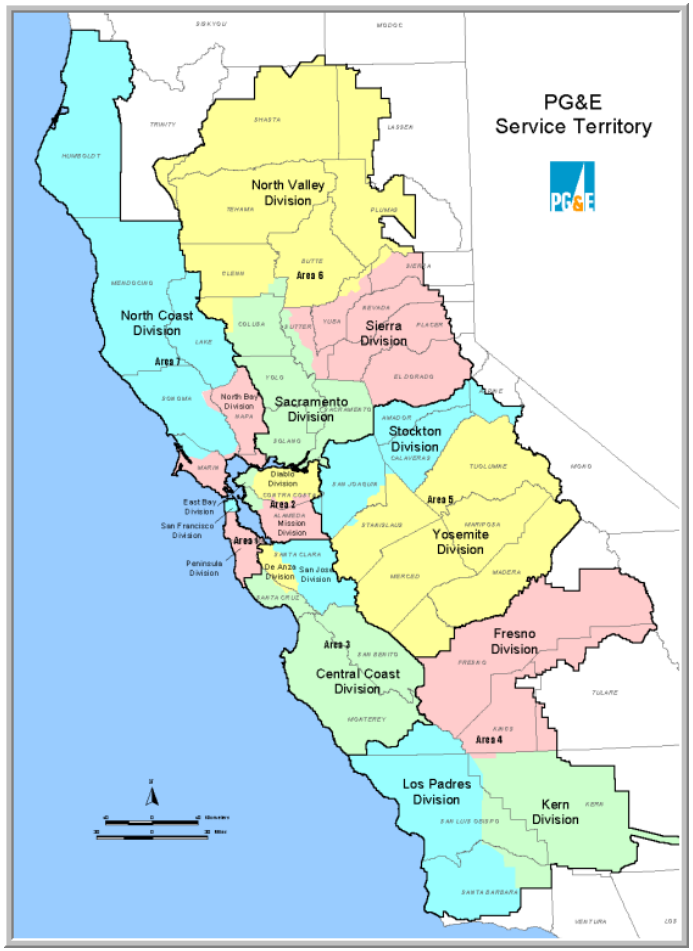
Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: Utility view of NAN drivers and requirements
Date Submitted: 15 July, 2008
Source: Chris Knudsen, Pacific Gas & Electric
Address 77 Beale, San Francisco, Calif.
Voice:415-973-4418, FAX: 415-973-0802, E-Mail:CxKq@pge.com
Re: IEEE 802 Plenary WNAN Tutorial

Abstract:

Purpose: To brief IEEE 802 Membership on the Utilities requirements and need of WNAN technologies, applications, and standards

About Pacific Gas and Electric Company



- Energy Services to about 15 M People:
  - 5.0 M Electric Customer Accounts
  - 4.1 M Natural Gas Customer Accts
- 70,000 square miles with diverse topography
- ~20,000 Employees
- Regulated by the California Public Utilities Commission (CPUC)

The US Macro Energy problem

Figure 50: WECC-U.S. Capacity Margins — Summary

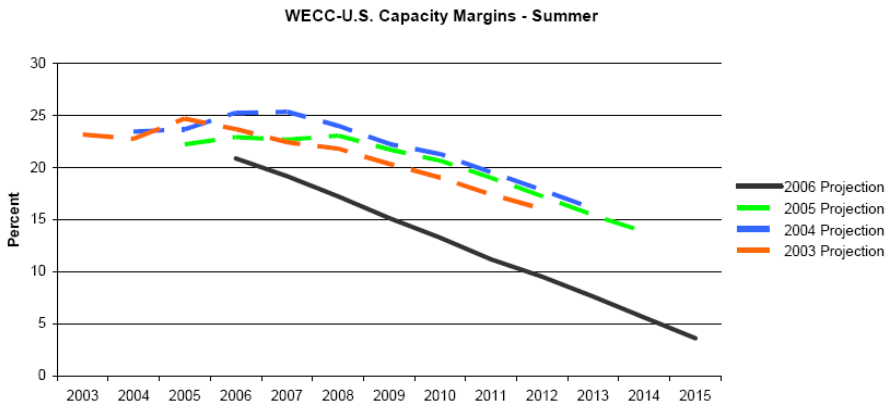
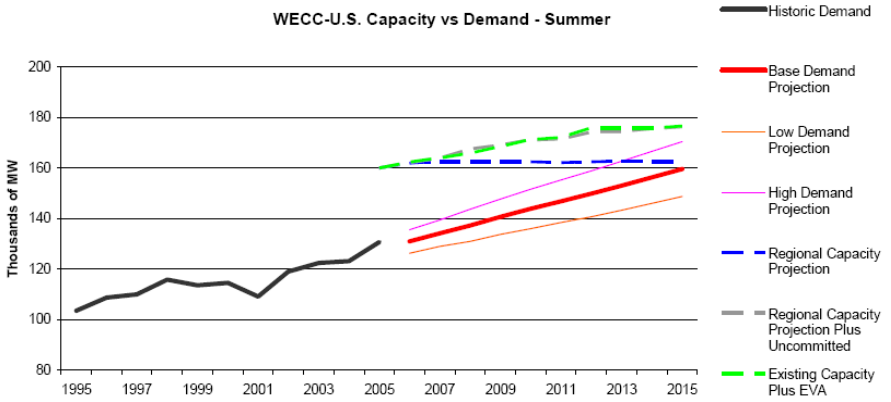
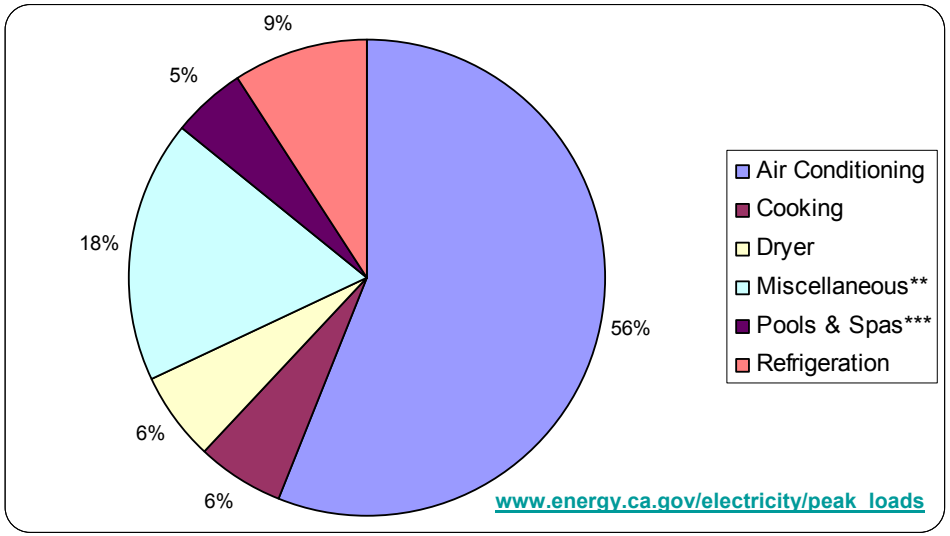


Figure 51: WECC-U.S. Capacity Versus Demand — Summary



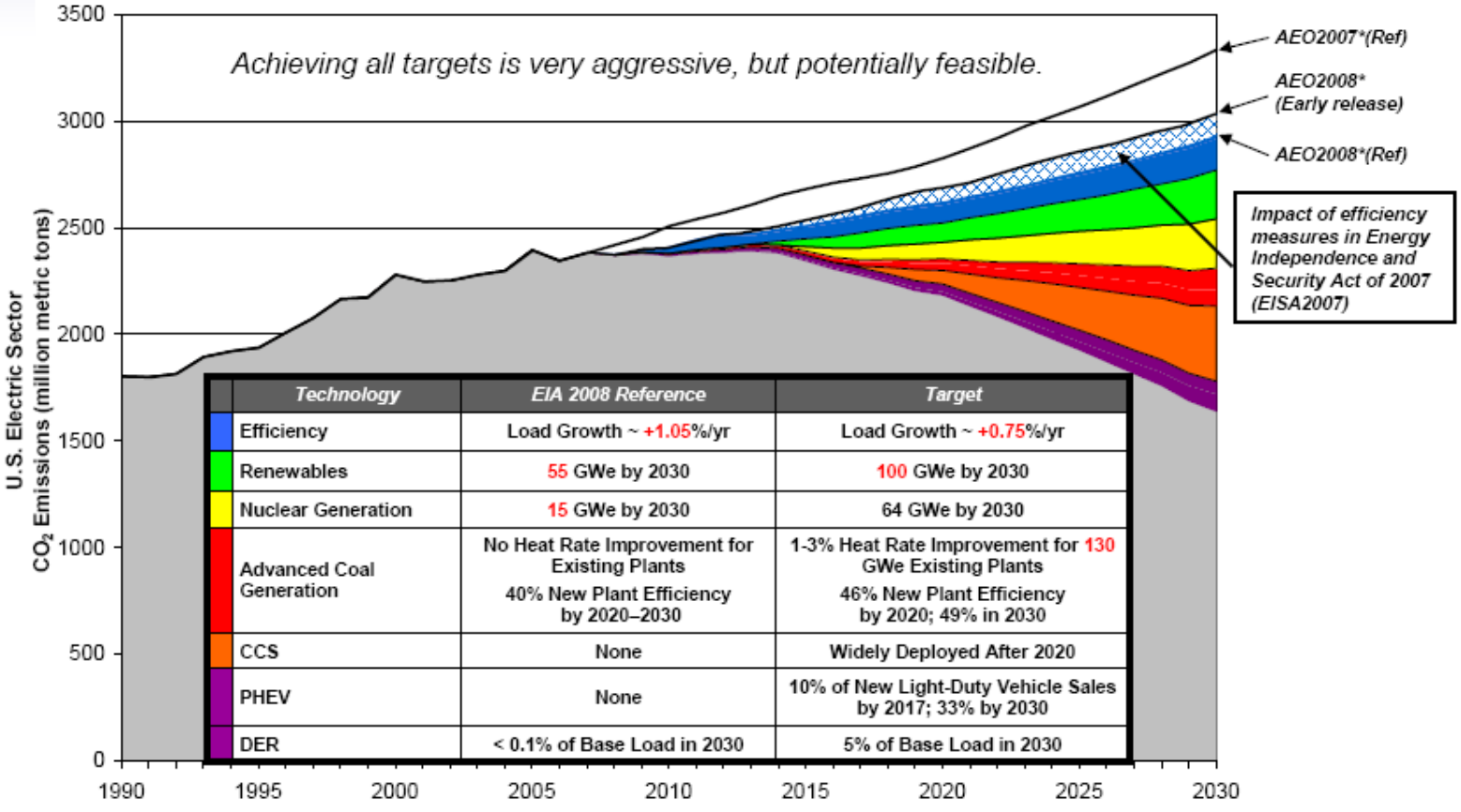
Source: NERC 2006 Long-Term Reliability Assessment

- The US is on a trajectory of declining bulk energy margin
- There is no good supply side solution
- The solution is a dynamic distributed demand side energy efficiency and load control system
- Reasonable reductions can dramatically improve our peak energy position
- A combined smart meter and HAN strategy enable us to implement such a system…



California Residential Peak Load

2008 Prism...Technical Potential for CO_2 Reductions



Technology	EIA 2008 Reference	Target
Efficiency	Load Growth ~ +1.05%/yr	Load Growth ~ +0.75%/yr
Renewables	55 GWe by 2030	100 GWe by 2030
Nuclear Generation	15 GWe by 2030	64 GWe by 2030
Advanced Coal Generation	No Heat Rate Improvement for Existing Plants 40% New Plant Efficiency by 2020–2030	1-3% Heat Rate Improvement for 130 GWe Existing Plants 46% New Plant Efficiency by 2020; 49% in 2030
CCS	None	Widely Deployed After 2020
PHEV	None	10% of New Light-Duty Vehicle Sales by 2017; 33% by 2030
DER	< 0.1% of Base Load in 2030	5% of Base Load in 2030

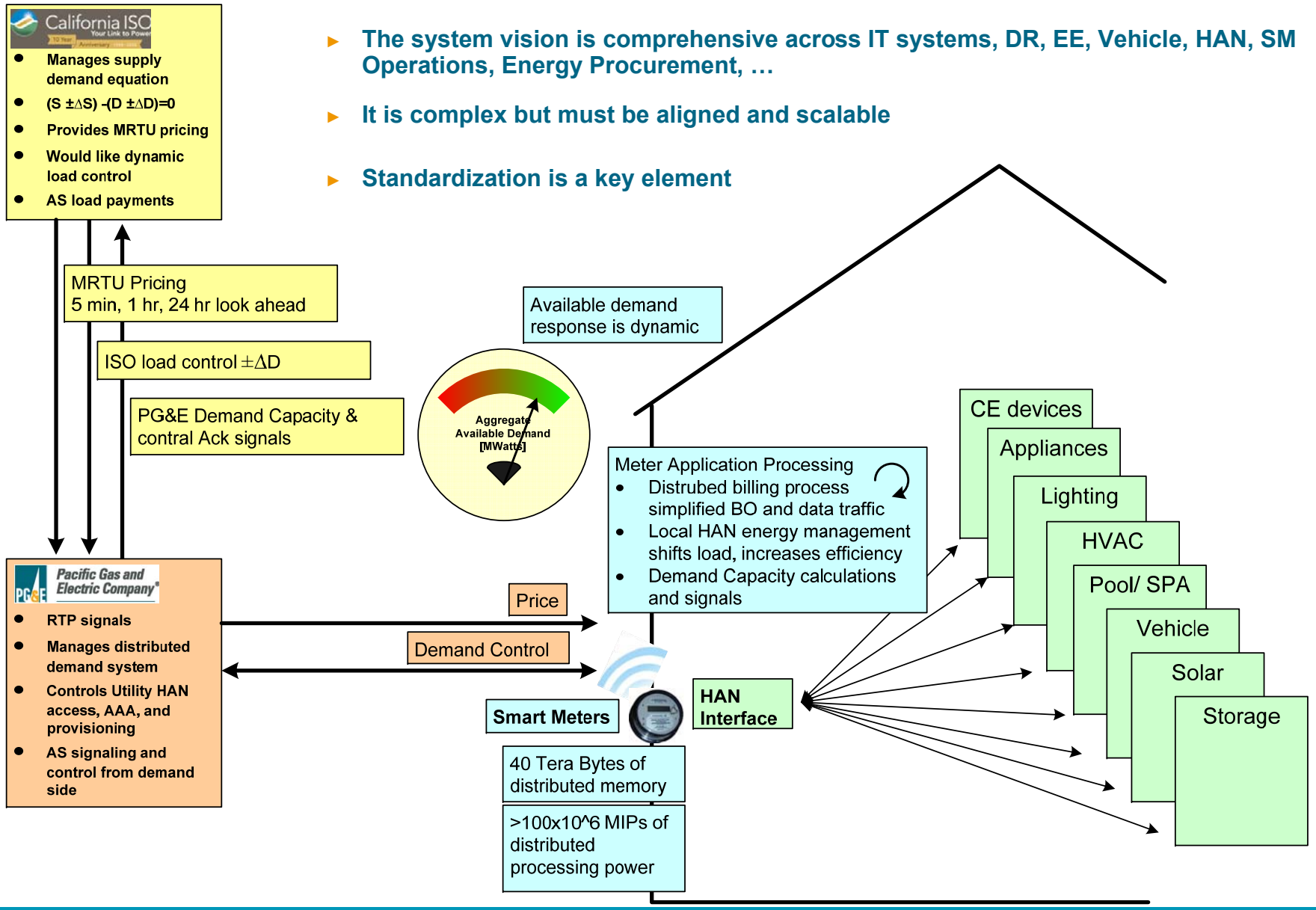
*Energy Information Administration (EIA) Annual Energy Outlook (AEO)

53

EPRI ELECTRIC POWER RESEARCH INSTITUTE

The Demand Side Dynamic System Solution

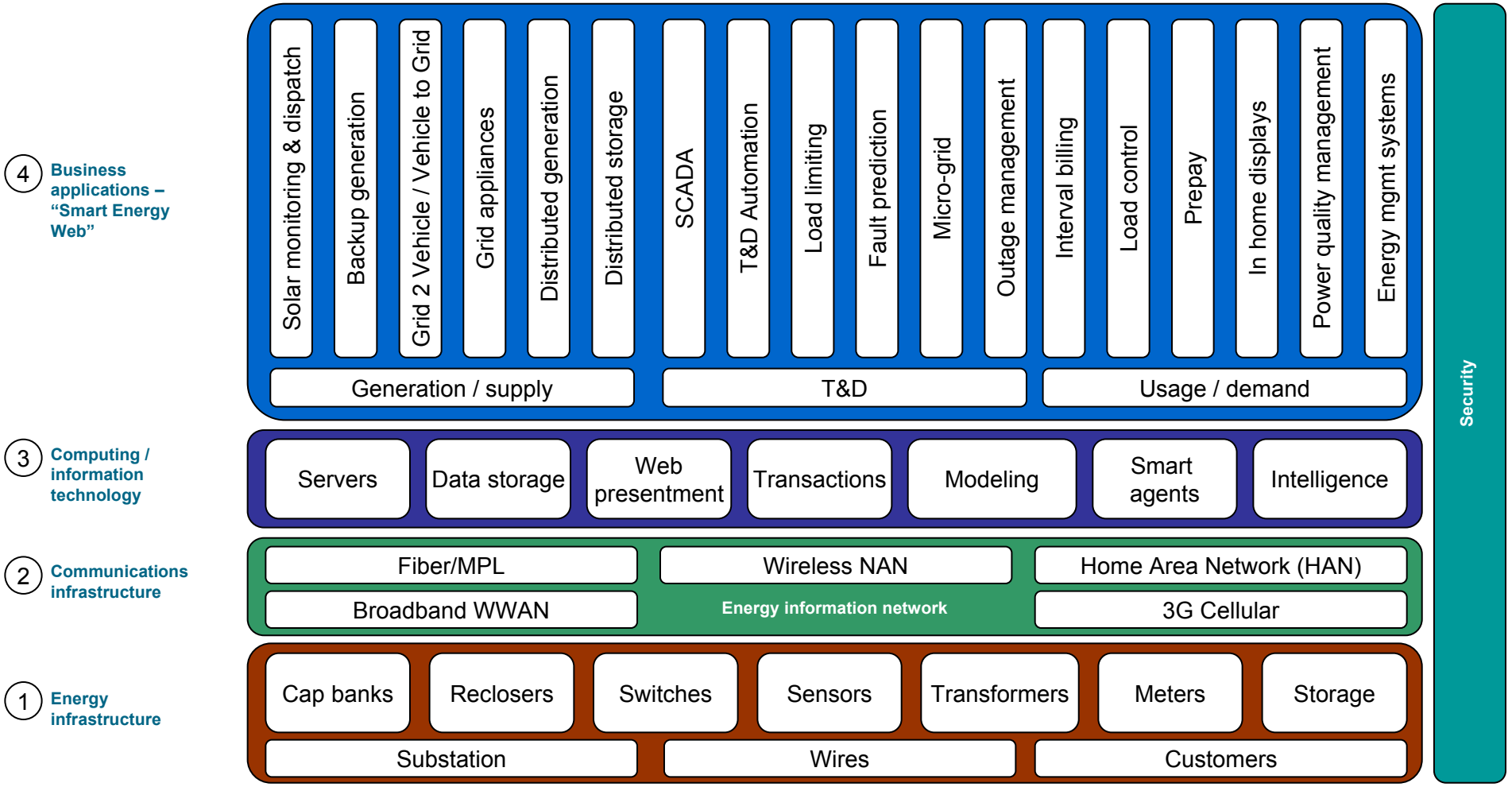
- **The system vision is comprehensive across IT systems, DR, EE, Vehicle, HAN, SM Operations, Energy Procurement, …**
- **It is complex but must be aligned and scalable**
- **Standardization is a key element**



SmartMeter Program Highlights

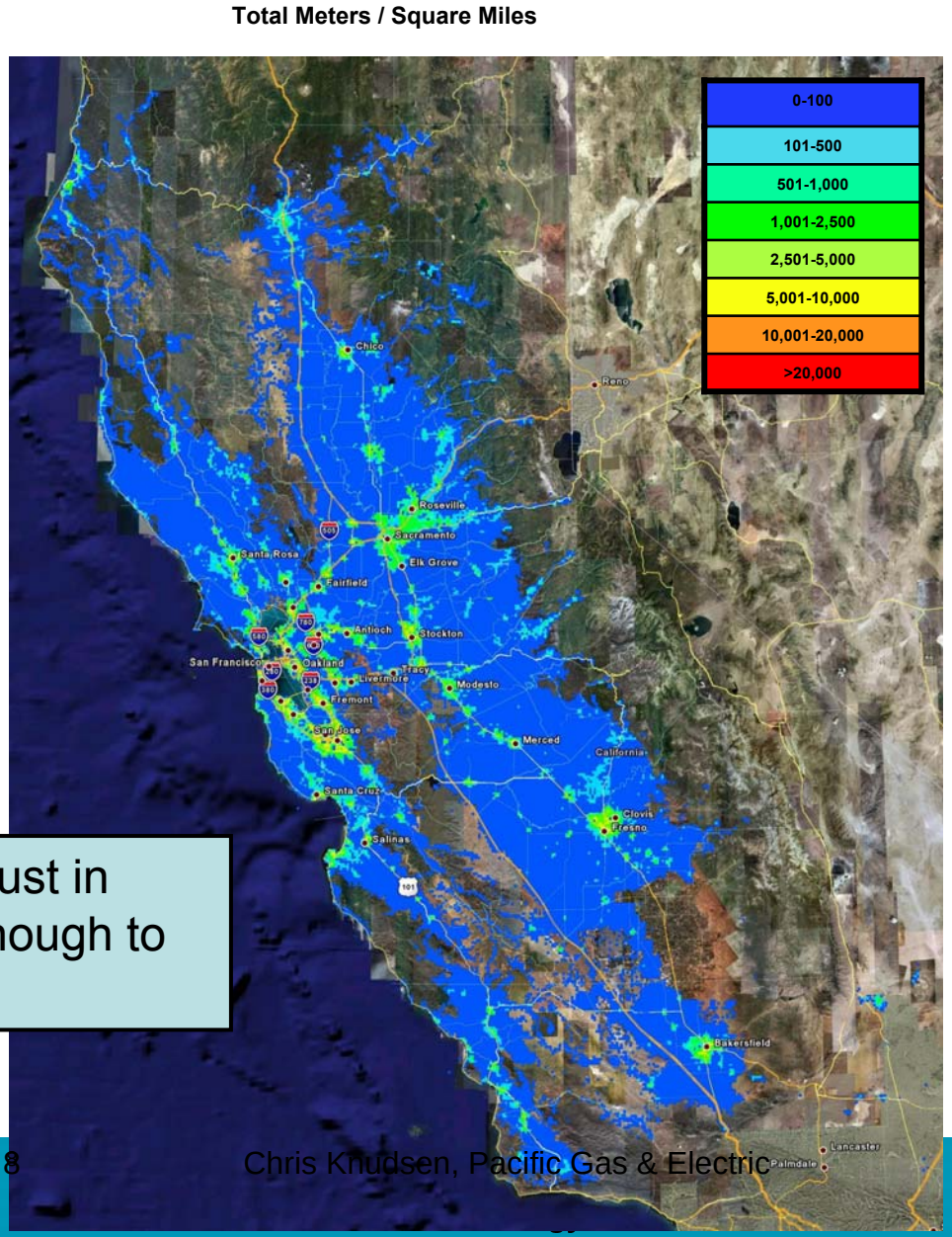
- Largest planned implementation of AMI technology in the U.S. to date – 10.3 million meters
  - $1.7 B in funding (CPUC, July 2006)
  - 5 year deployment: 2006 – 2011
- SmartMeter programs are a global focus for most if not all major utilities
- The program will pay for itself over its 20 year useful life through operational savings, demand response, and energy efficiency
  - First critical peak pricing program for residential customers in the nation
- The **SmartMeter** technology mix will evolve to take advantage of rapidly evolving technologies
  - We are moving toward our vision of the Smart Electric Grid
- Technologies deployed through the **SmartMeter** program establish a platform for future innovations that will benefit our customers, our operations, and the State of California

SmartGrid components



Coverage Requirements

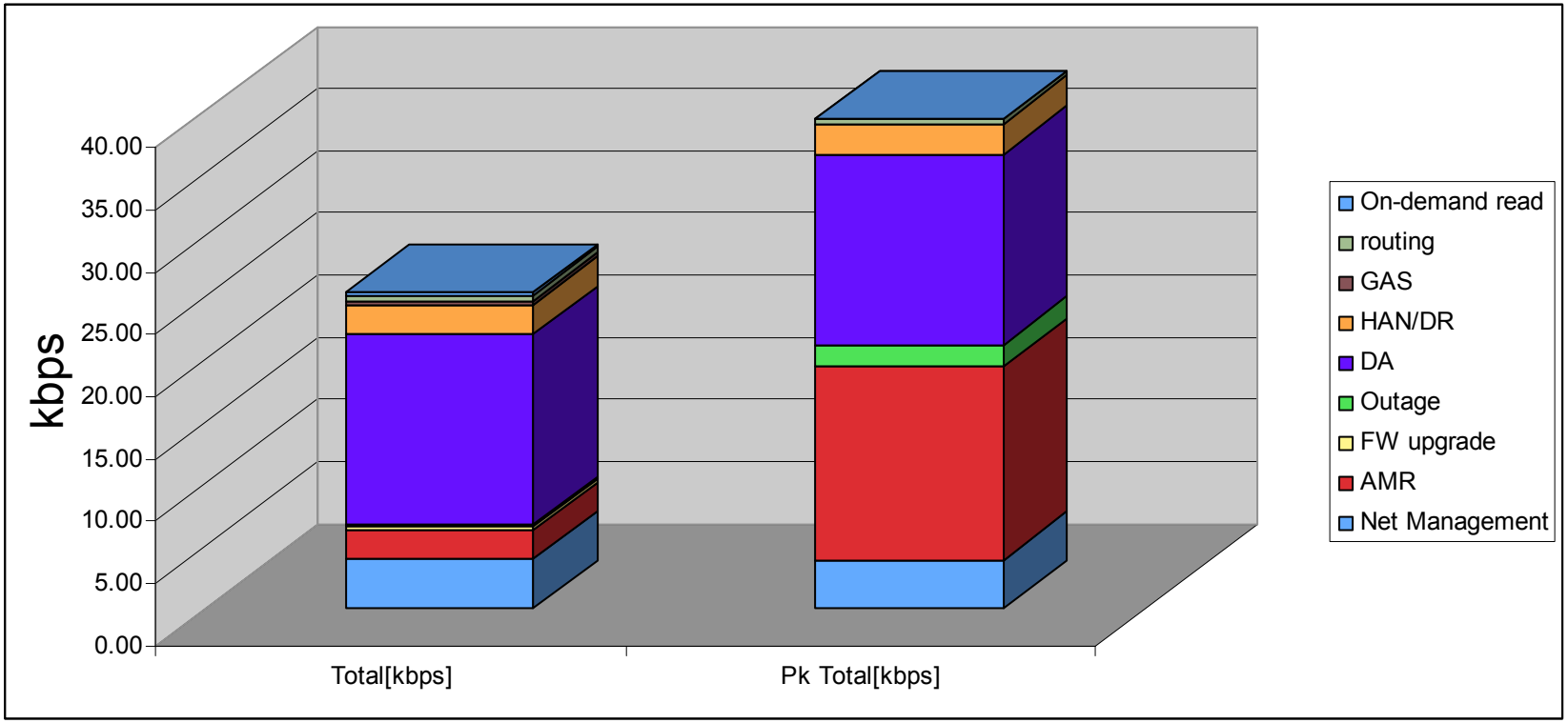
- 90% of our meters are deployed within only 15% of our territory but…
- Coverage probability must be 100%, so…
- The less than 10% of our meters that are spread across 85% will drive our technology choice



The technology choice must be robust in the dense areas and still be flexible enough to cover the rural areas

Capacity Requirements

- Capacity requirements are in 10's of kbps
- Traffic is raw data, no or very little formatting overhead
- Distributed processing in meters can further reduce the traffic needs of the NAN



Licensed Vs Unlicensed Comparison Matrix against Utility requirements

	Un-Licensed	Licensed
Coverage	▸ Robust w/ Mesh, 100% coverage probability ▸ Fill incremental cost is low	▸ Typically 80%-90%% coverage probability, requires expensive incremental infrastructure to achieve 100%
Spectral Efficiency/ Capacity	▸ significantly lower than licensed due to part 15 rules (10x lower or more)	▸ Typically > .5 bps/cell under load for current technology
Interference	▸ Narrow band, FSK limited receive(2dB FM capture window), low power, 1 watt max EIRP ▸ FCC part 15 rules apply, all in band must play by the same rules ▸ Self interference is the dominant mode for FHSS WWAN systems	▸ Only self interference
Spectrum Cost	▸ Free	▸ at $1 -$7 /MHz/POP the cost. ▸ Cost can range from $10s of M to B depending on spectrum
Spectrum Availability	▸ National coverage for WWAN, Global for HAN	▸ Limited or must use existing carrier ▸ Technology choice most likely proprietary or subject to shorter mobile operator product cycles
Re-Use/ Amount of Spectrum required	▸ Reuse =1	▸ Reuse =3+
Standards	▸ IP and HAN, WWAN PHY, DL, MAC, proprietary, usually low or no royalties	▸ Usually stds based but could be proprietary or strong IP royalties to a few big vendors
FCC	▸ Part 15	▸ Per spectrum

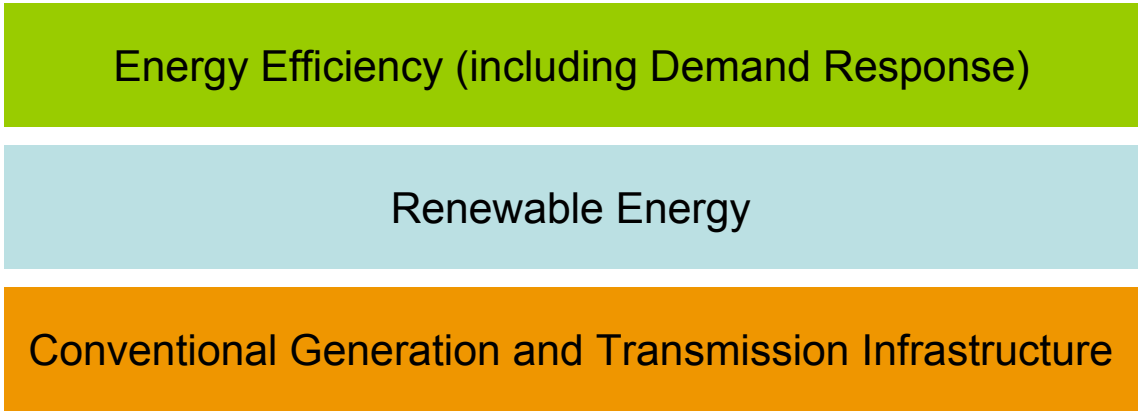
OpenHAN and ZigBee Utility Members

Utility Name	Geographic Area	Electricity Accounts (in Millions)	OpenHAN Member	ZigBee Member
AEP (American Electric Power)	11 states - TX, OH, TN, OK, AR	5.1	Active	
Alinta	Victoria, AUSTRALIA	0.3		Member
Alliant	IA, IL, MN, WI	1.4	Monitoring	
Baltimore Gas & Electric	MD	1.2	Active	Member
BC Hydro	British Columbia, CANADA	1.7	Active	
Center Point Energy	Houston, TX	2.0	Active	Member
Consolidated Edison	New York, NY	3.1	Monitoring	
Consumers Energy	Michigan penninsula	1.8	Active	Member
DTE (Detroit Edison)	Detroit, MI	3.0	Active	Member
Duke Energy	NC, SC, IN, KY, OH	3.9	Active	
EDF	FRANCE	30.0	Monitoring	Member
Entergy	LA, MS, AR, TX	2.7	Active	
FPL	Florida	4.3	Active	
Keyspan Energy	Long Island, NY	1.1	Monitoring	
Northeast Utilities	New England	1.7	Monitoring	
Oncor	TX	3.0	Monitoring	Member
PG&E	Northern CA	5.0	Active	Member
PGE	Portland, OR	0.8	Monitoring	
PowerCor	Victoria, AUSTRALIA	0.7		Member
Reliant	TX, Mid-Atlantic	1.8	Active	Member
SCE	Southern CA	4.8	Active	Member
Sempra Utilities	San Diego, CA	1.4	Active	Member
SMUD	Sacramento, CA	0.6	Monitoring	
Southern Company	Southeast	4.3	Monitoring	
TXU Electric Delivery	TX	2.1	Active	Member
Victorian Dept of Primary Industries	Victoria, AUSTRALIA	2.7		Member
Xcel	8 states - electric and gas	3.0	Monitoring	
OpenHAN Member customer accounts (in millions):		90.1		
ZigBee Alliance Member customer accounts (in millions):		58.8		

Demand Response: A Priority Resource

CA Demand Growth:
2% per year (CEC)

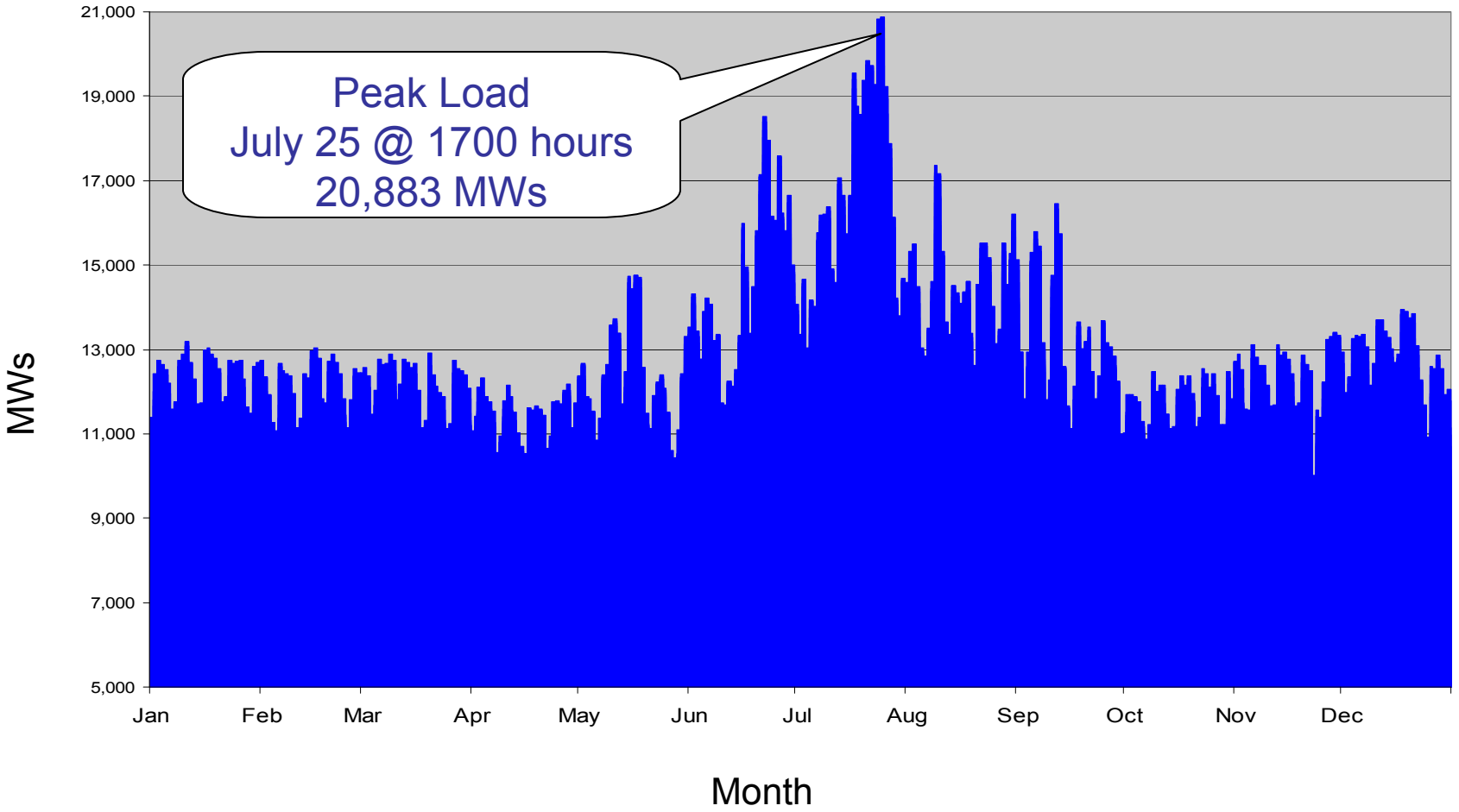
Demand Response:
A reduction in energy demand resulting from the customer's response to energy prices that vary by time of day, or other incentives

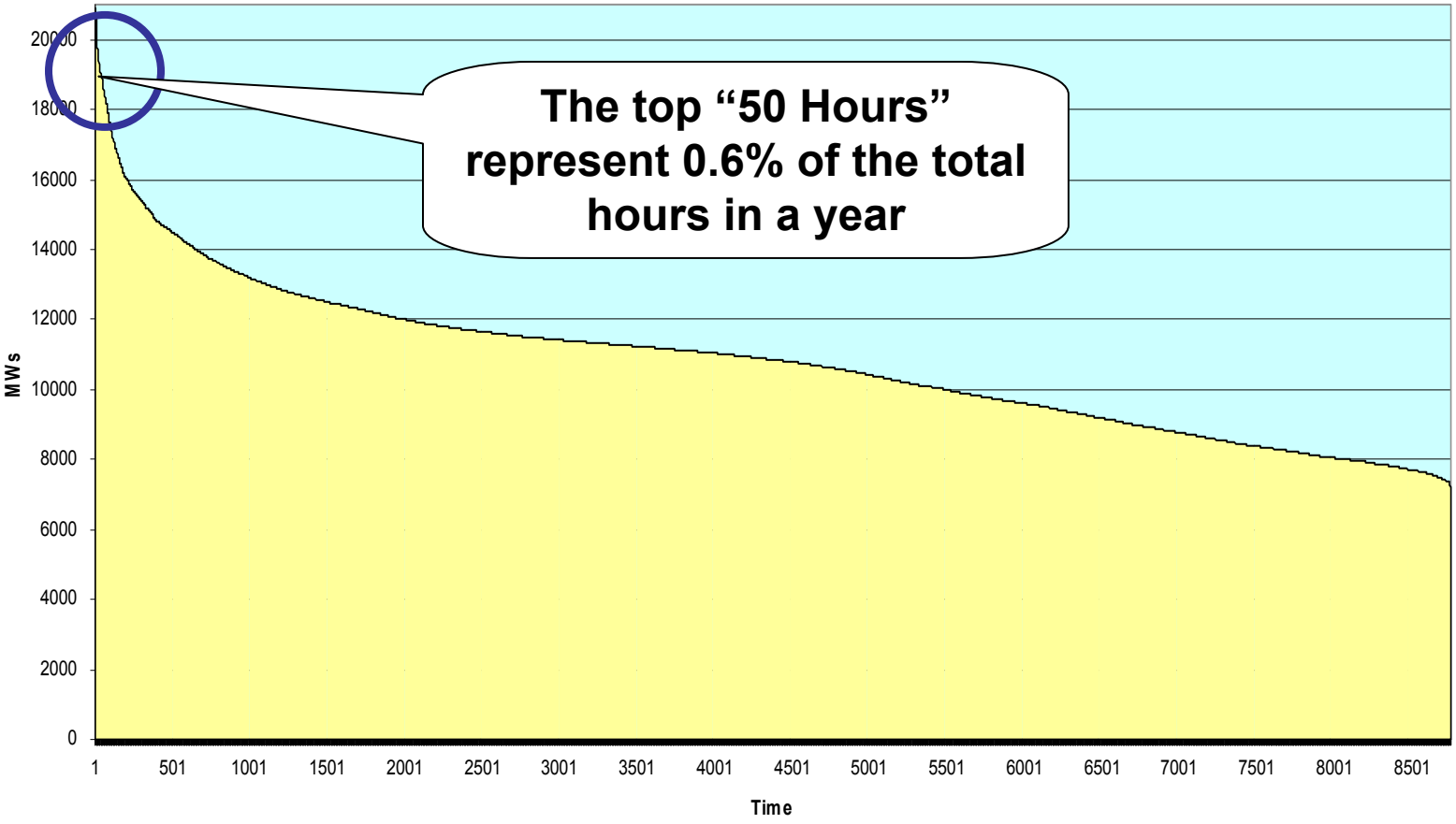


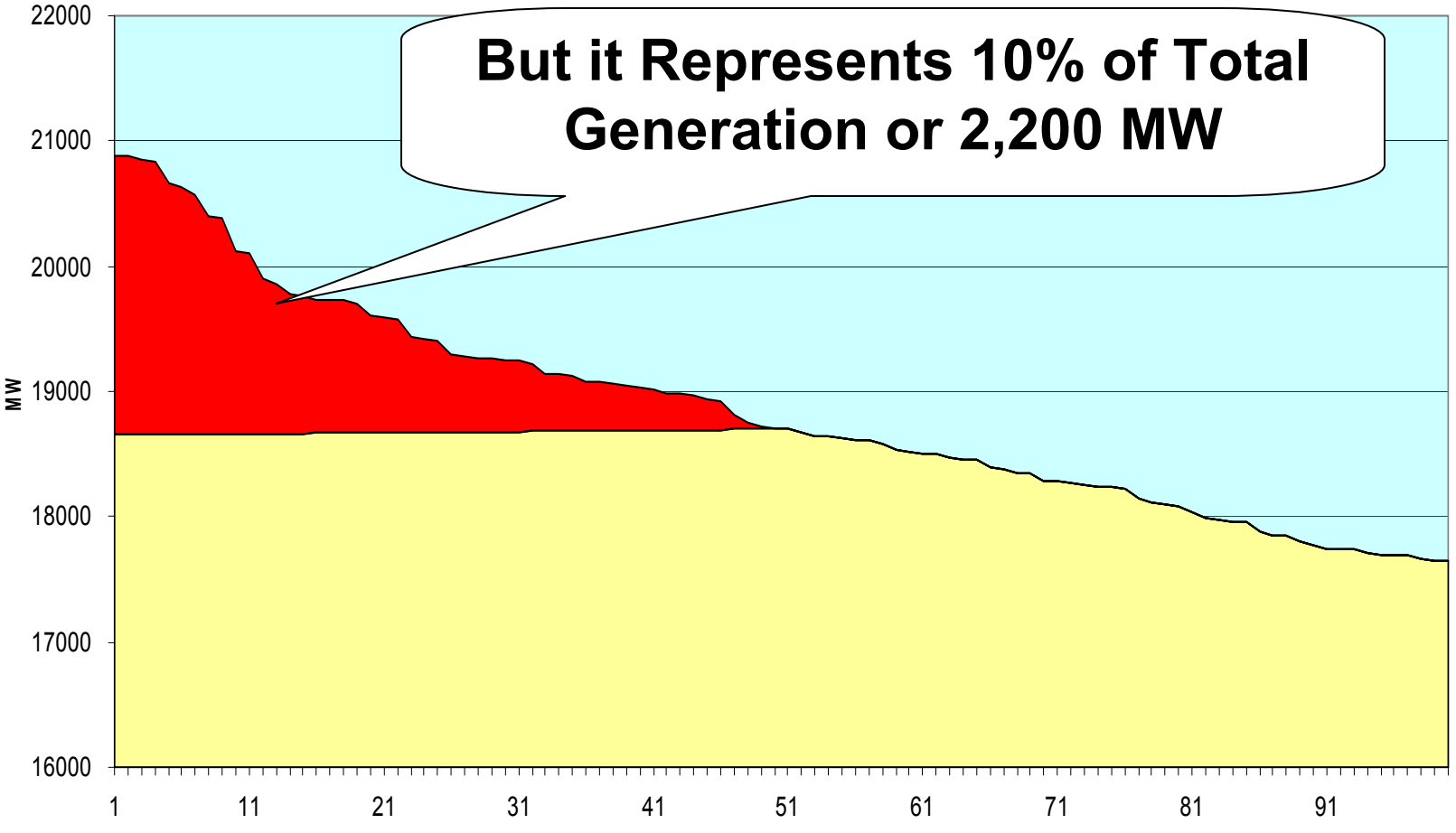
"The most important aspect of the Energy Action Plan was the concept of a 'loading order' for energy resource procurement. In that loading order, we defined energy efficiency as our first priority. Implicit in that priority was also demand response or price-responsive demand."

- CPUC Commissioner Peevey

PG&E 2006 Annual Usage




The top "50 Hours" represent 0.6% of the total hours in a year
MWs
Time
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
1
501
1001
1501
2001
2501
3001
3501
4001
4501
5001
5501
6001
6501
7001
7501
8001
8501


But it Represents 10% of Total Generation or 2,200 MW
22000
21000
20000
19000
18000
17000
16000
MW
1
11
21
31
41
51
61
71
81
91
Time

SmartMeter Upgrade Provides Enabling Communications Layer