



Climate Partners

FOR A CLEAN & PROSPEROUS FUTURE

climate.america.gov/brasil

The Transition to Clean, Low-Impact Energy Systems: *The California Experience*



Andrew McAllister, PhD
Commissioner
California Energy Commission



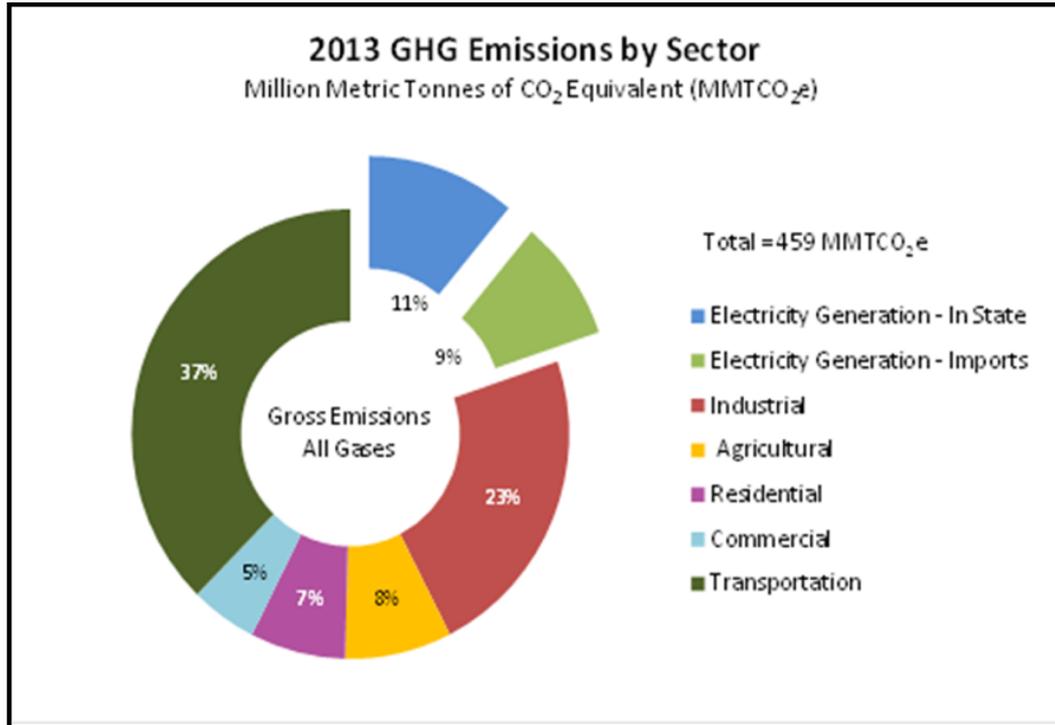
The Climate Imperative

California is fortunate to have broad agreement – population, elected leadership, business community, investors, local governments – that climate change must be confronted.

WE MUST LEAD.

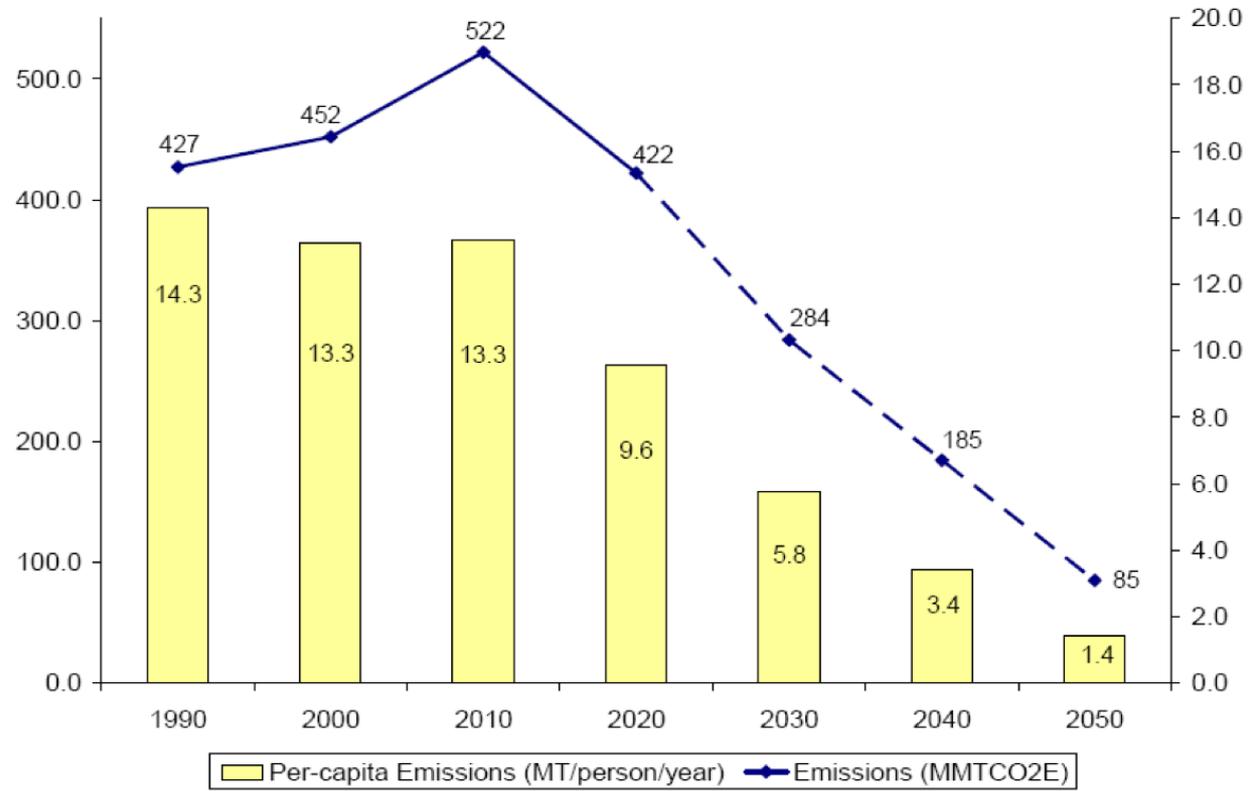
The Under2MOU is an expression of Gov. Brown's desire to work with his counterparts across the globe to solve our shared challenge.

GHG Emissions Statewide

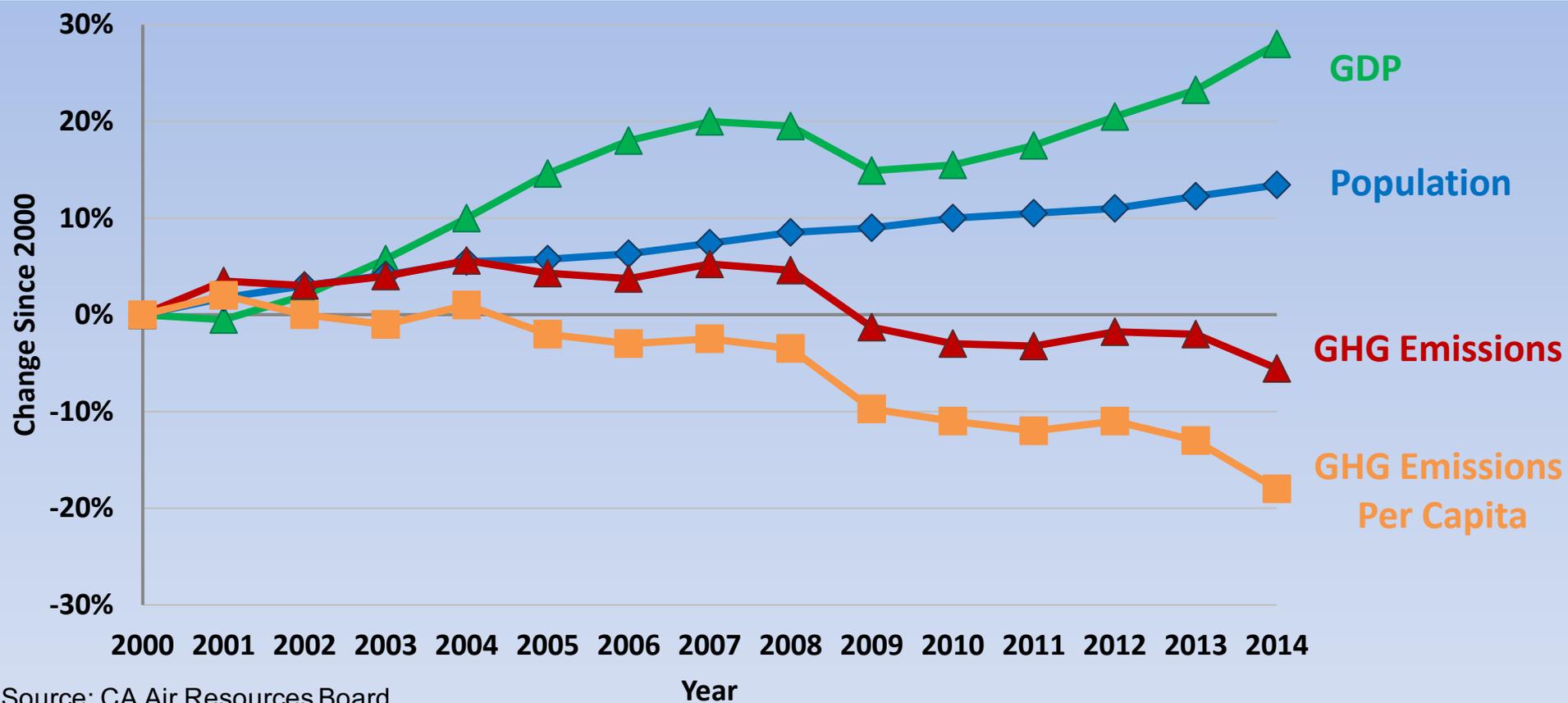


- 20% from electricity sector (About 45% of that is from the 33% out-of-state electricity)
- 37% from transportation

CA Emissions Trajectory Toward 2050



Since 2001: GDP Up 28%, Emissions Down 8%





Policies

A Broad Suite of
Complementary Initiatives

The transition to clean energy is full of opportunity.

A suite of complementary policies helps to encourage innovation in technology and – equally important – business model development for commercialization and scale-up.

California Policy Foundations

Codes and Standards (Since 1975)

Buildings Building Energy Efficiency Standards have improved the performance of new buildings by 80% since 1976

Appliances CA Has Authority to Create Standards Where No National Standards Exist. TVs, Showers, Computers...

Global Warming Solutions Act (2006)

AB 32 Reduces statewide greenhouse gas (GHG) emissions to 1990 levels by 2020

Long Term Energy Efficiency Strategic Plan (2008)

State's first integrated framework—a single roadmap to achieve maximum energy savings across all major groups and sectors.

Global Warming Solutions Act II (2016)

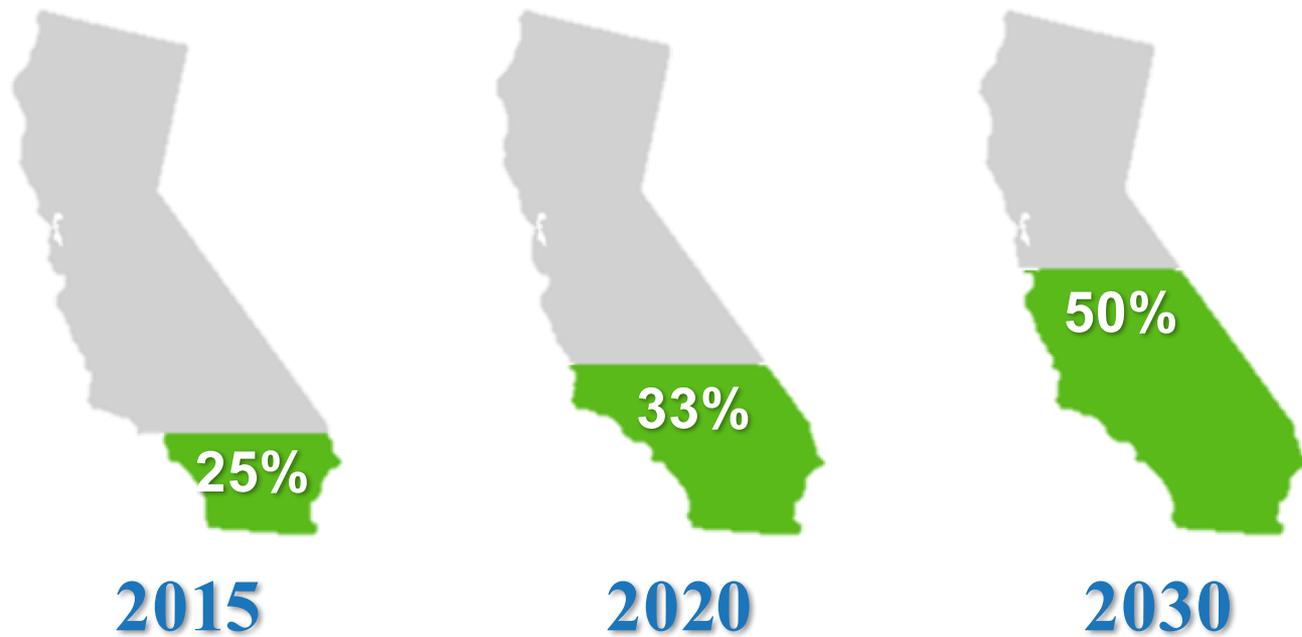
SB 32 Reduces statewide greenhouse gas (GHG) emissions to 40% below 1990 levels by 2030.

Clean Energy & Pollution Reduction Act (2015)

- * Mandates 50% Renewable Electricity by 2030
- * Doubles Expectations for Energy Efficiency

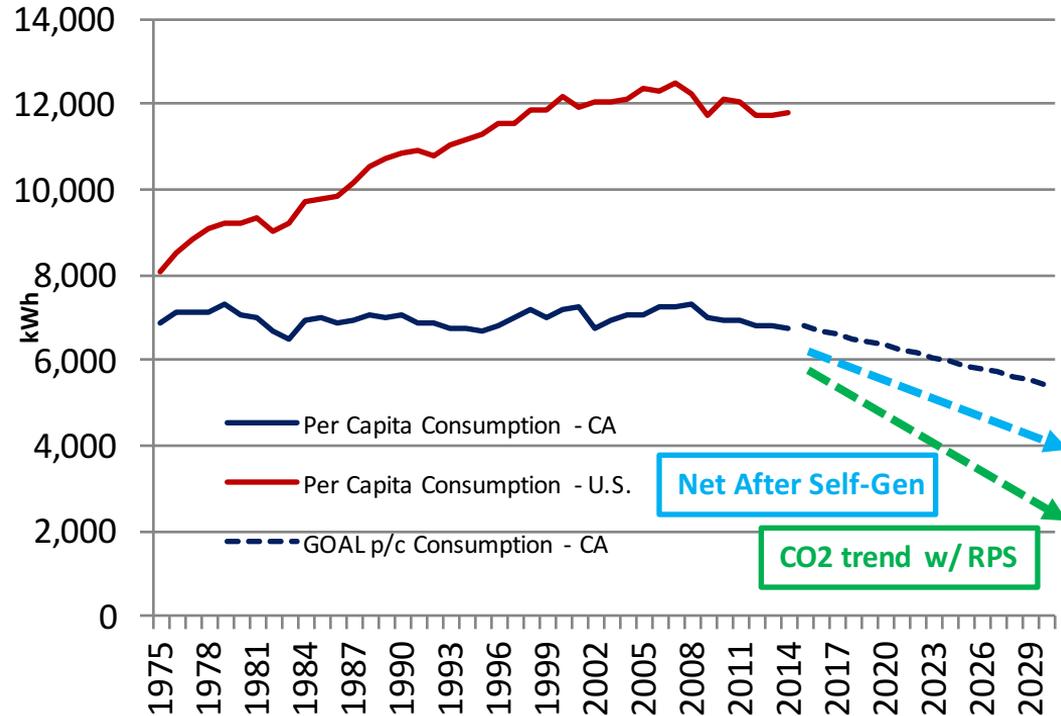


Part A: Half of Electricity From (Non-Hydro) Renewables



Part B: Improved Energy Performance of Buildings, Industry

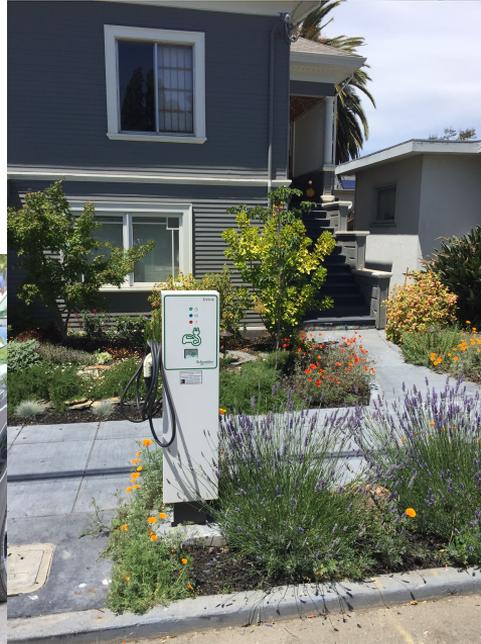
- \$1.8+B/yr in EE programs
- Leadership in State buildings
- Aggressive building codes
- Aggressive Appliance Standards
- Market Training and Support
- Research & Development
- Innovative financing approaches
- Benchmarking and Disclosure



Source: CA Energy Commission

Part C: Reducing Fossil Fuel Use By Half

- Heavy Duty Vehicles:
BioDiesel and Natural Gas
- Hydrogen Fuel Cell Vehicles
- Vehicle Electrification
- [Energy.ca.gov/altfuels/](https://www.energy.ca.gov/altfuels/)

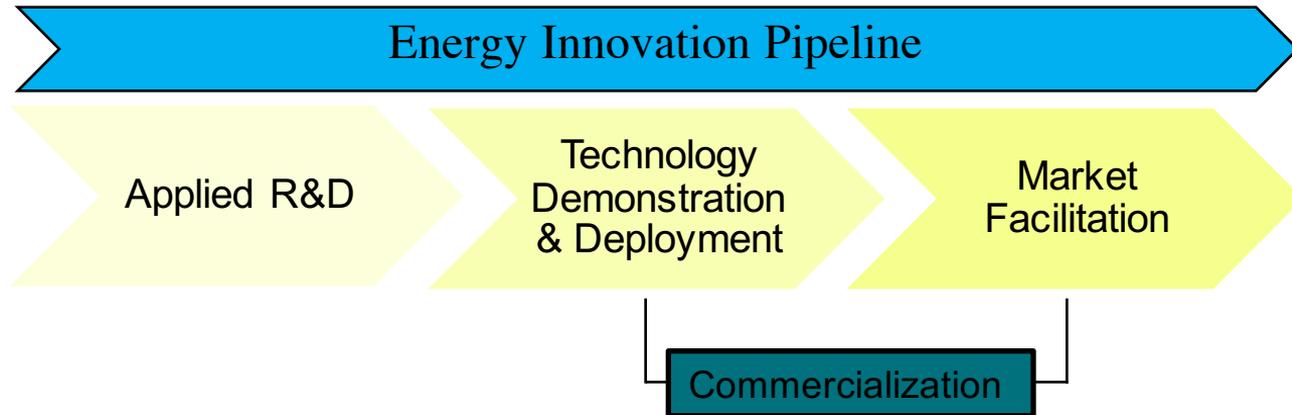


The Electrification of Transportation



CA Research and Clean Energy Funding

- \$284 million/year for research and clean energy infrastructure
- \$160M electricity R&D
- \$24M natural gas R&D
- \$100M clean transportation



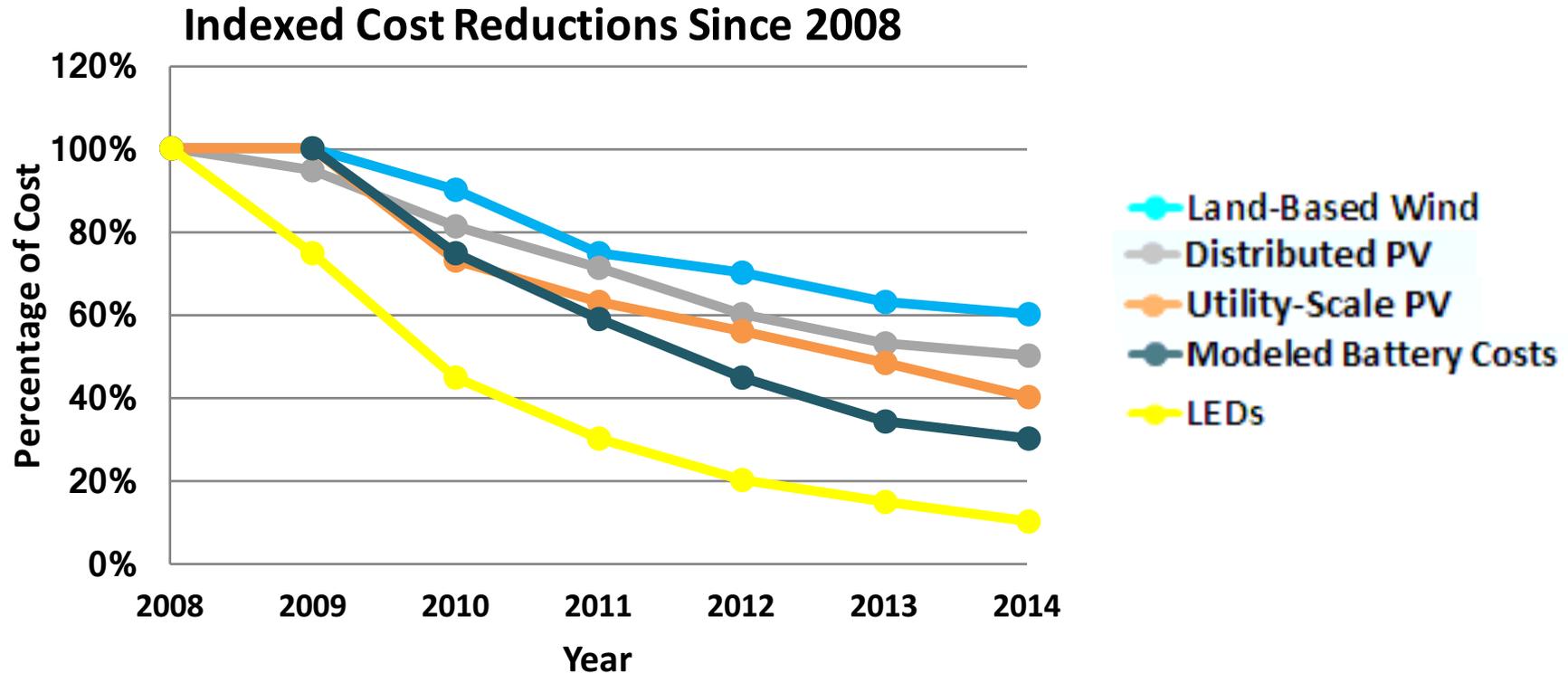
Markets Rising to the Challenge

Private Sector and Private Capital
Are Critical for Sustained Innovation

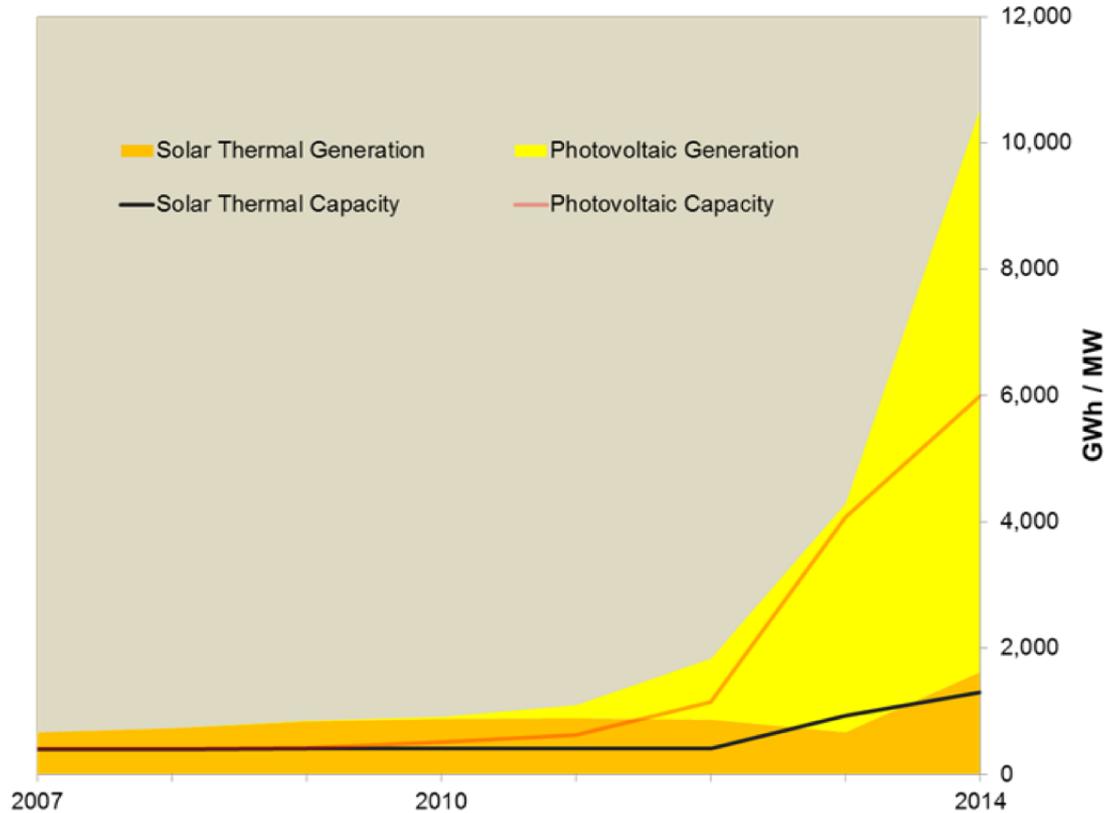
Well-designed policies create the certainty needed for the private sector to commit creativity and capital to moving markets forward.

There are \$ trillions looking for attractive places to deploy!

The Falling Cost of Clean Energy Technologies



California Utility-Scale Solar



Source: USDOE: Revolution Now, The Future Arrives for Five Clean Energy Technologies, 2015



World's Largest Geothermal Complex

350 Wells / 18 Plants Generate 835 MW

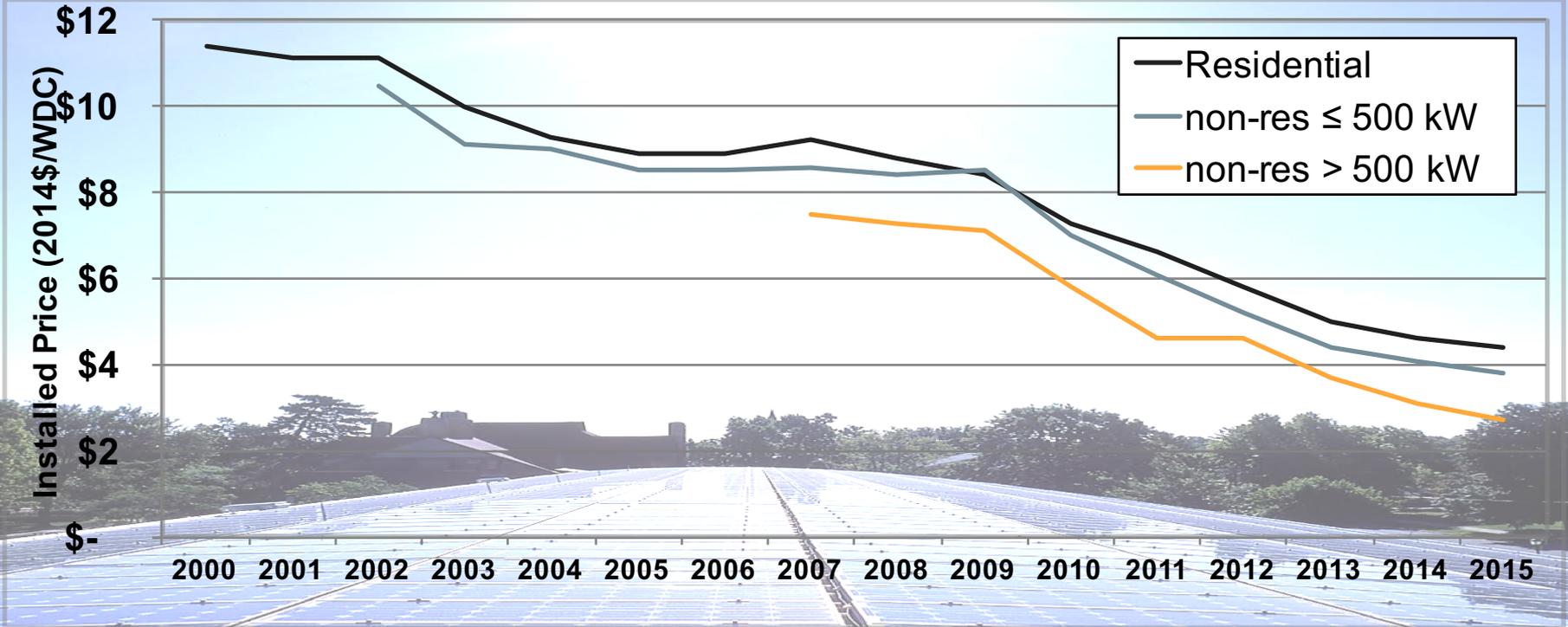


The Nation's Largest Wind Facility

Alta Wind Energy Center: 1548 MW wind power to Southern California Edison.



Small-Scale Solar Cost Decline



Typical Residential Rooftop PV System





Dashboard



Layout

Choose a site (insert at least 3 letters to search):

McAllister, Andrew

Show tree

Hide playback

Weekly

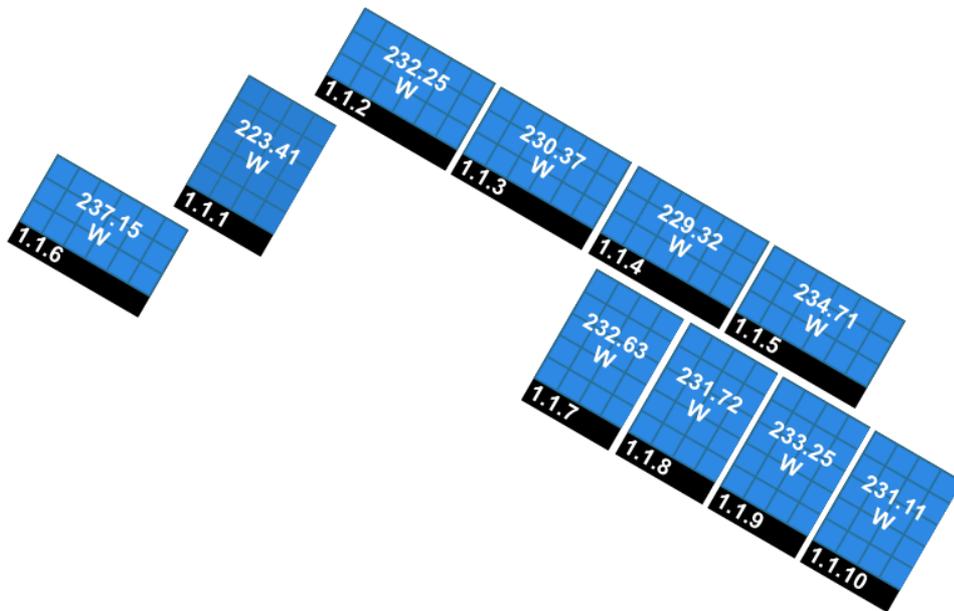
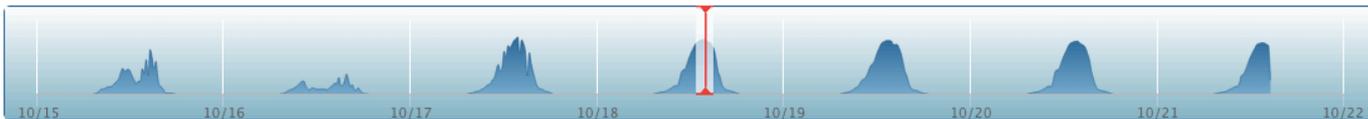
Physical layout



Time: 13:15:00

Normal

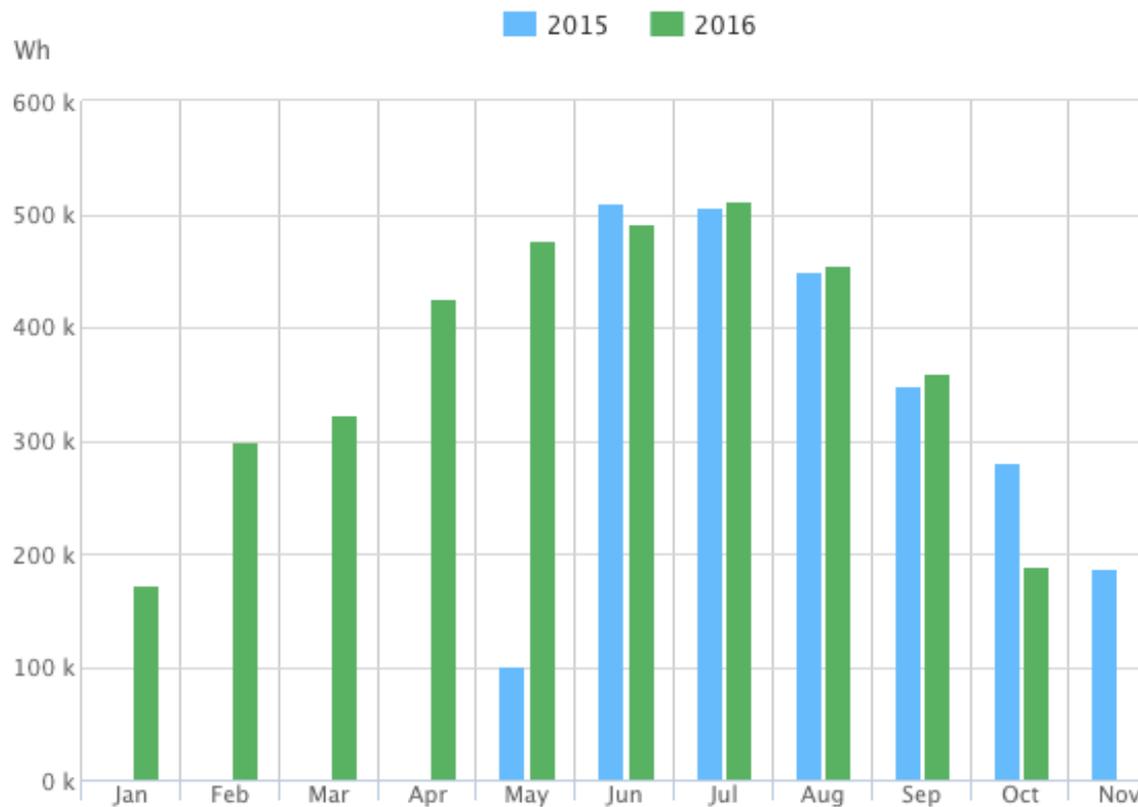
Accelerated



Comparative Energy



Month Quarter Year



Environmental Benefits



CO2 Emission Saved
8,772.67 lb



Equivalent Trees Planted
220.95



Light Bulbs Powered
17,167.95 For a day

Impact on Utility Bills

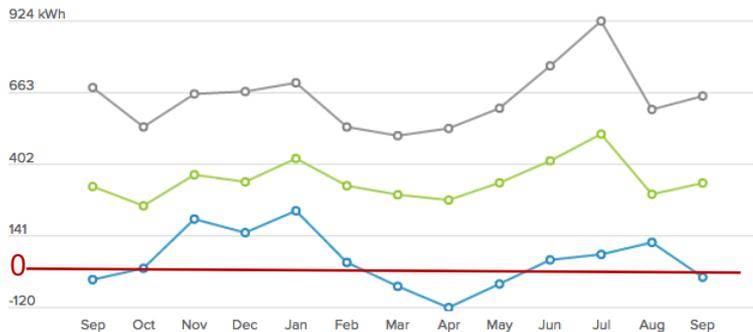
My Energy Use

Select fuel type:

Account:

Sep 2015 – Sep 2016
Similar homes comparison

Select view:



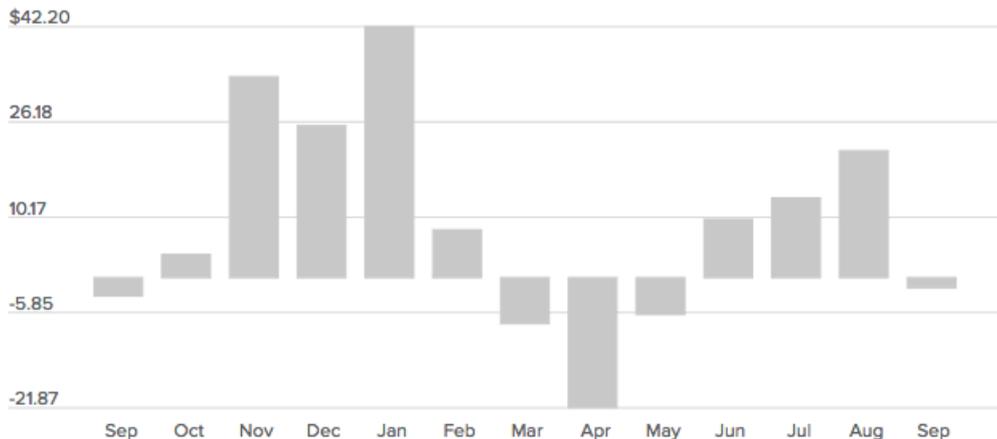
Similar homes Usage Costs Weather

- You
- All similar homes
- Efficient similar homes

[What homes are compared?](#)

Sep 2015 – Sep 2016
My costs

Select view:



Similar homes Usage **Costs** Weather



Green Button
Download
My Data

Solar Proliferation – one of MANY!

California Leads the Nation in Distributed Generation

591,197 Solar Projects 4,581 Megawatts (MW) Installed ?



<http://www.californiadgstats.ca.gov/>

Data Current Through 2016-07-31 ?

**The Principle Challenge to
Achieving Our 2050 Goals Is:**

Integration

VISION

Technologies at all scales

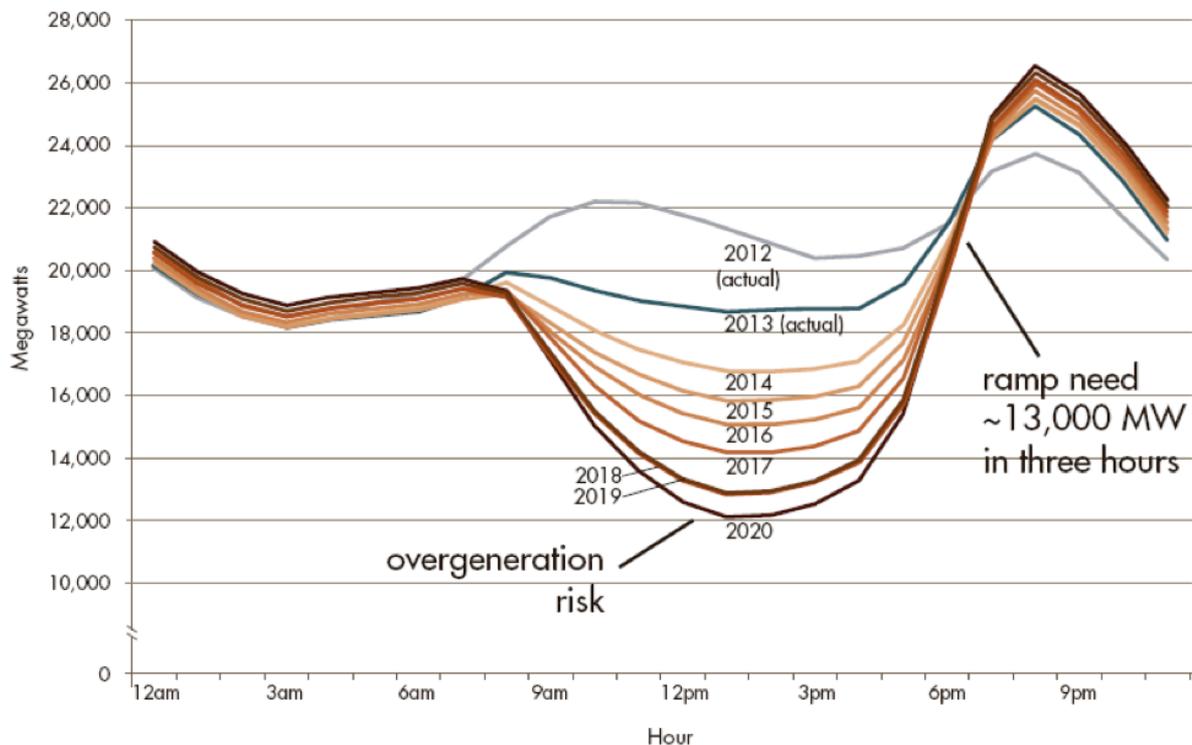
Supply AND Demand Are Responsive

Flexibility Throughout the System

Standardized Communications

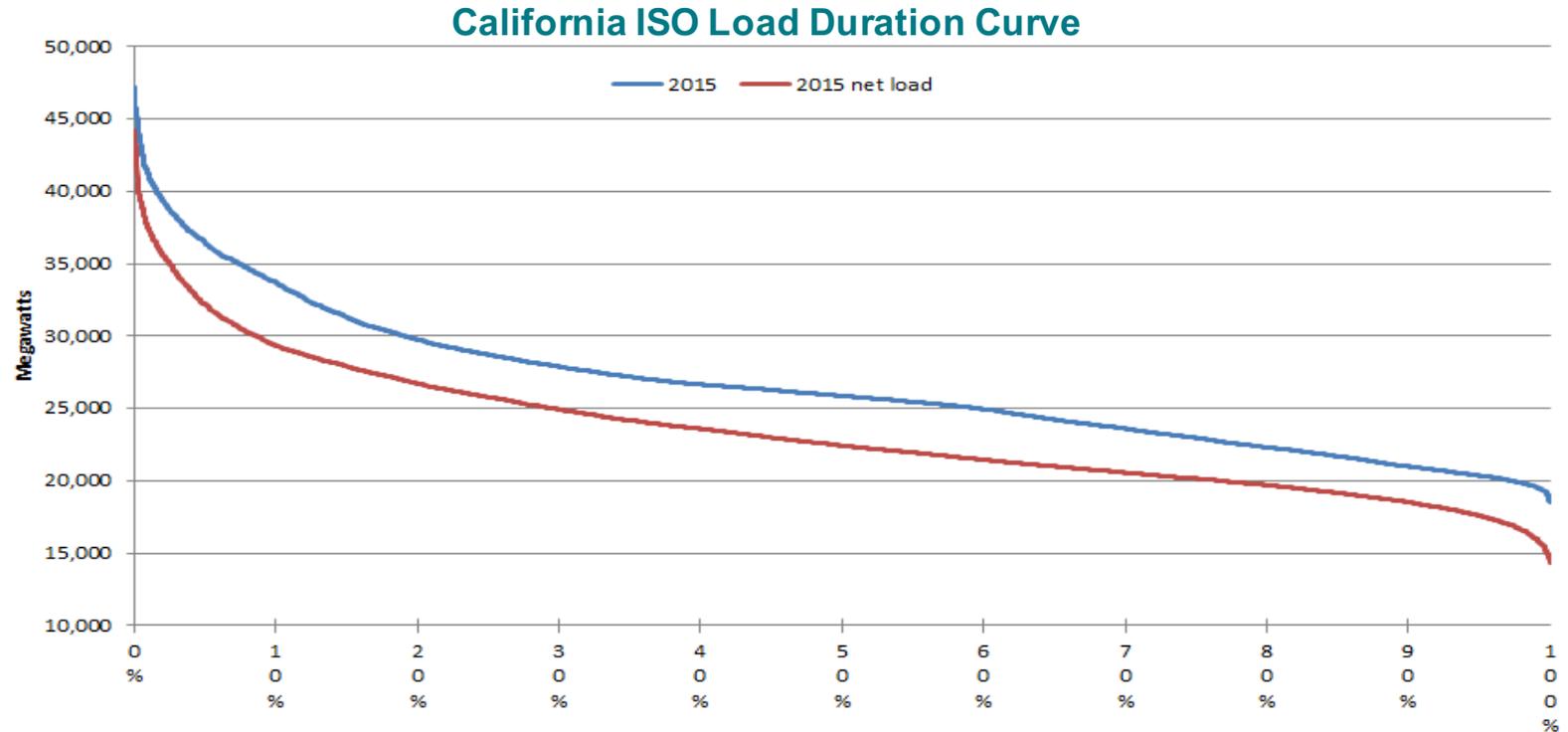
Control & Automation

Challenges of Renewable Generation: Ramping & Flexibility: CAISO “Duck” Chart



Source: California ISO

Solar and Wind Tend to Reduce System Load Factor



Net load is load minus utility scale wind and solar

Source: California ISO Open Access Same-time Information System (OASIS)

Percent of Annual Hours

Practical Solutions

How Will We Make This Great
Symphony Play in Harmony?

Energy Efficiency First!

Fund Research & Development
Consistently

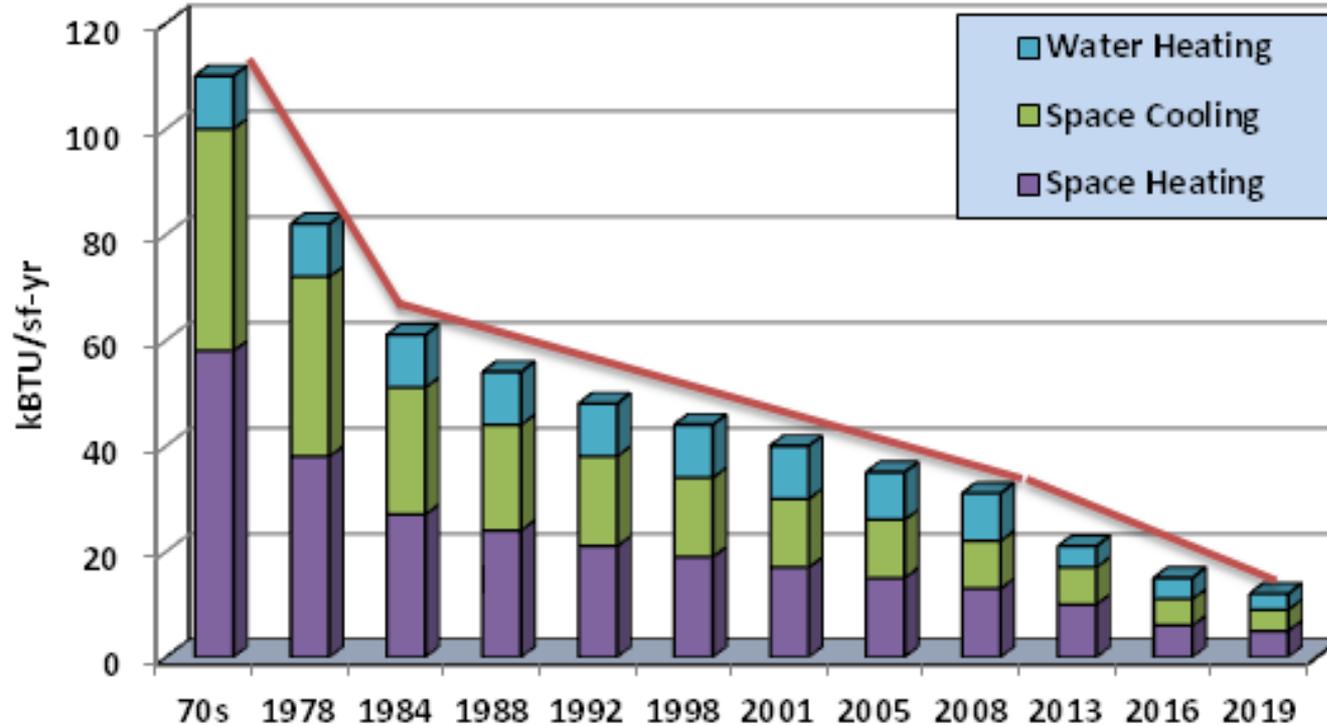
Pilot Projects that Lead To Mass
Commercialization

Low-Income Communities Must Benefit

Regional Integration + Transmission

Coordinate Federal/State/Local efforts

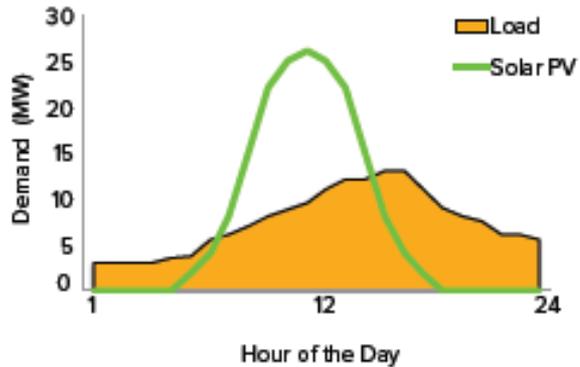
Building Standards Have Saved \$66B Since 1976



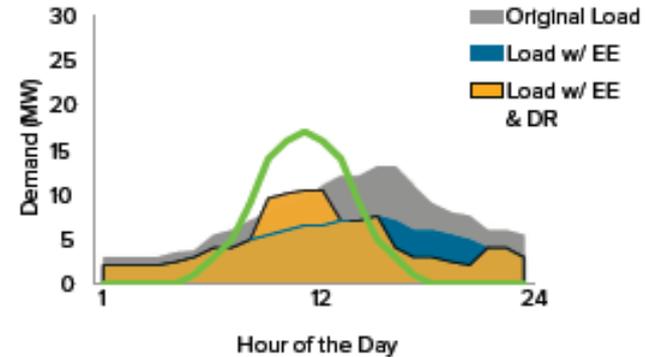
Tale of Two Buildings – BOTH Zero Net Energy



Solar PV Only



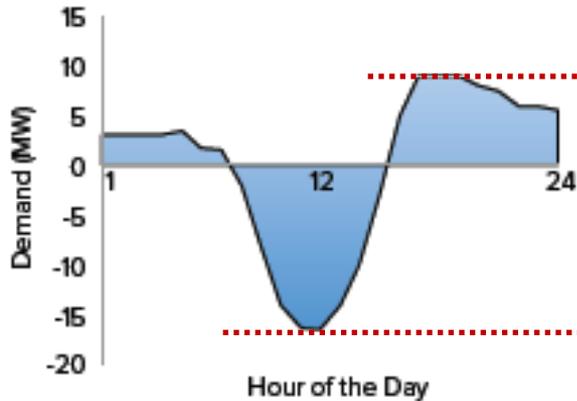
Efficiency, Demand Response, THEN PV



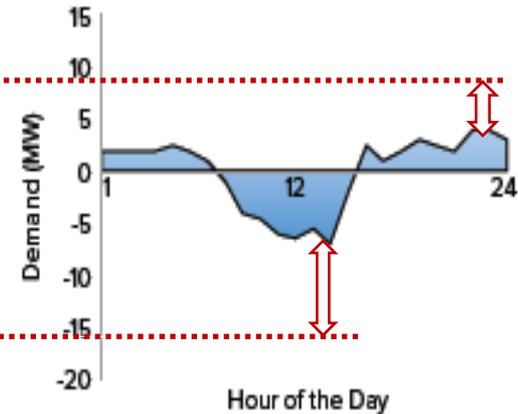
Tale of Two Buildings – Grid View



Solar PV Only



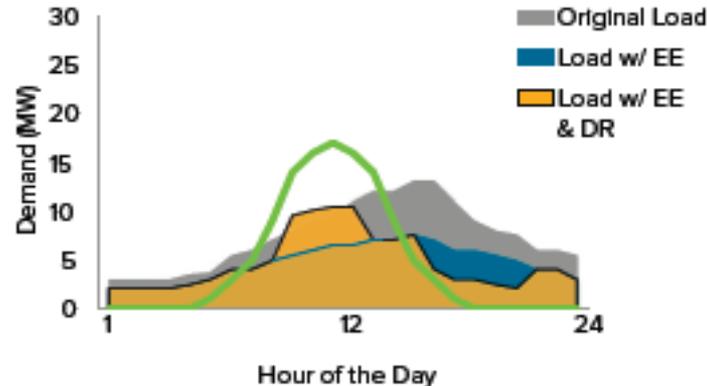
Efficiency, Demand Response, THEN PV



Integrated Design and Smart Operation

- *Lower Energy infrastructure cost (smaller PV system)*
- *Somewhat lower energy bill*
- *Customer satisfaction: a high-performing, more comfortable building*
- *Flexibility for the utility: load shifting, dynamic DR*

Energy Efficiency, Demand Response, then Solar PV





Existing Commercial Building Upgrade

BEFORE

Source: Kevin Bates, SHARP Development Co.

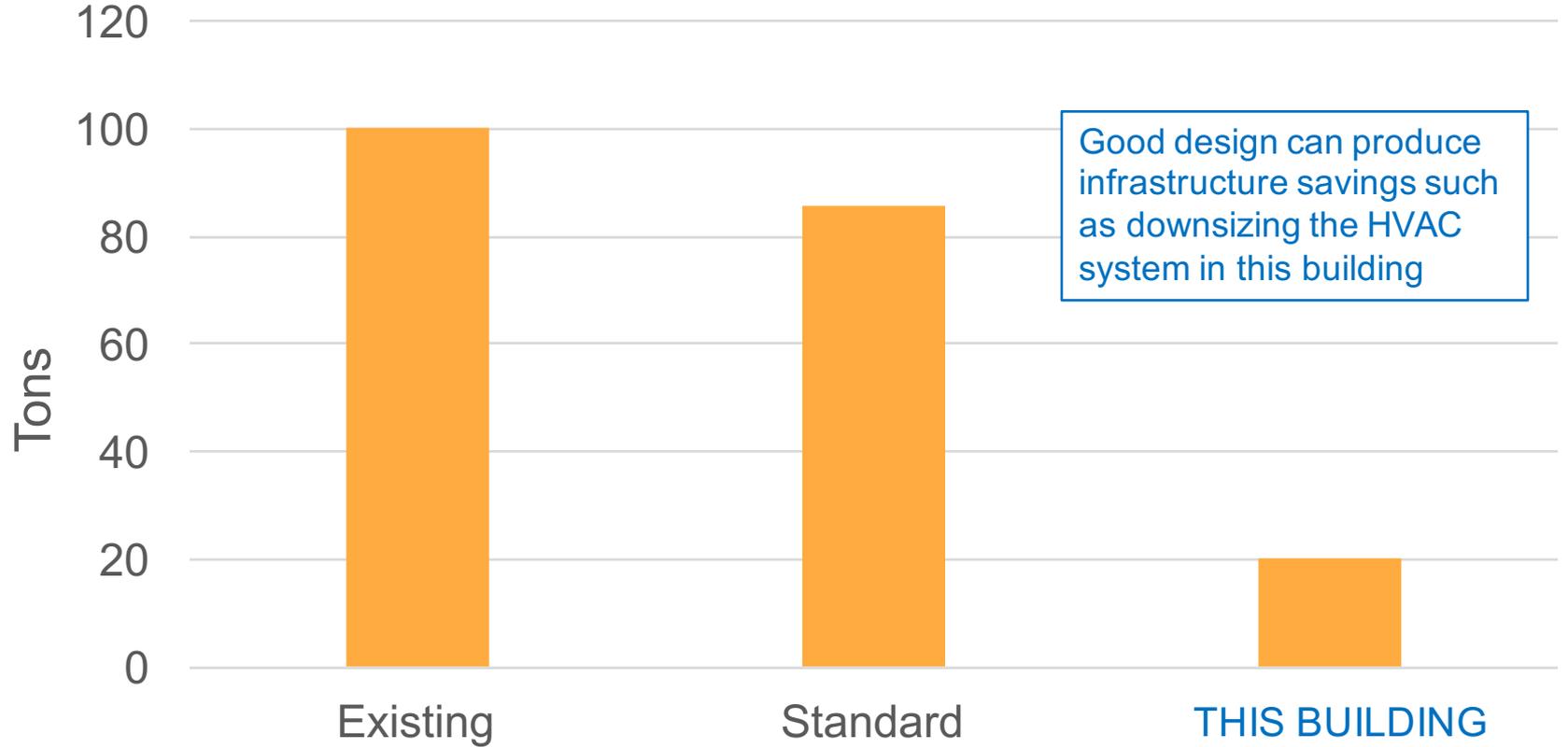
PASSIVE THERMAL COMFORT



After

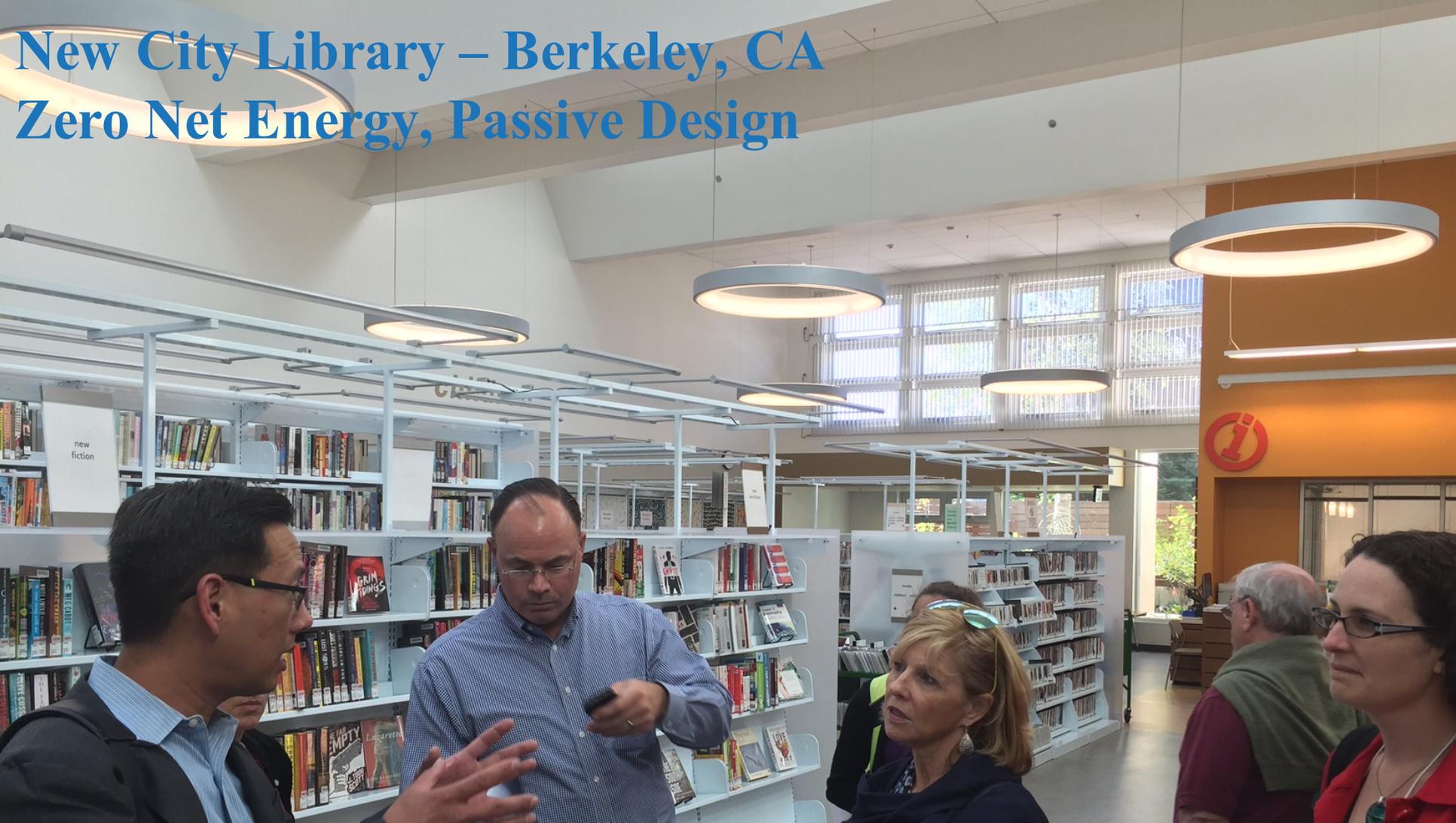
Source: Kevin Bates, SHARP Development Co.

REDUCED HVAC SIZE



New City Library – Berkeley, CA

Zero Net Energy, Passive Design

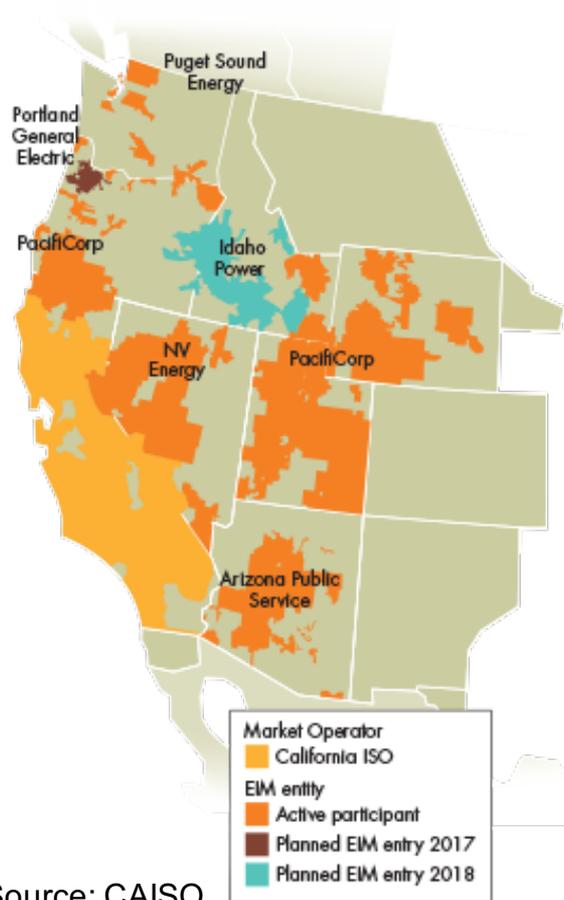


Regional Energy Imbalance Market

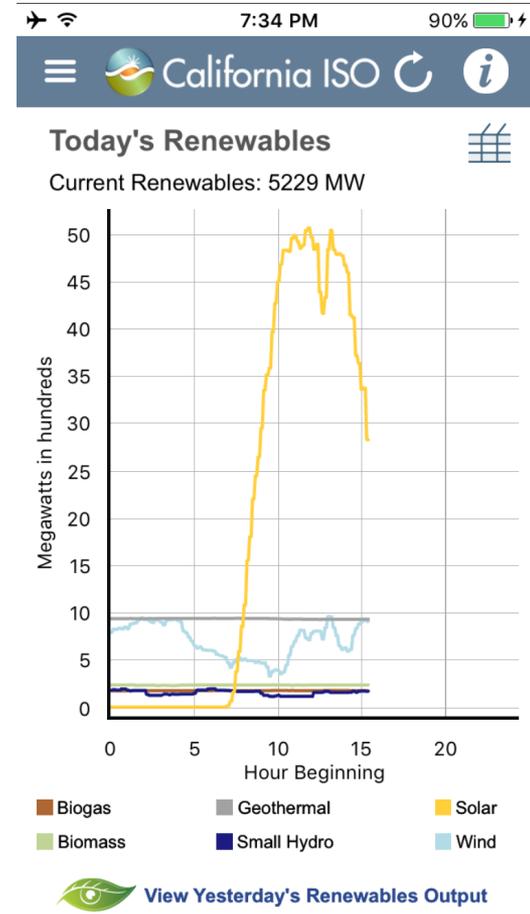
Trading “excess” renewables between balancing authorities

EIM takes advantage of geographic diversity across the Western US

Reduces curtailment and creates revenue for renewable generators



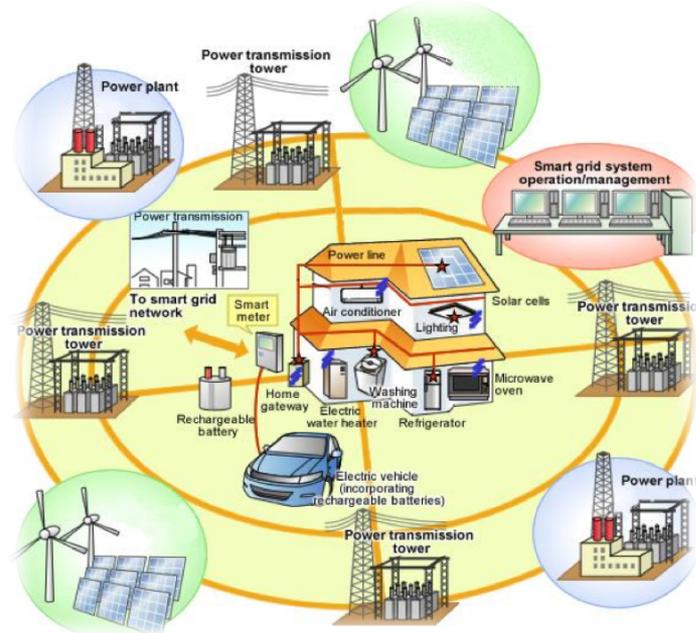
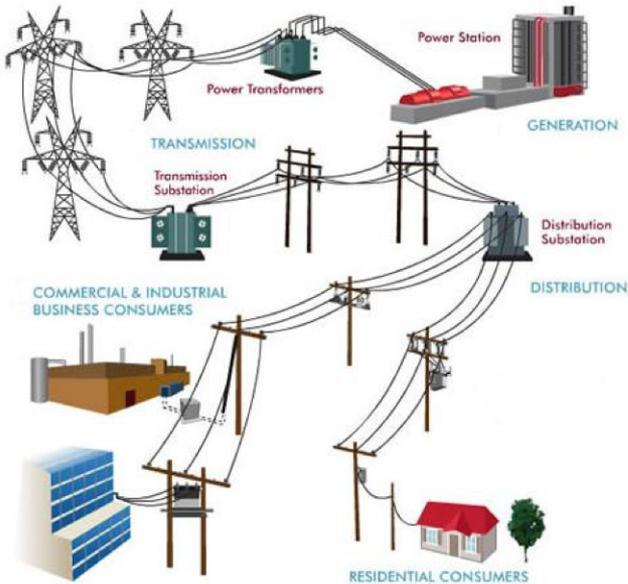
Source: CAISO



Economic Development is Central to the Sustainable Energy Transition



Transitioning to Sustainable Energy





Thank You!



Climate Partners
FOR A CLEAN & PROSPEROUS FUTURE

[CLIMATE.AMERICA.GOV/BRASIL](https://climate.america.gov/brasil)
