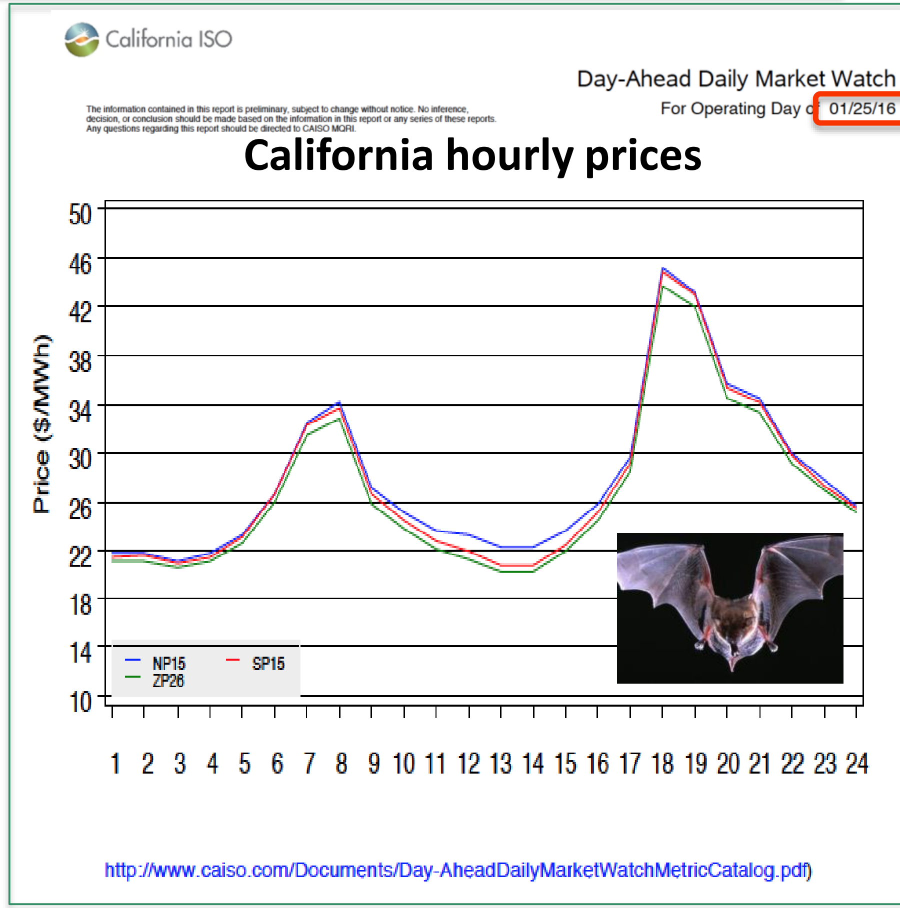
What could possibly go right?

Problems	Solutions
1 Renewable integration challenges including over-generation	1. Price signals
2 Greater complexity for the T&D grid	2. Demand Management
3 Investment in grid “assets” is expensive and growing	3. Interconnection
4 Institutional environment is disjointed and inflexible	4. Storage
	5. Transportation Fuel Switching
	6. Infrastructure as a Service
	7. Public (and private) institutional reform

1

Align price signals with system needs





- Short-term price differentials (and volatility) may not provide a long-term investment signal
- Customers may not always respond economically

1

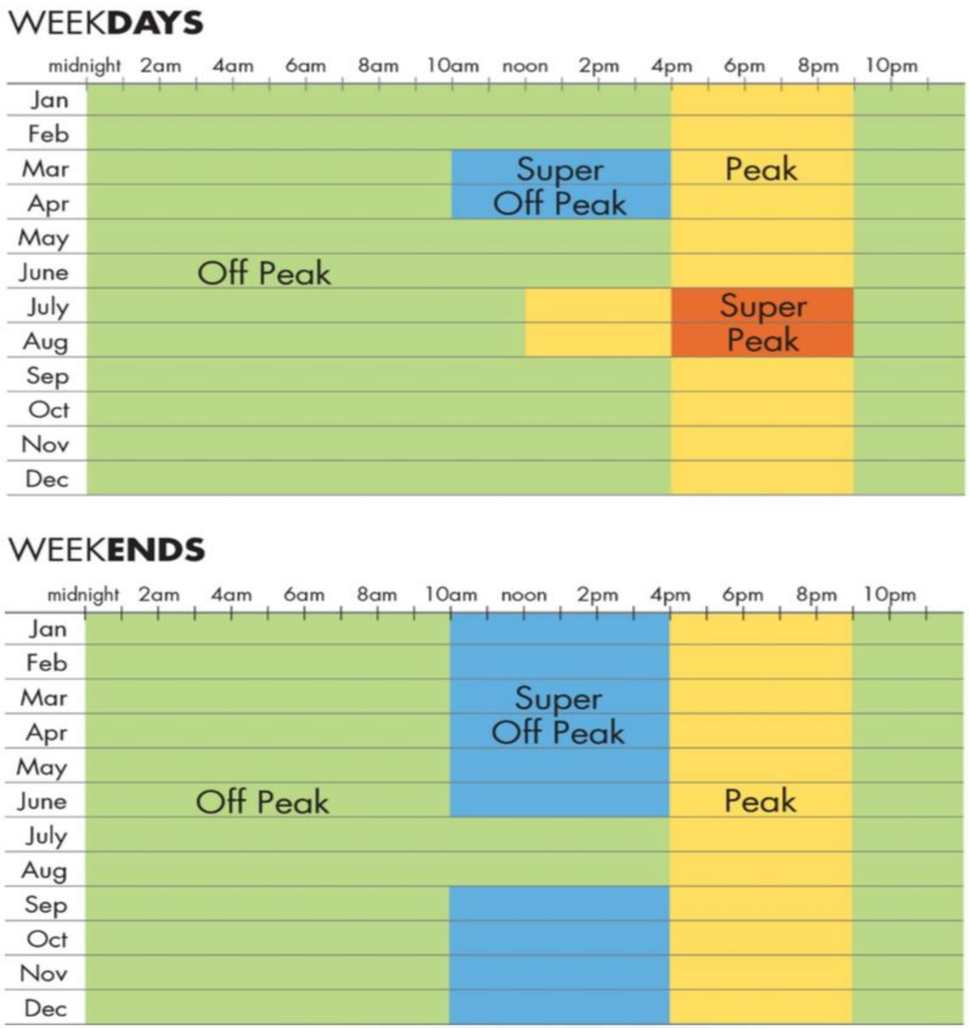
Aligning Time of Use Rates with Grid Conditions

<u>Grid Conditions</u>

- Over-generation and real-time negative energy prices will increase as more variable renewable resources are integrated into the system.

<u>TOU Rates</u>

- Super Off-Peak Prices during periods of over-generation
- Super Peak Prices during heavy ramping periods



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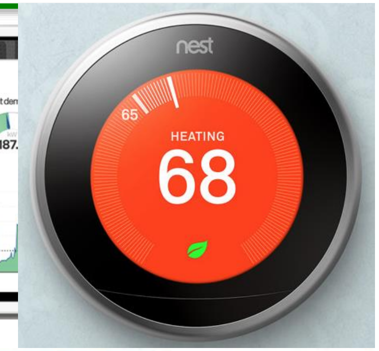
Expand Targeted Energy Efficiency and Advanced Demand Response

- Flexible loads reduce renewable overbuild
- EE can be targeted at specific locations but biggest impact may be on time-of-day
- Automation must play a critical role
- Many different market solutions including ISO's rule allowing aggregators to bid into the wholesale market
- Many potential variation to the business model for utilities and third parties



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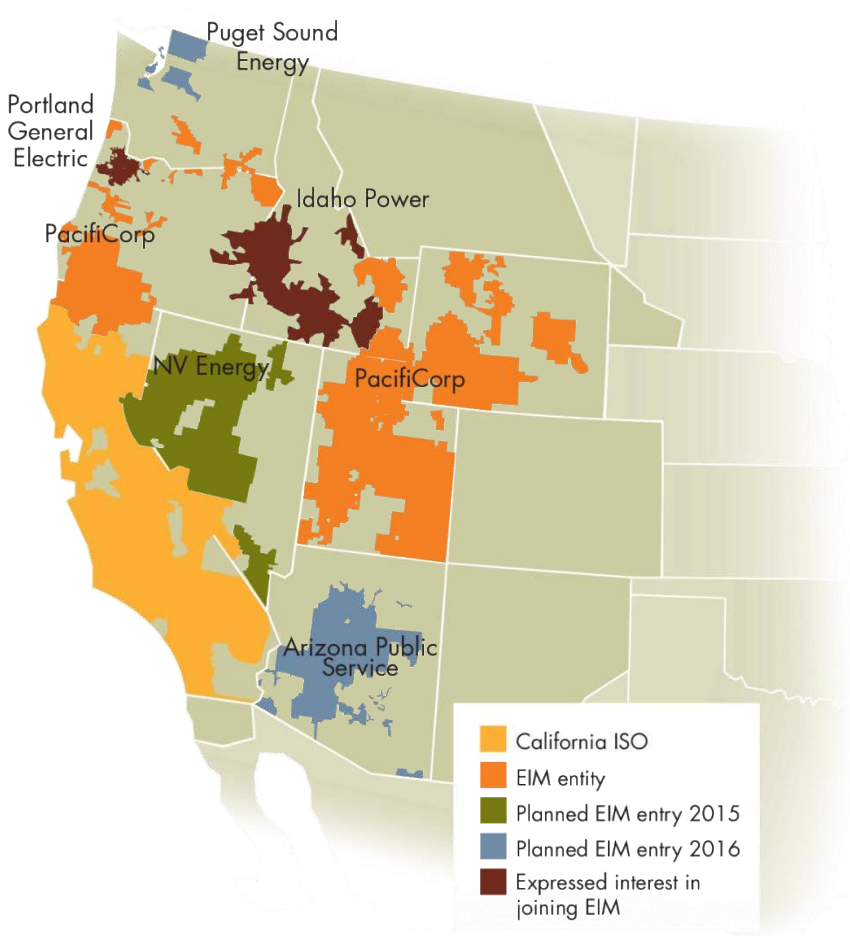
California can accelerate carbon reduction in the West by regionalizing the grid

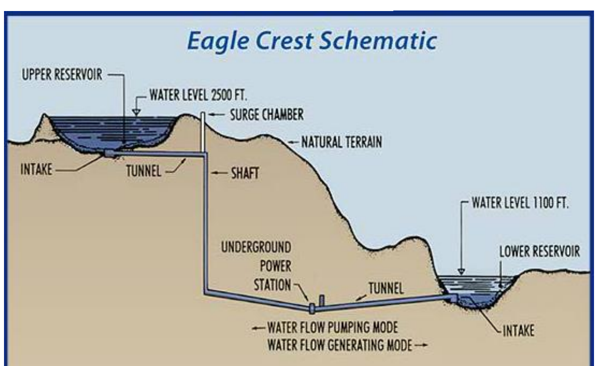


- West-wide coordination enables increased reduction in carbon emissions
- Consumers across region will save millions of dollars per year
- A larger region benefits renewable integration
- PacifiCorp wants to join the ISO balancing area. Next steps:
  1. Determine policy and tariff changes required in new states
  2. Seek necessary authorizations from regulatory entities in host states
  3. Plan and implement software and market design changes
  4. Determine appropriate Governance changes

4

Storage is a game changer

- Not just batteries!
- The greatest need is for longer-duration storage
- Focus on value stacking, not just cost reduction



Source: Eagle Mountain Energy, Inc: http://eaglemountainenergy.net

ENERGY STORAGE VALUES VARY DRAMATICALLY ACROSS LEADING STUDIES

ISO/RTO SERVICES
- Energy Arbitrage
- Frequency Regulation
- Spin / Non-Spin Reserves
- Voltage Support
- Black Start

UTILITY SERVICES
- Resource Adequacy
- Distribution Deferral
- Transmission Congestion Relief
- Transmission Deferral

CUSTOMER SERVICES
- Time-of-Use Bill Management
- Increased PV Self-Consumption
- Demand Charge Reduction
- Backup Power

Source: Rocky Mountain Institute. The Economics Of Battery Energy Storage: How Multi-Use, Customer-Sited Batteries Deliver The Most Services And Value To Customers And The Grid www.rmi.org/electricity_battery_value

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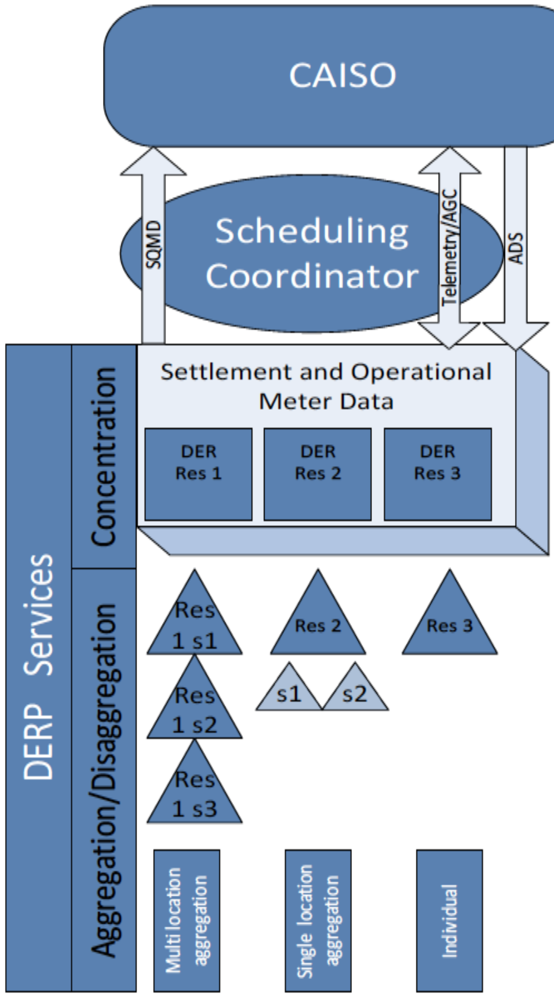
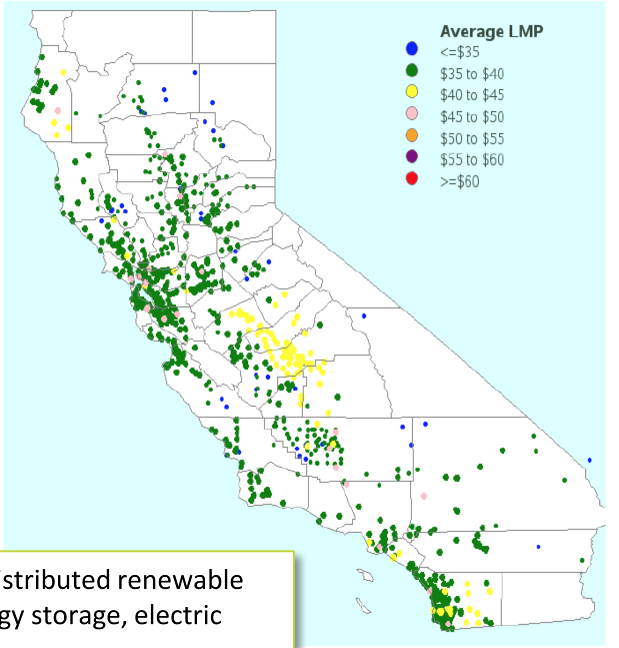
Creating access for Distributed Energy Resources to new Revenue Streams



Source: CAISO

- ESDER enables distribution connected resources to participate in the ISO market
- Allows aggregations of distribution connect resources to participate as a single market resource
- Includes resources connected behind or in front of the end-use customer meter
- Avoids having each sub-resource engaged in a direct metering relationship with the ISO
- Consistent with development of a Distribution System Operator



DER, "distributed energy resources" means distributed renewable generation resources, energy efficiency, energy storage, electric vehicles, and demand response technologies.

Switching to Electric Vehicles will reduce emissions and can help stabilize the grid

Networked EVs can provide multiple grid services

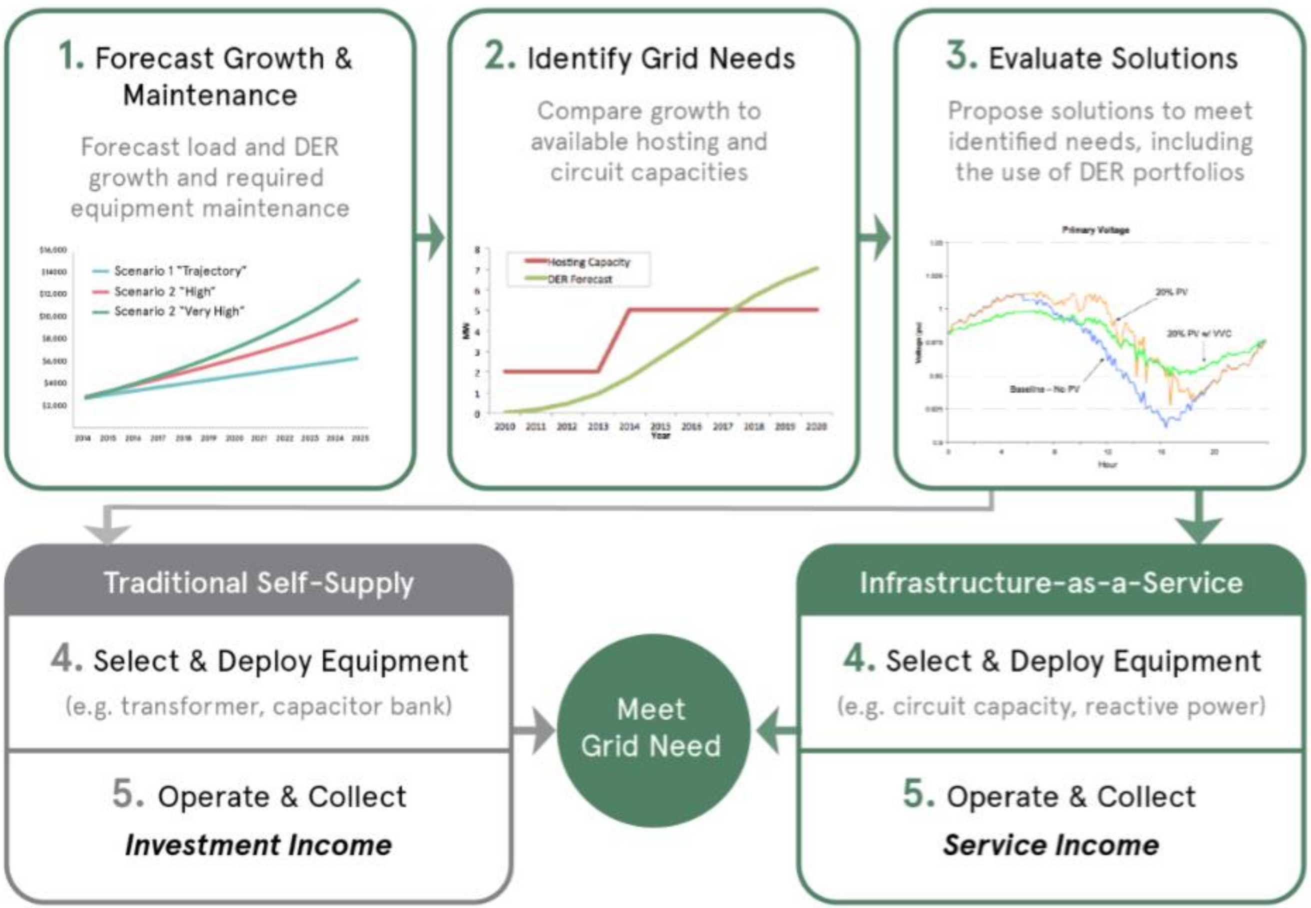
- ☑ Absorb excess generation
- ☑ Improve local power quality
- ☑ Improve grid stability
- ☑ Reduce peak power flows
- ☑ Provide emergency backup power
- ☑ Speed recovery from grid outages

Opening up compensation for these grid services will reduce the total cost of vehicle ownership and speed adoption

6

Infrastructure as a Service vs Rate-based "wires" assets

Utility Planning and Sourcing Utilizing Infrastructure-as-a-Service Model



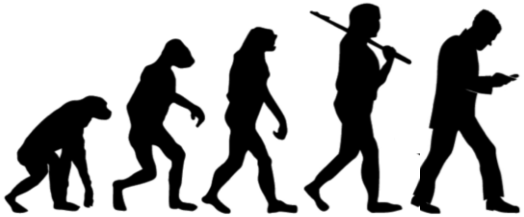
Source: SolarCity Grid Engineering: www.solarcity.com/gridx

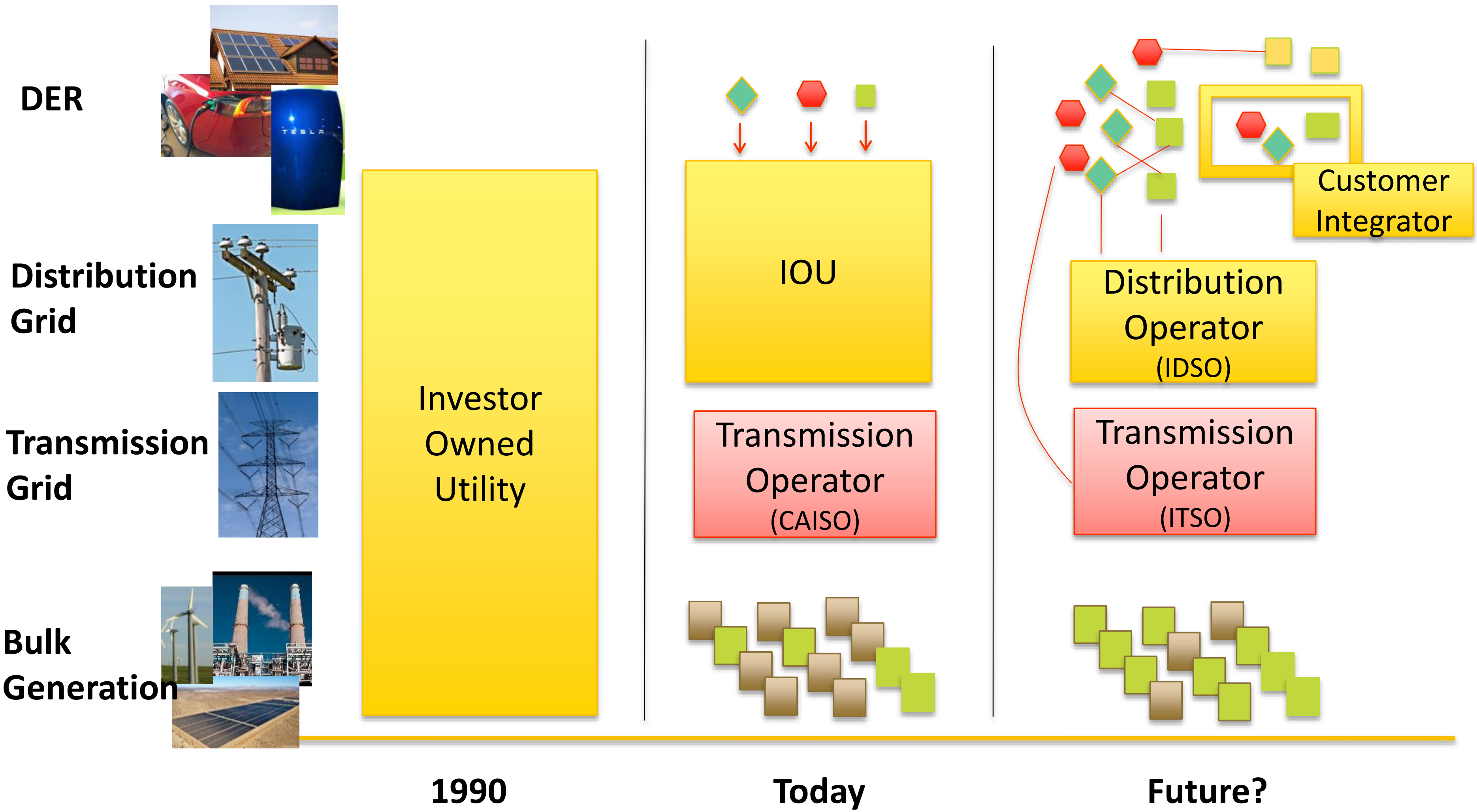
Using DERs instead of investing in Utility Infrastructure can:

- Save ratepayers money
- Promote competition
- Increase flexibility
- Encourage innovation
- Engage customers

7

How might the electricity industry evolve?





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7

Address Institutional and Policy Barriers

Regulatory and Industry Reform – Topics to address:

- Market structure and asset ownership
- Planning and operational responsibilities
- Changes to Cost of Service regulation vs Performance-based or Market-based Income
- Utility roles in providing value-added services
- Openness of utility networks
- Role of mandates vs markets
- Regulatory processes
- Coordination between energy policy agencies

✓ *Regulation must encourage new entrants*

✓ *Regulation should "support the race, but not pick winners"*

Thank you!
Questions?

Contact:
Mark Ferron, Governor
California Independent System Operator
250 Outcropping Way
Folsom, CA 95630
General: markferron@gmail.com
ISO: markferron+caiso@gmail.com