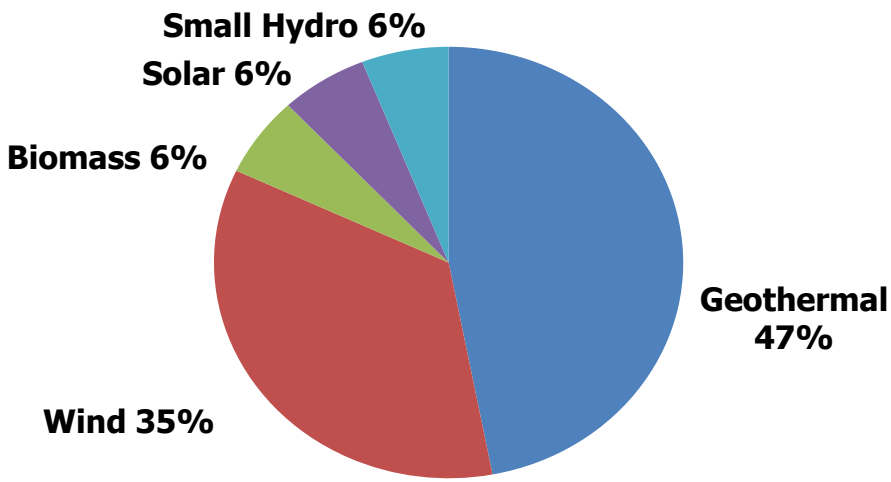
SCE Solar Programs Overview

Southern California Edison Overview

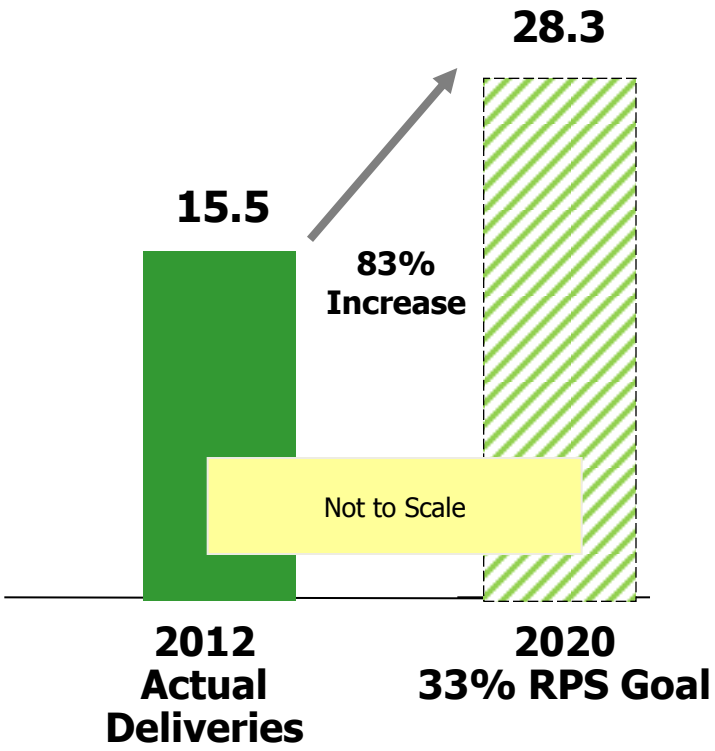
- An Edison International company, SCE is one of the nation's largest investor-owned electric utilities, with more than 120 years of service.
- Serves a population of 14 million people, via 4.8 million business and residential accounts in a 50,000-square-mile service area within central, coastal and Southern California.
- Delivering that power takes 93,500 circuit miles of line connecting 1.5 million poles, 683,000 transformers and 737,000 area and street lights and the days and nights of 13,000 employees.

SCE Delivers More Renewable Energy Than Any Company in the U.S.

Actual 2012 Renewable Resources
Total: 15.5 billion kWh*
21.1% of SCE's portfolio



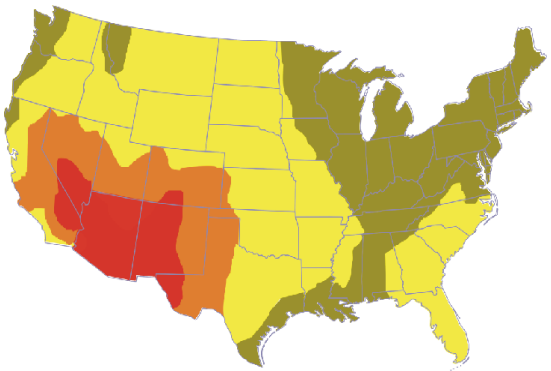
Renewables Goal
(billion kWh)



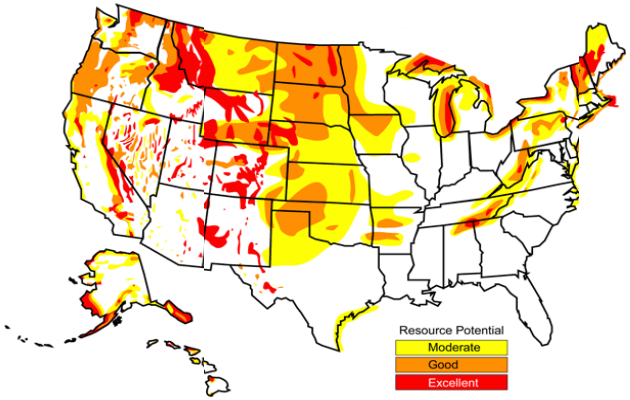
*http://www.cpuc.ca.gov/PUC/energy/Renewables/compliance.htm

Renewable Energy in America

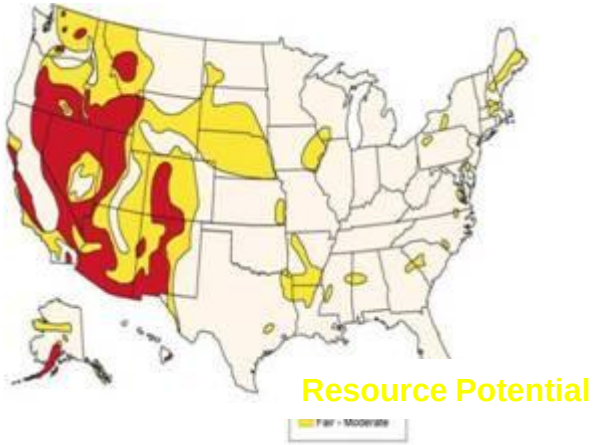
SOLAR ENERGY



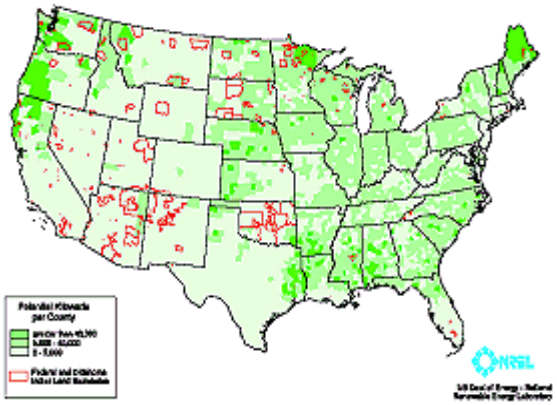
WIND POWER



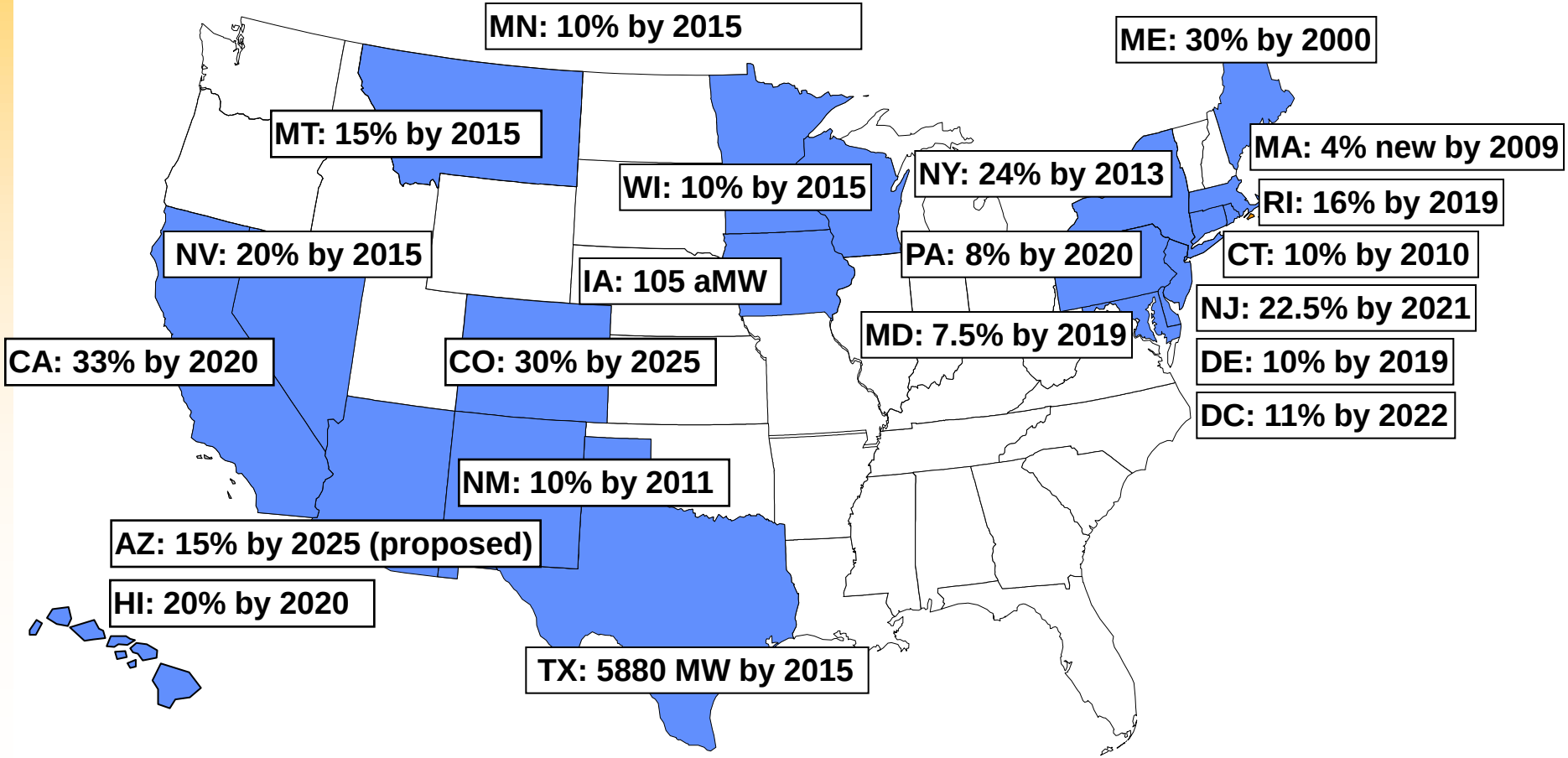
GEOTHERMAL



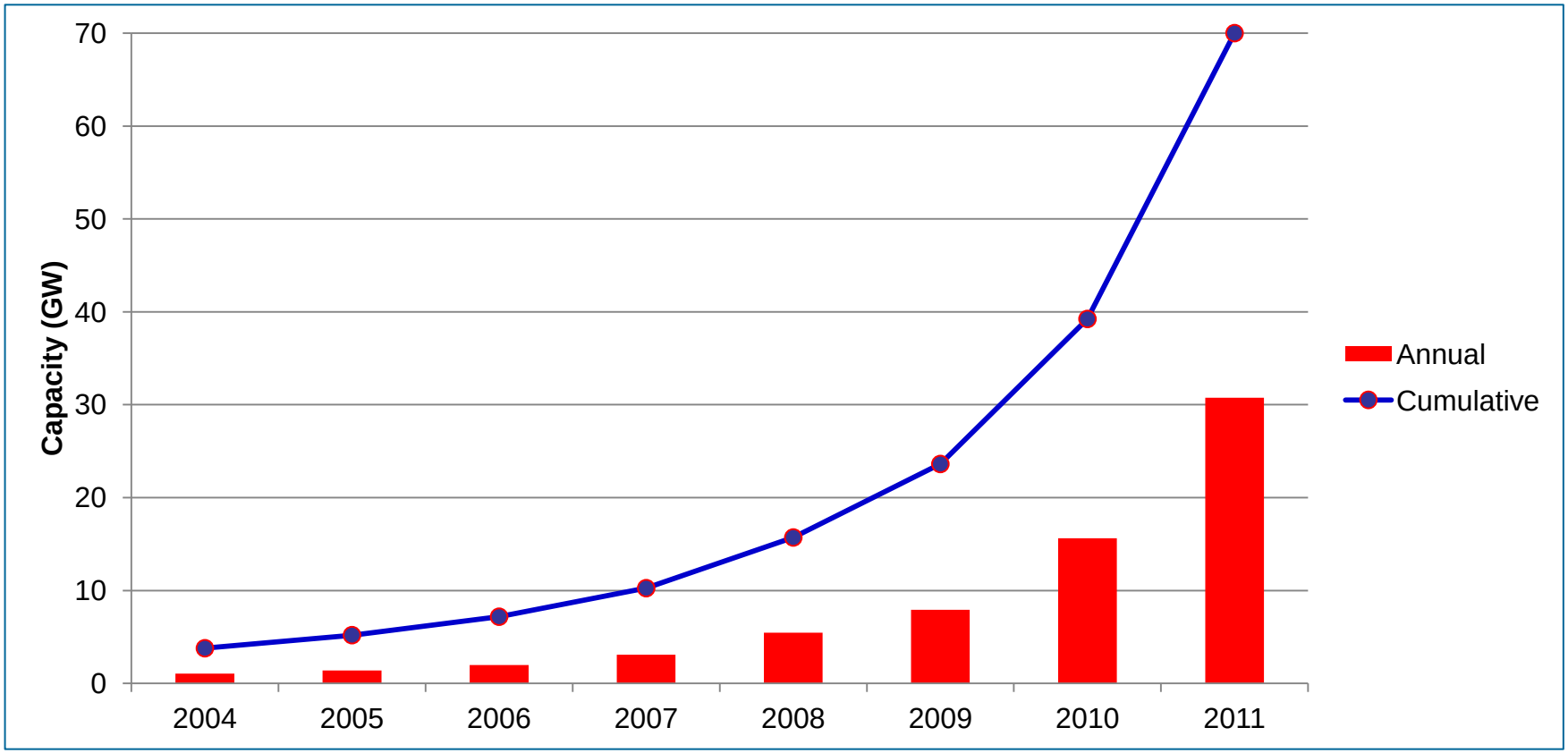
BIOMASS



State RPS Policies and Mandates



Global PV Installations 2004-2011

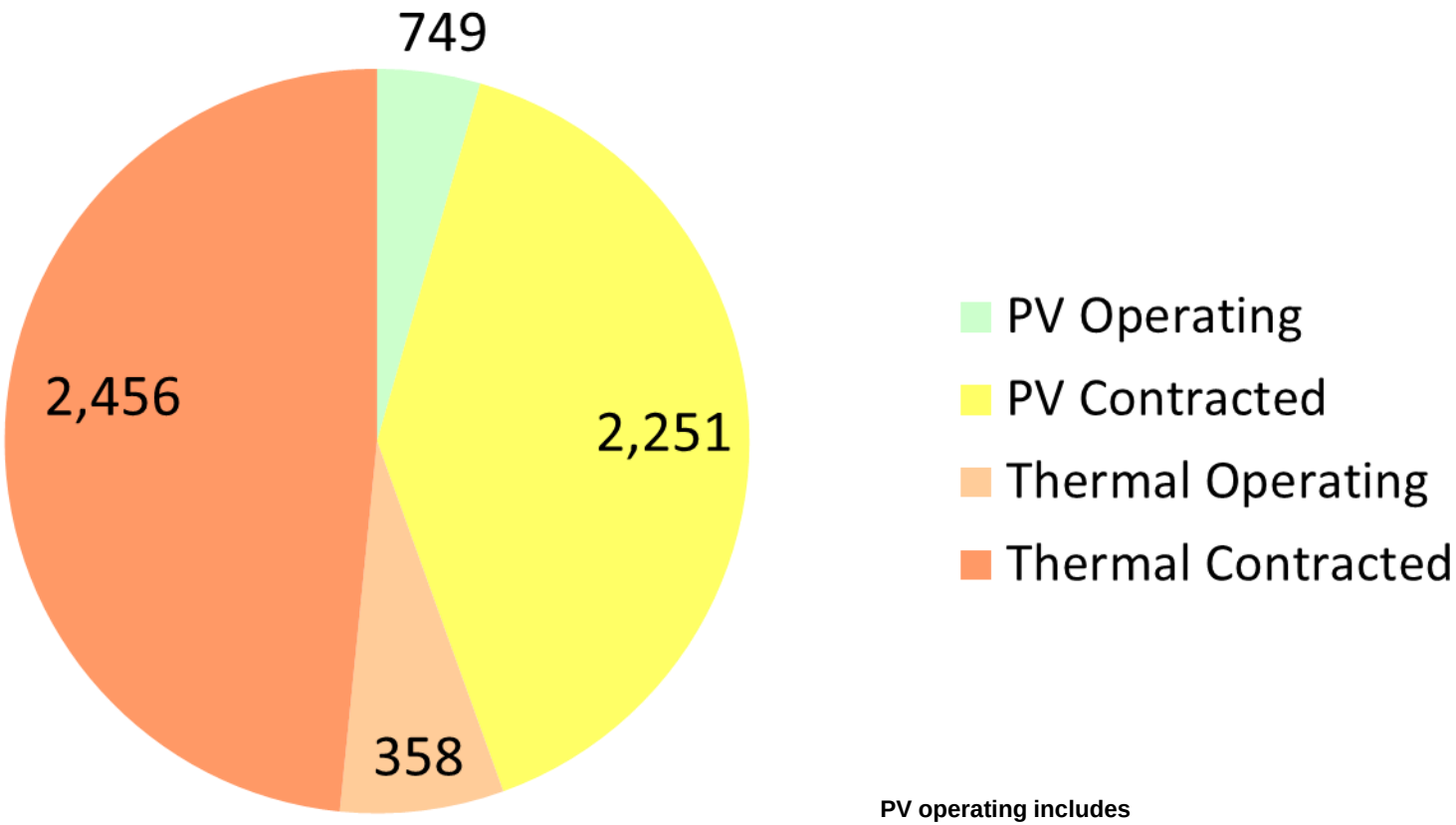


Sources: EPRI, Navigant Consulting, Solar Power Consulting

~25 GW to be installed globally in 2012

Over 5,800 MW of Solar

Solar (MW Capacity)

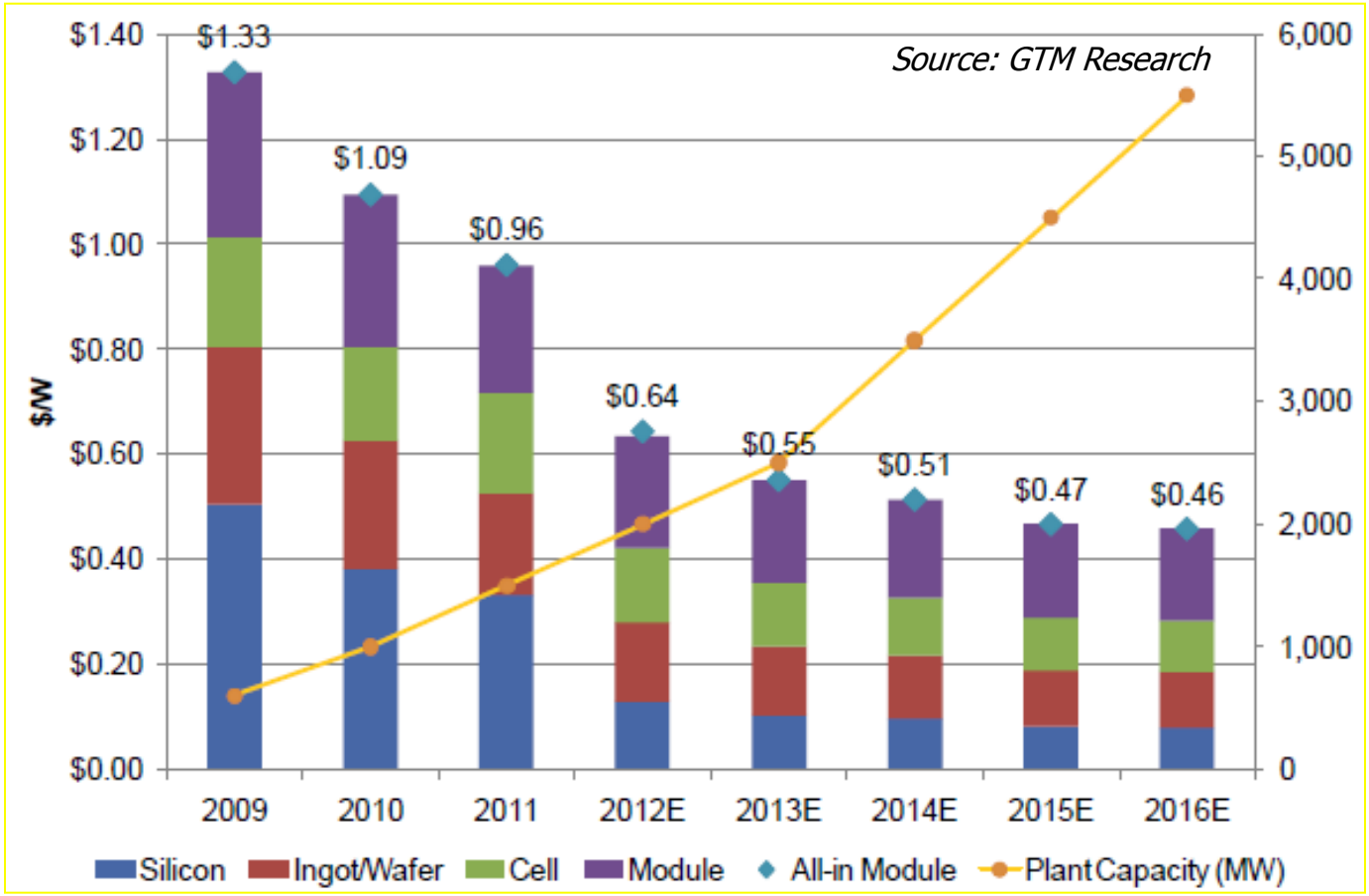


PV operating includes

71 MW of UOG PV Roof/Ground

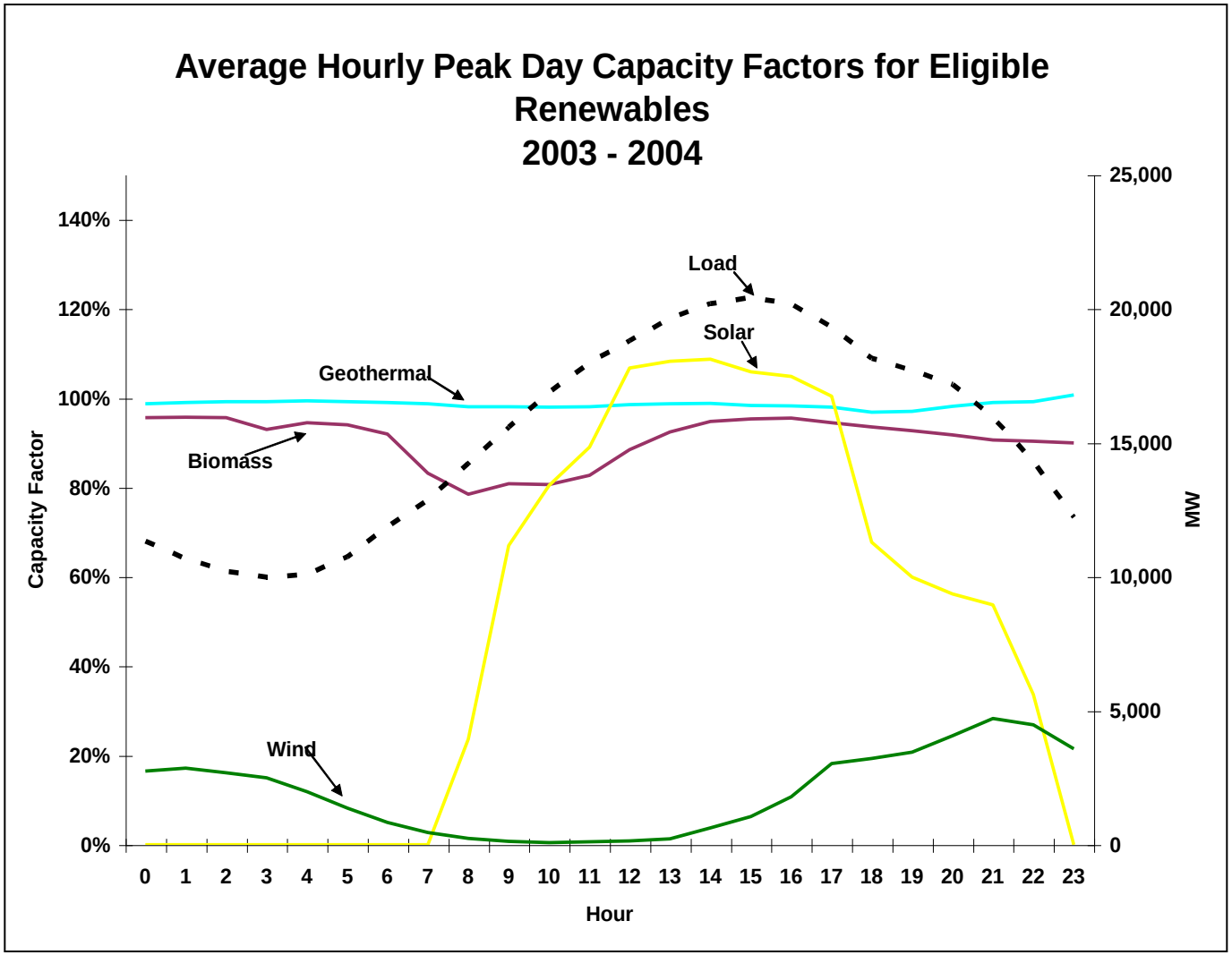
412 MW of CSI solar

Market Overview



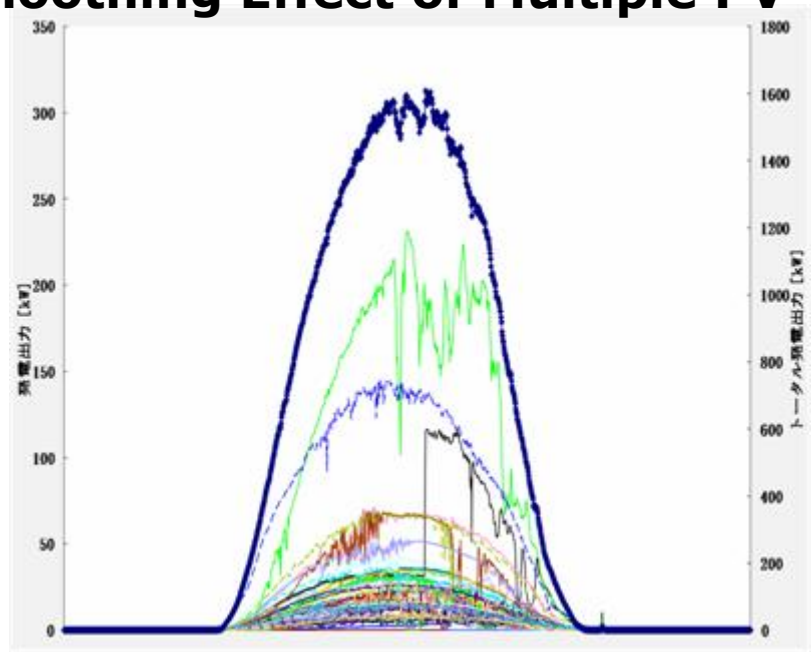
Module average selling prices have been cut in half since 2008 when the program began

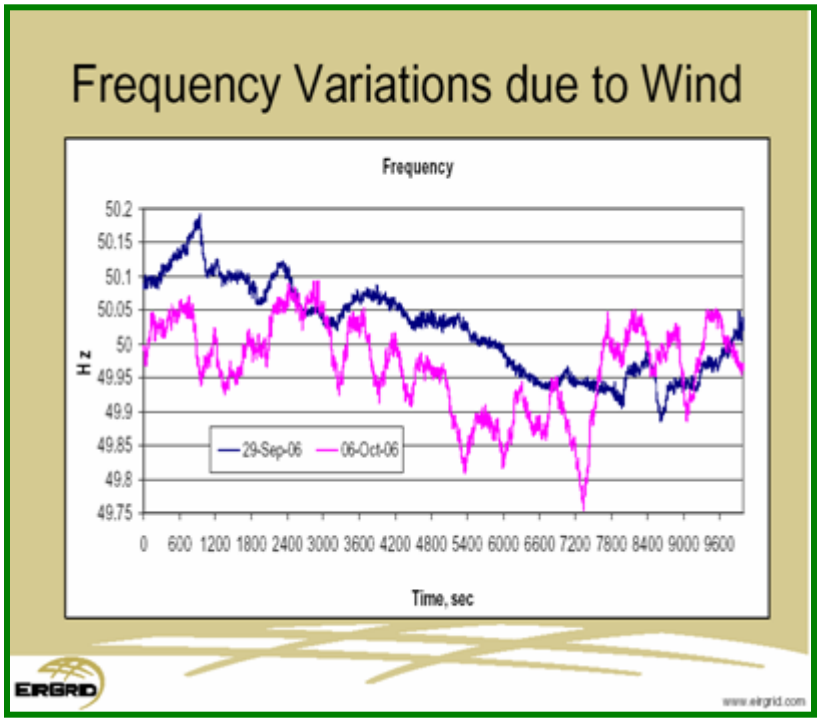
Renewable Delivery Compared to Load



Intermittency of Renewable Energy

Smoothing Effect of Multiple PV





SCE Solar Programs

Program Name	Owner	Summary
California Solar Initiative (CSI)	CSBU	Incentives for Customer owned PV to serve on-site load
Solar Photovoltaic Program (SPVP)	GBU	250 MW of Utility Owned Generation – 1 to 2 MW
Renewable Power Purchase Agreements	RAP	Purchase of Energy from Independent Power Produces

SCE Incentive Programs for Renewables

- California Solar Initiative (CSI)
  - $2.1 billion statewide program pays incentives to customers who install solar on their home and/or business. 3,000 MW installation goal.
- Multifamily Affordable Solar Housing
  - Financial incentives for ***existing*** income-eligible apartment complexes that off-set loads to common areas and individual tenants
- New Solar Homes Partnership (NSHP)
  - Financial incentives for construction of ***new*** energy-efficient homes
- CSI Thermal (Solar Water Heating)
- Self-Generation Incentive Program (SGIP)
  - Wind, Fuel Cell, Advanced Energy Storage
- SCE currently has 24,000 customers installed

Renewable Energy Procurement

Small RPS
< 20 MW
(~ 450 MW)

- California Renewable Energy Small Tariff (CREST)
- Solar Photovoltaic Program (SPVP)
- Renewable Auction Mechanism (RAM)

Renewable Portfolio Standard (RPS) Solicitations and Bilateral Negotiations
(~ 9,000 MW)

PURPA*
(Historically)
(~ 2,300 MW)

SCE has over 11,000 MW of renewable resources in its portfolio.

SCE has signed hundreds of RPS contracts totaling over 9,000 MW since 2002.

SCE prefers *competitive solicitations* for renewables procurement.

*PURPA - Public Utility Regulatory Policies Act

Solar Photovoltaic Program (SPVP) Overview

- Solar Photovoltaic Program (SPVP)
  - Existing SPVP Program (250 MW UOG + 250 MW PPAs) approved June 2009
    - 250 MW of Utility-Owned Generation
      - Primarily 1 to 2 MW projects installed on commercial warehouse rooftops, with up to 10% (25 MW) ground-mount
      - 50 MW per year with an average cost of $3.97/Watt ($ '11)*
    - 250 MW from IPP PV Solicitation
      - RAP coordinates annual solicitations for up to 50 MW per year for 5 years
      - Price capped at the utility LOCE, 26 cents per kWH
      - Other terms similar to UOG constraints

*** Reasonableness cap approved in 2008 is $3.85/w dc installed. $3.97/w is escalated to 2011 dollars.**

SPVP Objectives

- Market Transformation
  - Program large enough to impact costs/resources
  - Shift Focus away from Europe/Japan
  - Develops trained PV Installation workforce
- Adds 1.0% to RPS Goals by 2014
- Supports CSI Goals: 83,333 equivalent roofs
- Leverage SCE's Solar Expertise –
  - History with solar
  - Utility implementation coupled with energy efficiency deployment
- Advance R&D and PV Industry Knowledge
  - Grid impacts – intermittency, power quality, circuit saturation
  - Business Modeling
- Deployment of PV on circuits in a distributed manner
  - Does not require any transmission upgrades
- Can provide generation in critical AQMD emissions sensitive areas, such as the Inland Empire, with No Green House Gas Emissions

Complete UOG SPVP Projects

SPVP 005 - PLD Redlands 1

3.39 MWdc - 10,680

Sunpower Modules

468,000 Square ft.

5 Satcon Inverters

SPVP 007 - PLD Redlands 3

3.20 MWdc - 10,840

SunPower Modules

446,000 Square ft.

5 Satcon Inverters

SPVP 042 – Porterville

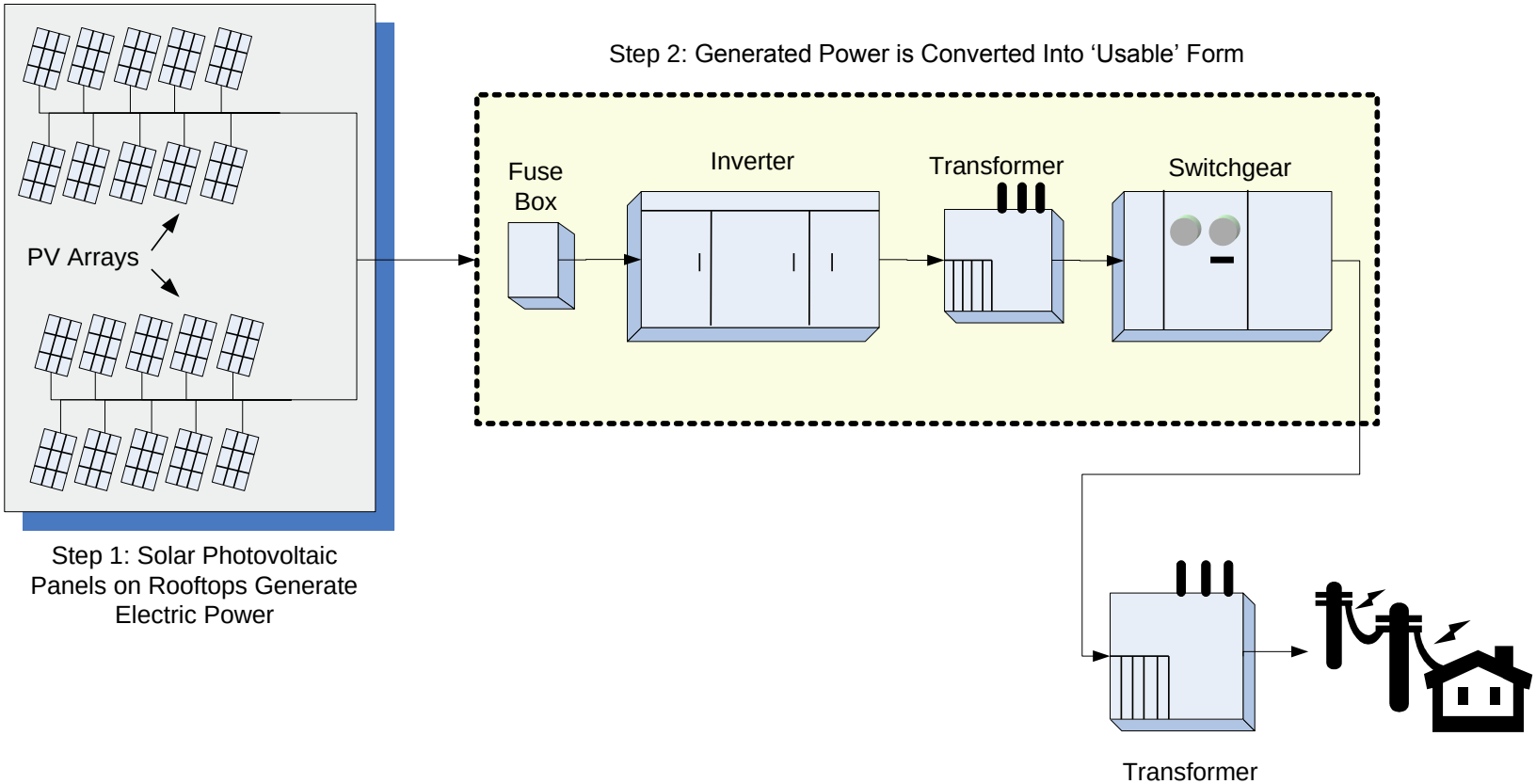
6.77 MWdc - 29,428

Trina Modules

33 acres

10 Satcon Inverters

PV System Overview



Step 1: Solar Photovoltaic Panels on Rooftops Generate Electric Power

Step 3: Solar Generation Site is Connected to SCE Electric Grid

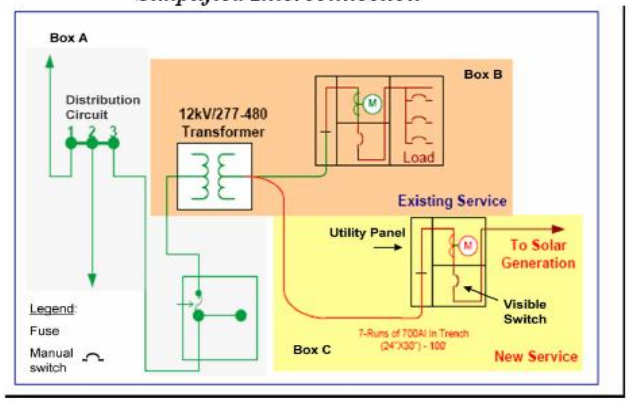
Project Challenges - General

- **Leasing Issues -**
  - Liability Issues
  - Lease Rates considered low
  - Rooftop Mounting Constraints (wind, weight, etc.)
- **Permitting**
  - Roof - Building Permit, Fire Dept, EH&S
  - Ground – Site Assessments
- **Site Security**
- **WDAT Interconnection**
- **ISO Forecasting and Scheduling**
- **CPUC Oversight & Reporting Requirements**

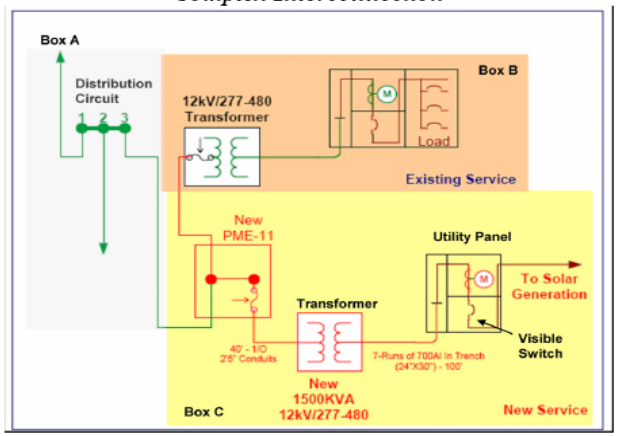
Interconnection

- Not Net Energy Metering (NEM)
- Will interconnect directly to 12 or 16 kV circuits, not to host load
- "Merchant Plant" interconnected under WDAT application
- Originally 15% circuit penetration – 2MW limit. Now up to 8 MW on a circuit

Proposed System Single Line
Simplified Interconnection



Proposed System Single Line
Complex Interconnection



ISO Scheduling Issues

- ISO requires:
  - Special metering and Data Acquisition System (DAS)
  - Power to be scheduled on an hourly basis, can be aggregated up to the A-Bank
  - SCE will fine-tune forecasting of intermittent resource

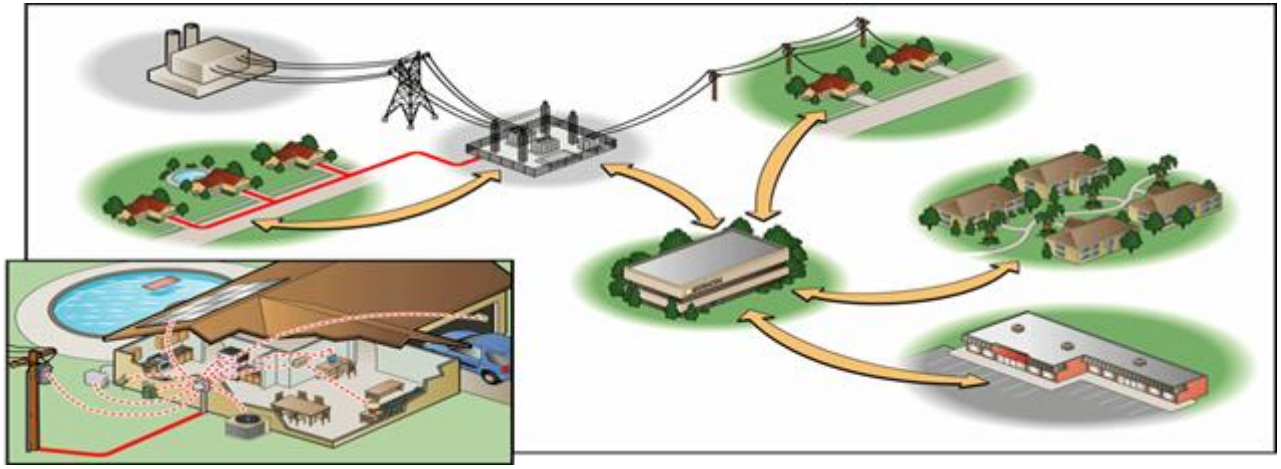
- The DAS components are forecast to cost approximately $60,000 per location:
  - Meter $10,000
  - Communications $15,000
  - Data collection $20,000
  - Weather station $10,000
  - Auxiliaries $5,000

Issues affecting Cell Performance

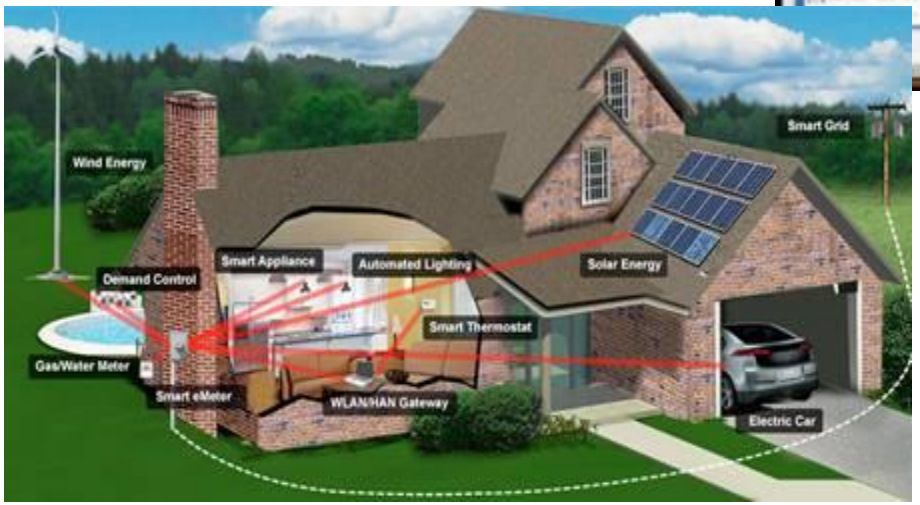
- Efficiency
  - 1,000 W/sq. m flash test at 25C (77F) and 1.5m/s air flow
  - 20% for Sunpower T-5 High Efficiency (175,000 sq/ft per MW)
  - 14.5% for Trina PolyCrystalline Panels (225,000 sq/ft per MW)
  - 10.5% for First Solar CdTe Thin Film (300,000 sq/ft per MW)
- Tilt
  - Corresponding to Latitude (34degrees) is optimal
  - Any tilt can help with water/dirt run-off
- Dirt
  - Can reduce output by 34%
- Shading
  - 50% of the panel output is lost if ONE cell is shaded.
- Temperature Effect
  - ½% degradation per degree C for Silicon (120F=78.5%, 32F=122.5%)
  - ¼% degradation per degree C for CdTe (120F=89.5%, 32F=111.2%)
- Effects of Diffused Light
  - Different Panels absorb different wave lengths. Silicon better in white/yellow, CdTe on red/diffused light

Upcoming Changes in the Electric Industry

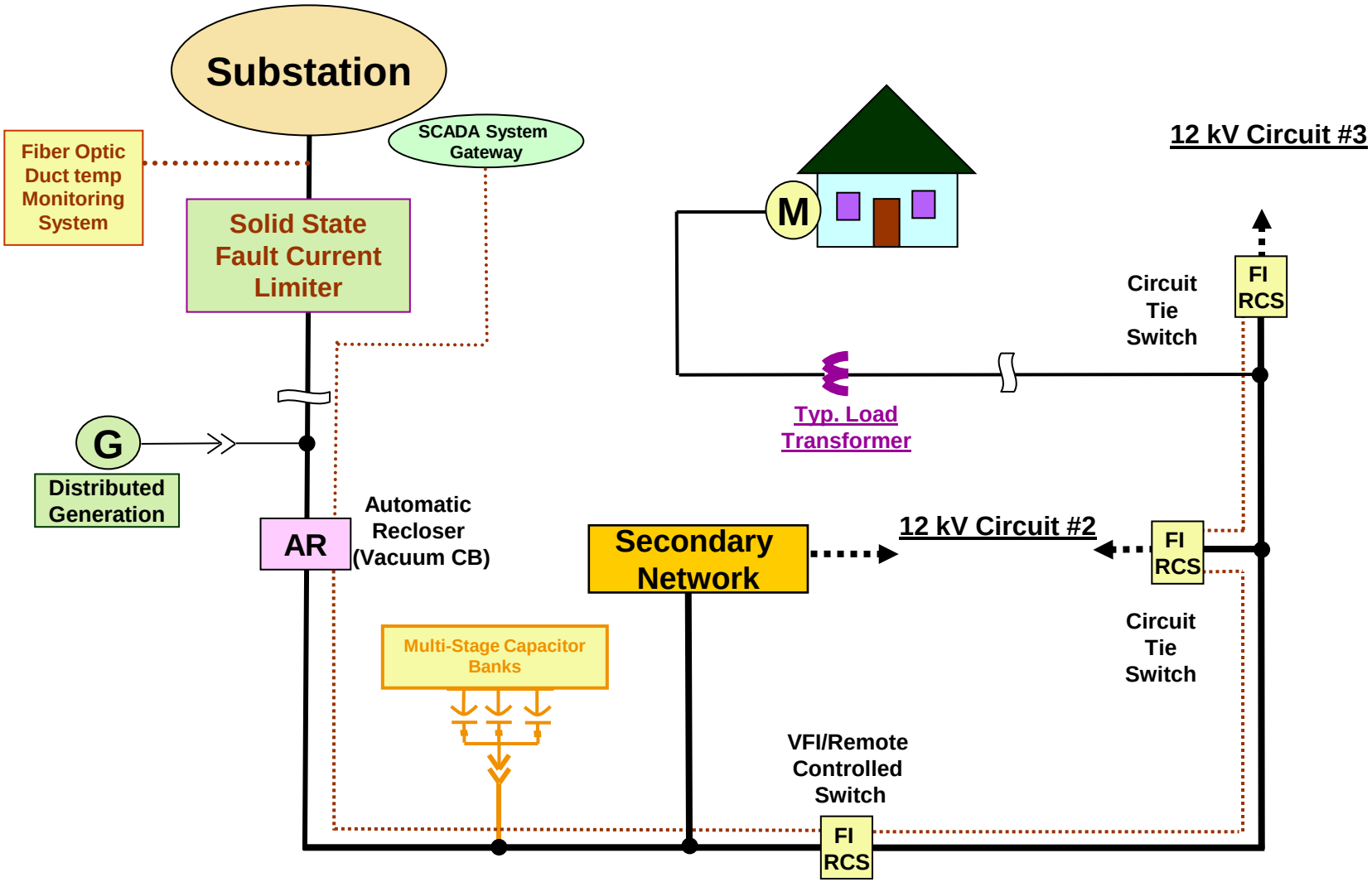
- Smart Meters
- Smart Grid
- Plug-in Hybrids / Storage



What Smart Meters Can Do For You

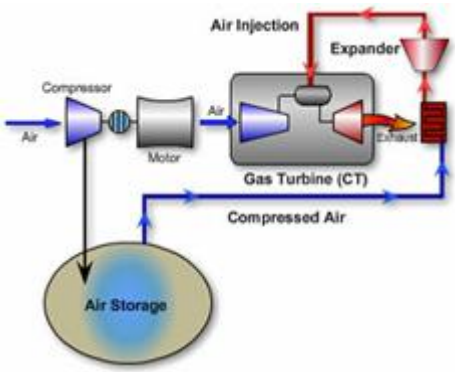


SCE Circuit of the Future

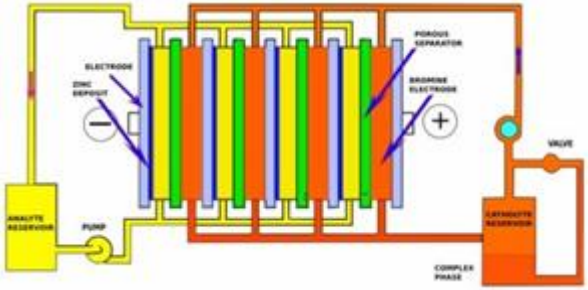


Plug-in Hybrids / Energy Storage Options

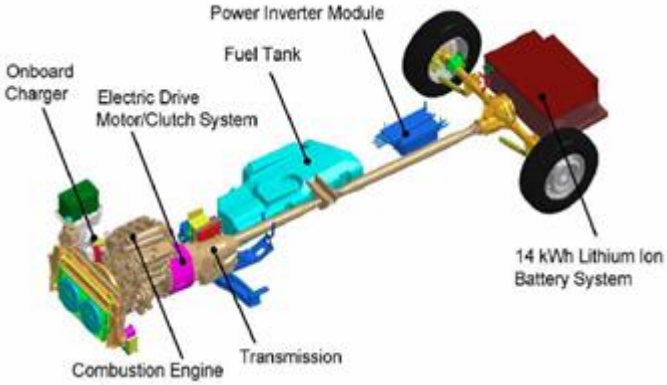
- Bulk System Storage
  - Compressed Air Energy Storage (CAES)
  - Pumped Hydro
  - Flywheel Frequency Regulation



- Mid-sized Storage
  - NAS and Flow Batteries
  - Supercapacitors



- Customer Level Storage
  - Plug-in Hybrids
  - PV system storage
  - Power Quality Storage



Questions