TRIO Symposium

October 6, 2015
David Brower Center - Berkeley, CA

Welcome!

Technology Research Innovation (TRIO) Symposium

Mangesh Basarkar
Manager, Emerging Technologies
PG&E

October 6, 2015

Safety Message

In Case of Emergency

Location - Goldman Room in the David Brower Center

2 emergency exits

East Exit -> leads to the front lobby

West Exit -> Hallway directly to Allston

Meet-Up Location – Saturn

Across the street at the corner of Allston and Oxford

Today's Agenda

9:00 AM	Welcome Address
9:15	Big Picture: EE in California
9:45	Supplier Diversity Program
10:00	Networking Break
10:20	California's EE Programs
10:55	Engaging in Demand Response
11:15	TRIO Program and ET
11:35	Codes & Standards
12:00 PM	Lunch
1:00	Vendor Panel
2:15	Breaking into Energy Efficiency
3:00	Networking Reception

Background on TRIO

- Joint initiative of California's investor-owned utilities (IOUs): PG&E, SCE, SoCal Gas, and SDG&E
- Authorized for the benefit of California energy consumers by the California Public Utilities Commission
- Funded through electric and gas rates

- ➢Engage early-stage entrepreneurs in Energy Efficiency and Demand Response marketplaces
- ➢Support California's billion dollar rebate and incentive programs
- ➢Benefit from customer incentives, participate as a third-party implementer, or receive development support

Big Picture: EE in California

Shannon Valenti Cheng
Energy Efficiency Strategy, PG&E

October 6, 2015

Outline

- History of EE in California
- Current EE Model
- The Future for EE in California

California's Model for Energy Efficiency

Policy

- 35+ years of energy efficiency
- First in the loading order
- Decoupling and shareholder incentive mechanism

Programs

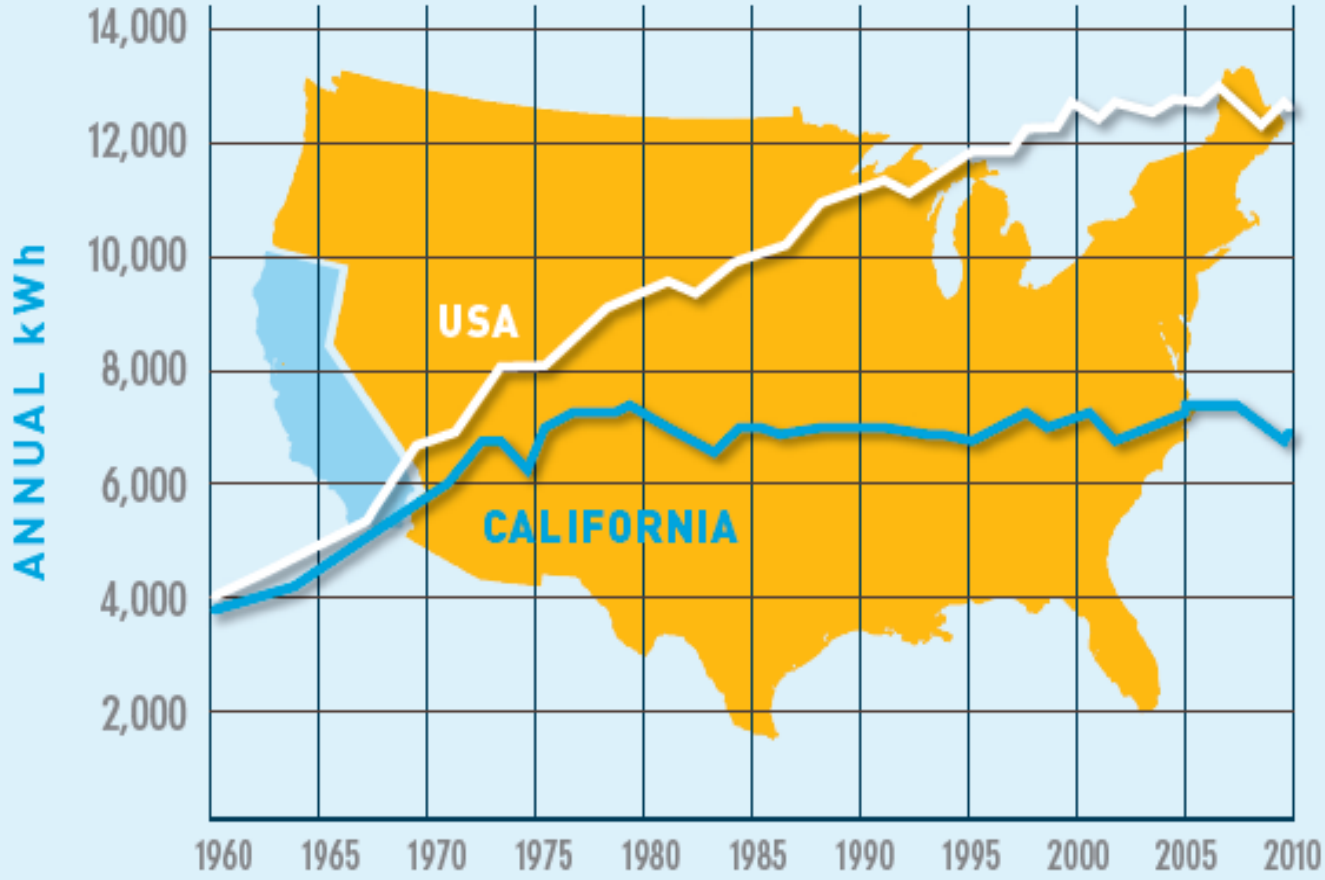
- ~$1.5B per year of investment
- Administered by IOUs, POUs, RENs, CCAs
- Delivered to all customer segments via multiple channels and broad technology families
- Codes and Standards
- Workforce Training and Customer Education

Enabling the Future

- Goal to double EE (SB350)
- Focus on opportunity in existing buildings (AB758 and AB802)
- Flexibility to support grid reliability (DRP/IDER)
- Incorporate newest technologies (AB793)

What Have These Policies Achieved?

35+ Years of Energy Efficiency Success



PER CAPITA ELECTRICITY CONSUMPTION:

UNITED STATES vs. **CALIFORNIA**

(source: U.S. Energy Information Administration)

Benefits of California's Investment in Energy Efficiency

DECREASES POLLUTION

- Avoided at least **30 LARGE POWER PLANTS** since 1970s, 11 more expected to be avoided over the next decade
- Cuts MILLIONS OF TONS OF POLLUTANTS contributing to asthma, other ills

CREATES JOBS, SPURS ECONOMY

- Efficiency jobs grew 15% compared to 2% economy-wide (2002–2012)
- California produces 2x benefit for every unit of electricity compared to the rest of U.S.

CUTS ENERGY WASTE

- Saved enough electricity since 2003 to power MORE THAN HALF OF CALIFORNIA'S HOMES FOR ONE YEAR
- Met about 1/5 of the state's electricity need in 2013
- Helped keep per capita electricity use flat vs. 50% increase in rest of U.S. (since 1970s)

HELPS LOW-INCOME CUSTOMERS

- Low-income efficiency programs served almost **3 MILLION HOUSEHOLDS** (since 2003)
- Saved enough electricity to power **90,000 HOMES** and enough natural gas for nearly **80,000 HOMES** for 1 year

SAVES CALIFORNIANS MONEY

- Efficiency programs saved $12 billion after costs (2003-2013)
- Research projects yielded $446 for every $1 invested
- Newest building codes to save $6,000 per house
- Codes and standards saved a total of **$75 billion** (since 1970s)

HELPS MEET CLIMATE GOALS

- Slashed **30 MILLION** metric tons of CO_2 pollution, equal to annual emissions of 6 MILLION cars (since 2003)

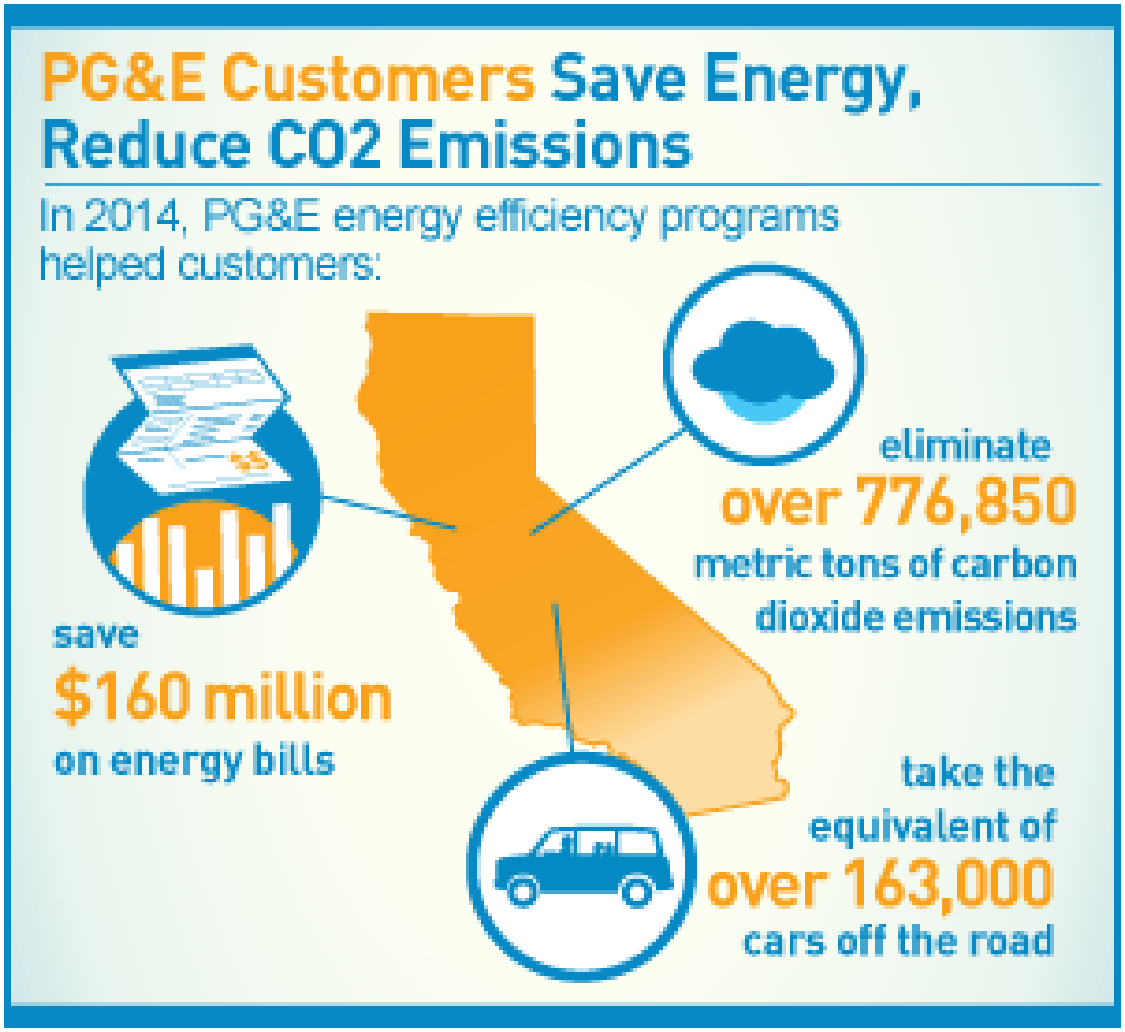
- Cuts one of the largest sources of California's greenhouse gas emissions

NRDC

NATURAL RESOURCES DEFENSE COUNCIL

Source: NRDC/E2 "Golden EE Opportunity," August 2015

Impact of Energy Efficiency



Source: PG&E Currents, June 2015. Reported savings (not evaluated).

How do we achieve these savings?

Energy Efficiency Portfolios Are Comprehensive

Multiple customer segments

Multiple channels

	Residential	Commercial	Industrial	Agriculture	Low Income
Direct to customer rebates					
In-store promotions					
Manufacturer or distributor incentives					
Government partnership programs					
Third-party programs					
On-bill financing					

Multiple market development mechanisms

- C&S advocacy / compliance training
- Emerging Technology assessments / demos / incubation
- Workforce education

Multiple technologies

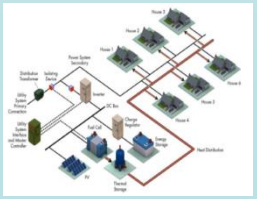
- Plug Load
- Appliances
- Lighting
- Buildings / Envelope
- New construction
- Retrofits
- Home / facility audits
- HVAC systems
- Food services
- Refrigeration
- Boilers / steam systems
- Industrial systems / processes
- Motors
- Pumps and fans
- Energy Management Systems

Future of EE in California

Carbon Reduction

Renewable Mandate

Double Energy Efficiency



Distributed Energy Resources

Changing Grid

The Grid

Residential Rooftop PV

Electric Vehicles

Small Commercial PV

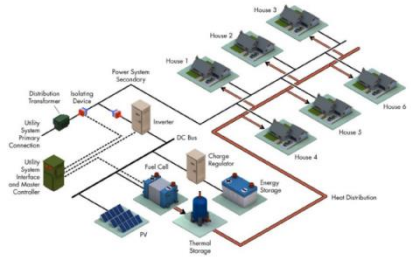
Distribution Level Energy Storage

Home Energy Storage

Community Energy Storage

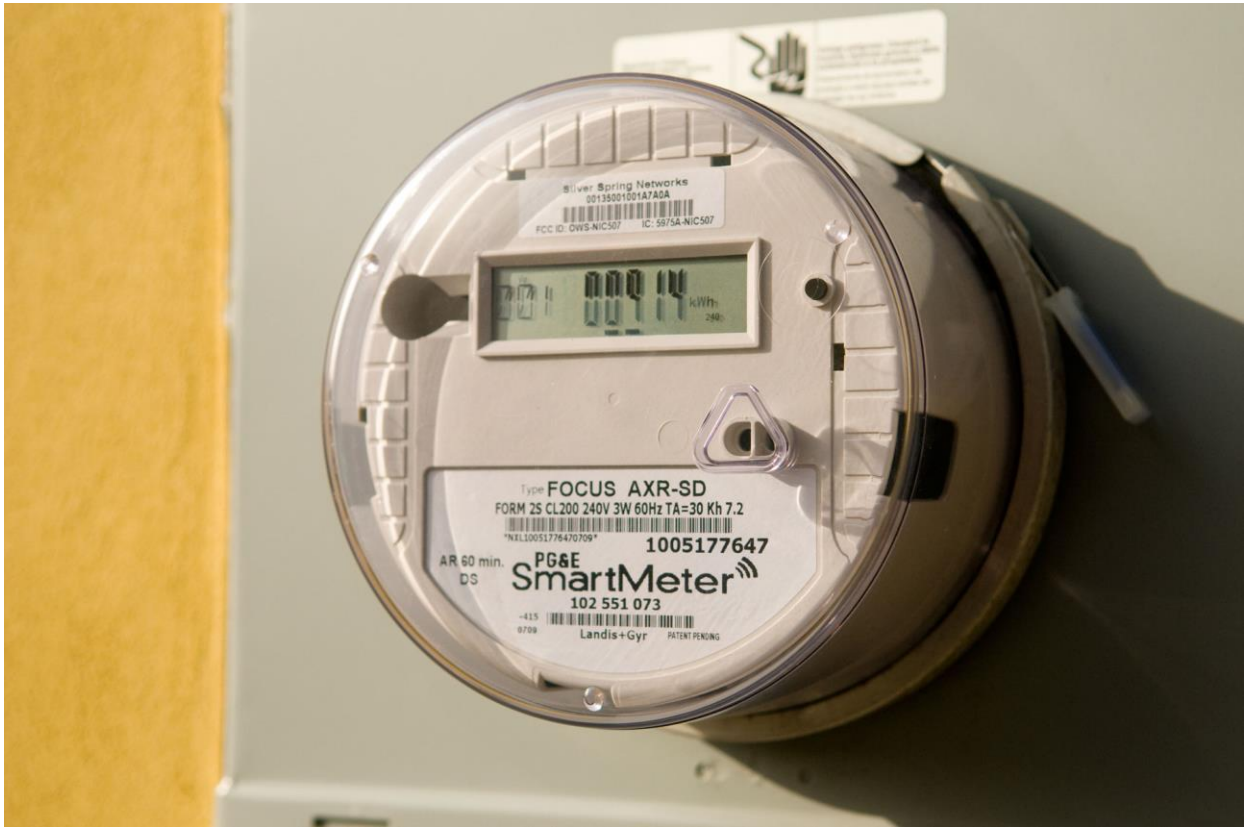
Fuel Cells

Demand Response & Energy Efficiency

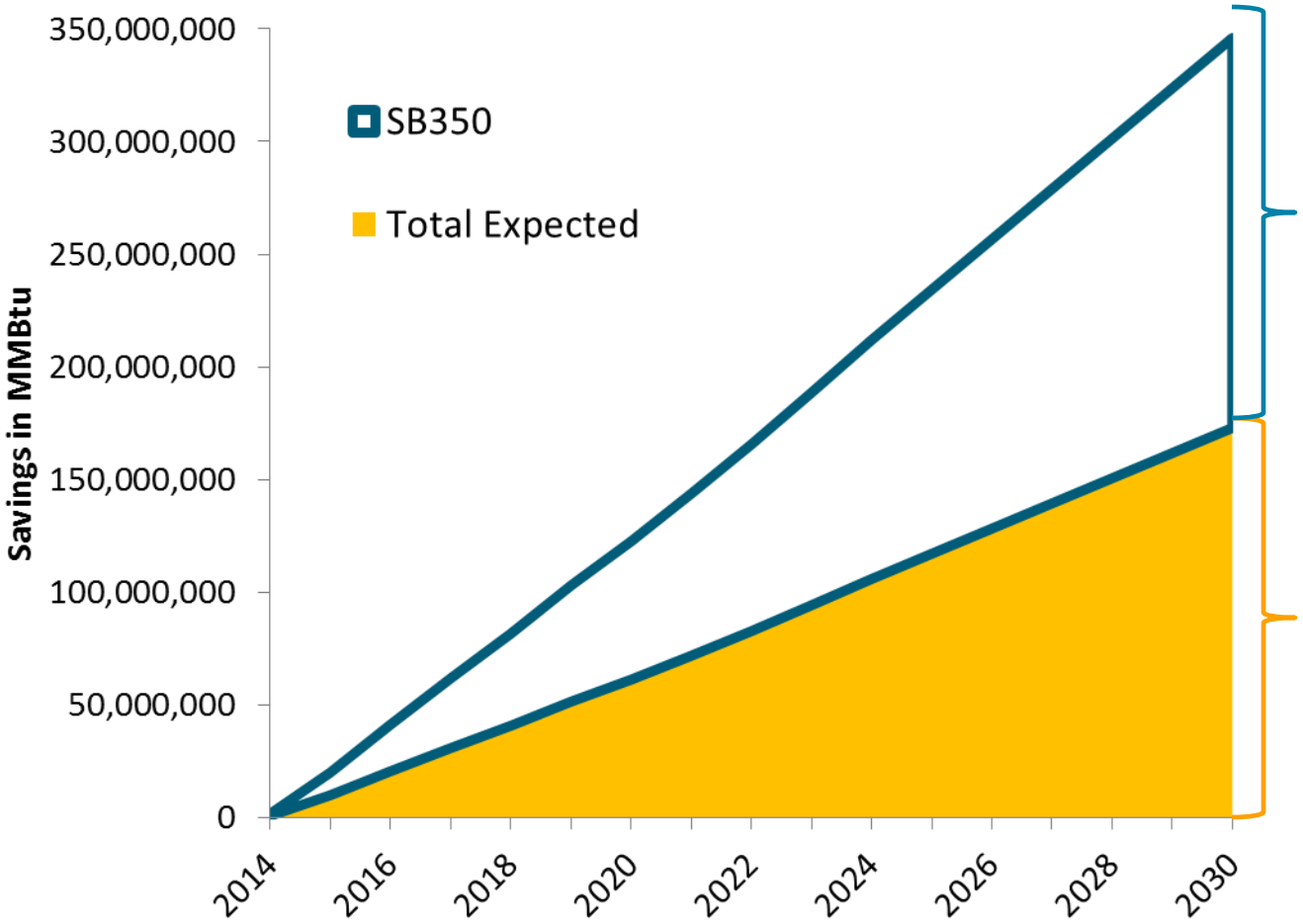


Microgrids

Leveraging SmartMeters



Impact and Implications of SB350



SB350 includes:

- Electric and Gas EE
- IOU and POU programs
- Meter-Based Savings
- O&M savings
- Additional Future C&S
- PACE programs
- Fuel switching
- Conservation Voltage Reduction
- AB758 Existing Buildings
- Proposition 39
- Cap & Trade Unallocated Revenues

IOU Statewide Cumulative EE Forecast Savings from 2013 AAEE Forecast

Notes and assumptions:

- SB350 requires a doubling of the CEC's Additional Achievable Energy Efficiency (AAEE) mid-case forecast by 2030, subject to what is cost-effective and feasible. SB350 also expands AAEE accounting for a number of efforts, as listed above, meaning IOUs goals may increase, but may not double.
- The above graph is statewide across all IOUs and is shown on a cumulative basis through 2030, which aligns with the requirements of AB350.
- The bill requires a doubling of the 2015 AAEE, which is forthcoming; the analysis above is based on the 2013 AAEE.
- AAEE is not identical to, but is based on the CPUC Potential Study.
- The AAEE forecast extends through 2024. The bill requires an average annual growth rate be applied to this period, but does not identify the rate or how to calculate it. This graph uses an average of the last available four years of savings 2021-2024.
- Electric savings is converted to MMBtus on a site basis: 3,412 btus/kwh.

Questions?

Thank You

Shannon Valenti Cheng
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Supplier Diversity Program

David Pell, Supplier Diversity Consultant
Supplier Diversity and Sustainability
PG&E

October 6, 2015

Supplier Diversity Contacts

California Public Utilities Commission

- **Stephanie Green, stephanie.green@cpuc.ca.gov (415) 703-5245**

Pacific Gas and Electric Company

- **David Pell, DRPR@pge.com (415) 973-6360**

Southern California Edison

- **Eric Fisher, eric.fisher@sce.com (626) 302-7820**

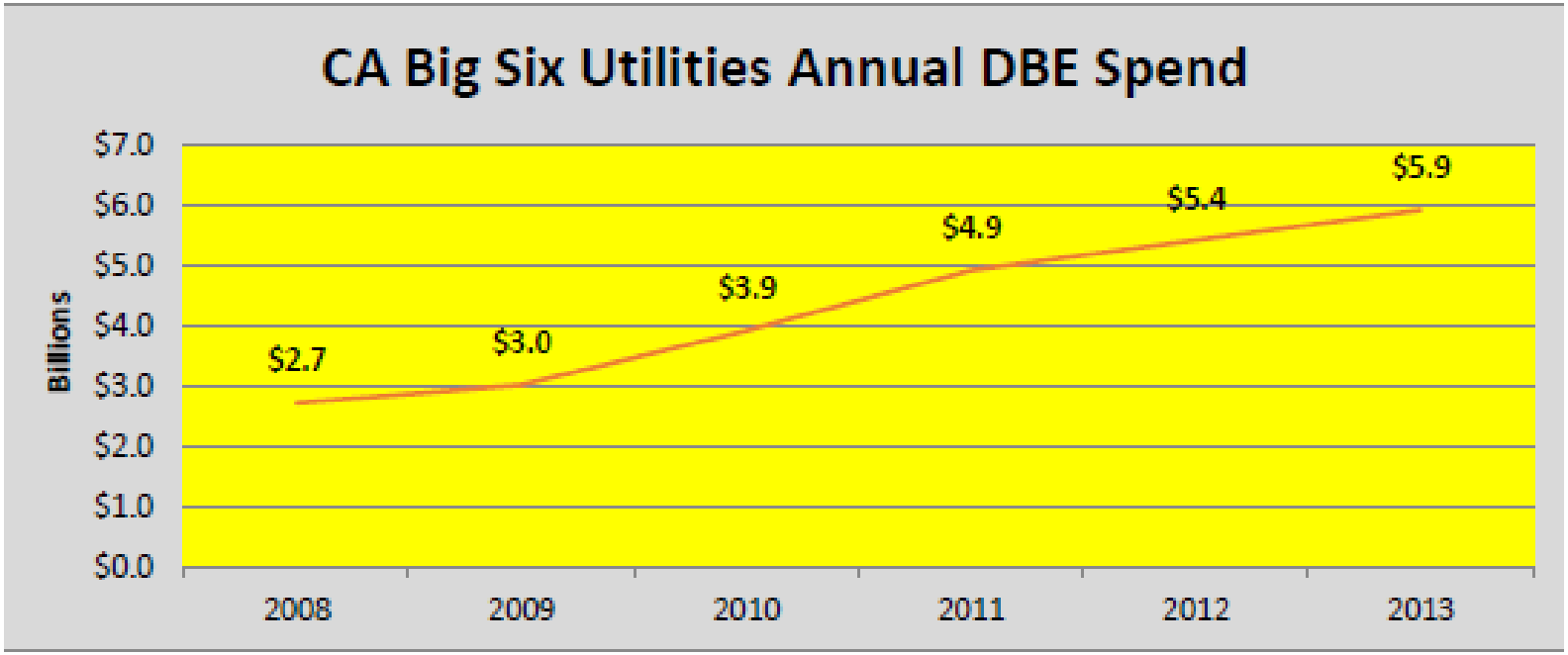
Southern California Gas Company

- **Kathlina Lai, klai@semprautilities.com (213) 244-3056**

San Diego Gas & Electric

- **Sydney Furbush, SFurbush@semprautilities.com (858) 654-6391**

CA Utilities 2013 Supplier Diversity Results

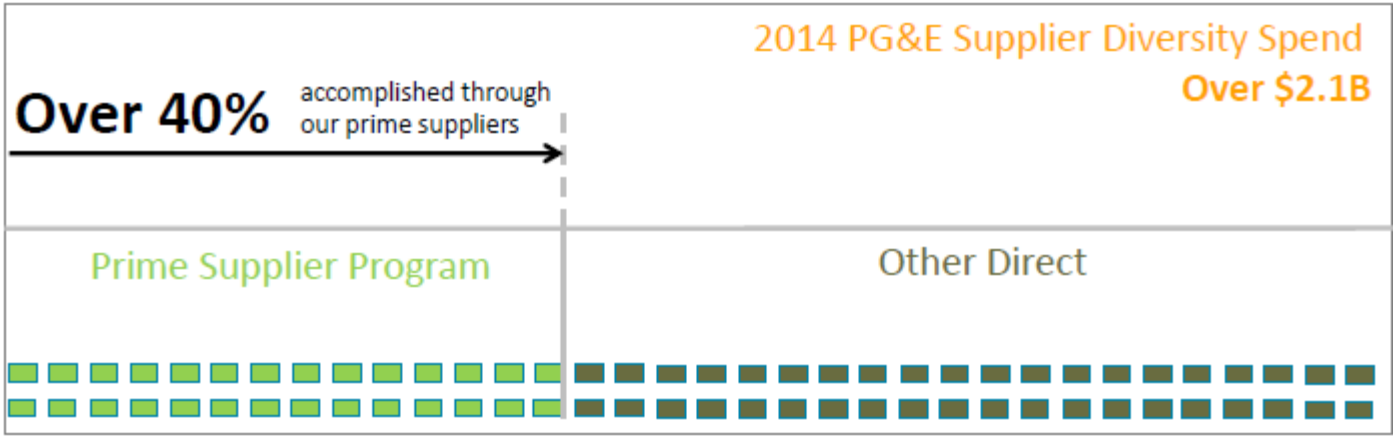


The top 6 Utilities spent $5.9B on diverse suppliers out of $13.5B total spend in 2013 (43.7%)

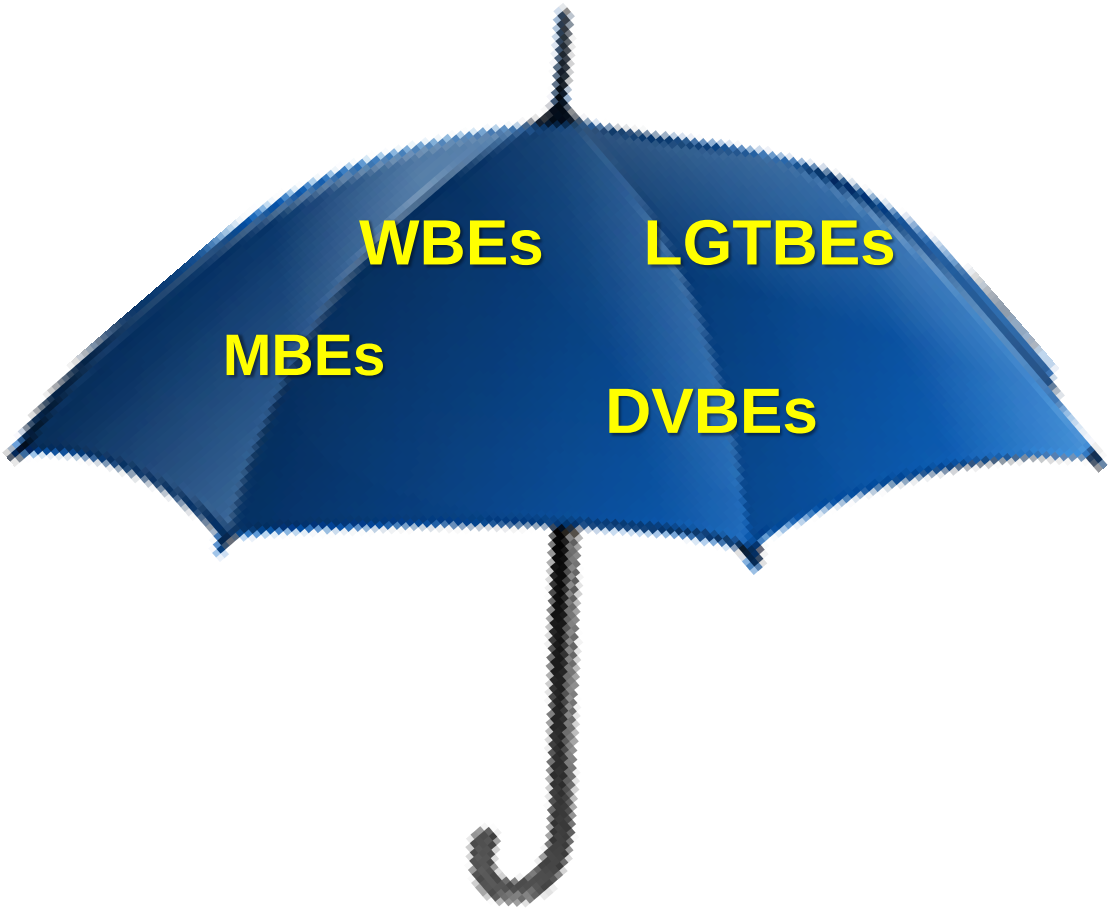
Prime Supplier Involvement

- **Prime Suppliers are expected to join us in achieving our Supplier Diversity Results**

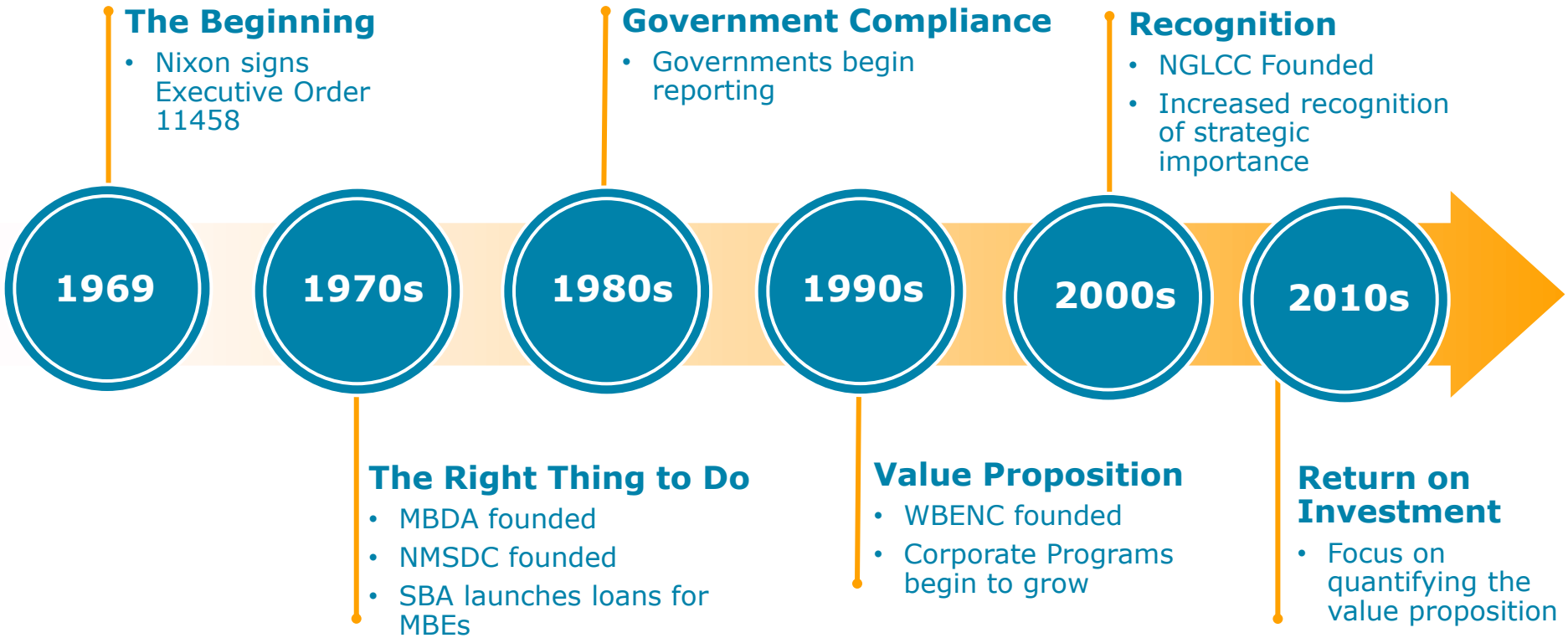
- **The Prime Supplier Program was responsible for over 40% of PG&E's 2014 total diverse spend.**



What is a Diverse Supplier?



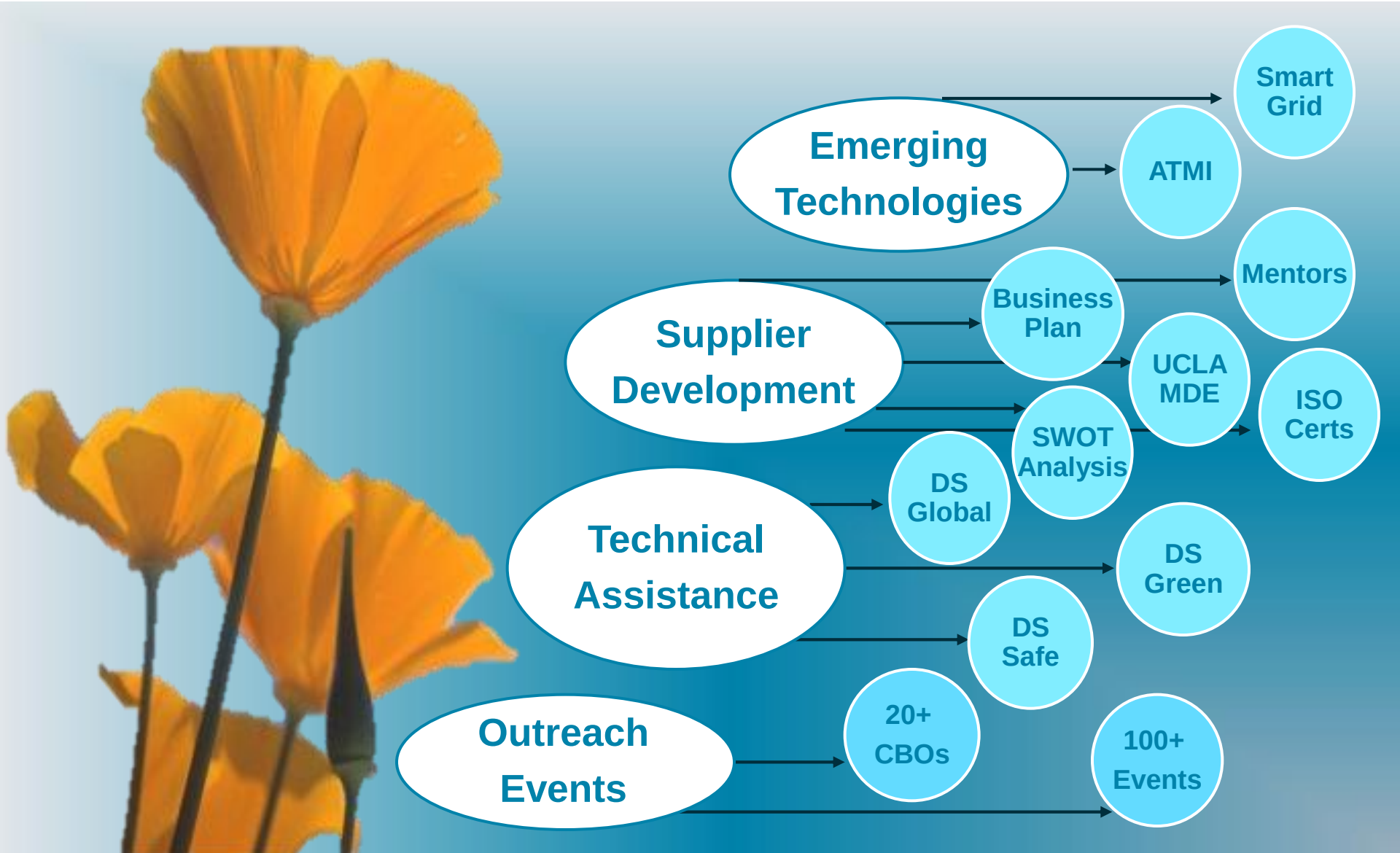
History of Supplier Diversity



Supplier Diversity is Good Business

- Supports economic development and job growth in the communities we serve
- Demonstrates a tangible commitment to our customers by reinvesting in their communities
- Provides new business perspectives and ideas that lower supply chain costs, increase flexibility and improve quality
- Provides additional access to community, government or global suppliers and markets
- Increases brand value and community standing

PG&E SD Key Initiatives



Emerging Technologies

University of California Advanced Technology Management Institute

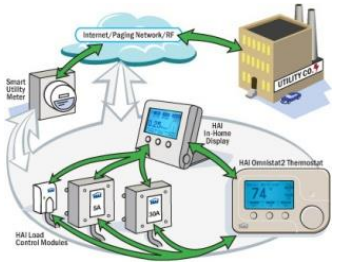
- Helping entrepreneurs compete in a world of constant innovation

Technology Resources Innovation Outreach (TRIO) Annual Symposium

- Educating on CA's incentive/rebate and emerging technology programs

DistribuTECH Conference and Exhibition

- Utility industry's leading smart grid conference covering automation and control, renewable energy integration and advanced metering, etc.



PG&E Pacific Energy Center Programs

- Hosting a series of free engagement and educational workshops on Smart Grip technologies, process and markets

Supplier Development

- Each year, suppliers are identified for robust Track One supplier development.
- Selection based on opportunity assessment by Cross-Functional Development Team.
- Customized Business Development Plan created for each supplier designating actions and owners.
- Supplier has access to executive mentorship and technical assistance scholarships.

Our Supplier Development Program Helps Us Reach New Heights in Supplier Diversity

Technical Assistance

Signature Initiatives

- NEW-Diverse Suppliers are Cyber Secure
- Diverse Suppliers are Safe
- Diverse Suppliers Go Green
- Diverse Suppliers Go Global

Trade Missions to Industry Tradeshows

- DistribuTECH, American Gas Association, HydroVision, PowerGen

Technical Assistance Partnerships and Scholarships

- UCLA and University of Washington MDE Programs
- ISO 9001/14001 Certification Training
- SBA Workshop Partnerships
- Access to Capital Training
- Small Business Development Training / Scholarships

Community Involvement

PG&E partners with over 20 Community-Based Organizations (CBOs)

- Recruiting new diverse suppliers
- Training and developing diverse suppliers

PG&E attends over 100 diverse events annually

- CBO event sponsorships
- Presentations / panelists
- Stand-alone workshops / trainings
- Business match-making
- Trade shows / business expos

Registration and Certification

Suppliers need to be certified to participate in the Supplier Diversity Program

- At least 51% owned, operated and controlled by one or more women, minorities or service-disabled veterans
- CPUC Supplier Clearinghouse (CHS) certifies WBEs and MBEs
- California State Department of General Services (DGS) certifies DVBEs
- National Gay & Lesbian Chamber of Commerce (NGLCC) certifies LGBTs

For applications and more information:

- **www.suppliernetwork.net** **(800) 359-7998**
- **www.dgs.ca.gov** **(916) 375-4940**
- **www.nglcc.org** **(202) 234-9181**

Questions?

Thank You

David Pell
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Networking Break

Understanding Energy Efficiency Programs as a vehicle for new technologies

California's Energy Efficiency Programs – Karen Zelmar

Engaging in Demand Response – Sam Piell

TRIO and ET – Robyn Zander

California's Energy Efficiency Programs

Karen Zelmar, Director, Energy Efficiency Programs
PG&E

TRIO Symposium, Berkeley

October 6, 2015

Big Picture Overview

- **Demand Side Management Programs**
  - Need, Priorities and Imperative
  - Scope and Scale
  - Program Pathways
- **Trends & Developing Program Needs**

DEMAND SIDE MANAGEMENT PROGRAMS

The Utility Value Chain

California Public Utilities Commission (CPUC)

Competitive Wholesale Market

Merchant Generators

Regulated Investor Owned Utilities (IOUs)

Municipal Utilities (Munis)

California Independent System Operator (CAISO)

Balancing Competing Priorities

Environmental Sustainability

Reliable Service

Reasonable Cost

Demand-side Management

•Reducing electric demand is much cheaper than building new electric generation capacity

•A “Negawatt” is not only cheaper, it can be delivered more quickly and has a much smaller environmental impact

Two primary ways to reduce electric demand:

- Energy efficiency
- Demand response

EE programs impact behavior today

2015 Energy Efficiency Budget and Projected Savings				
	Budget	Projected Savings (Electricity and Natural Gas)		
	(In Million)	GWH	MW	MMTH
PG&E	$ 412	980.5	154.4	14.3
SCE	$ 344	983	160.1	-
SDG&E	$ 120	239.7	39.6	2.5
SCG	$ 79	-	-	25.3
Total	**$ 941**	**2,203.2**	**354.1**	**40.9**

Two approaches to motivating energy efficient choices

Rebates

- Large volume
- Standard systems
- Similar performance

Deemed

Standard energy savings attributed when measure deployed

Incentives

- Small volume
- Custom systems
- Unique performance

Calculated

Manual calculation of energy savings when measure deployed

Energy Efficiency Portfolios

Multiple customer segments

Multiple channels

	Residential	Commercial	Industrial	Agriculture	Low Income
Direct to customer rebates					
In-store promotions					
Manufacturer or distributer incentives					
Third-party programs					
Government partnership programs					
On-Bill Financing					

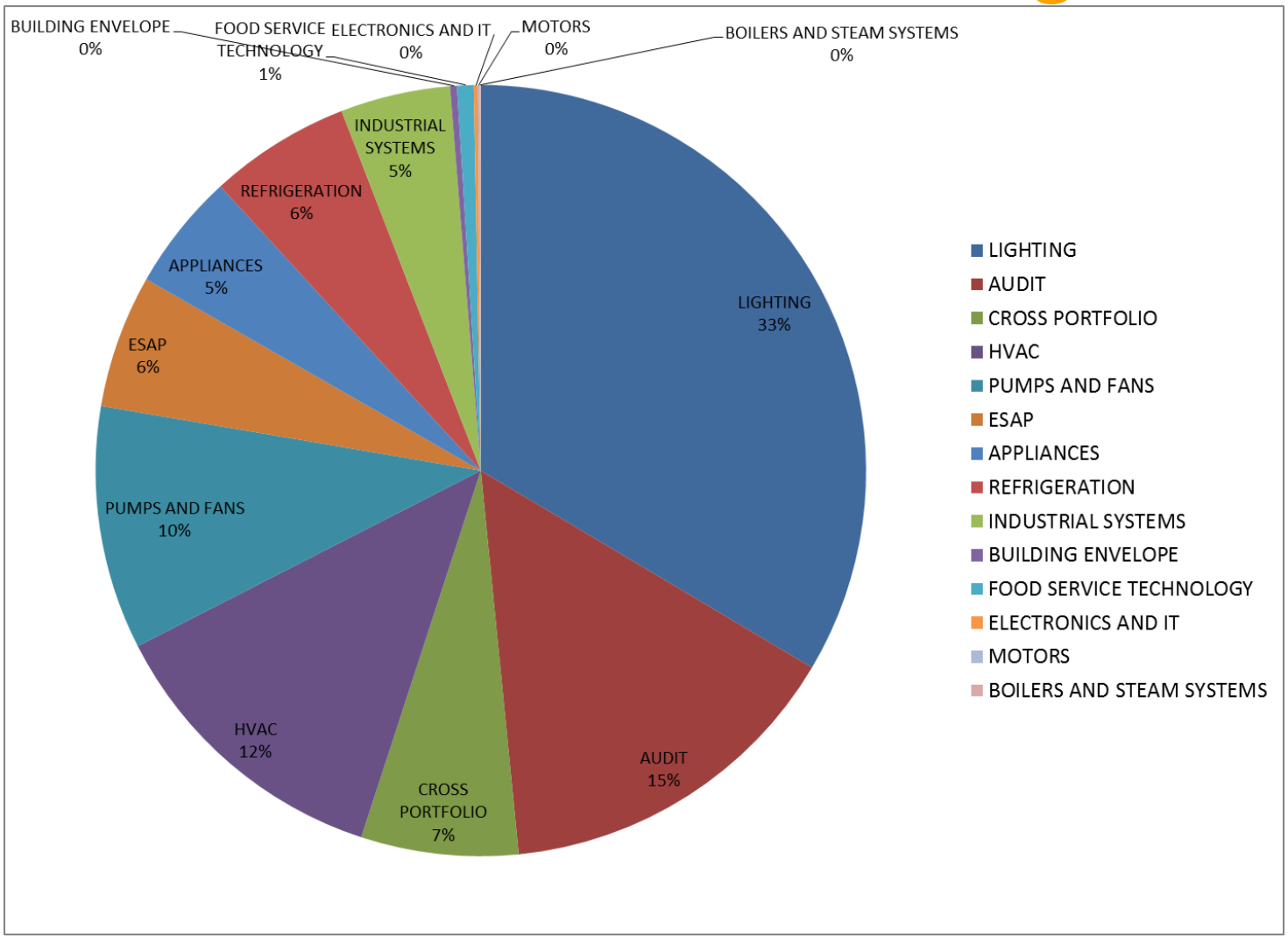
Multiple market development mechanisms

- C&S advocacy / compliance training
- Emerging Technology assessments / demos / incubation
- Workforce education

Multiple technologies

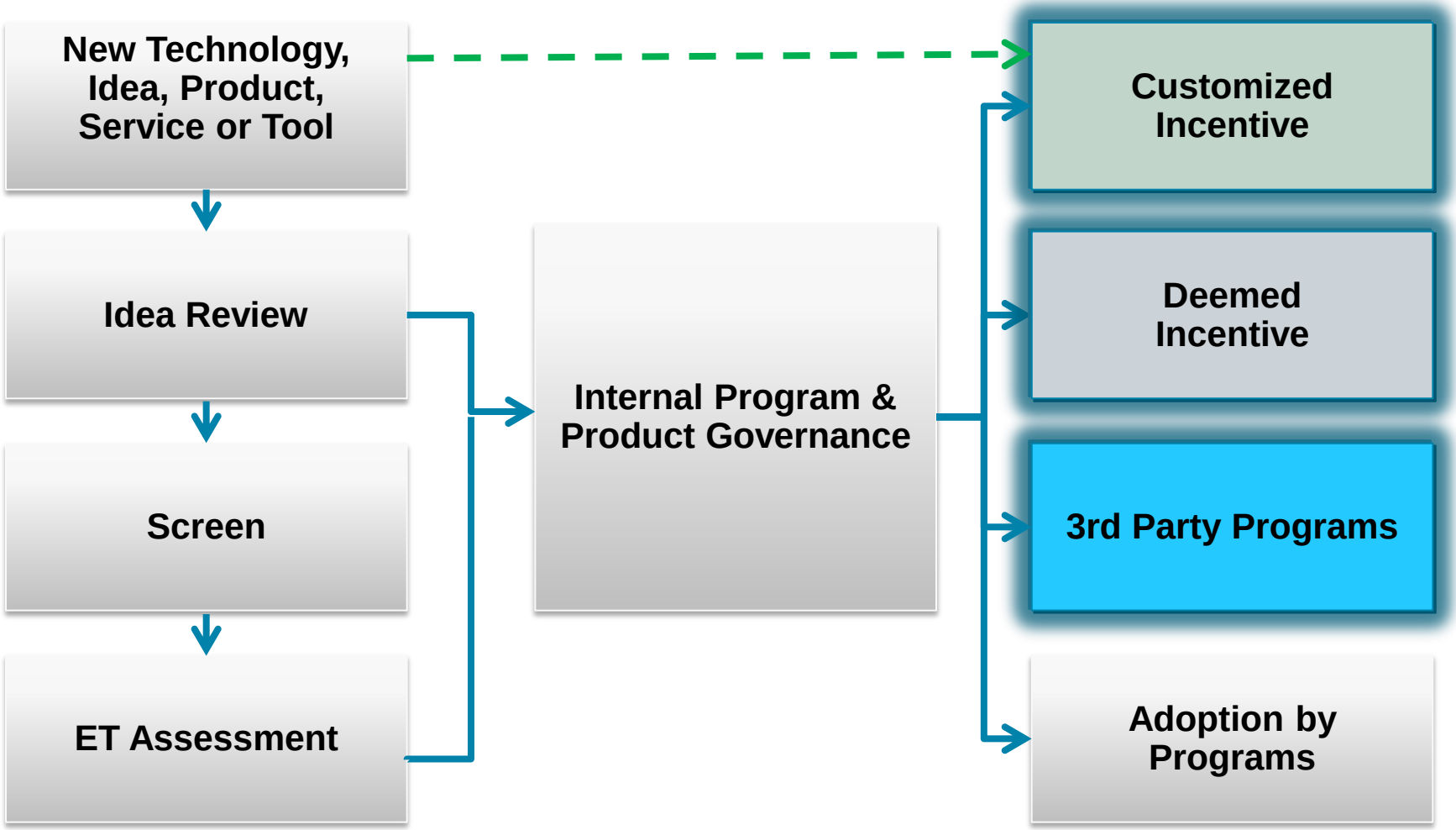
- Appliances
- Lighting
- Electronics
- Buildings
  - New construction
  - Retrofits
  - Home / facility audits
- HVAC systems
- Food services
- Refrigeration
- Boilers / steam systems
- Industrial systems / processes
  - Motors
  - Pumps and fans
  - Energy Management Systems

PG&E 2014 Electric Savings Drivers



Gigawatt Hour Savings: *Largest End Use Drivers*

Roadmap into Utilities Programs



TRENDS AND DEVELOPING PROGRAM NEEDS

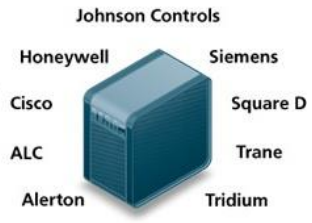
Trends: Whole Building

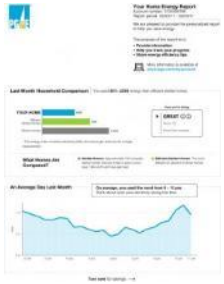
Unlock deep energy savings through a variety of retrofit, operational and behavioral measures across both gas and electric systems

Key Program Principles:

- Offers customers flexibility to pursue multiple treatments over time
  - Few, if any, restrictions
- Program benefits are tied to measured results
  - May or may not include financial incentives
- Savings estimates are informed by interval meter data (billing analysis or calibrated simulation)
  - Utility savings claims tied to measured ex-post savings
  - Minimum 10 - 15% savings

Buildings → **Building controls** → **Building analytics** ↔ **Information products** ↔ **AMI**





Trends: Big Data

Help customers understand energy usage and savings opportunities, and target program offerings using analysis and data-driven tools

- Customer segmentation enables PG&E to target relevant offerings through multiple channels
- Energy and program participation data helps identify opportunity by segment, geography and customer
- Mapping tools help managers plan and direct account managers more effectively

Trends: Zero Net Energy (ZNE)

Achieve maximum energy efficiency and load reduction by leveraging advanced design, construction and building operations before the addition of on-site renewable energy generation

- A zero net energy building produces as much clean, renewable, grid-tied energy on site as it uses when measured over a calendar year
- Promotes California's long term energy goals through a portfolio of research, development, and demonstration projects
- Complementary education, outreach and information activities

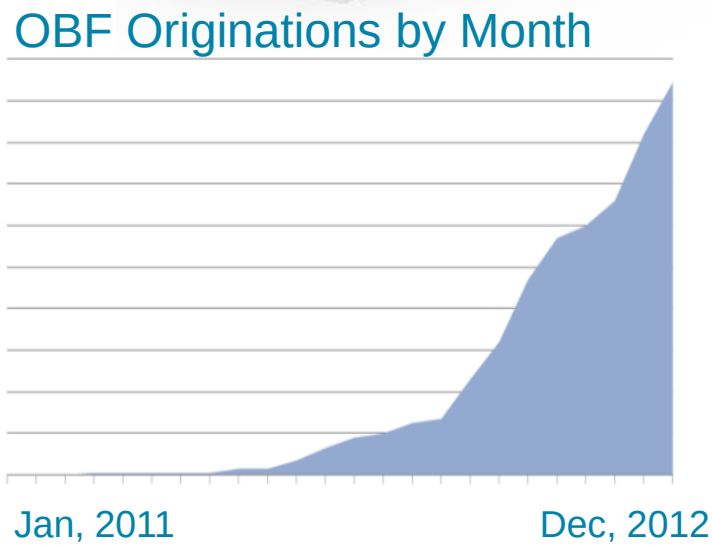
Trends: Financing

Unlock cash flows from energy efficiency savings and spur customer investment in energy efficiency

On-Bill Financing (OBF): A ratepayer-funded financing product, to the non-residential market.

Support for ARRA-originated programs: Continue successful ARRA-originated financing programs using external capital

Pilot new financing products, including Line-Item Billing: New financing products will further expand the availability of capital for energy efficiency projects across different market sectors.



Trends: Water-Energy Nexus

Identify cost-effective energy saving opportunities through products/processes that also deliver water savings.

- Capture the embedded energy savings associated with saving water
- Put in place infrastructure to track water savings (in gallons)
- Quantify the costs of saving water using new technologies and approaches

Questions?

Thank You

Karen Zelmar
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Engaging in Demand Response Programs

Prepared for the TRIO Symposium

October 6, 2015

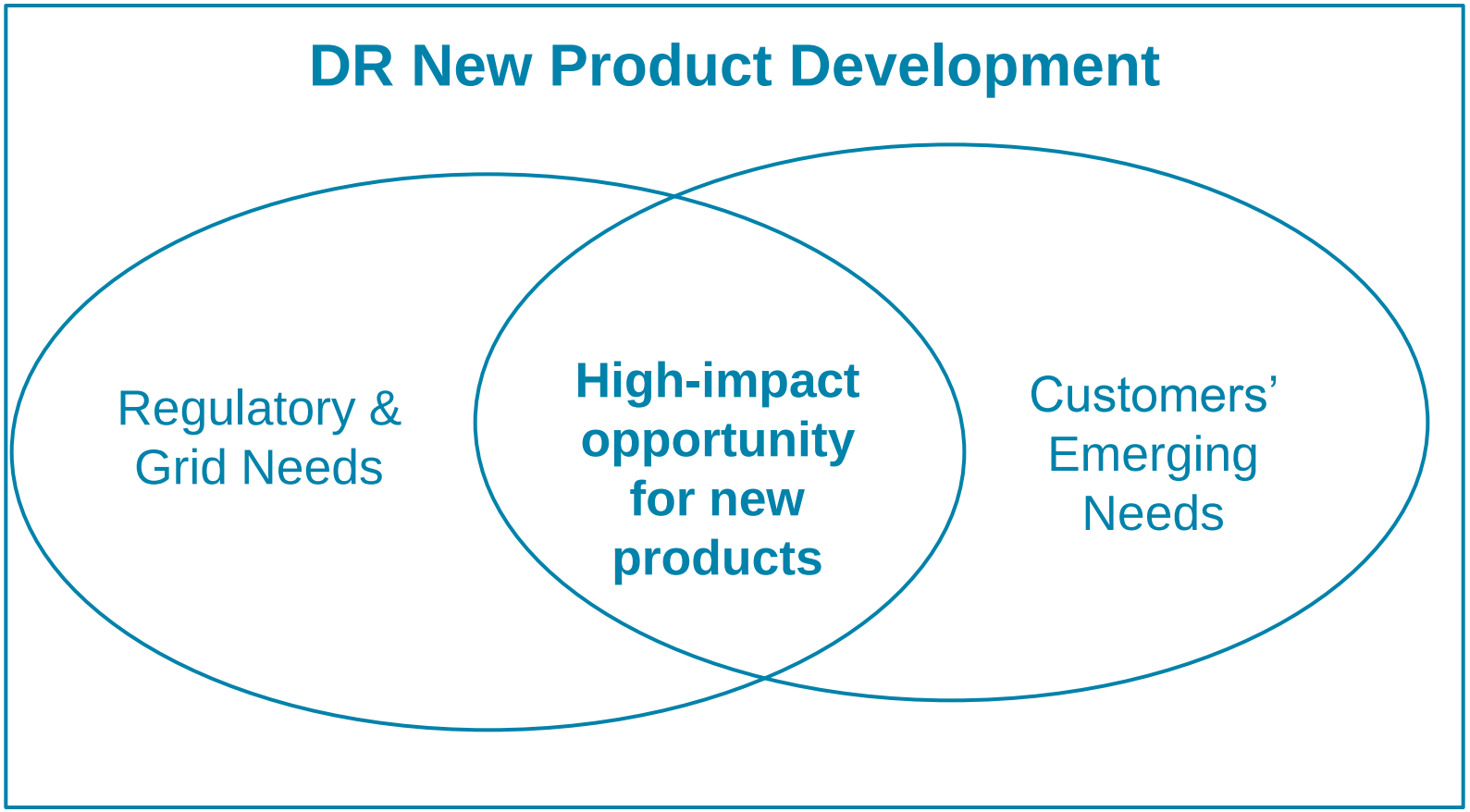
Sam Piell, Program Manager, Demand Response Emerging Technologies

What is Demand Response?

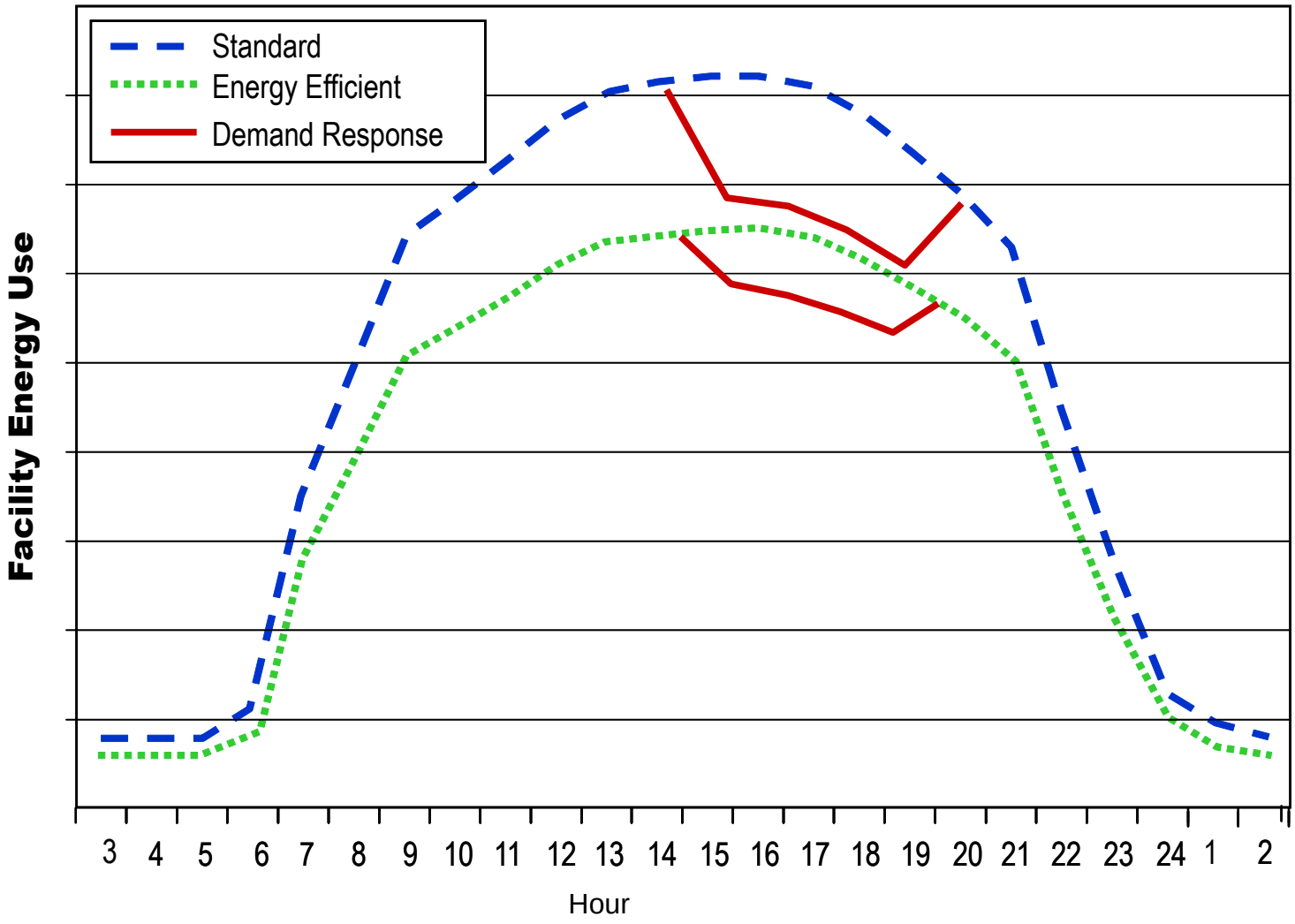
Changes in electric usage by demand-side resources from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized. **--- Federal Energy Regulatory**

Changes in electric use by customers at specified times in exchange for a financial reward.

Demand Response Emerging Technologies



Impact of EE and DR on customer load



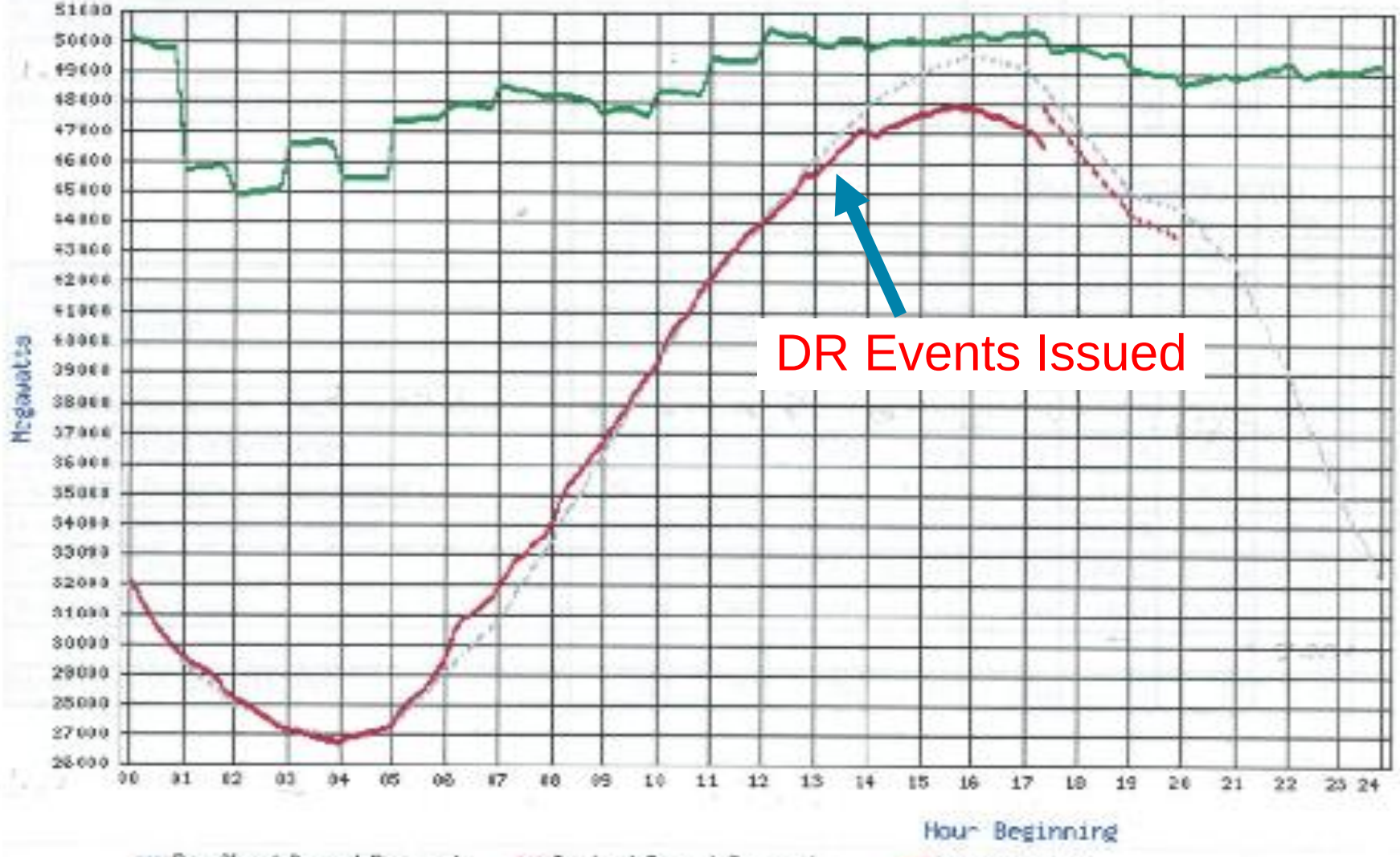
Source: Public Interest Energy Research (PIER) Demand Response Research Center

California ISO
Your Link to Power

PUBLIC MEDIA & OPERATIONS CENTER

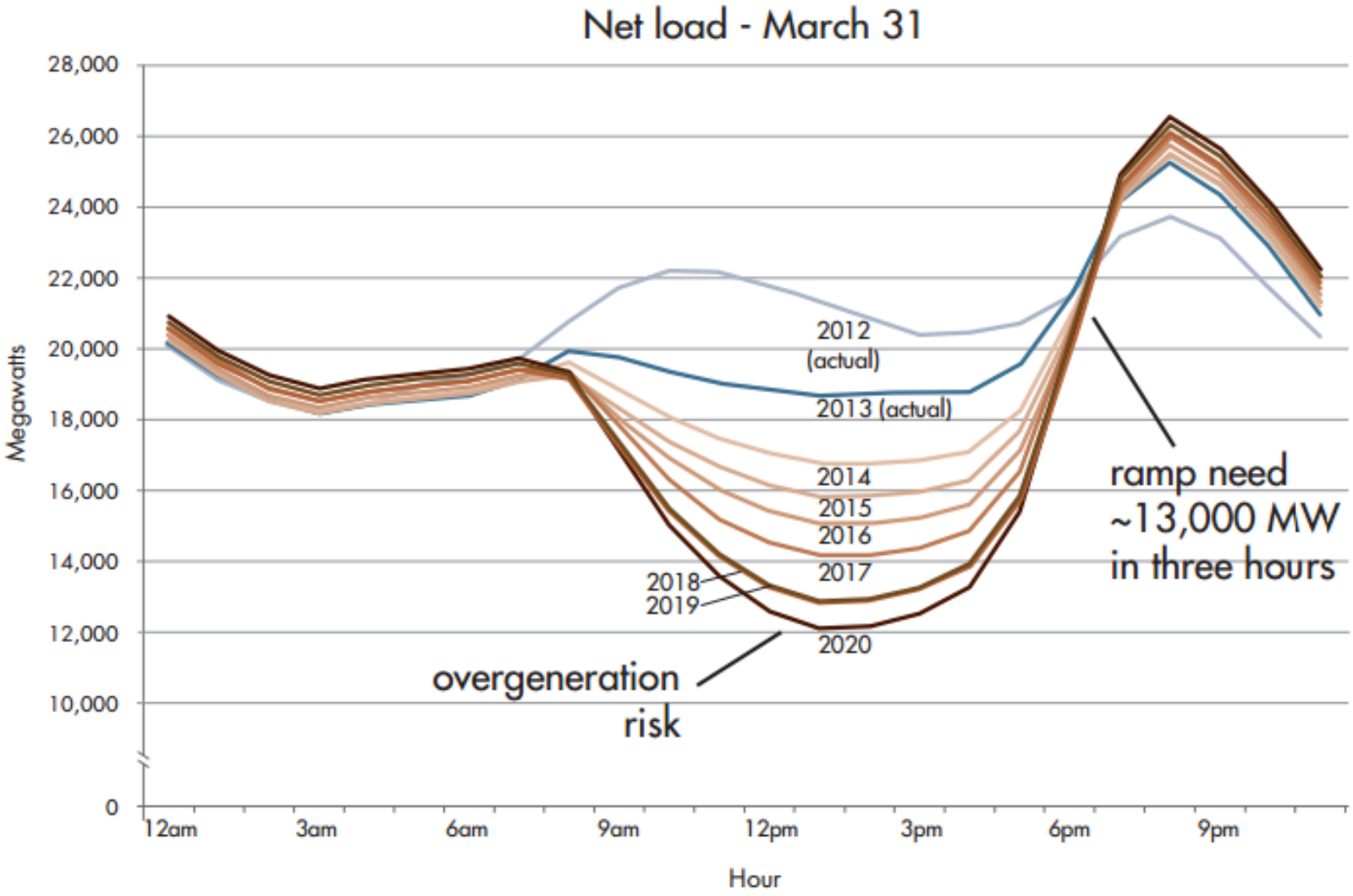
Today's Outlook /

Today's Outlook



Sudden spikes in resource curve graph may indicate false data briefly reported by system

More flexibility is needed to integrate renewable generation -> DR is not just load reduction anymore

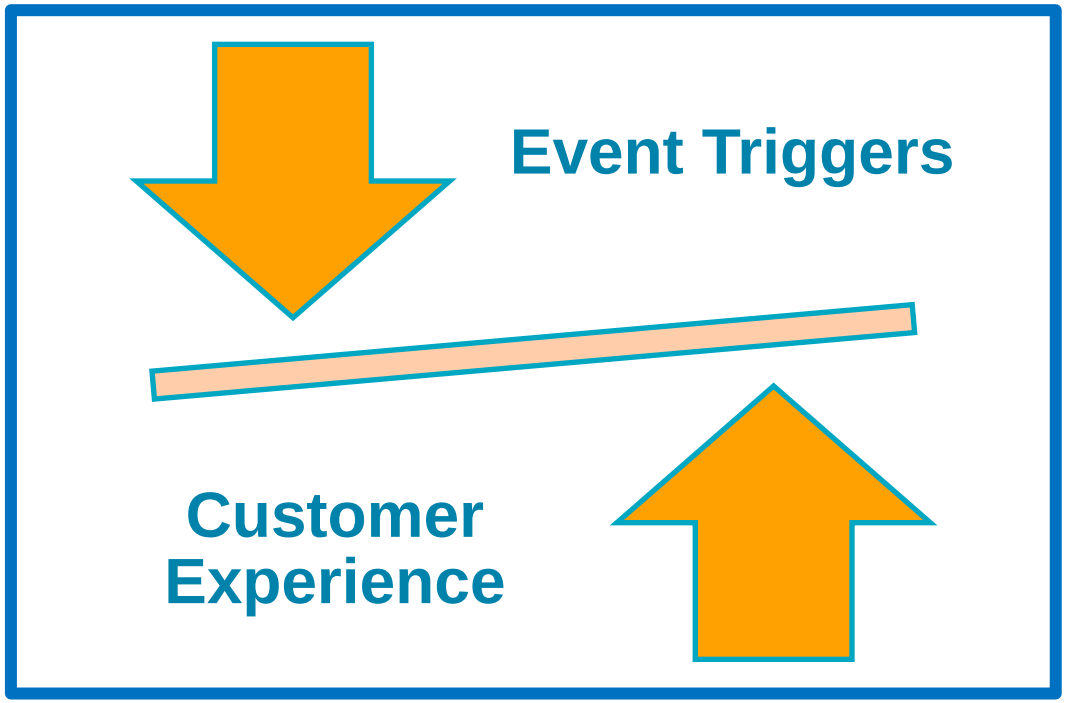


Event Parameters are Program-Specific

Event Frequency	• Times per year • Hours per month • Consecutive days
Event Durations	• Ranging from one hour to eight hours
Notification Time	• Day-ahead • Day-of
Notification Methods	• E-mail, text , and phone call • Automated

Customer satisfaction is important in DR for sustained program participation

108 events across all programs in 2015 to date



How can my organization engage with DR?

Collaborate for a DRET Assessment

- Fund technology assessments of new products to enable customer participation in demand response
- Budget ~$2.5 mm for 2015-2016

2013

- Usage patterns of Electric Vehicle Charging Stations
- Transition from ADR 1.0 to 2.0

2014

- Two-way communicating load control switch
- Statistical sampling

2015

- Smart Thermostats
- Telemetry
- EVSE communication

How can my organization engage with DR?

Participate in a Utility DR Pilot Program

Give customers the freedom to elect their own DR resource availability

Supply Side DR

Excess Supply DR

Let customers know when clean energy is abundant on the grid to power their life and business

Questions?

Thank You

Sam Piell
S4P4@pge.com

Emerging Technologies and Technology Resource Innovation Outreach Program - TRIO

Presented by:

Robyn Zander, Senior Project Manager
Emerging Technologies

New Program Design & Launch

Process & Infrastructure Management

SOUTHERN CALIFORNIA EDISON
An *EDISON INTERNATIONAL*℠ Company

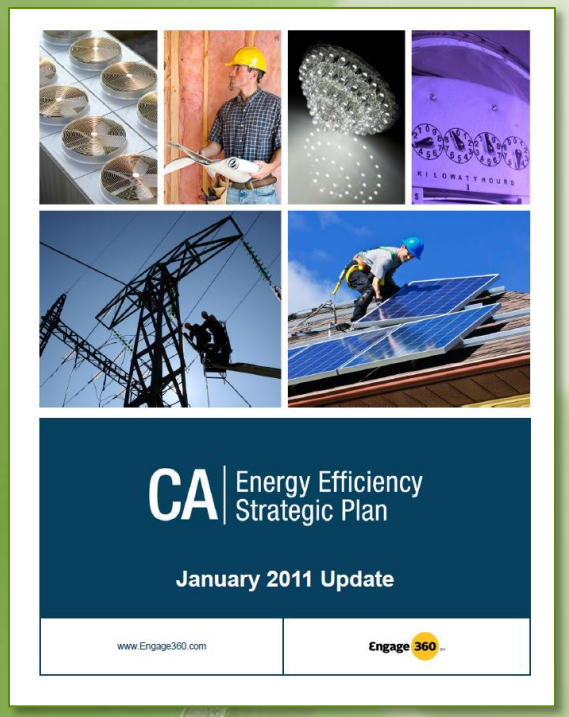
Background

Technology Resource Innovation Outreach - A statewide program that seeks to engage ***non-traditional methods*** and greater outreach to generate new innovative program ideas and identify newer technologies for capturing cost-effective electric energy savings.

The CPUC directed the utilities to integrate, coordinate and innovate in order to provide more comprehensive solutions to customers.

Commission mandate to pull new and innovative technologies from early stage to commercialization

Policy Drivers



"BIG BOLD" ENERGY EFFICIENCY STRATEGIES

In order to guide market transformation in a number of key sectors, this Plan embraces four specific programmatic goals, known as the "Big Bold Energy Efficiency Strategies" (BBEES), established by the CPUC in D.07-10-032 and D.07-12-051. These goals were selected not only for their potential impact, but also for their easy comprehension and their ability to galvanize market players.

1. All new residential construction in California will be zero net energy by 2020;
2. All new commercial construction in California will be zero net energy by 2030;
3. Heating, Ventilation and Air Conditioning (HVAC) will be transformed to ensure that its energy performance is optimal for California's climate; and
4. All eligible low-income customers will be given the opportunity to participate in the low income energy efficiency program by 2020.

Policy Tools for Market Transformation

The market transformation strategies covered in the Plan are built upon one or more of the following policy tools employed to "push" or "pull" more efficient products or practices to market:

- ***Customer Incentives*** including rebates; innovative or discounted financing; and/or non-financial support to consumers are the "carrots" that help *pull* consumers into choosing the efficient option.
- ***Codes and Standards*** which mandate minimum efficiency thresholds for buildings, appliances and/or equipment, removing the less efficient choices from the marketplace are the "sticks" that *push* builders and manufacturers to provide efficient goods and services.
- ***Education and Information*** through marketing, education and outreach inform market actors about energy efficiency opportunities. These programs often include labeling; benchmarking; internet-based comparisons; professional and trade materials; school curricula; peer-to-peer exchanges; and other resources.
- ***Technical Assistance*** helps to ensure that knowledge barriers on the part of customers, installers or retailers are not unnecessarily hampering the progress of critical efficiency initiatives.
- ***Emerging Technologies*** rely on research, development, demonstration and/or deployment to move energy-efficient products and developments from the laboratory into the commercial marketplace.

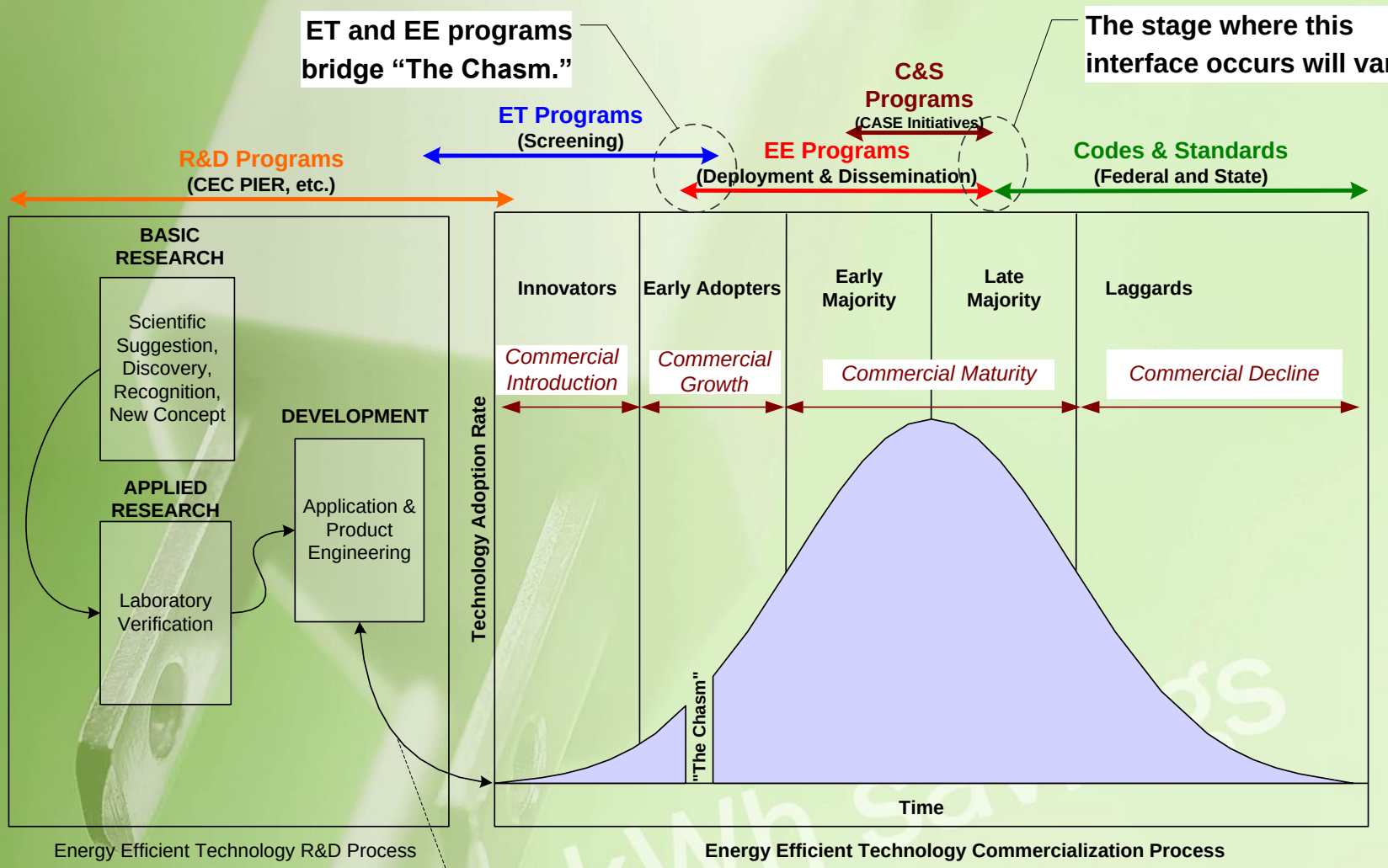
Emerging Technologies Program (ETP) – *Mission*

To support increased energy efficiency market demand and technology supply by contributing to development and deployment of new and underutilized energy efficiency (EE) and demand response (DR) measures (that is, technologies, practices, and tools), and by facilitating their adoption as measures supporting California's aggressive energy and demand savings goals.

What is Emerging Technology?

A market-ready or near market-ready technology that needs validation, technical assistance, and/or increased visibility to succeed in the marketplace. ETs include hardware, software, design tools, strategies, and other services.

Energy Efficiency Framework



ET 2013-2015 Program Design –
Three-Pronged Approach

Technology Development Support—Increase energy efficiency technology supply

Engage in targeted technology support efforts; increase developer outreach

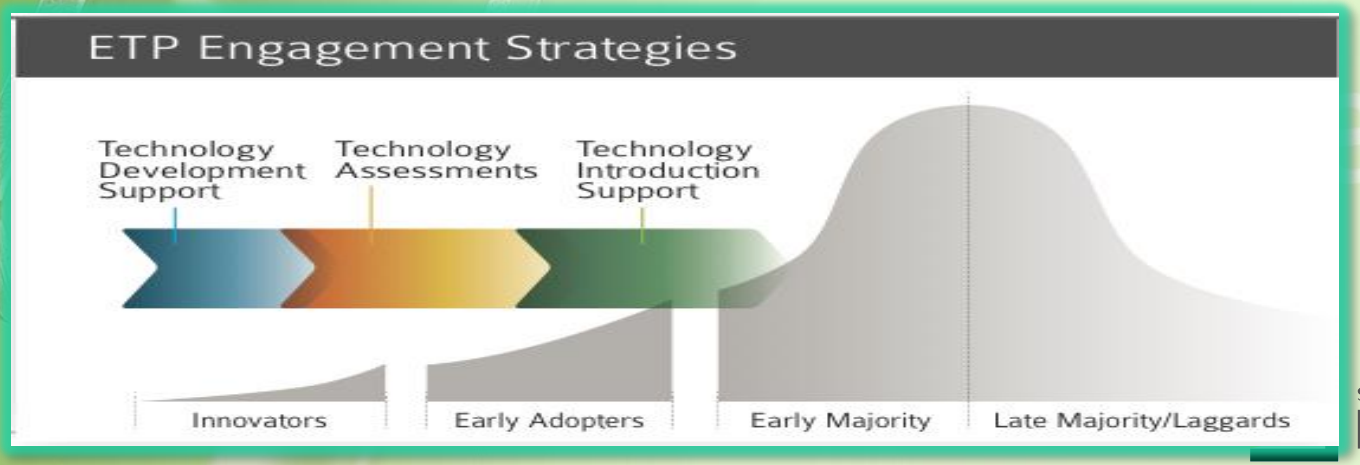
Technology Assessments—Increase the number of measures offered by programs

Assess energy efficient technologies; support technology transfer

Technology Introduction Support—"seed" market demand

Conduct demonstrations and targeted field placements; help increase market knowledge of new technologies

Together, the three strategies work in concert to help technologies make the leap from idea to adoption. The visual below illustrates the diffusion of innovation—how ETP provides support across the lifecycle of technologies from the Innovators stage to Early Adopters and Early Majority.



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Examples of innovation

- Deliver increased Customer participation or installation of existing technologies
- Seek out and develop new combinations of existing and new technologies
- Establish untapped relationships and channels
- New wheel – best thing since sliced bread - widget

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Tool for those Ideas

Technology Resource Innovation Program (TRIP)

TRIP originated with the Technology Resource Innovative Outreach program (TRIO)

Solicitation used to actually do the business with utilities

The intent of this TRIP solicitation is to find, fund, and test the best new EE (energy efficient) or IDSM (integrated demand side management) technologies available in the marketplace discovered through the TRIO program and/or outreach events

Resource only

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Tool for those Ideas

Innovative Design for Energy Efficient Approaches (IDEEA

The intent of this IDEEA365 solicitation is to find, fund, and foster the best new EE (energy efficient) or IDSM (integrated demand side management) delivery approaches available in the marketplace discovered through the TRIO program and/or outreach events

Resource and Non-resource

Open all year – PEPMA-ca.com - Request for Abstract

Review monthly

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Is My Technology Ready??

Unverified / Unavailable

Concept (Idea)

Alpha

Beta

To Do:

TRIO

Idea Form

Open Forum

Independent Lab Test

Submit results

Unverified / Available

UL Certified

Sales, but not part of existing CA utility programs

To Do:

TRIO

Open Forum

Idea form

Independent Lab & Field Tests

TRIP Program

Verified / Available

UL Certified

Similar products on market already being sold with CA utility incentives

To Do:

TRIO

Existing Programs

3rd Party Programs

IDEEA365

Goal:

Future Codes & Standards

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Successes

- **Entrepreneurs partner with existing third parties**
- **Communicate/Network**
- **Set realistic expectations**
- **Submit a proposal**
- **Take advantage of the TRIO resources**
  - Where are the utility people?
  - Where are the consultants?
  - Where are the existing 3P implementers?

kWh savings

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Wrap-up Slide

Capture	▪ Capture cost-effective energy savings
De-mystify	▪ De-mystify utilities ▪ Codes &standards and regulatory requirements ▪ Increase the diversity of 3rd party implementers
Relationships	▪ Utilize a network of utility relationships to create innovative solutions by communicating and connecting similar activities
IOU Interest	▪ Leverage IOU interest for investment funding ▪ Showcase innovative technologies
Feedback	▪ Energy industry expertise / utility feedback

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Questions

kWh savings

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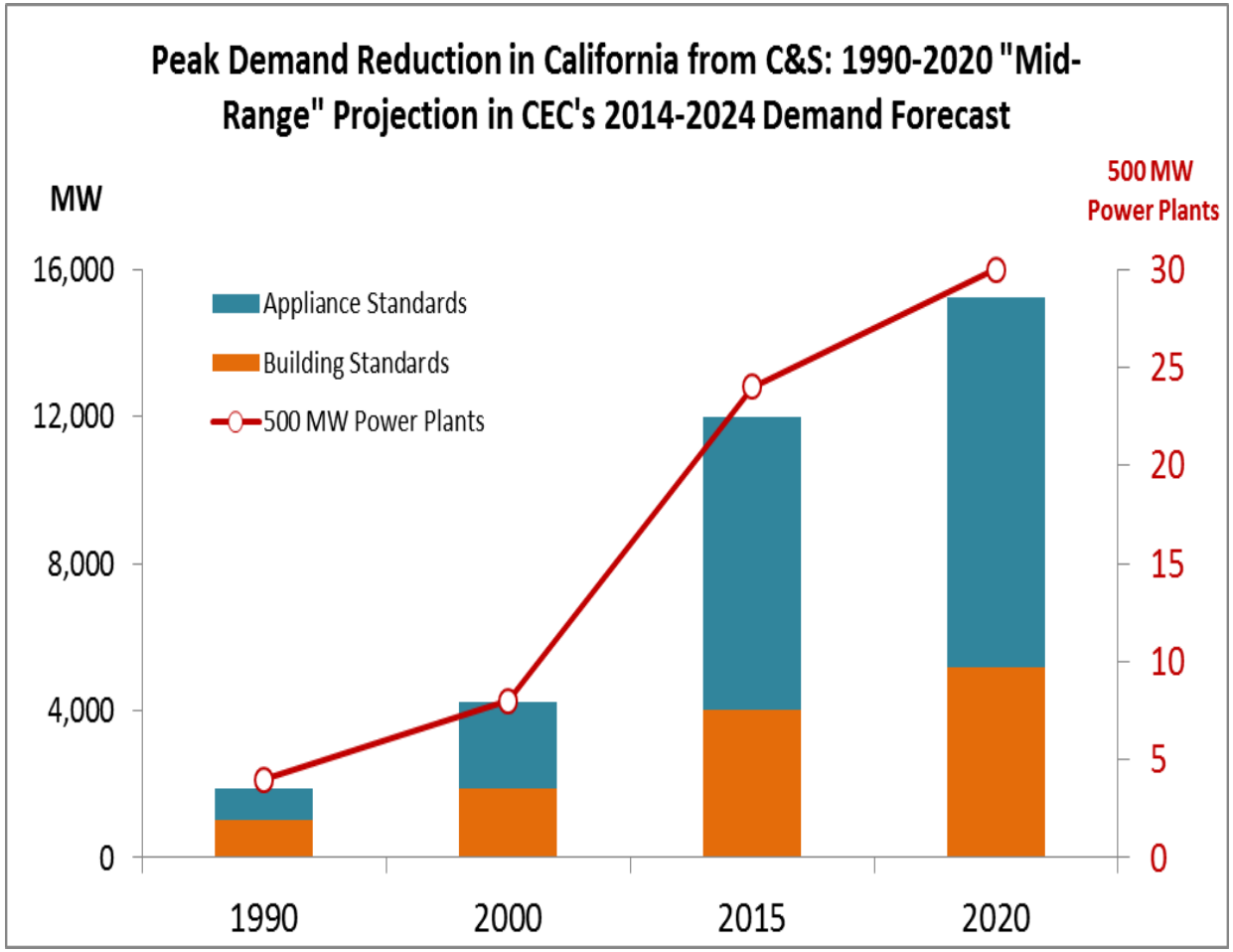
TRIO Symposium: Innovative Technologies for the Portfolio

Pat Eilert, Manager

PG&E Codes & Standards Program

October 6, 2015

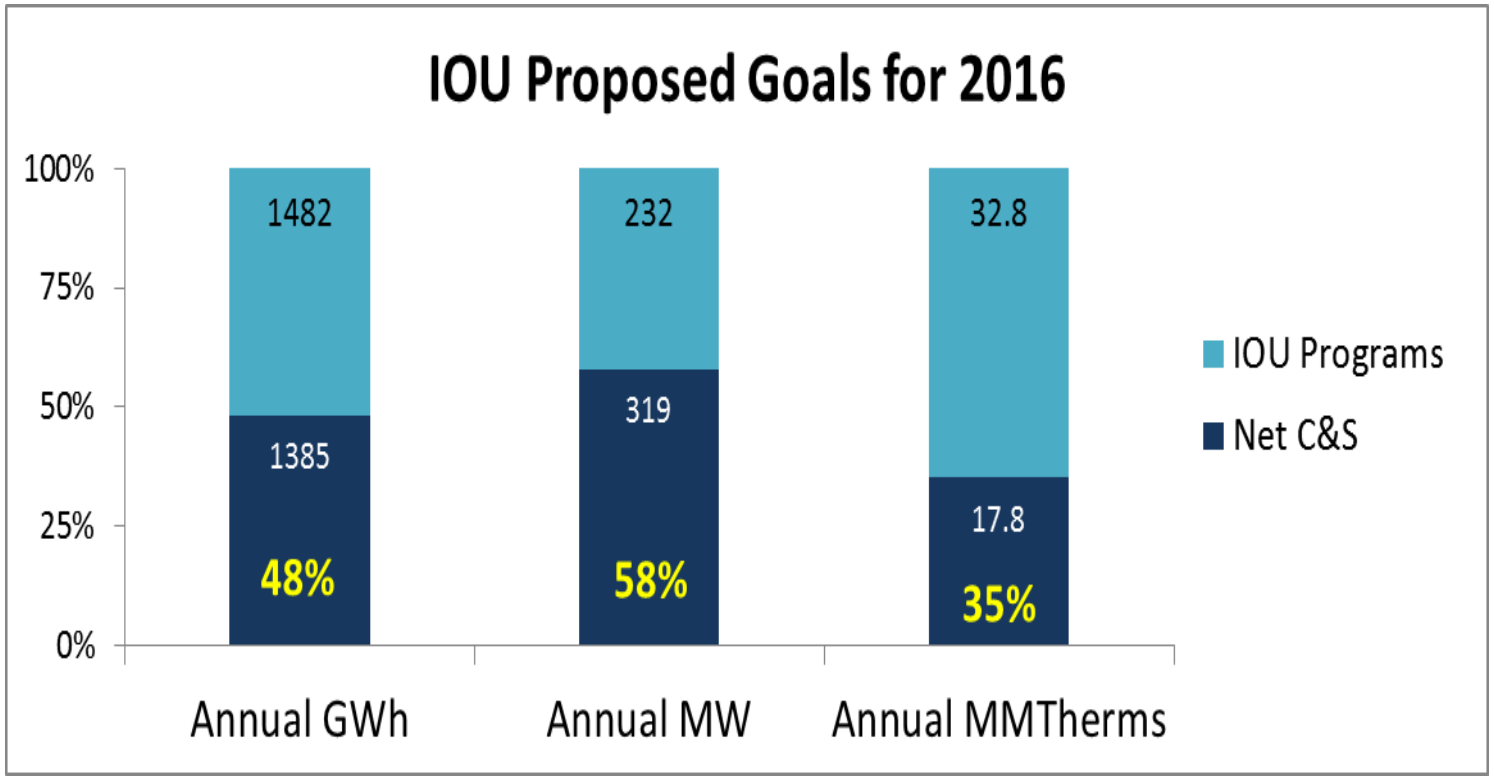
Statewide Impact of Codes & Standards



Source: Table 25 from CEC's 2014-2014 Demand Forecast.

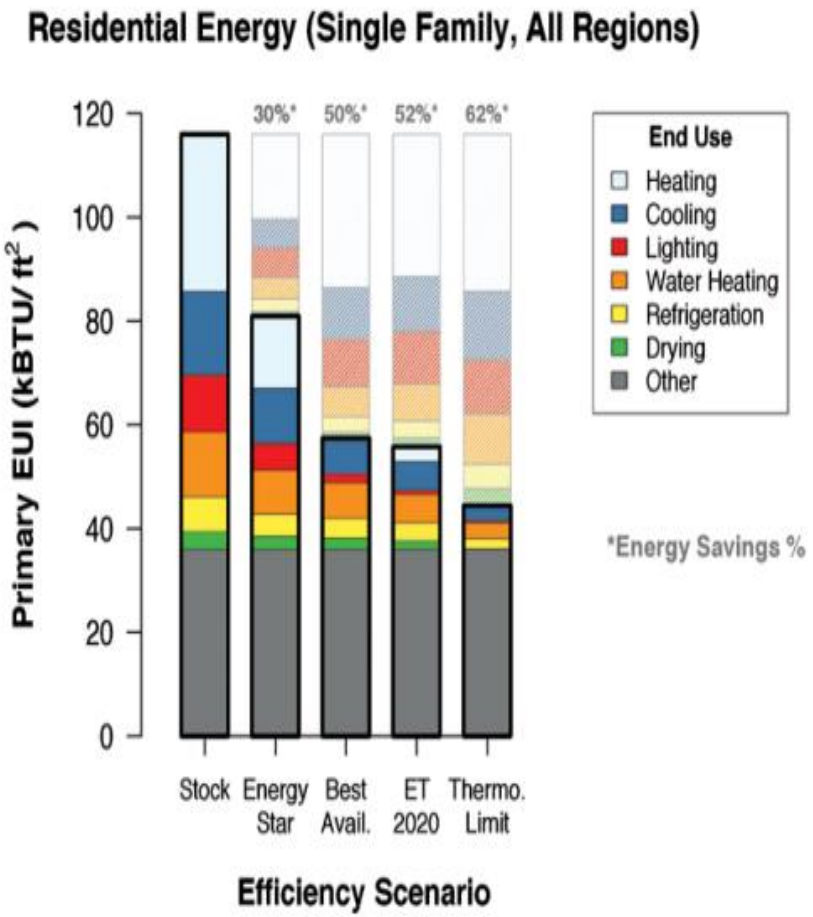
IOU C&S Statewide Program History

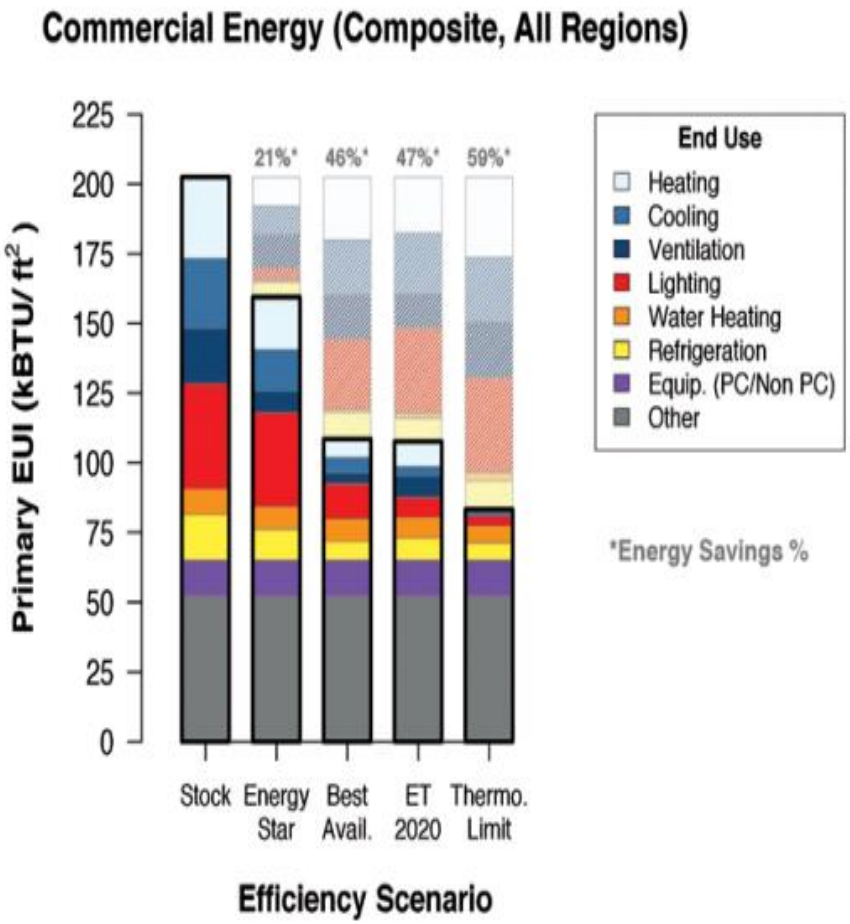
C&S Savings in Context



Source: Figure 1 from Proposed decision "RE ENERGY EFFICIENCY GOALS FOR 2016 AND BEYOND AND ENERGY EFFICIENCY ROLLING PORTFOLIO MECHANICS" 8/18/2015.

Plenty Opportunity Remains

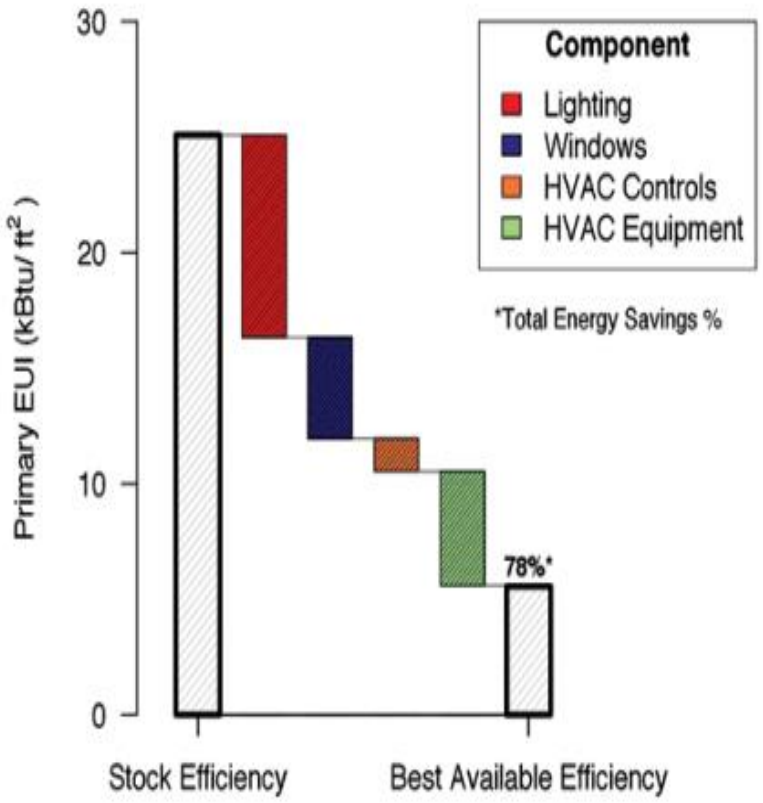


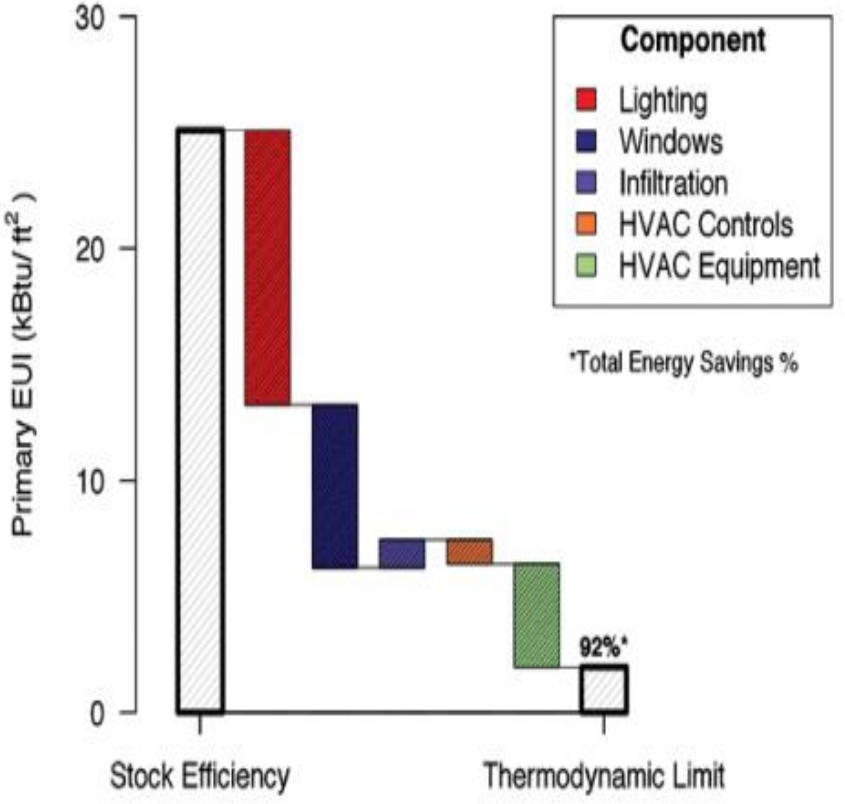


Source: Figure 5.2 and 5.3. DOE's *2015 Quadrennial Technology Review*

Need Integrated Design Solutions

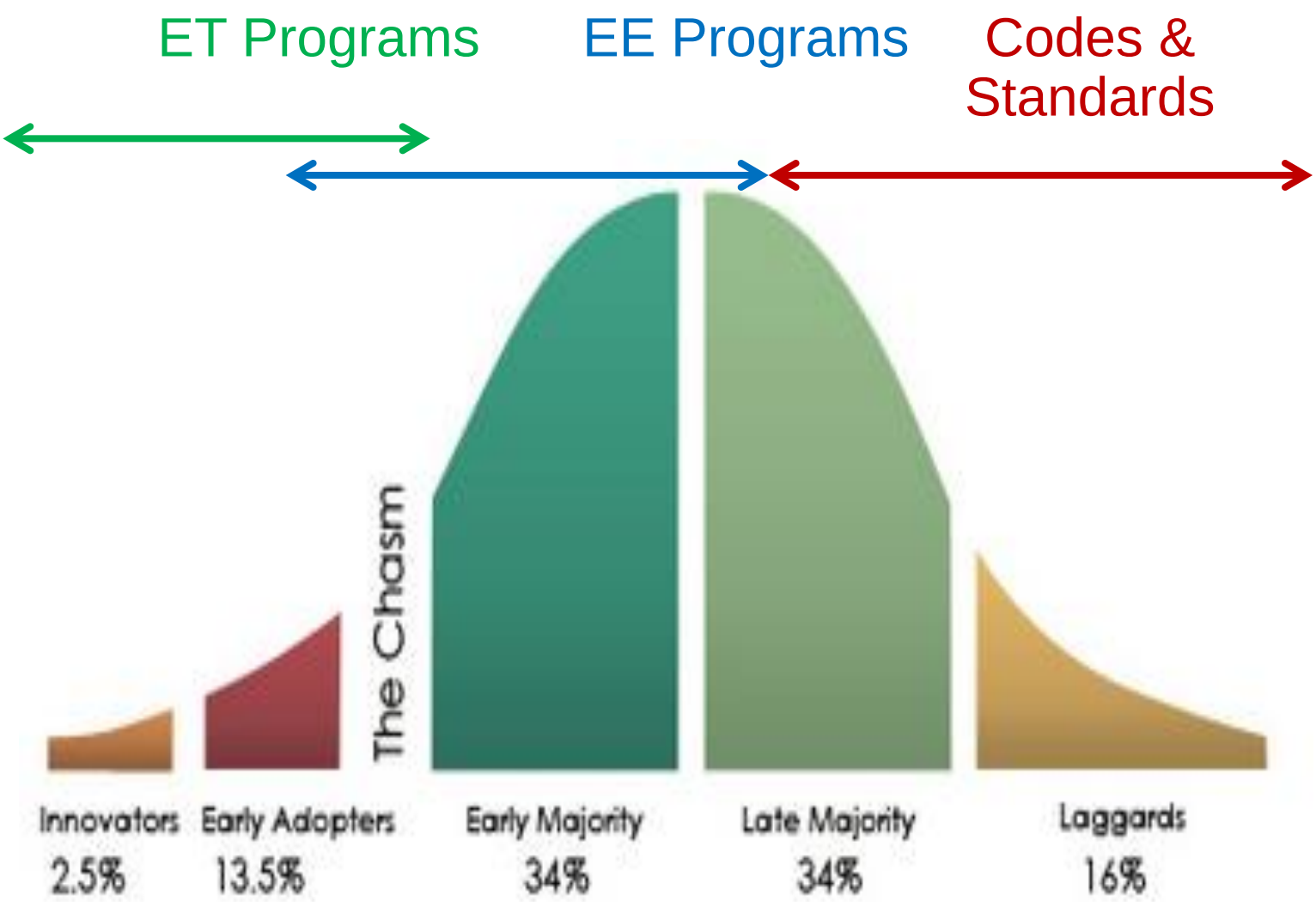
Use of the most efficient wall, window, and HVAC equipment now available could reduce **commercial** cooling 78%. The theoretical limit is a 92% reduction.





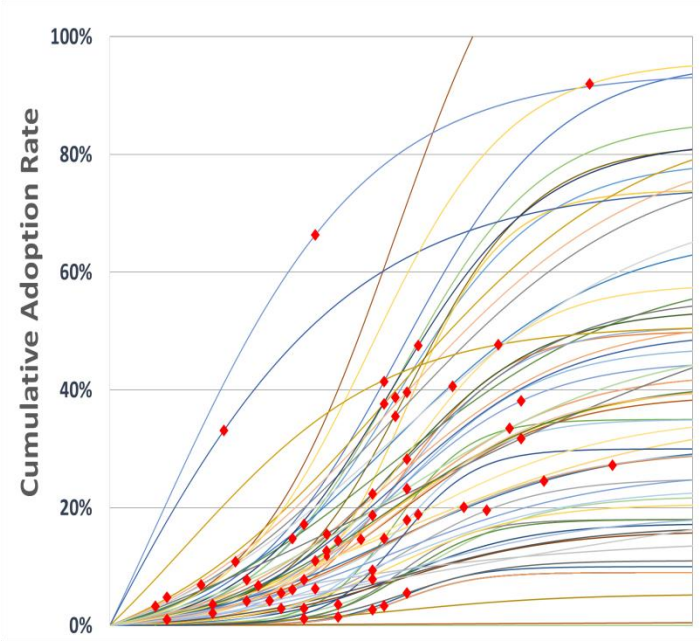
Source: Figure 5.8. DOE's *2015 Quadrennial Technology Review*

Traditional View

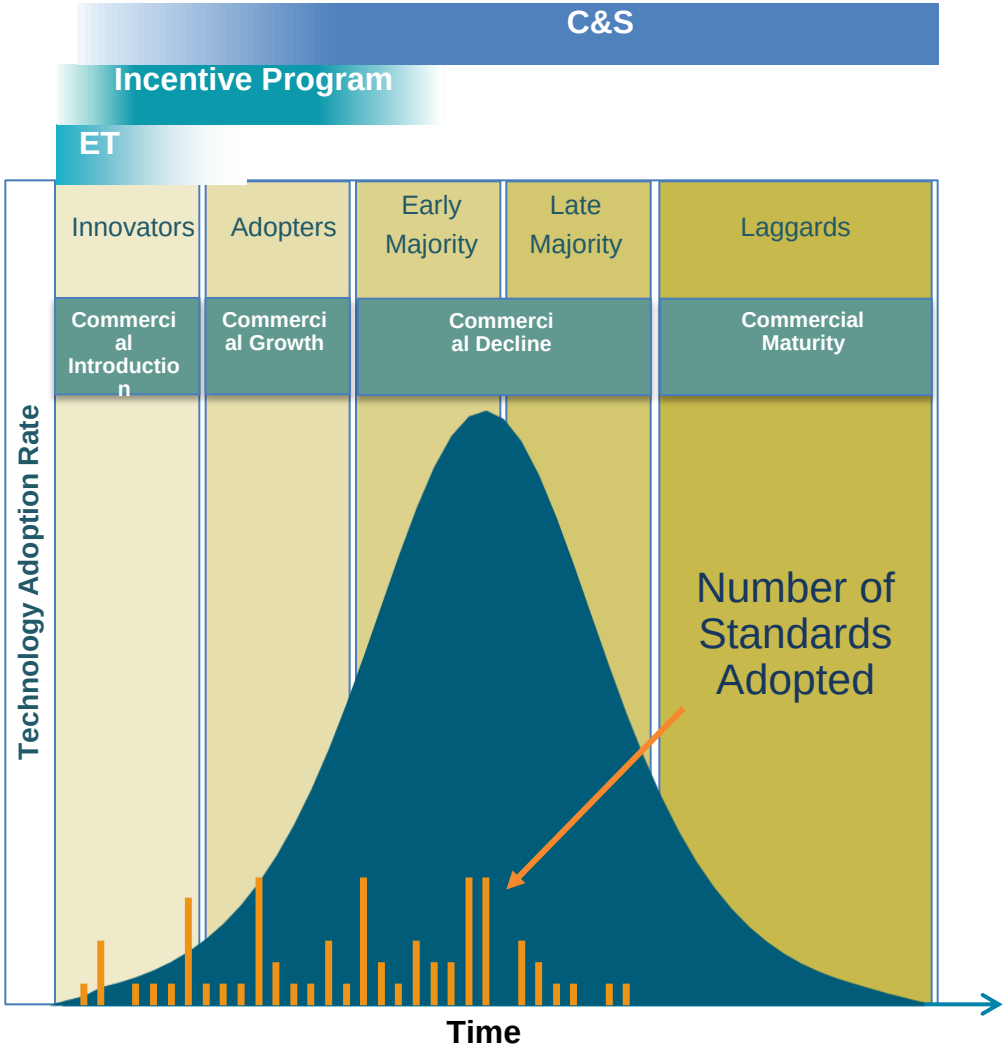


Here's what's actually happening…

Naturally Occurring Market Adoption (NOMAD) Curves



Red Mark: adoption point



California's Policy Goals

Sector	Type	Now	2020	2025	2030	2050
Residential	New Construction ZNE		100%			
	Existing Homes (reduction relative to 2005 stds)		40%			
Commercial	New Construction ZNE				100%	
	Existing ZNE				50%	
State Bldgs	New construction & major retrofit ZNE		50%	100%		
	Existing (by square footage) ZNE			50%		
SB 350	Increase energy efficiency in buildings				50%	
AB 32	GHG Levels		1990 Levels		40% Below 1990	80% Below 1990
Water Eff	Reduce Water Use	25%				

Supporting Agencies:

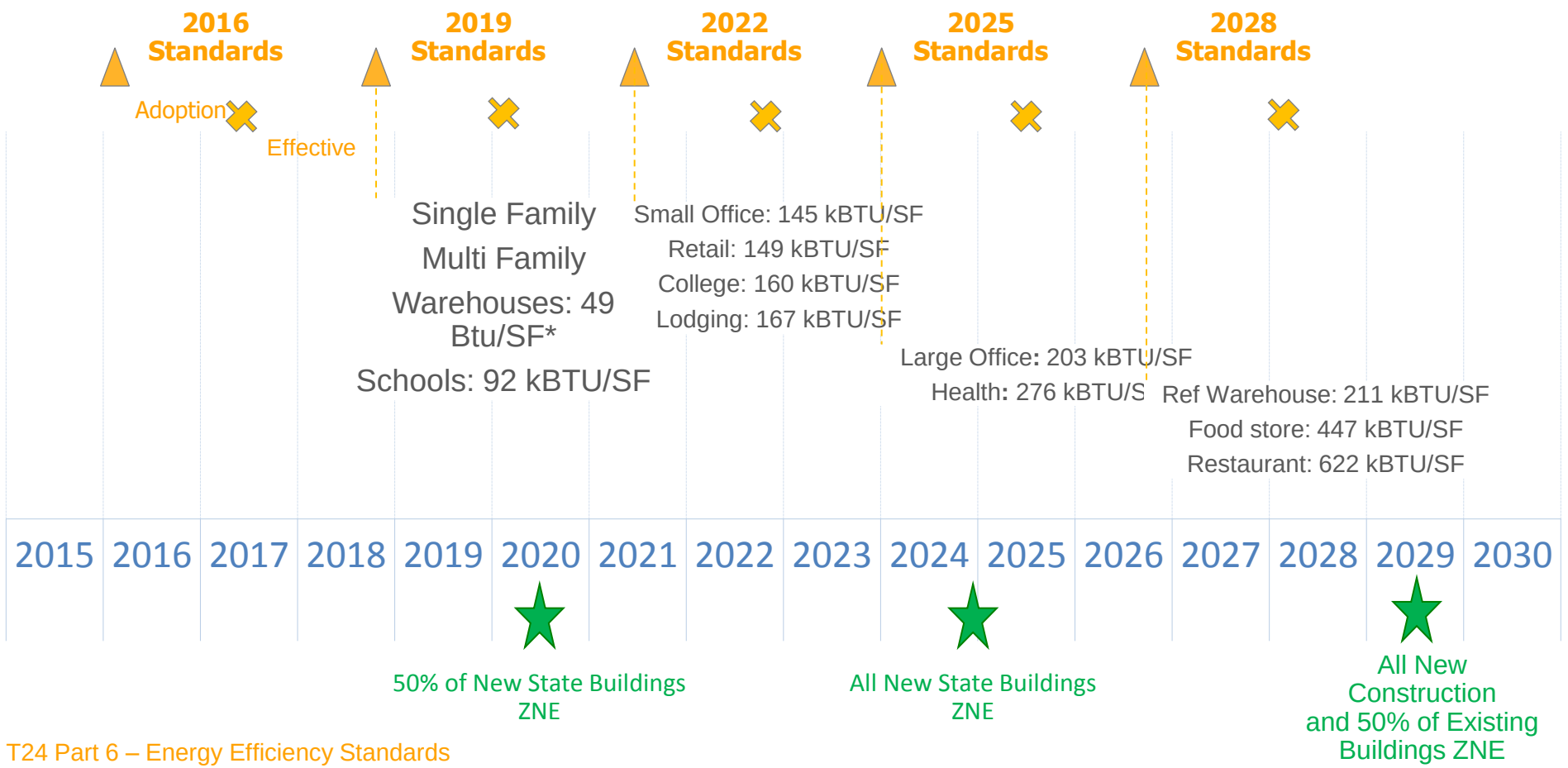
Note: Residential and commercial goals initially established in California's *Long Term Energy Efficiency Strategic Plan*, developed by the CPUC. The State buildings goal was established by Governor Brown's Executive Order B-18-12.

ZNE Goals and Title 24 Timeline

Easiest Building Classes First and Support Exec Order

Start now doing buildings that are easier.

Begin with End in Mind



T24 Part 6 – Energy Efficiency Standards

PG&E Recommended Interim Milestones

Executive Order B-18-12 Goals

*Source energy kBtu/SF from CEUS CA Commercial End-Use Survey

Residential NC ZNE

Single Family

- **Quality controls: insulation, envelope leakage**
  - Indoor air quality: toxic building materials, ventilation air delivery and ventilation controls
- Cool attics: **light colored roofs** and roof insulation
- More efficiency HVAC, incl EVAP and C02 refrigerants
- Reduce AC duct losses: duct sealing and duct location.
- Reduce length of hot water piping
- Drain water heat recovery
- HVAC self-diagnostics
- Simulation models: plug loads, photovoltaics, mini-split A/C, and drain water heat recovery
- Photovoltaics and battery integration
- Roofing replacement: cool roof, insulated roof deck and photovoltaics

Multi Family

- **Drain water heat recovery**
- **Quality controls: insulation, envelope leakage**
  - Indoor air quality: toxic building materials, ventilation air delivery and ventilation controls
- HVAC self-diagnostics
- Separate code section for multifamily buildings
- Cool attics: light colored roofs and roof insulation
- Reduce AC duct losses: duct sealing and duct location.
- Reduce length of hot water piping
- MF Simulation models: plug loads, photovoltaics, mini-split A/C, and drain water heat recovery
- Photovoltaics and battery integration
- Roofing replacement: cool roof, insulated roof deck and photovoltaics

Residential NC ZNE

Single Family

- **Quality controls: insulation, envelope leakage**

Multi Family

- **Drain water heat recovery**

2020 Commercial NC ZNE Goals

Warehouse

- **Warehouse LED Lighting & Compatible Controls**
- Envelope design: Unrefrigerated Warehouse
- Optimal Warehouse HVAC
- DR Controls Forklift Charging
- Warehouse PV
- PV + Storage Integration

Schools

- **School indoor lighting & controls**
- **High eff low load HVAC & controls** – radiant, mini-split, heat pump
- School daylighting
- School outdoor lighting & controls
- Dedicated Outside Air Supply (DOAS)
- Natural ventilation (operable windows)
- Improved ventilation
- Advanced air conditioning systems
- Occupant based comfort
- Standardized Optimized Controls
- Improved lab fume hoods
- Efficient School Kitchens
- Plug load controls for schools
- Efficient hot water systems
- High perform relocatable classrooms
- Water reduction at schools
- Emergency generation, storage and PV

State Buildings

- **ZNE Definition, EDRating = 0 TDV**
  - Simulation model defining TDV ZNE Comm Bldg
- **High eff low load HVAC**
- **High eff lab fume hoods**
- Plug Load Model Comm Buildings
- Drainwater Heat recovery and heat recovery from Ac to pre-heat water
- Lighting and Daylighting Controls
- Daylighting: Window VT and Overhangs
- Dedicated outdoor air systems (DOAS)
- Improved ventilation
- Water reduction measures
- Emergency gen, storage and renewables
- High eff kitchens
- ZNE State Building Retrofits

2020 Commercial NC ZNE Goals

Warehouse

- **Warehouse LED Lighting & Compatible Controls**
- Envelope design: Unrefrigerated Warehouse
- Optimal Warehouse HVAC
- DR Controls Forklift Charging
- Warehouse PV

Schools

- **School indoor lighting & controls**
- **High eff low load HVAC & controls** – radiant, mini-split, heat pump
- School daylighting
- School outdoor lighting & controls
- Dedicated Outside Air Supply (DOAS)
- Natural ventilation (operable windows)
- Improved ventilation
- Advanced air conditioning systems

State Buildings

- **ZNE Definition, EDRating = 0 TDV**
  - Simulation model defining TDV ZNE Comm Bldg
- **High eff low load HVAC**
- **High eff lab fume hoods**
- Plug Load Model Comm Buildings
- Drainwater Heat recovery and heat

2020 Commercial NC ZNE Goals (Cross-Cutting Building Types)

Non-Res Lighting

- **Interior and Exterior Lighting LPDs based on LEDs**
- **Lighting controls retrofits in existing buildings**
- Statewide lighting and daylighting model
- Daylighting controls rating
- Daylight dimming plus OFF controls
- Acceptance testing - interior and exterior controls
- Task/ambient lighting design
- Lighting quality/screw-base high efficacy luminaires (JA8)
- Expand bi-level control exterior lighting

- Daylighting controls when lighting altered
- Exterior lighting controls for retrofits
- Bi-level motion controlled lighting in plazas

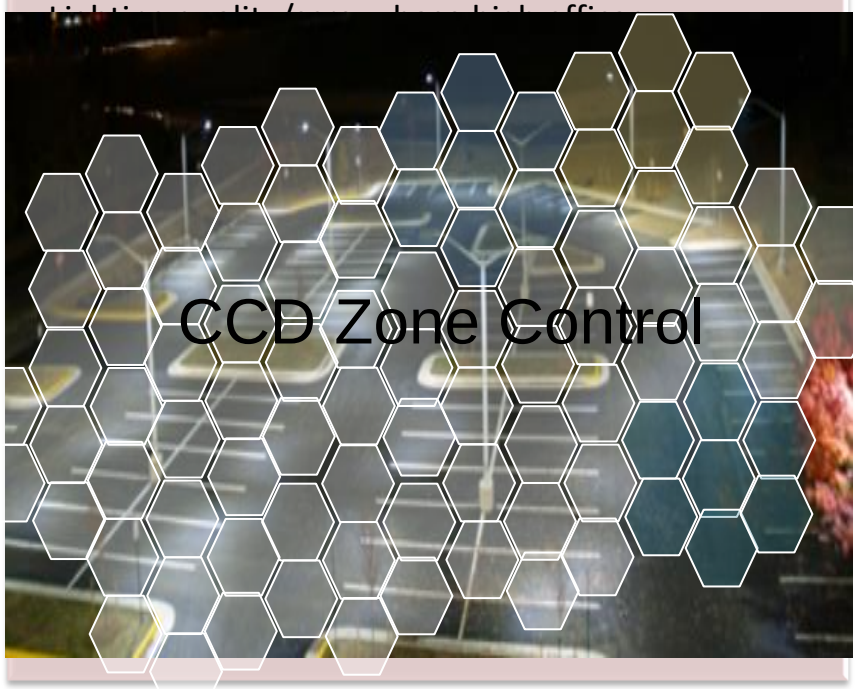
Non-Res HVAC

- **High eff low load HVAC & controls –** radiant, mini-split, heat pump
- **Operable windows with window HVAC lock-out switches**
- Ventilation requirements and controls
- HVAC On Board Diagnostics
- Heat recovery from exhausted air
- Improved outside air dampers (economizer) diagnostics
- Variable Refrigerant Flow (VRF) HP
- Demand Response Enabled Equipment
- Radiant Heating and Cooling
- Duct Leakage minimization
- Package Terminal Heat Pump resistance heat control
- Reduce electric resistance heating in heat pumps
- Thermally driven (solar or waste heat) air conditioning

2020 Commercial NC ZNE Goals (Cross-Cutting Building Types)

Non-Res Lighting

- **Interior and Exterior Lighting LPDs based on LEDs**
- **Lighting controls retrofits in existing buildings**
- Statewide lighting and daylighting model
- Daylighting controls rating
- Daylight dimming plus OFF controls
- Acceptance testing - interior and exterior controls
- Task/ambient lighting design



Non-Res HVAC

- **High eff low load HVAC & controls –** radiant, mini-split, heat pump
- **Operable windows with window HVAC lock-out switches**
- Ventilation requirements and controls

2022 Commercial NC ZNE Goals

Offices

- **Office indoor & outdoor eff ltg & controls**
- **High eff low load HVAC & controls–** radiant, mini-split, heat pump
- Improved ventilation
- Office daylighting and glazing VT
- Office water reduction
- Emergency generation, storage & PV
- Energy use display
- Efficient envelope
- Natural ventilation (operable windows)
- Advanced air conditioning systems
- Building level controls, including plug load controls
- Simulation models for advanced HVAC

Retail

- **LED display and general lighting**
- **Occupancy sensor control of display and/or general lighting**
- Task/ambient lighting design
- Occupancy sensing controlling TV's and other equipment displays
- Warehouse measures
- Bi-level motion controlled parking lighting (including tall poles)
- Env retrofits incl cool roof

Lodging

- **Drain water heat recovery**
- **Central scheduling control –** ventilation and purge control
- **Operable windows with window HVAC lock-out switches**
- All high efficacy lighting
- High eff elevators and regeneration
- Set top box scheduling and sleep mode
- Exhaust air heat recovery
- Electric vehicle charging
- Solar pool heating

2022 Commercial NC ZNE Goals

Offices

- **Office indoor & outdoor eff ltg & controls**
- **High eff low load HVAC & controls**– radiant, mini-split, heat pump
- Improved ventilation
- Office daylighting and glazing VT
- Office water reduction
- Emergency generation, storage & PV
- Energy use display

Retail

- **LED display and general lighting**
- **Occupancy sensor control of display and/or general lighting**
- Task/ambient lighting design
- Occupancy sensing controlling TV's and other equipment displays
- Warehouse measures
- Bi-level motion controlled parking lighting (including

Lodging

- **Drain water heat recovery**
- **Central scheduling control** – ventilation and purge control
- **Operable windows with window HVAC lock-out switches**
- All high efficacy lighting
- High eff elevators and

Federal Standards Process

- According to U.S. Code (42 U.S.C. 6295(m)), DOE shall revisit a standard every 6 years after issuance of any final rule and shall publish
  - a notice of the determination of the Secretary that standards for the product do not need to be amended OR
  - a notice of proposed rulemaking including new proposed standards
- The "ASHRAE Trigger" requires DOE review when ASHRAE Standard 90.1 raises its efficiency level in comparison to the current Federal minimum standard

DOE Standards Likely to be Developed or Revised between 2015 and 2030

Residential

- Battery Chargers
- Ceiling Fan Light Kits
- Ceiling Fans
- Central ACs/HPs
- Clothes Dryers
- Clothes Washers
- Computers
- Dehumidifiers
- Direct Heating Equip
- Dishwashers

Residential (con't)

- External Power Supplies
- Furnace Fans
- Furnaces
- Microwave Ovens
- Misc Refrigeration Products
- Pool Heaters
- Pool Pumps
- Portable ACs
- Ranges & Ovens
- Refrigerators and Freezers
- Room ACs
- Water Heaters

Nonresidential

- Automatic Icemakers
- Clothes Washers
- Compressors
- Distribution Transformers
- Electric Motors
- Fans and Blowers
- Prerinse Spray Valves
- Pumps
- Refrigeration Equipment
- Small Motors
- Vending Machines
- Walk-in Coolers and Freezers
- Water-source HPs
- **Packaged Boilers**
- **Package ACs & HPs**
- **Package Terminal ACs & HPs**
- **Single Package Vertical ACs & HPs**
- **Warm-air Furnaces**
- **Water Heaters**

Lighting

- Candelabra & Intermediate Base Incandescent Lamps
- Ceiling Fan Light Kits
- Compact Fluorescent Lamps
- Fluorescent Lamp Ballasts
- General Service Fluorescent Lamps
- General Service Lamps
- HID Lamps
- Incandescent Reflector Lamps
- Incandescent Reflector Lamps (includes certain BR and Other Exempted IRLs)
- Mercury Vapor Lamp Ballasts
- Metal Halide Lamp Fixtures

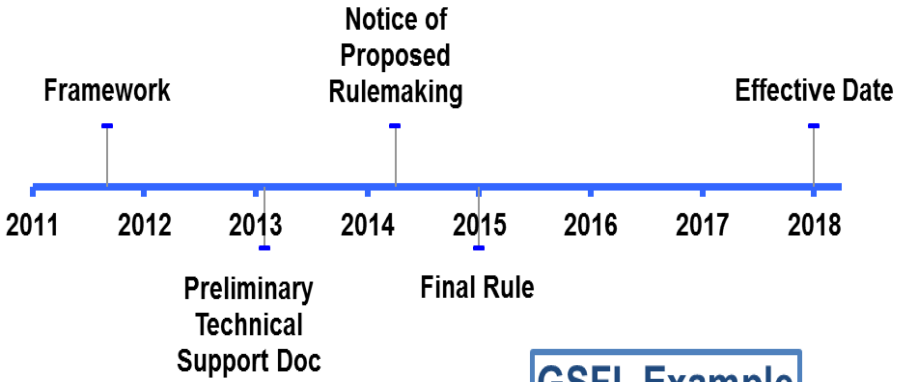
Blue bolded text indicates equipment subject to the "ASHRAE Trigger"

DOE Standards Likely to be Developed or Revised between 2015 and 2030

.s)
or Lamp Ballasts
Lamp Fixtures

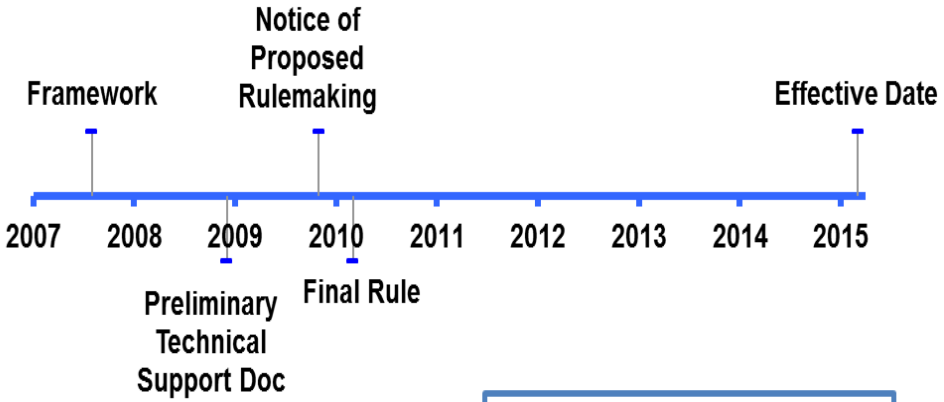
DOE Process and Timeline: Examples

Advanced Planning is Critical



GSFL Example
3 Year Lag

Source: Wikipedia



Small Motors Example
5 Year Lag

Title 20 Support of ZNE Goal

Phase I
•LED Lamp Quality
•Small Diameter Directional Lamps
•Computers
•Displays
•Game Consoles
•Small Network Equipment
•Pool Pump Motors
•Spas
•Commercial Clothes Dryers
•**Dimming Ballasts**
•**Air Filter Labeling**
•**Toilets**
•**Urinals**
•**Faucets**

Phase II & III	
•Small Motors	•Computer Kiosks
•GSFLs (T12 Loophole)	•EV Chargers
•EISA Exempt Lamps	•Whole House Fans
•Televisions	•Evaporative Coolers
•Imaging Equipment (Res & Commercial)	•Lab Grade Coolers & Freezers
•Power Factor	•Blast Freezers
•Imaging Equipment (Medical)	•Spot Air Conditioners
•Set Top Boxes	•Digital Billboards
•Servers	•Commercial Convection Ovens
•Lighting Accessories	•Projectors
•Outdoor Lighting	•Portable Air Cleaners
•Recirculation Pumps	•Residential Ice Makers
•Cordless Phones	•Commercial Range Tops (Gas)
•Home Audio	•Lower Power Modes
•Plug-in Luminous Signs	•Refrigeration Condensing Units
•Stovetop Cooking (Electric)	•Soft-serve & Slushy Machines
•Coffee Makers	•DR Enabling
	•VFDs
	•Fluorescent Fixtures

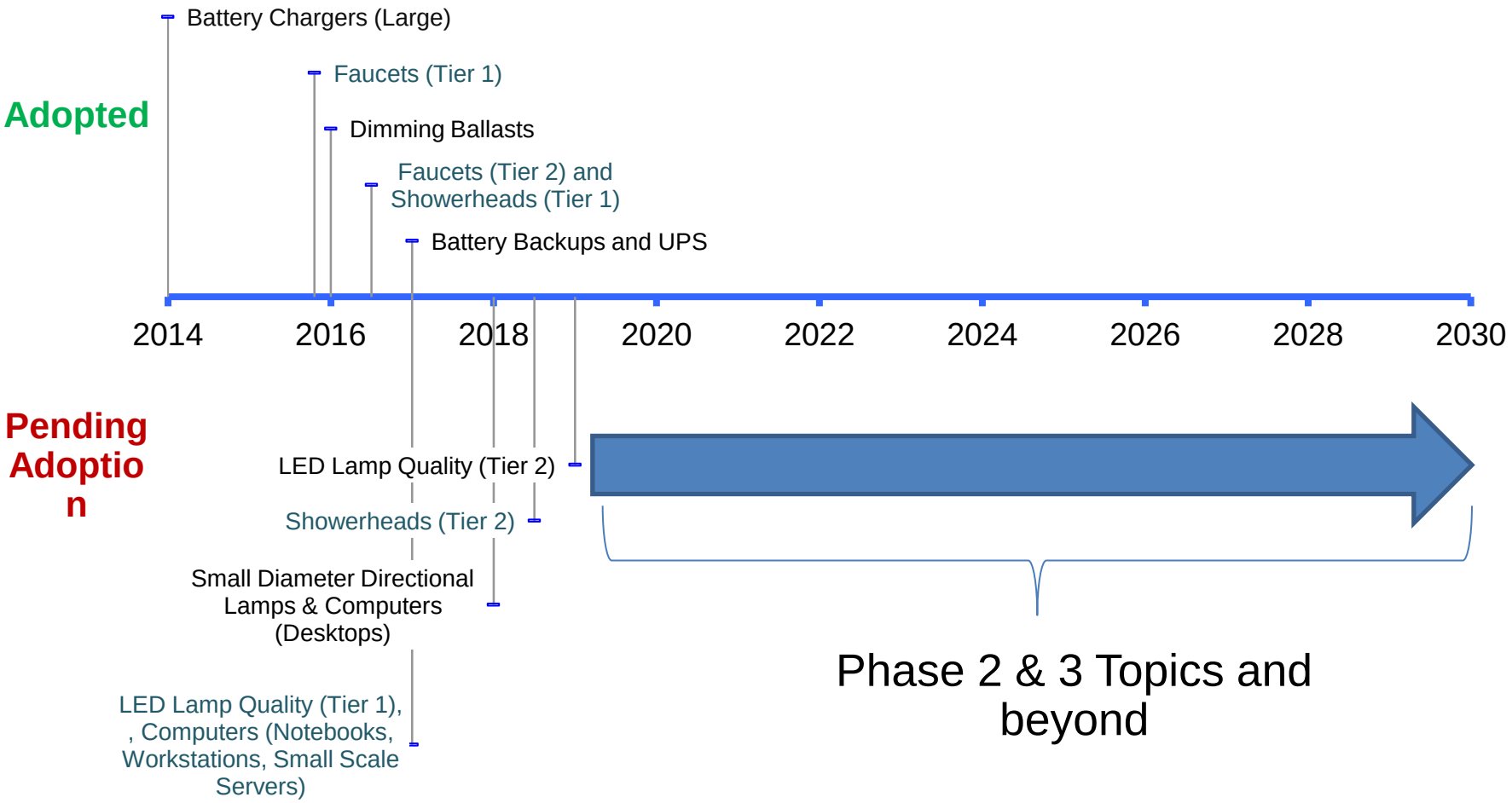
Emergency Water Measures
•**Showerheads**
•Commercial Dishwashers
•Landscape Irrigation Equipment
•Landscape Irrigation Emitters
•Agricultural Irrigation Equipment
•Spa Covers*

Bold = completed measures

= Awaiting CEC determination whether or not to include as part of emergency rulemaking or to add to Phase 1 Pools and Spas staff report.

CA Title 20 Appliance Effective Date Timeline

Phase 1, 2, 3, and beyond



Title 20 Support of ZNE Goal

How can you help?

Cost effectiveness

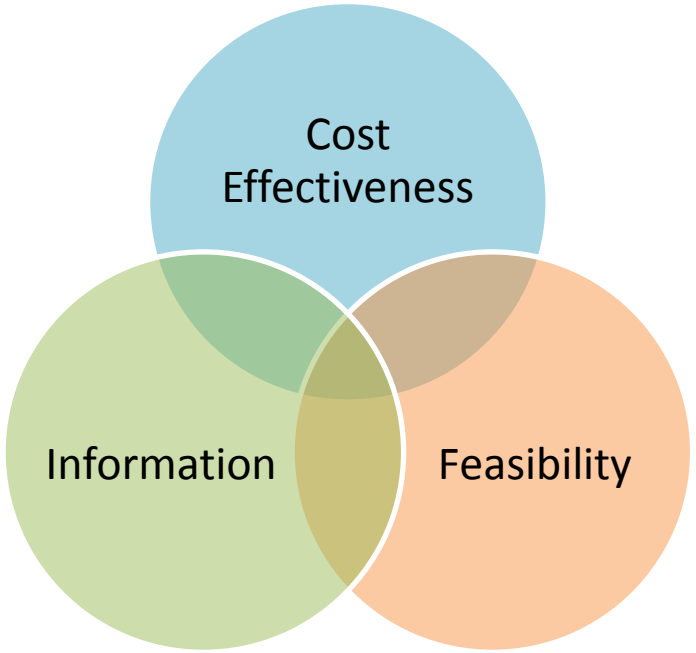
- Measure is not cost effective. Projects need to address commercialization, economies of scale, efficiency optimization, etc.

Feasibility

- Measure is not feasible. Projects need to address uncertainty of unintended consequences, satisfaction, amenity, training, etc.

Information

- Measure may be cost effective and feasible but there's not enough information available to support code adoption. Projects need to address ways to collect and highlight information.



Thank You.

Networking Lunch