CALIFORNIA CLIMATE STRATEGY

An Integrated Plan for Addressing Climate Change

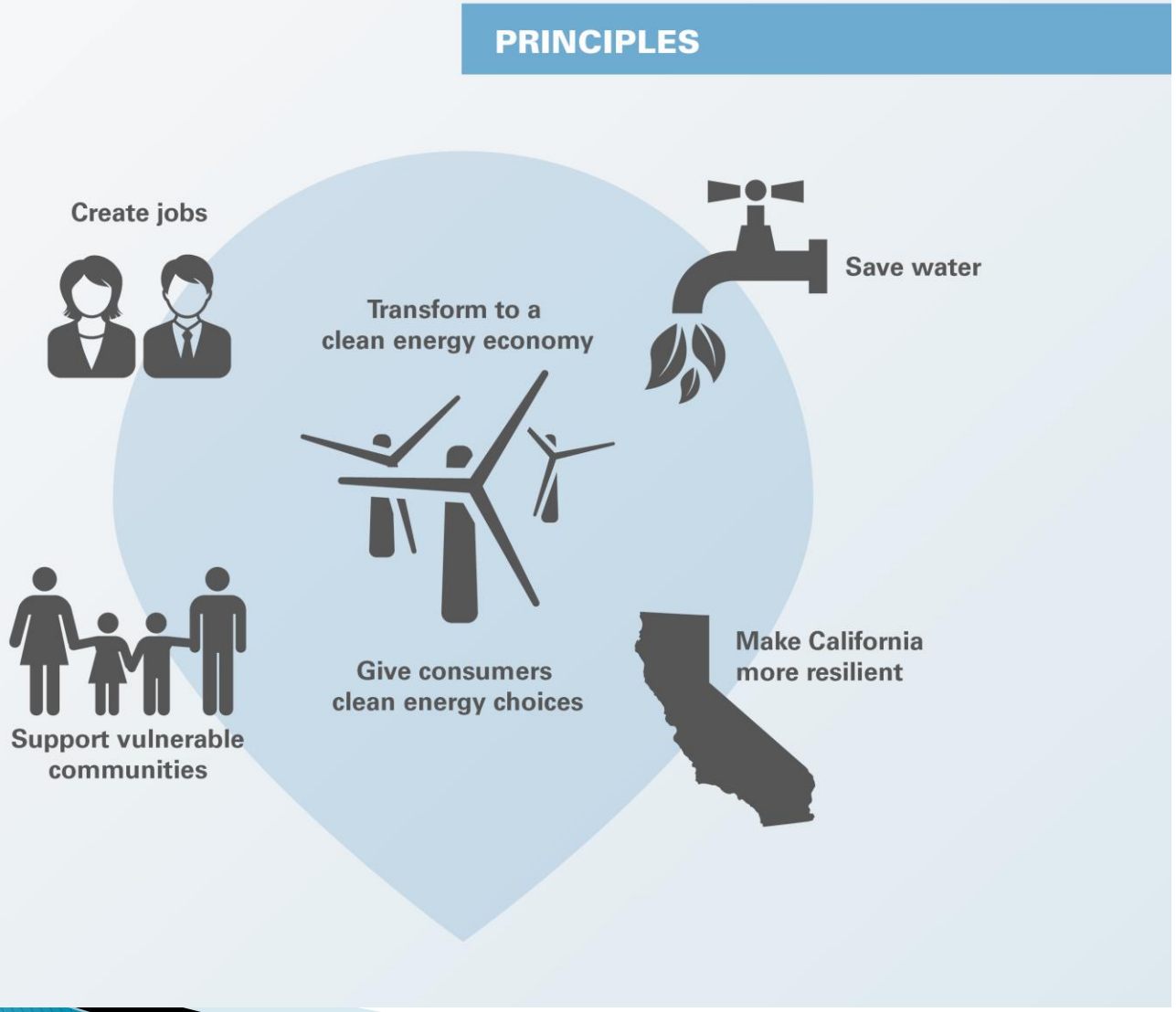
VISION

Reducing Greenhouse Gas Emissions to 40% Below 1990 Levels by 2030

GOALS

- 50% renewable electricity
- 50% reduction in petroleum use in vehicles
- Double energy efficiency savings at existing buildings
- Carbon sequestration in the land base
- Reduce short-lived climate pollutants
- Safeguard California

CALIFORNIA CLIMATE STRATEGY



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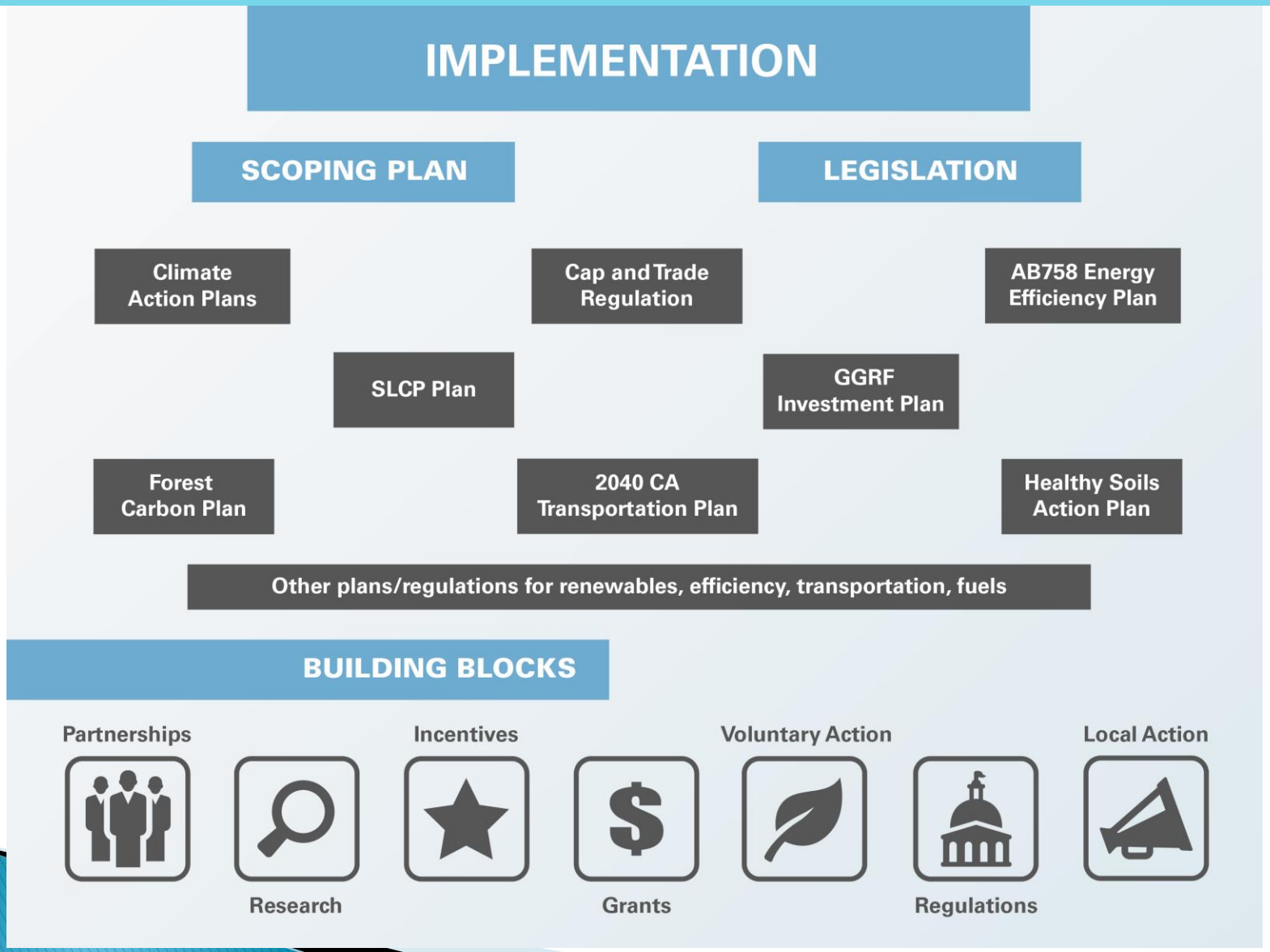


Public Comments

- To facilitate consideration by state agencies ahead of program and measure specific workshops*, please provide comments by August 8, 2015
- Links to submit both written comments and view all comments received can be found at: http://www.arb.ca.gov/cc/cc.htm

*There will be additional opportunities to comment at these workshops

Energy+Environmental Economics

+California PATHWAYS: Long-Term Greenhouse Gas Reduction Scenarios for California

Symposium on Governor Brown's GHG Reduction Goals
July 9, 2015

Dr. Nancy E. Ryan
Senior Director, Policy and Strategy

The California PATHWAYS project

Purpose

- To evaluate the feasibility and cost of a range of greenhouse gas reduction scenarios in California (prior to development of Governor's 2030 goals)

Project sponsors

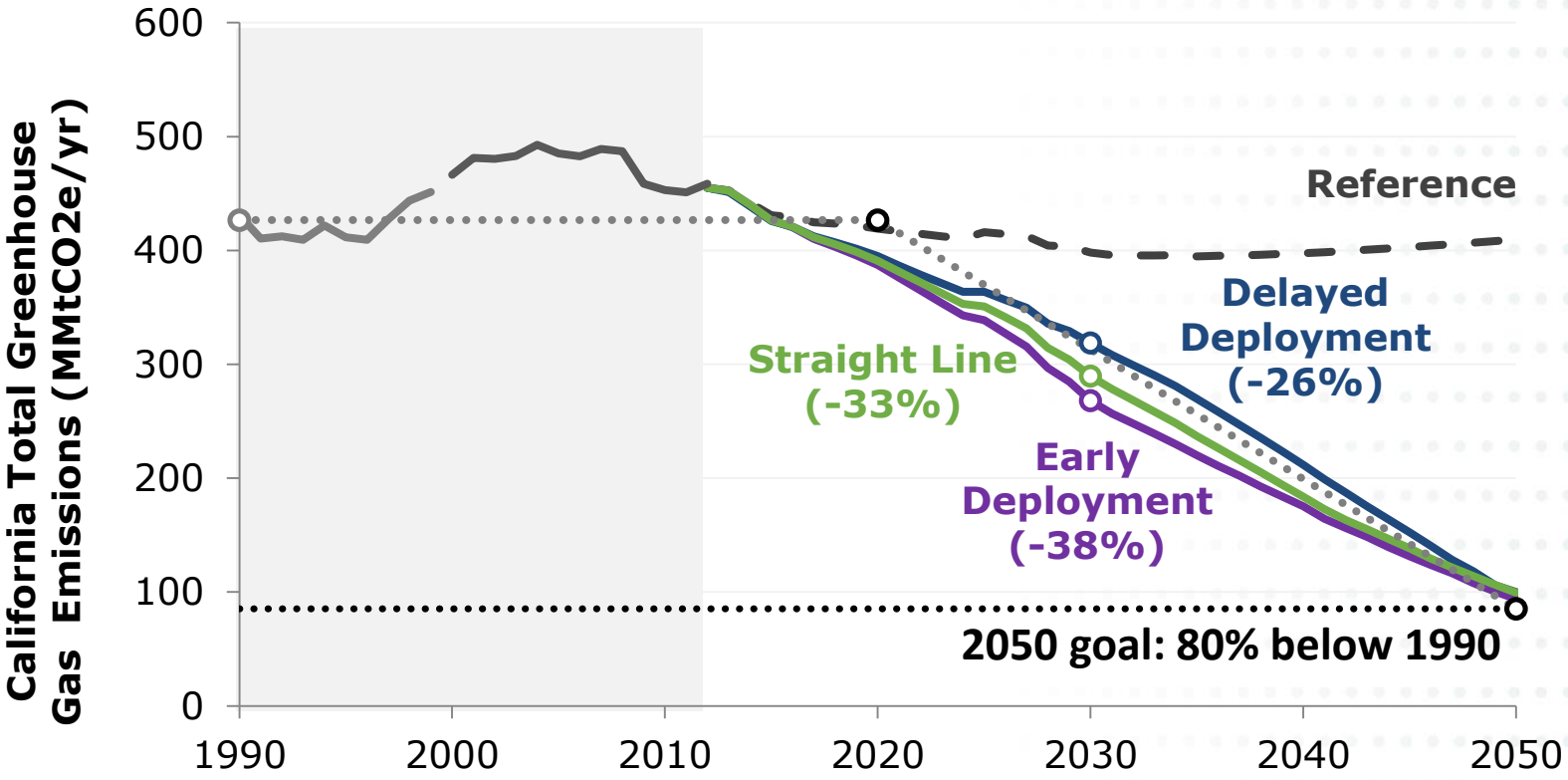
- California Air Resources Board, Energy Commission, Public Utilities Commission, Independent System Operator & the Governor's Office
- Additional funding provided by the Energy Foundation

Team

- Energy & Environmental Economics with support from LBNL

Study results: https://ethree.com/public_projects/energy_principals_study.php

Multiple scenarios are on a consistent trajectory to meet 2050 GHG goal

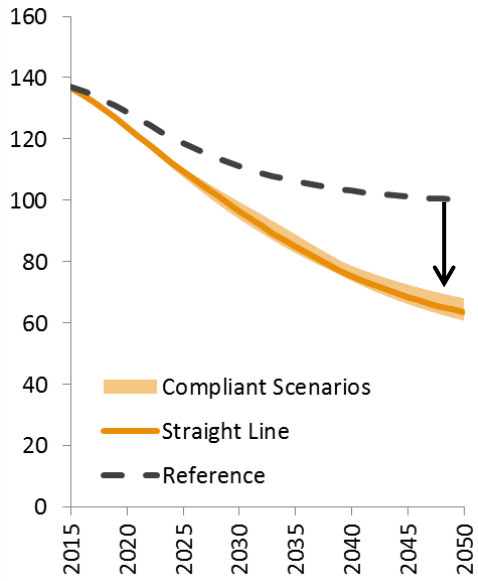


- **Timing scenarios** vary the pace of decarbonization: 2030 GHG emissions range from 26-38% below 1990 level
- **Technology scenarios** (not shown) assess impacts and interactions for specific technologies

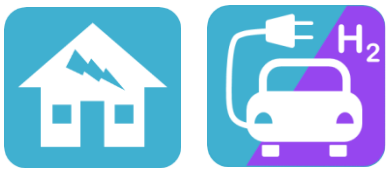
Decarbonizing CA's economy depends on four energy transitions

1. Efficiency and Conservation

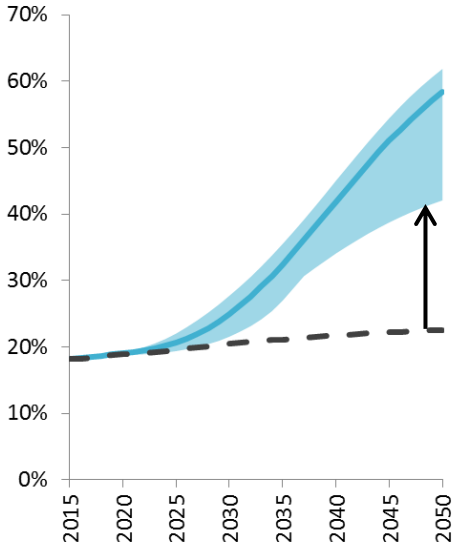
Energy use per capita (MMBtu/person)



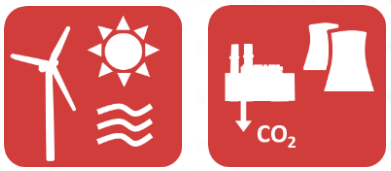
2. Fuel Switching



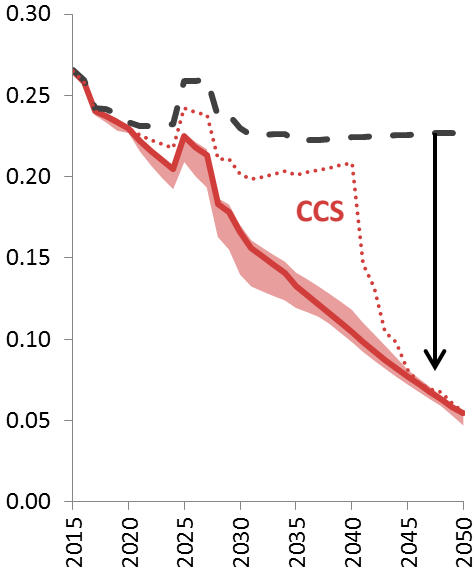
Share of electricity & H_2 in total final energy (%)



3. Decarbonize electricity

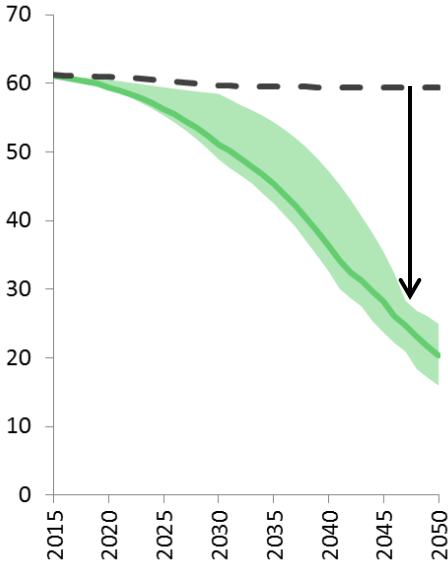


Emissions intensity (tCO2e/MWh)



4. Decarbonize fuels (liquid & gas)

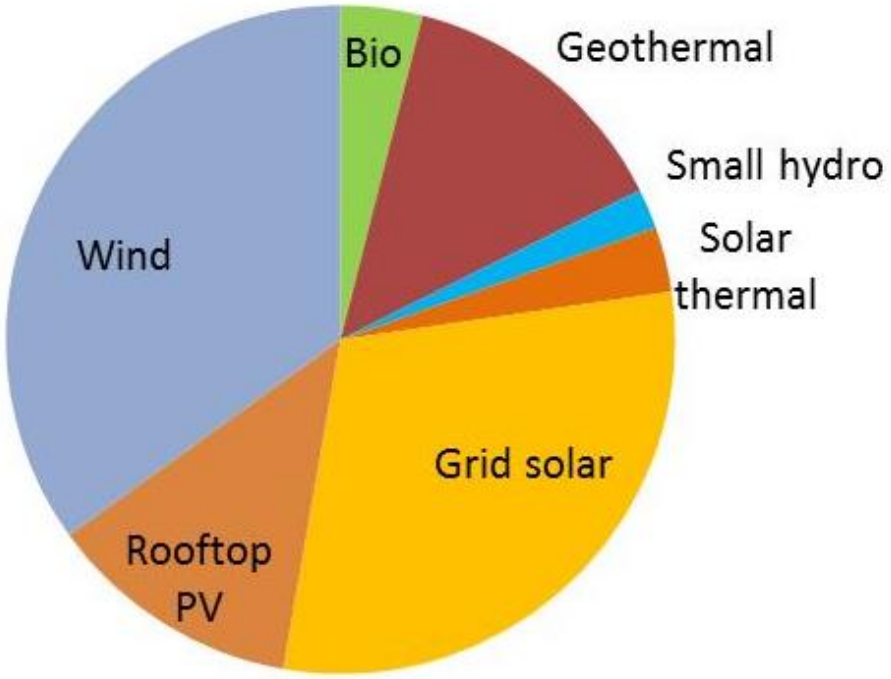
Emissions intensity (tCO2/EJ)



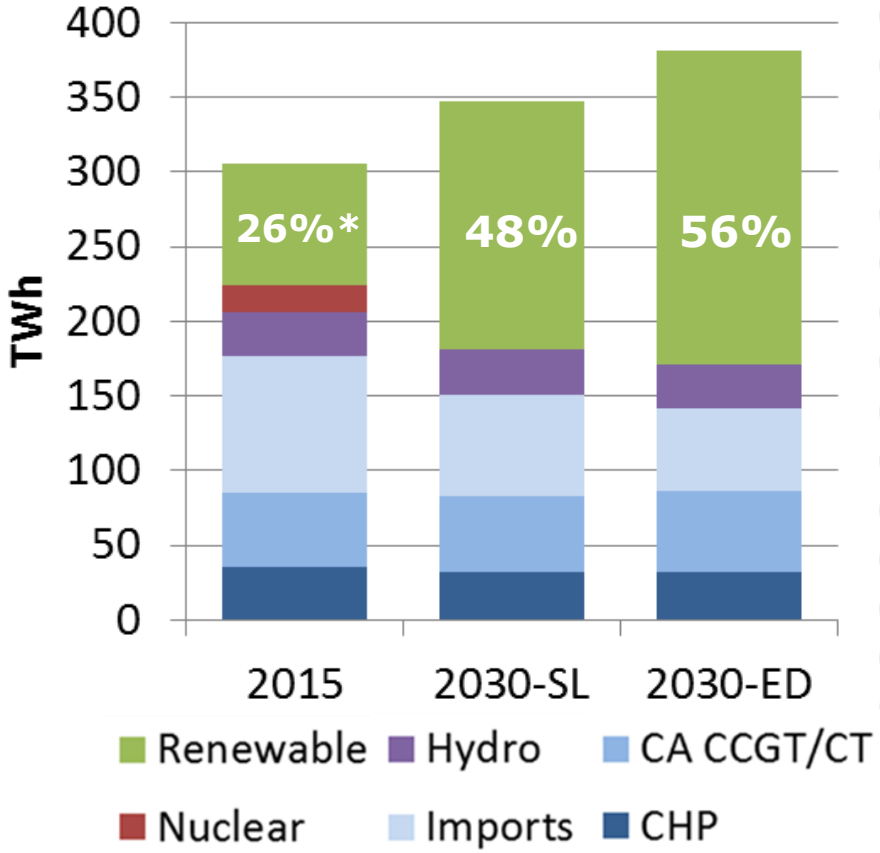
Renewables account for 50-60% of annual generation by 2030

- Average grid scale renewable additions are ~2,400 MW/year (mostly solar, wind) plus total 11,800 MW rooftop PV by 2030

2030 Renewable Generation by Type (%) – Straight Line



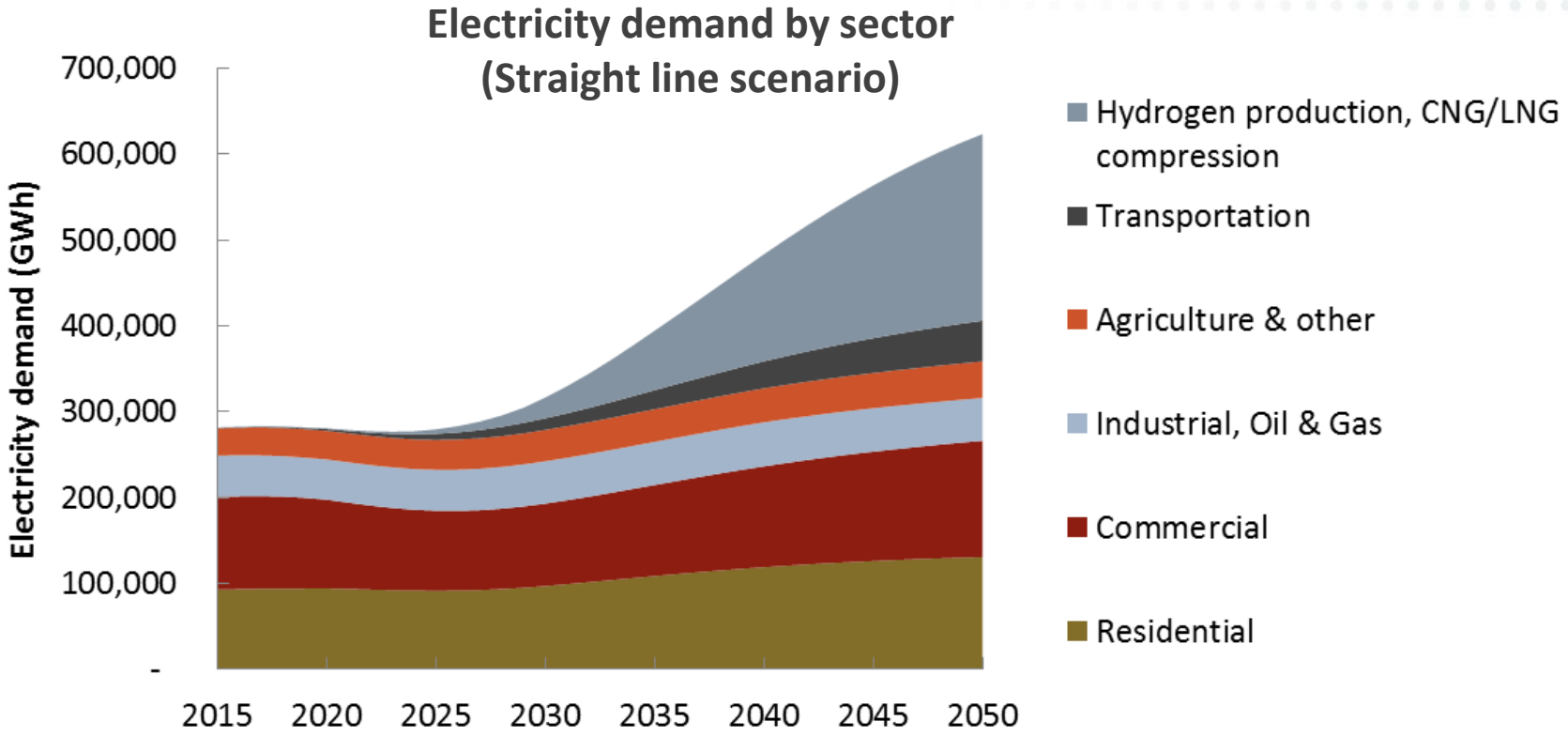
2015 & 2030 Annual Generation



* Estimated, not actual value

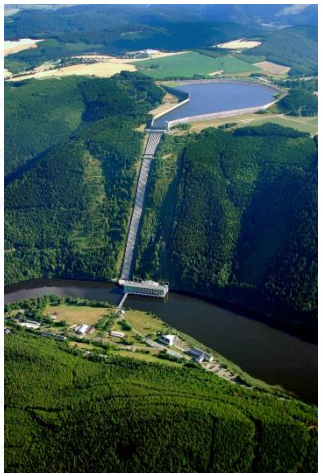
Fuel switching drives rapid growth in electric generation after 2030

- Energy efficiency offsets impact of electrification through 2030
- Beyond 2030 new loads offer potential for flexibility to help integrate solar and wind generation



Integration solutions are needed in all high renewables scenarios

+ **Increased regional coordination**
  - Make best use of latent flexibility in current system
+ **Renewable resource diversity**
  - Reduces overgeneration and need for flexible resources
+ **Flexible loads**
  - Shifting loads from one time period to another, sometimes on short notice
+ **Flexible generation**
  - Need generation that is fast ramping, starts quickly, and has min. gen. flexibility
+ **Energy storage**
  - Deep-draw (diurnal) storage is important



Energy+Environmental Economics

Thank You!

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For more information:

https://ethree.com/public_projects/energy_principals_study.php

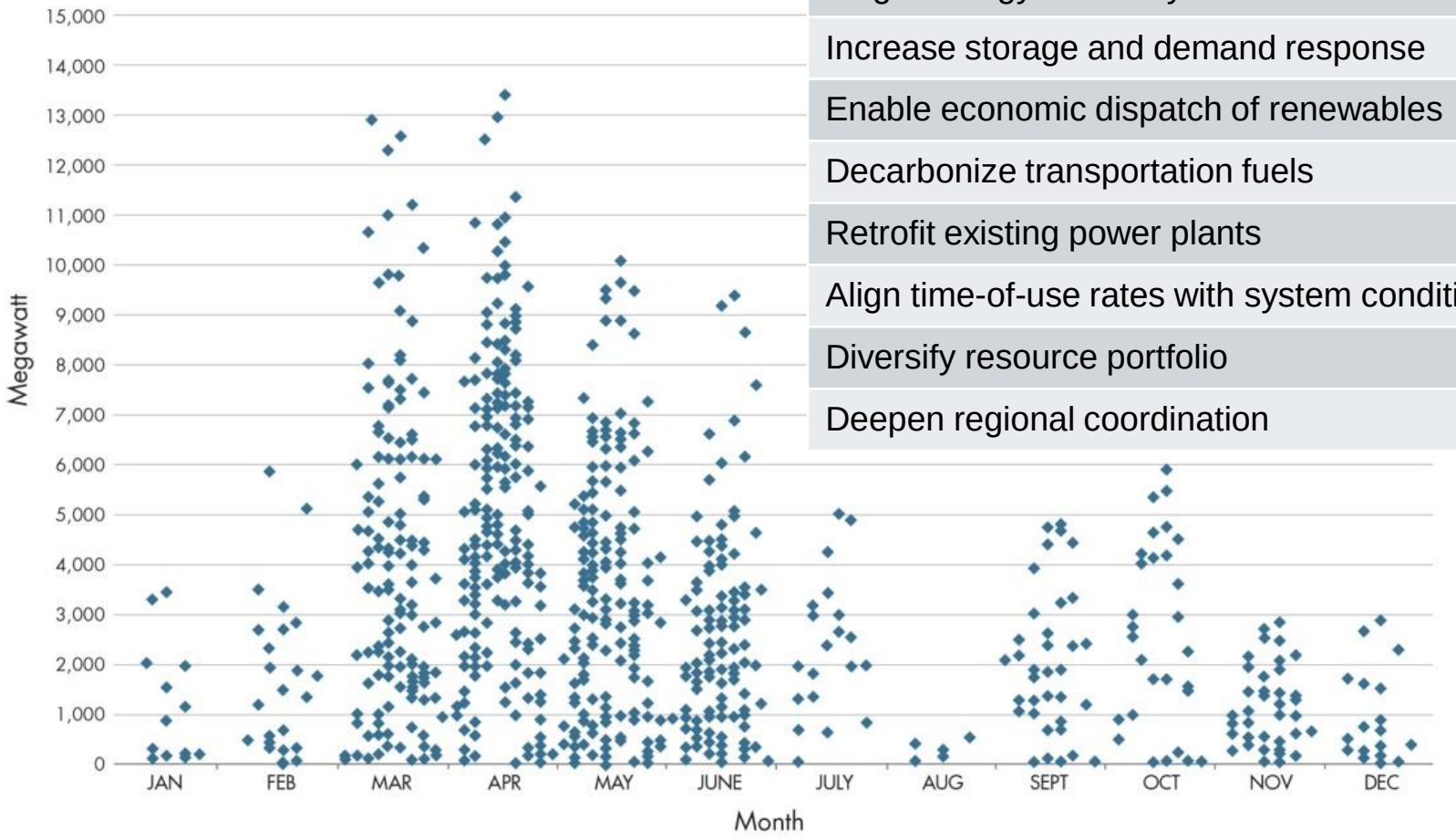
Governor's Greenhouse Gas Reduction Goals

Operational lessons important to a low-carbon grid

Phil Pettingill, Director, Regional Integration

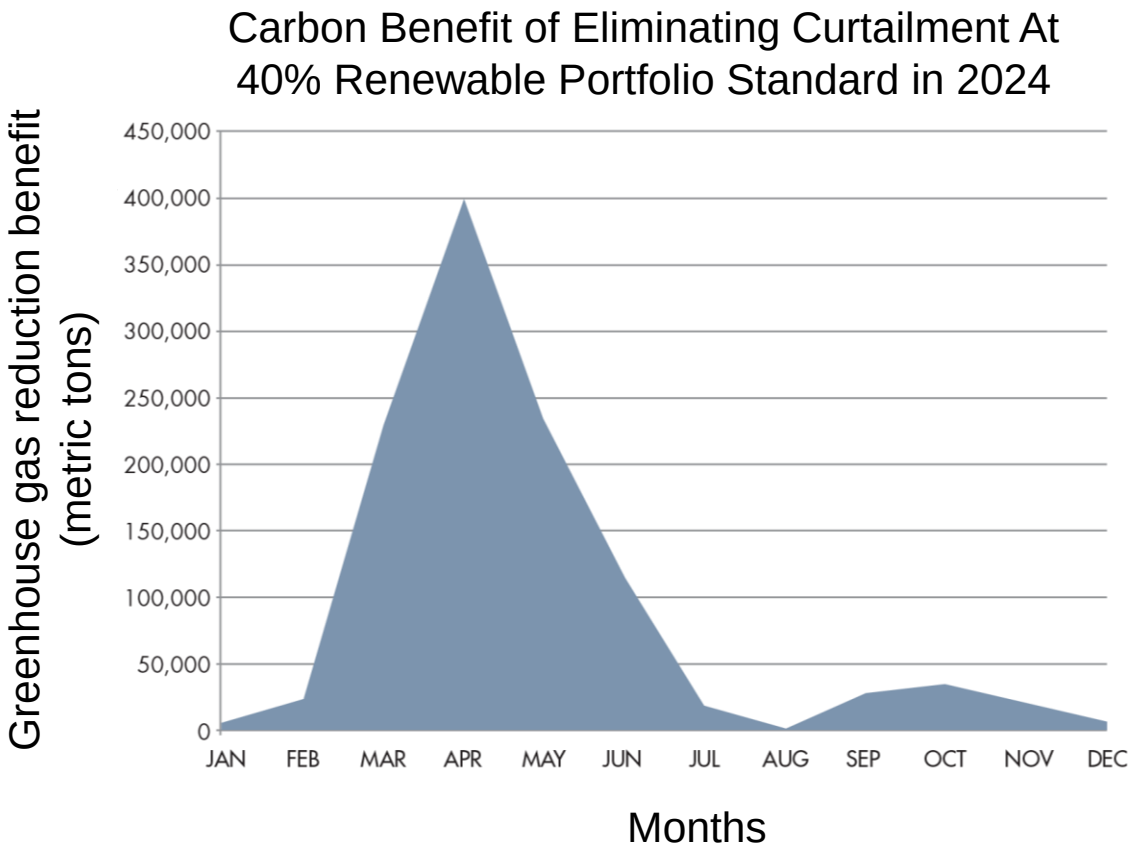
July 9, 2015

Renewable curtailment in 2024 at 40% RPS is significant.



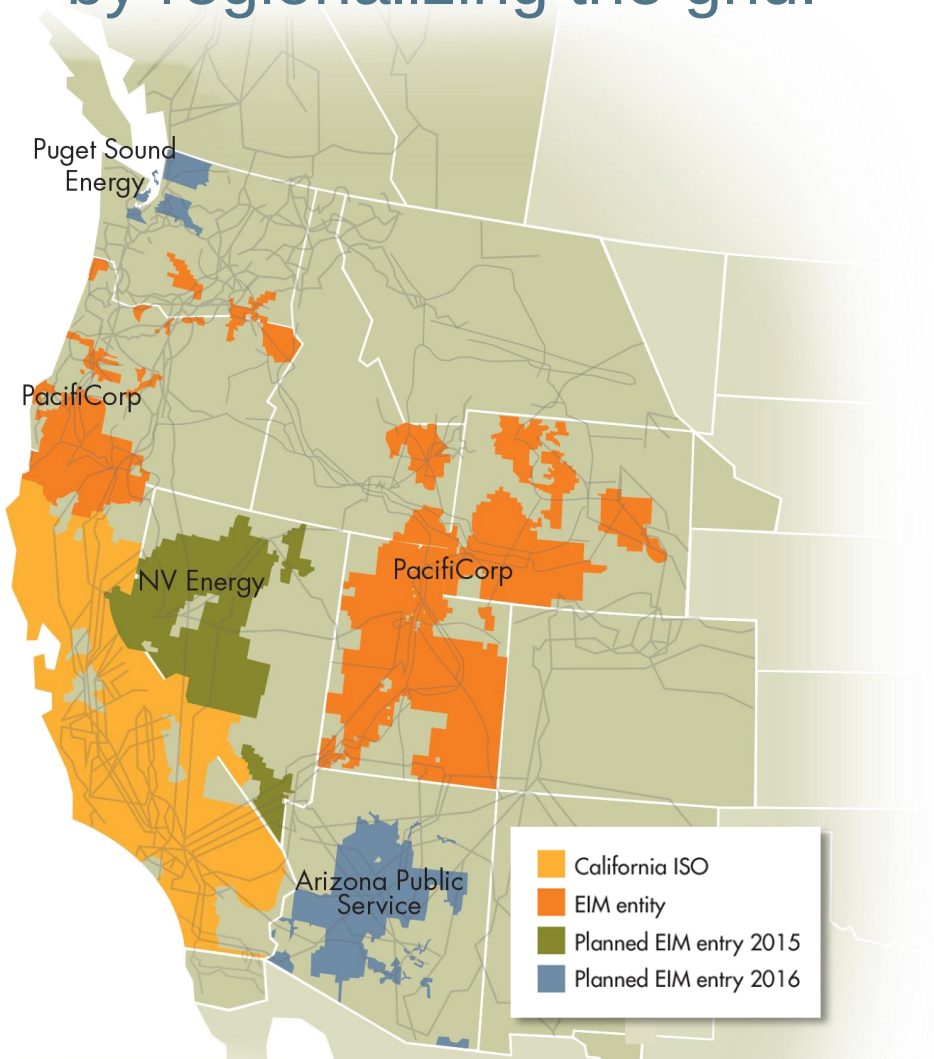
Solutions
Target energy efficiency
Increase storage and demand response
Enable economic dispatch of renewables
Decarbonize transportation fuels
Retrofit existing power plants
Align time-of-use rates with system conditions
Diversify resource portfolio
Deepen regional coordination

A regional grid means power that would have been curtailed can reach customers in other states, which lowers costs and reduces carbon emissions.



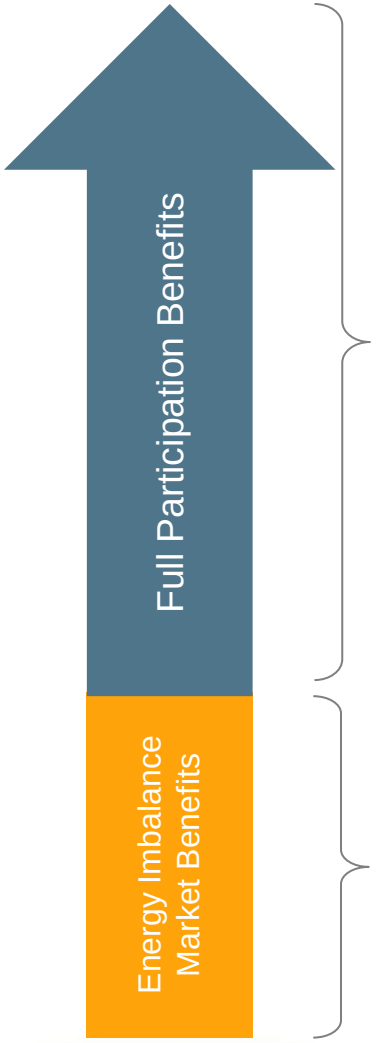
- Eliminating 2024 renewable curtailment at a 40% renewable portfolio standard reduces carbon emissions by 1.1 million metric tons per year.
- West-wide coordination at a 50% renewable portfolio standard lowers carbon emissions by an additional 1.5 million metric tons/year.

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 is interested and evaluating joining the ISO balancing area

Carbon and cost benefits increase with a regional market.



- Increases development of renewable generation in California and the region
- Optimizes what power plants are turned on ahead of time
- Increases development of new transmission to enhance reliability, lower costs, and achieve policy objectives
- Improves reliability by providing greater visibility and load/resource diversity across the region

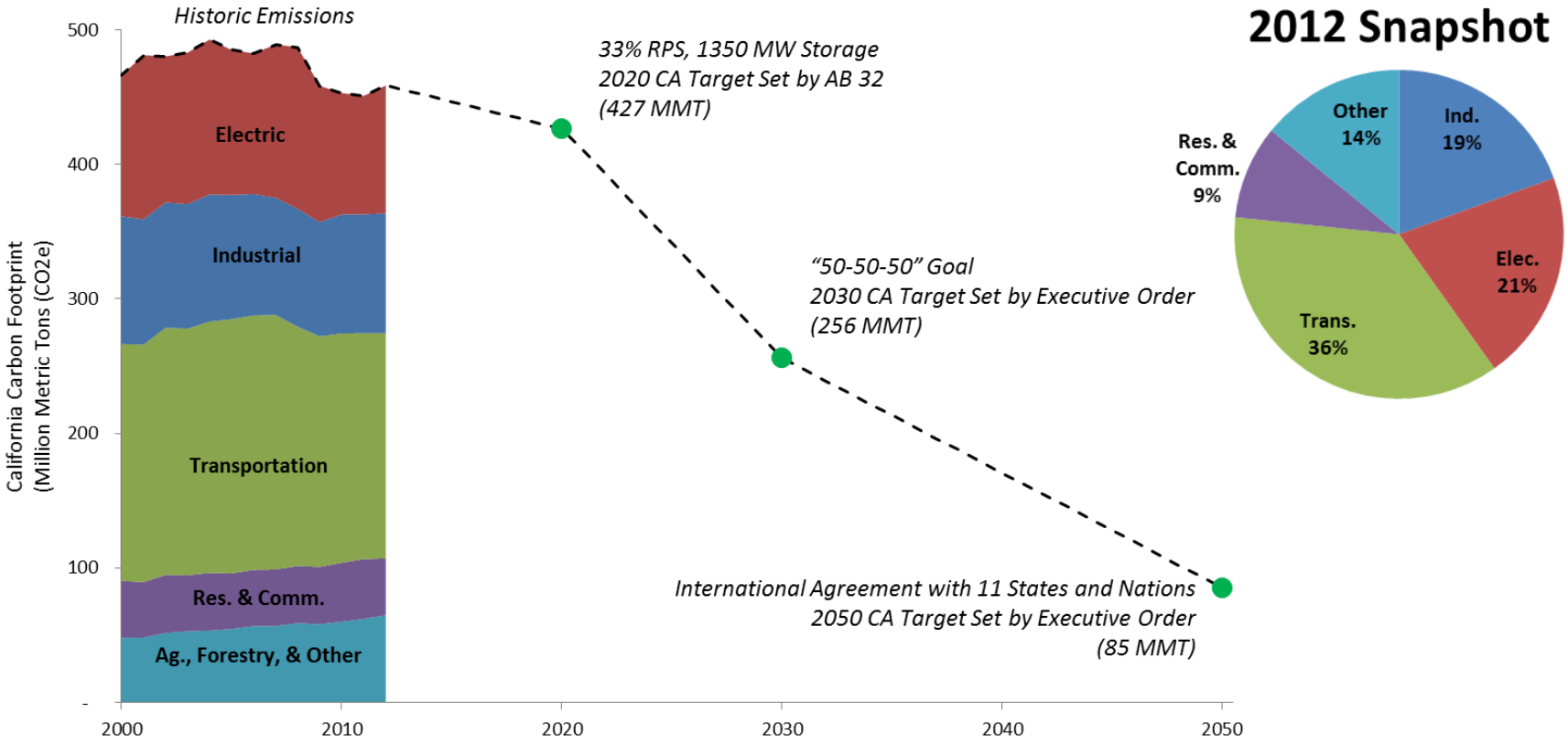
- State-of-the art technology that balances supply and demand every five minutes
- Dispatches the use of the lowest cost generation available in real-time

SOUTHERN CALIFORNIA EDISON®
An EDISON INTERNATIONAL® Company

Symposium on Governor Brown's Greenhouse Gas Reduction Goals

Caroline Choi
Vice President
Energy and Environmental Policy

Electricity sector progress



The electricity sector has reduced emissions nearly 20% below 1990 levels, according to ARB's 2013 Emissions Inventory, and utilities will be key players to achieve California's climate goals