California Independent System Operator (CAISO)

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What is the ISO?

LEED Platinum certified building

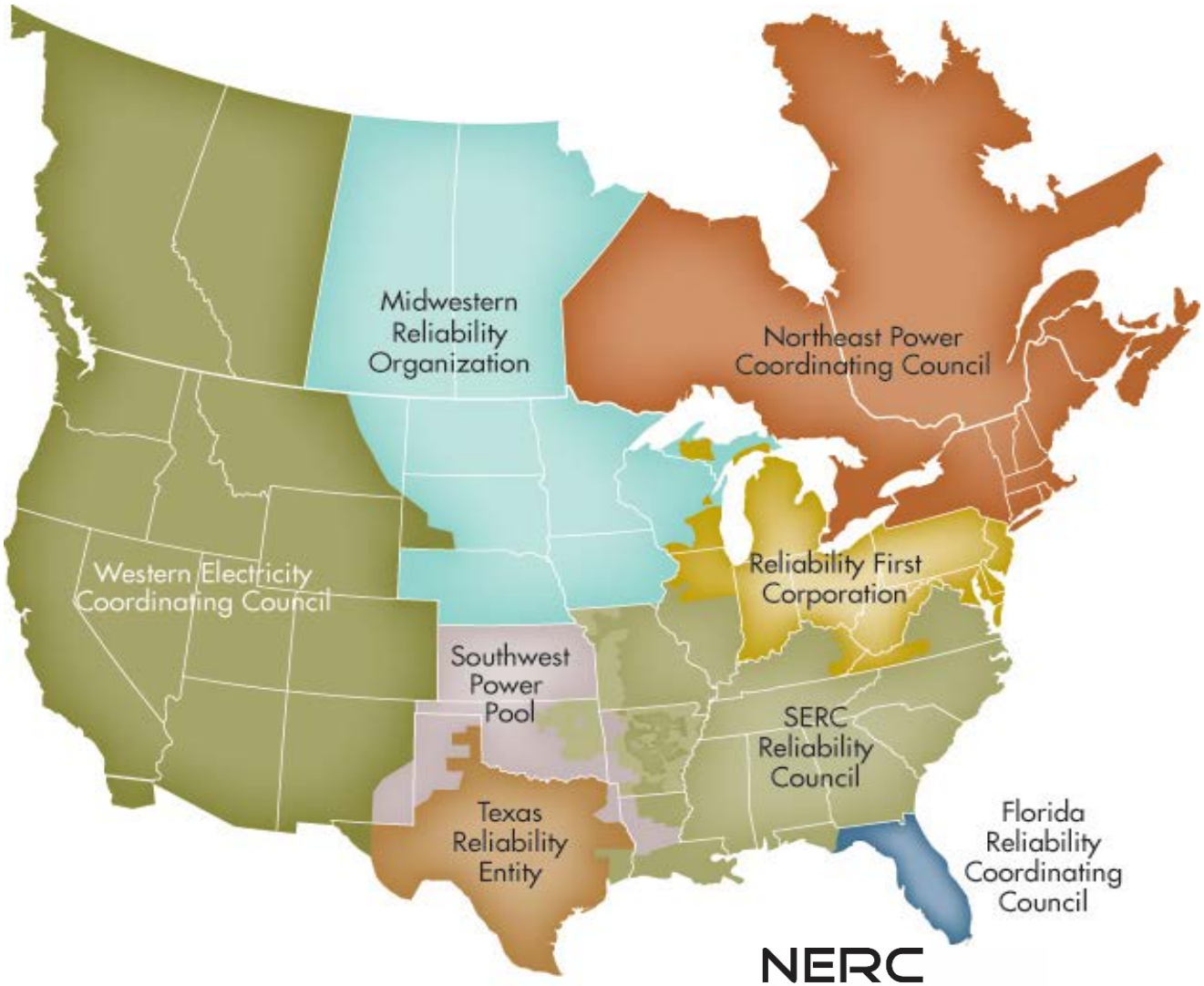
What does the ISO do?

Three primary functions (focus on open and fair access):

- Reliability: Real Time grid management
- Infrastructure planning and resource interconnection
- Run the market for wholesale electricity

North American Electric Reliability Corporation (NERC)

NERC regulates the North American grid through the adoption & enforcement of reliability standards.



Western Electricity Coordinating Council (WECC)

- CA is one of 14 states within **WECC**

California balancing authorities

- PacifiCorp
- California ISO
- Bonneville Power Administration (BPA)
- Balancing Authority of Northern California (BANC)
- Turlock Irrigation District (TID)
- NV Energy
- Los Angeles Department of Water and Power (LADWP)
- Western Area Lower Colorado (WALC)
- Imperial Irrigation District (IID)

Who oversees us today?

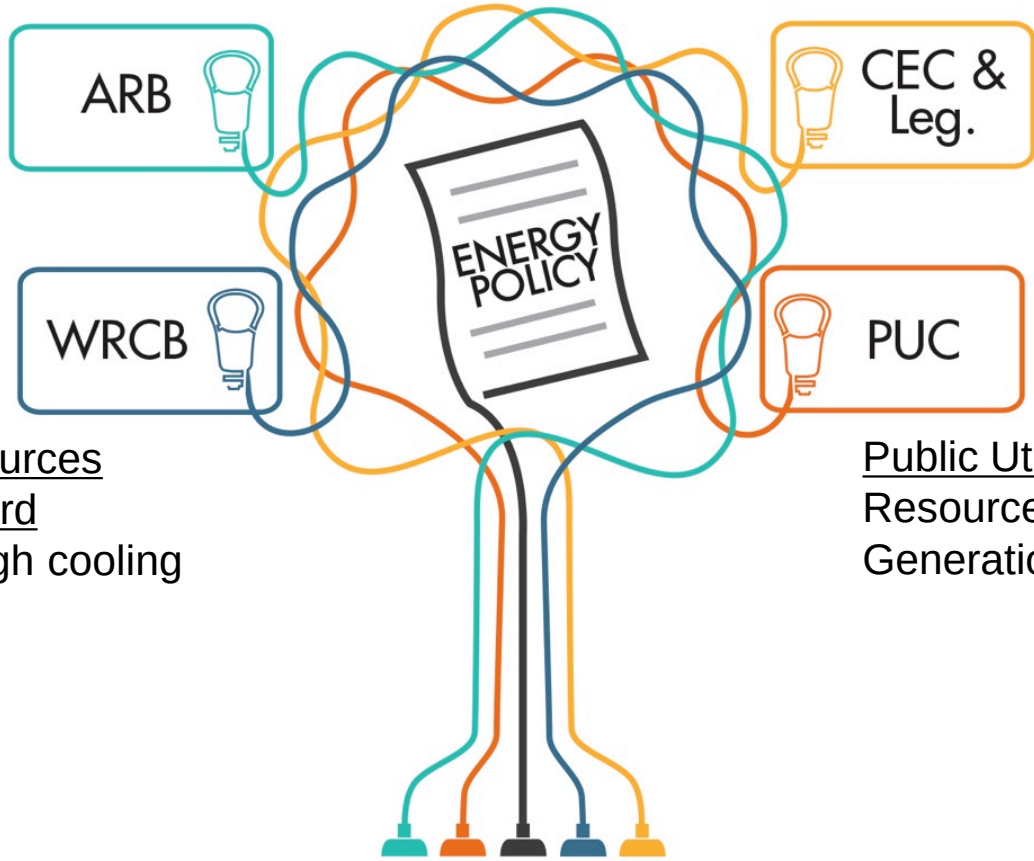
We are:

- governed by a governor appointed/ Senate confirmed **Five Member Board**
- regulated by **FERC** Federal Energy Regulatory Commission
- compliant with **NERC** North American Electric Reliability Corporation
- part of **WECC** Western Electricity Coordinating Council

ISO coordination with state agencies

Air Resources Board
Greenhouse gas regulations

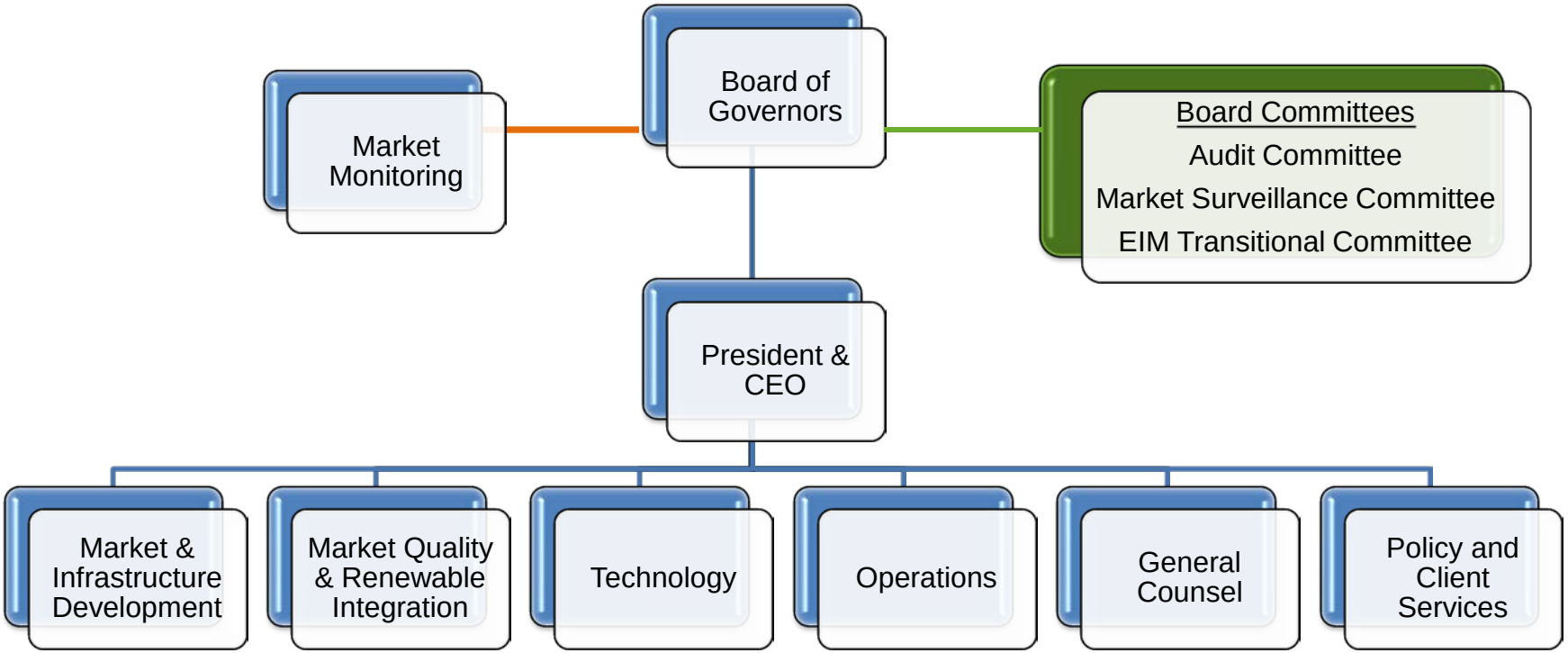
Energy Commission and Legislature
Renewable portfolio standard
Load forecasting



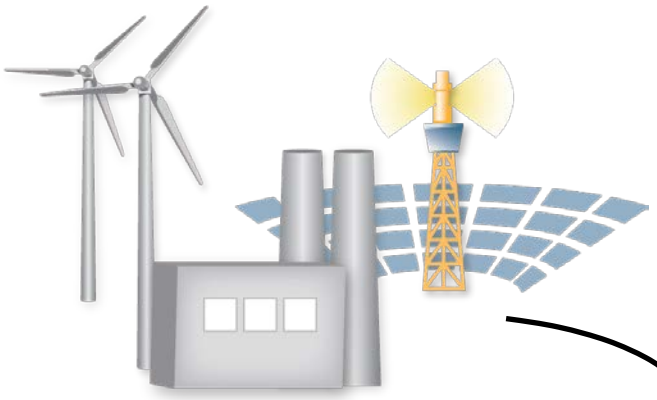
Water Resources Control Board
Once-through cooling

Public Utilities Commission
Resource adequacy
Generation procurement

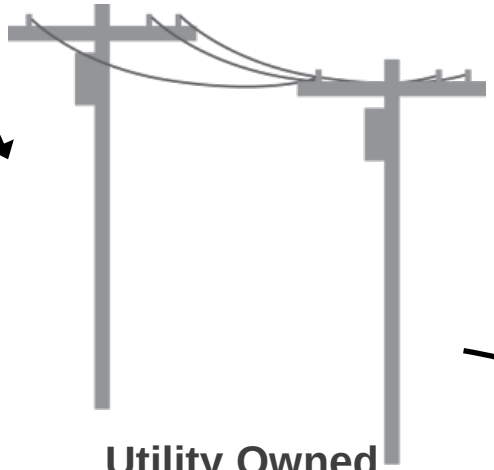
ISO Organization Chart



Before the ISO…

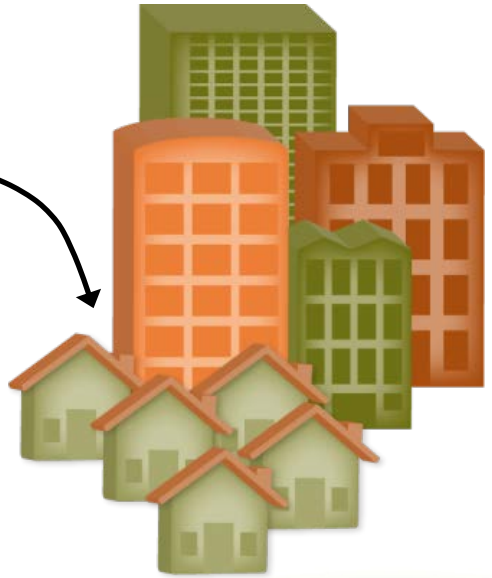


Utility owned generation

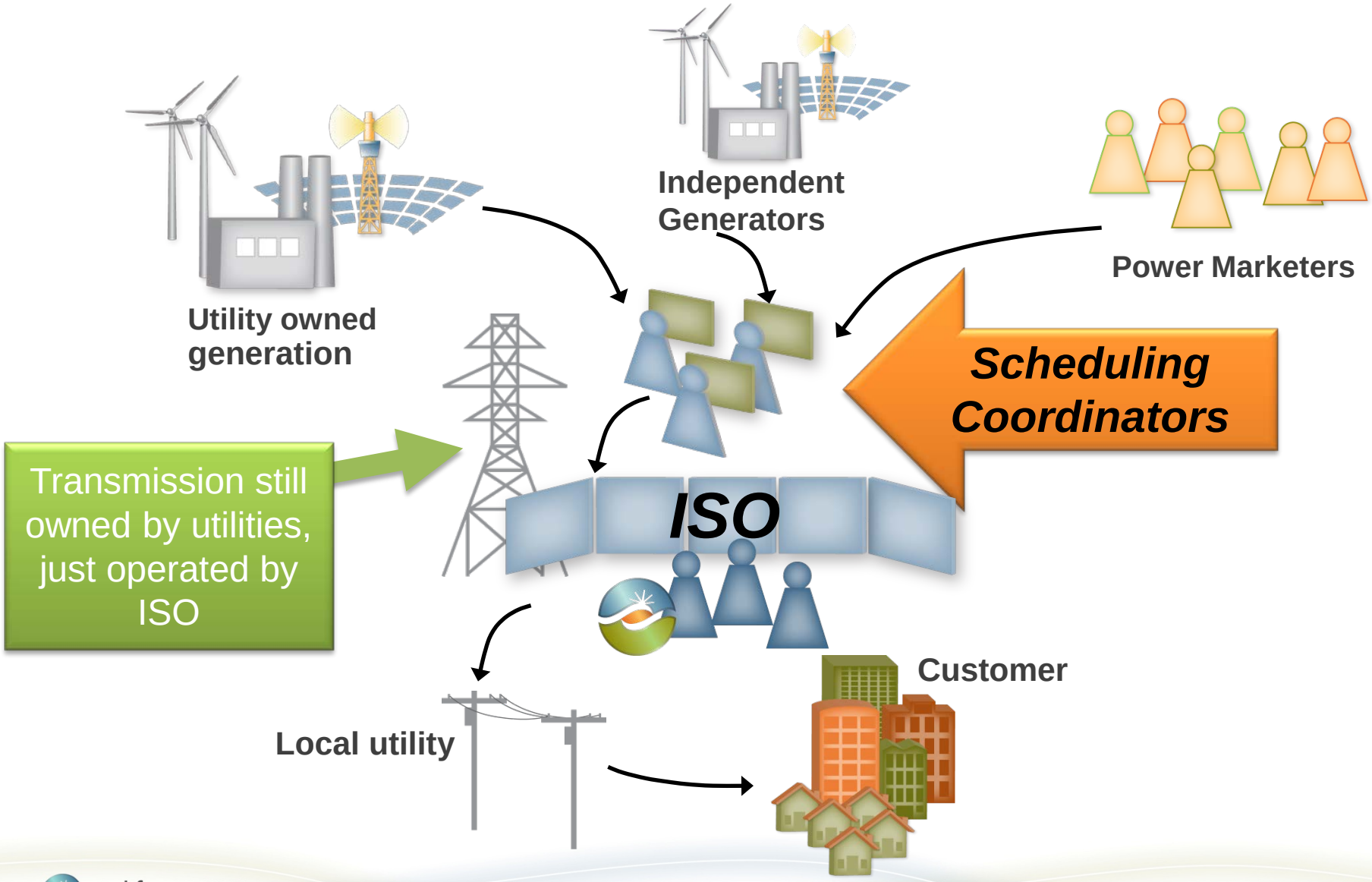


Utility Owned Transmission

Customer



How the ISO fits in…



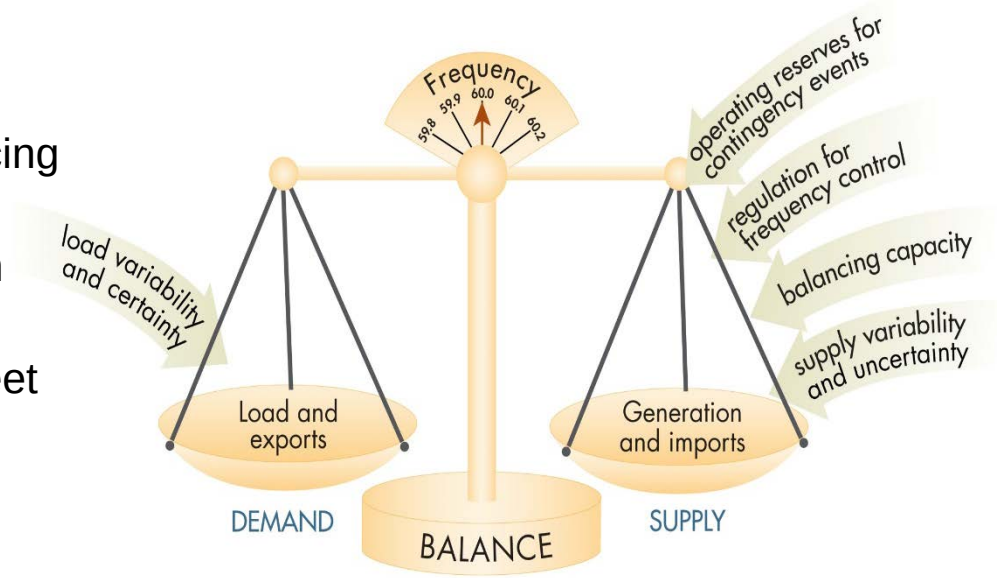
ISO

Reliability

Markets

Reliability and real time

- For most of California and part of Nevada:
  - Responsible for electric system reliability, including constantly balancing supply and demand
  - Optimizes day-ahead electric system dispatch
  - Plans the transmission system to meet reliability requirements as well as economic and policy objectives
  - Manages generation interconnection



- Optimizes electric system dispatch every five minutes for most of California and parts of six additional states.
- Operates in furtherance of California energy and environmental goals.

ISO

Reliability

Markets

The ISO has two markets

Day-Ahead Energy Market

- Enables:
  - parties to schedule contracted supply/demand
  - suppliers to offload excess supply in the form of energy or ancillary services
  - LSEs the ability to secure pricing for load due to:
    - *changes in load forecasts or*
    - *incremental changes in demand*

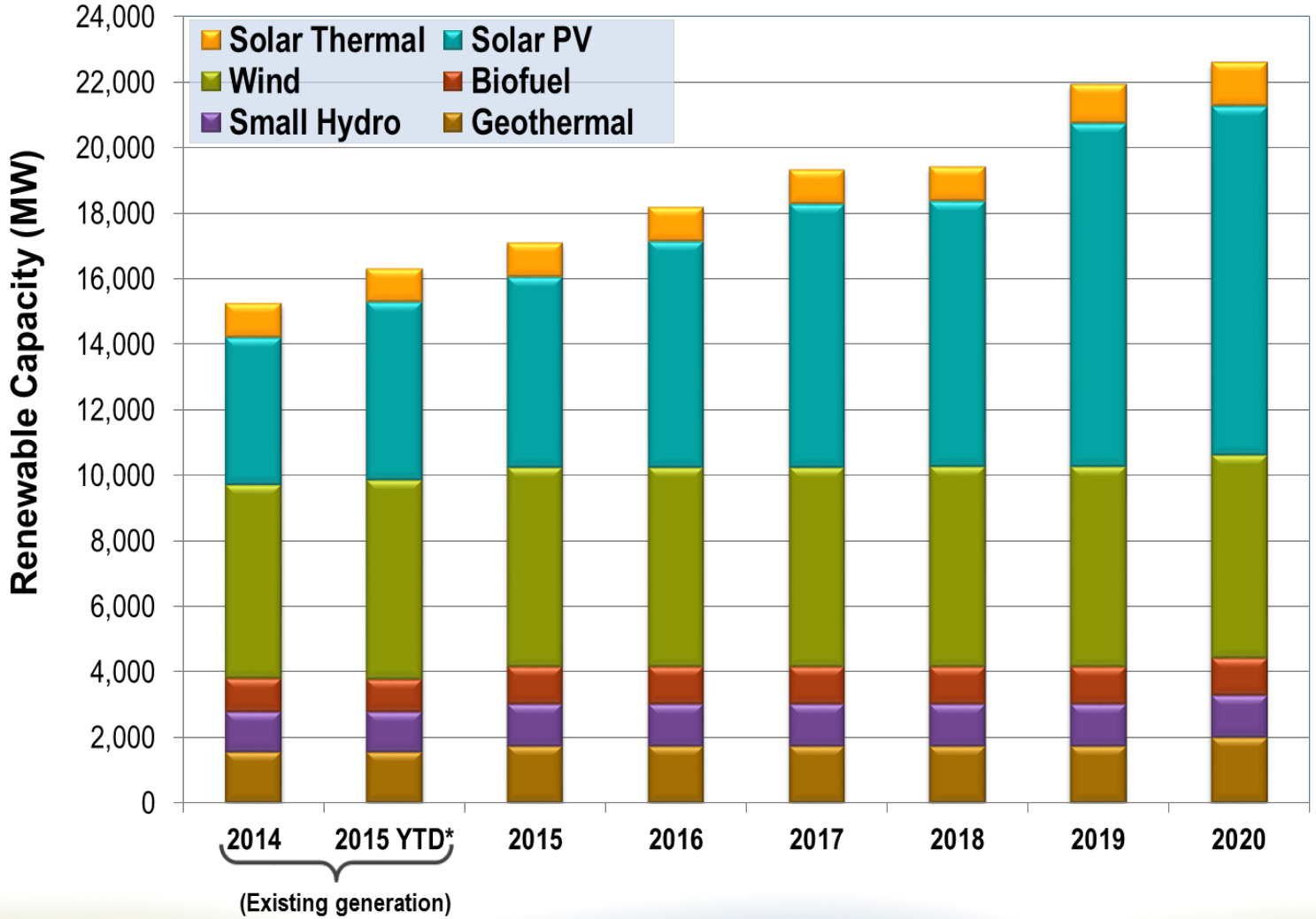
Real-Time Energy Market

- Hour-ahead scheduling for intertie resources
- 15-min market supports renewable integration
- 5-min market intended to meet instantaneous demand
- Includes:
  - ISO Balancing Authority Area
  - EIM Balancing Authority Areas

Challenges & Opportunities

- Current interconnection queue
- Variable Energy resources
- The “Duck Curve”
- Curtailment risk
- Energy Imbalance Market
- Regionalization

Current and projected renewable generation capacity in operation within the CAISO

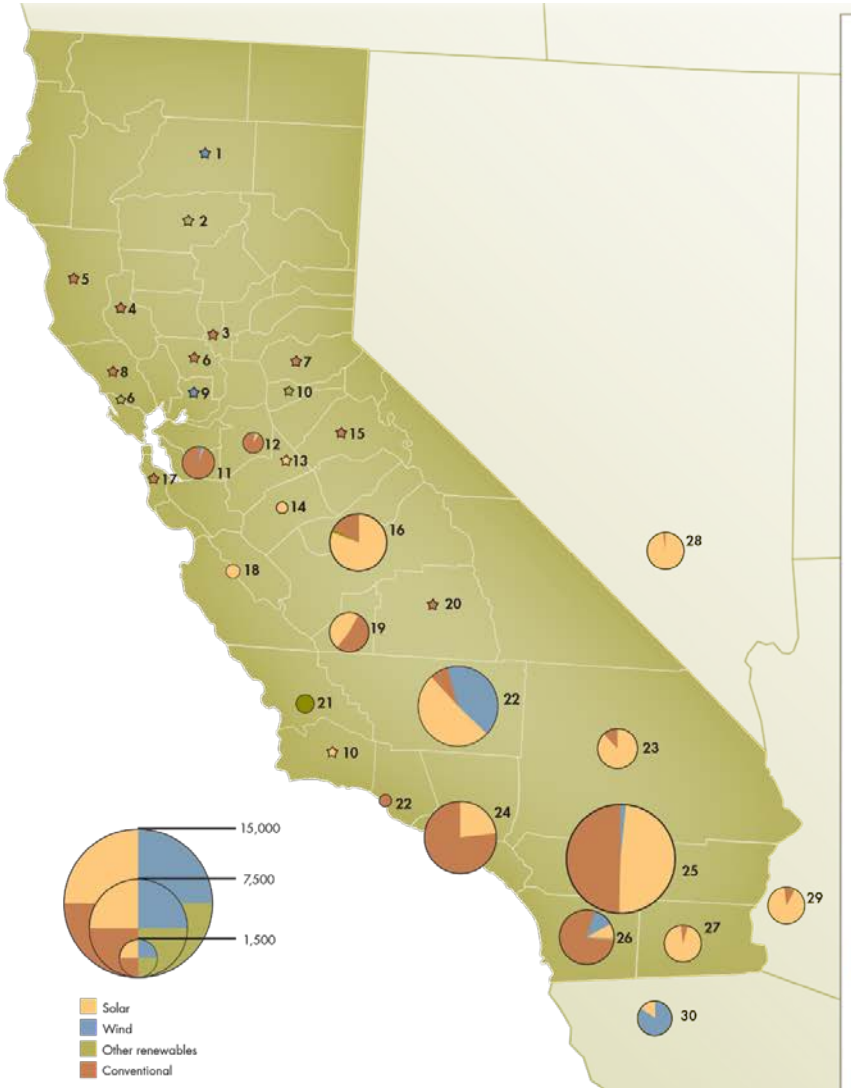


*All online resources are included in the 2015 YTD amounts, including those yet to achieve full commercial operation.

Significant amount of energy storage projects entered the CAISO queue in 2014 & 2015

- CPUC procurement target for energy storage capacity by 2020
  - 1,325 MW, approximately 700 MW in transmission interconnected
- 79 projects totaling 8,076 MW currently in the CAISO queue
- 5,586 MW of stand-alone energy storage
- 2,490 MW combined with other generation technologies
- Technologies include battery, pumped storage, molten salt, flywheel and rail energy storage

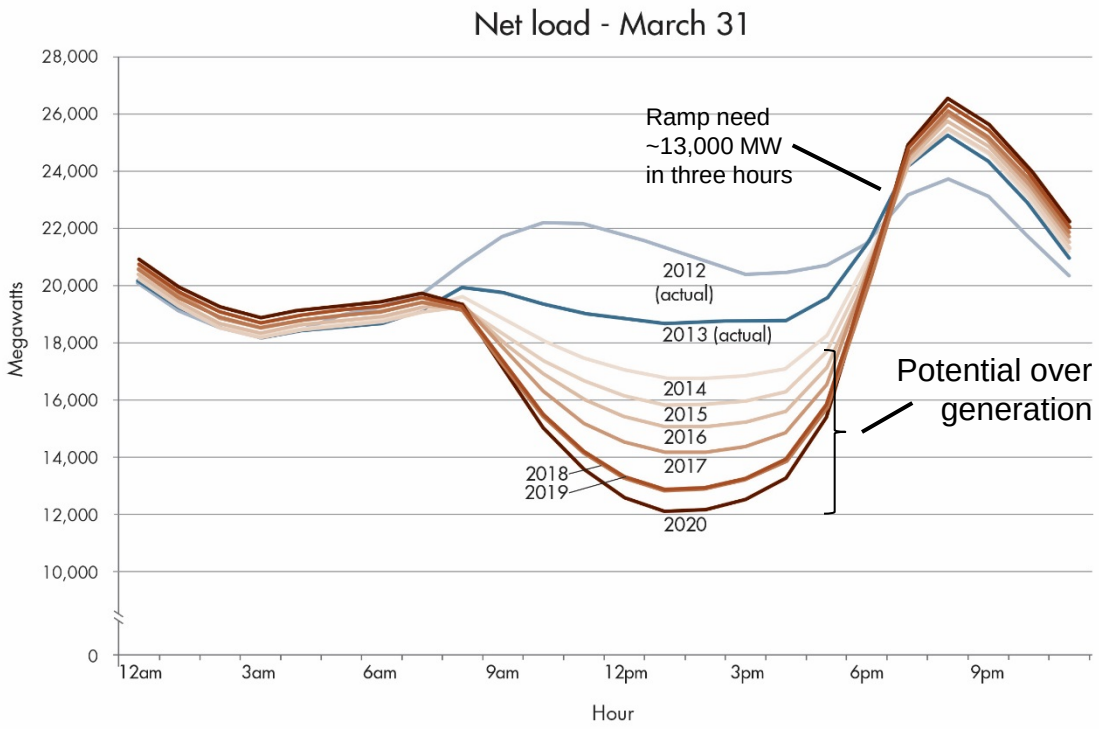
CAISO Queue Map – Conventional & Renewables



Interconnection queue by county		Megawatts		
County	# of Projects	Renewables	Conventional	Total
1 Shasta	2	2		27
2 Tehama	2	6		6
3 Sutter	1		64	64
4 Lake	1		13	13
5 Mendocino	1		10	10
6 Yolo	2	12	25	37
7 El Dorado	1		10	10
8 Sonoma	2		10	10
9 Solano	1	2		2
10 Santa Barbara	2	99	42	141
11 Alameda, Contra Costa	14	117	1,252	1,369
12 San Joaquin	8	171	709	880
13 Stanislaus	2	320		320
14 Merced	7	570		570
15 Tuolumne	1		30	30
16 Fresno, Madera	51	2,821	805	3,626
17 San Mateo	2		432	432
18 Monterey, San Benito	2	520		520
19 Kings	20	1,190	1,093	2,202
20 Tulare	5	20	443	463
21 San Luis Obispo	2	690		690
22 Kern	57	5,666	646	6,312
23 San Bernardino	15	1,730	238	1,968
24 Los Angeles, Orange	20	1,253	4,255	5,508
25 Riverside	25	4,141	4,090	8,231
26 San Diego	47	864	3,079	3,943
27 Imperial	10	1,423	238	1,661
In-state Totals	303	21,761	17,484	39,245
28 Nevada	13	1,797	44	1,841
29 Arizona	7	1,212	300	1,512
30 Mexico	4	1,321		1,321
Out-of-state Totals	24	3,210	344	4,674
TOTAL ALL PROJECTS	**327**	**26,091**	**17,828**	**43,919**

as of June 18, 2015

Non-Flexible resources create oversupply conditions and potential for RPS curtailment



Oversupply may lead to curtailment because of dispatch limitations on some resources, such as:

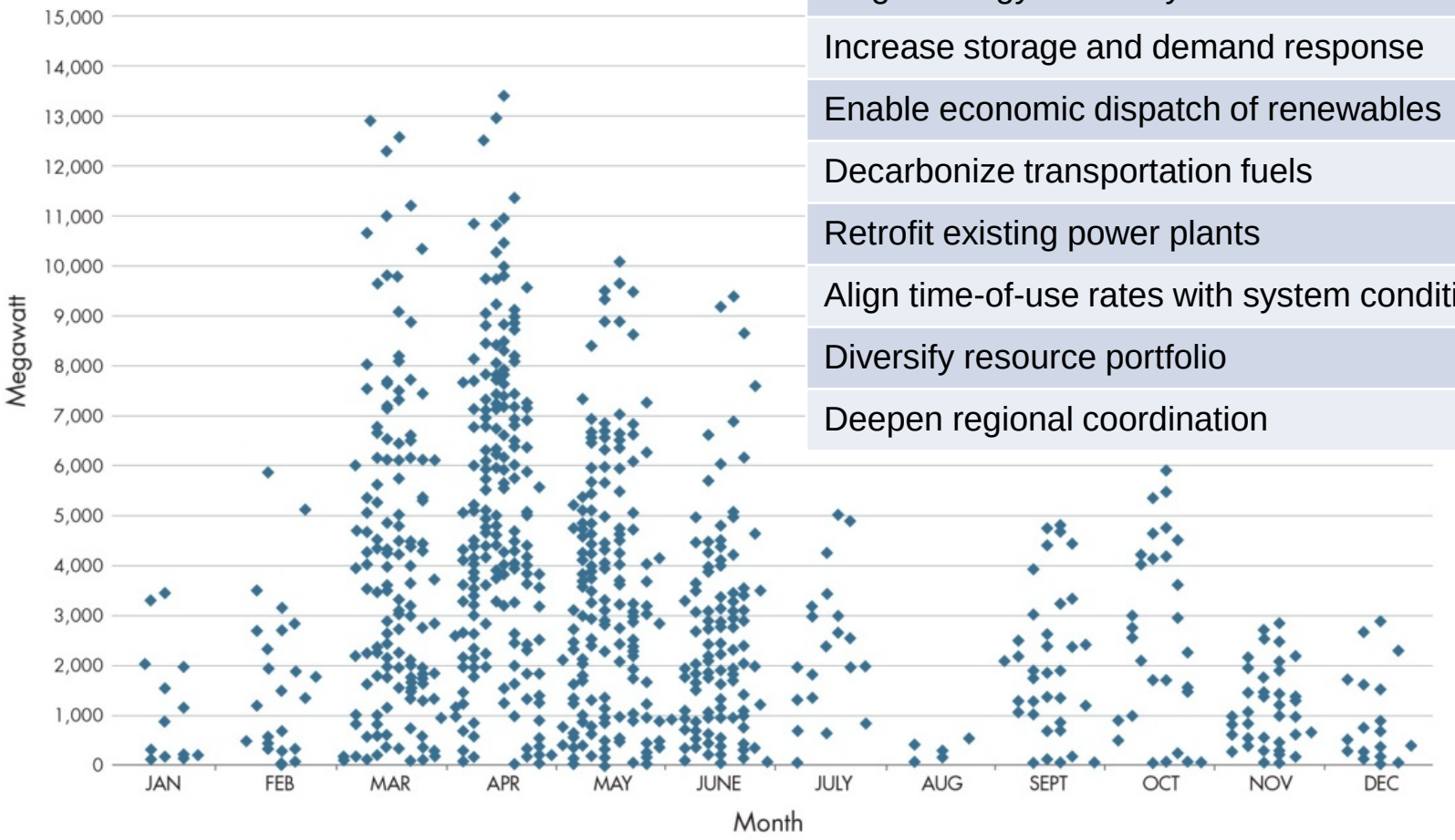
- combined heat and power
- nuclear
- geothermal
- small hydro
- generation needed for reliability services

Operational requirements include:

- generation needed to meet ramping requirements
- Required standby generation, voltage support and other reliability services
- load following capability

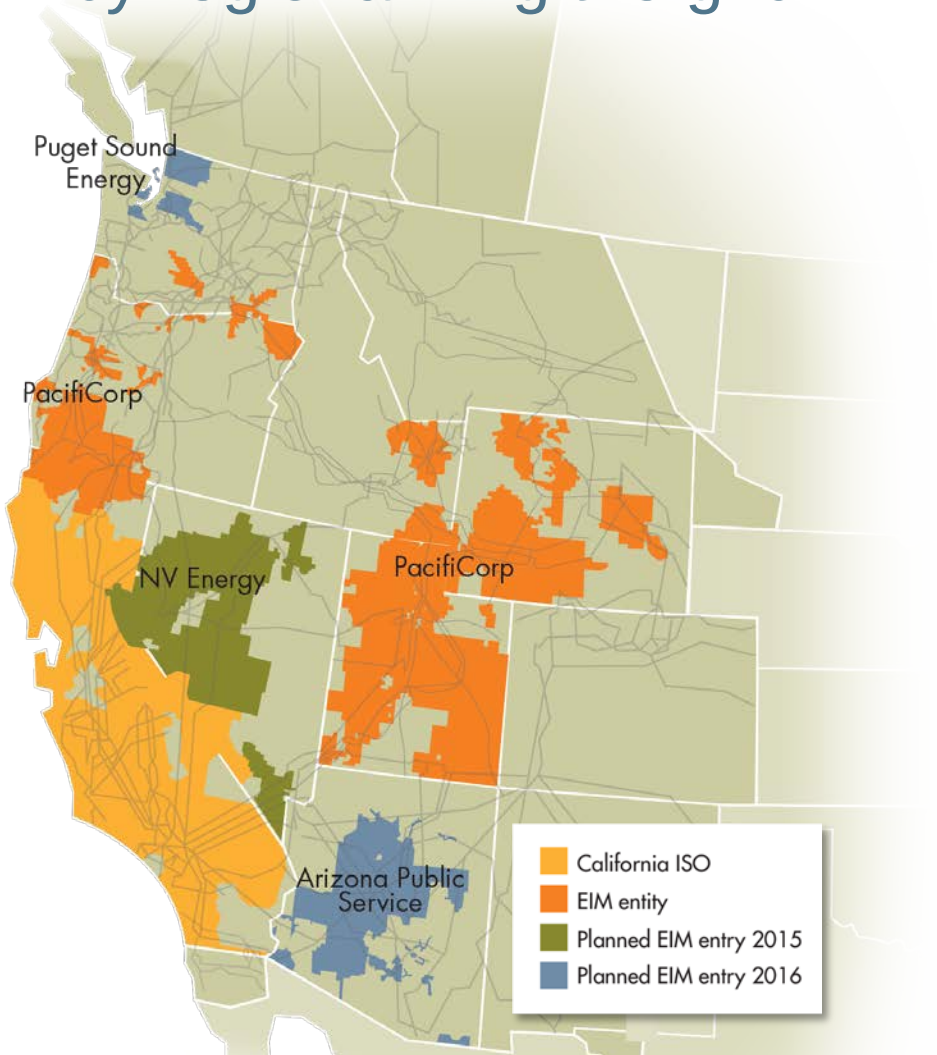
- ISO has already seen the need to curtail generation in 2014

Renewable curtailment in 2024 at 40% RPS is significant



Solutions
Target energy efficiency
Increase storage and demand response
Enable economic dispatch of renewables
Decarbonize transportation fuels
Retrofit existing power plants
Align time-of-use rates with system conditions
Diversify resource portfolio
Deepen regional coordination

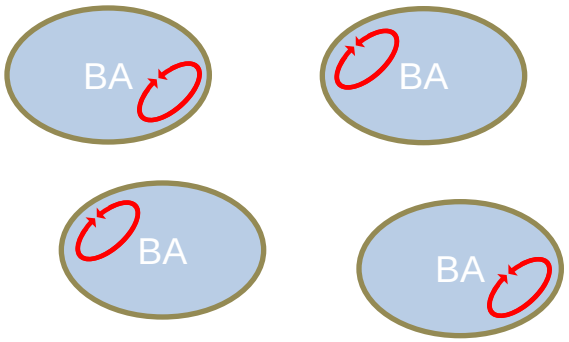
California can accelerate carbon reduction in the West by regionalizing the grid.



- Regional operation of the Energy Imbalance Market (EIM) is underway and growing.
- EIM is already saving consumers millions of dollars per year.
- A larger region benefits renewable integration
- PacifiCorp is evaluating whether to become a full participant in the ISO.

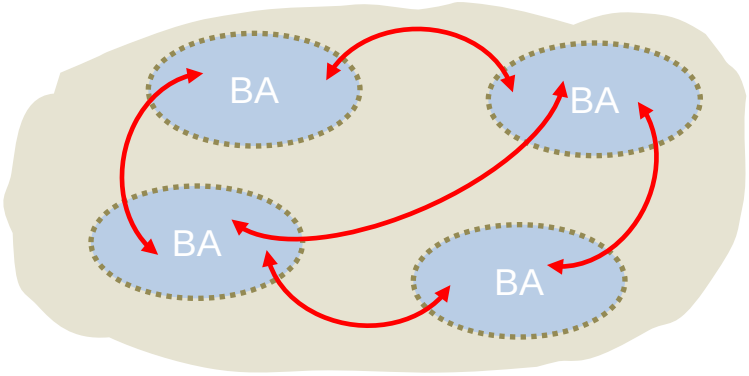
Energy imbalance market – key points

Without EIM:
Each BA must balance loads and resources within its borders



- Limited pool of balancing resources
- Inflexibility
- High levels of reserves
- Economic inefficiencies
- Increased costs to integrate wind/solar

With EIM:
The market dispatches resources across BAs to balance energy



- Diversity of balancing resources
- Increased flexibility
- Decreased flexible reserves
- More economically efficient
- Decreased integration costs

Summary of EIM benefits for the 1st Quarter 2015

BAA	January	February	March	Total
ISO	$0.48	$0.49	$0.48	$1.44
PACE	$0.88	$0.83	$0.91	$2.63
PACW	$0.42	$0.49	$0.28	$1.19
Total	$1.78	$1.81	$1.67	$5.26

Benefits reflect:

- More efficient dispatch, both inter- and intra-regional
- Reduced renewable energy curtailment
- Reduced flexibility reserves needed in PacifiCorp BAAs

This report contains enhancements over the 2014 Q4 report:

- Benefit calculations include all fifteen minute market intervals
- Calculations used relevant prices including any corrections
- Calculations of avoided renewable curtailment

Considerations for non-California entities for becoming full grid participant (Pacificorp is currently analyzing this option)

ISO stakeholder processes:

- Greenhouse gas
- Transmission charges
- Full network model
- Resource adequacy

Multi-state engagement:

- Briefings
- Consultation
- Regulatory review

Implementation:

- Project design and development
- Testing
- Market simulation
- Readiness assessment

Regional Operations:

- Day-to-day operations
- Facilitate CARB enforcement of cap & trade compliance