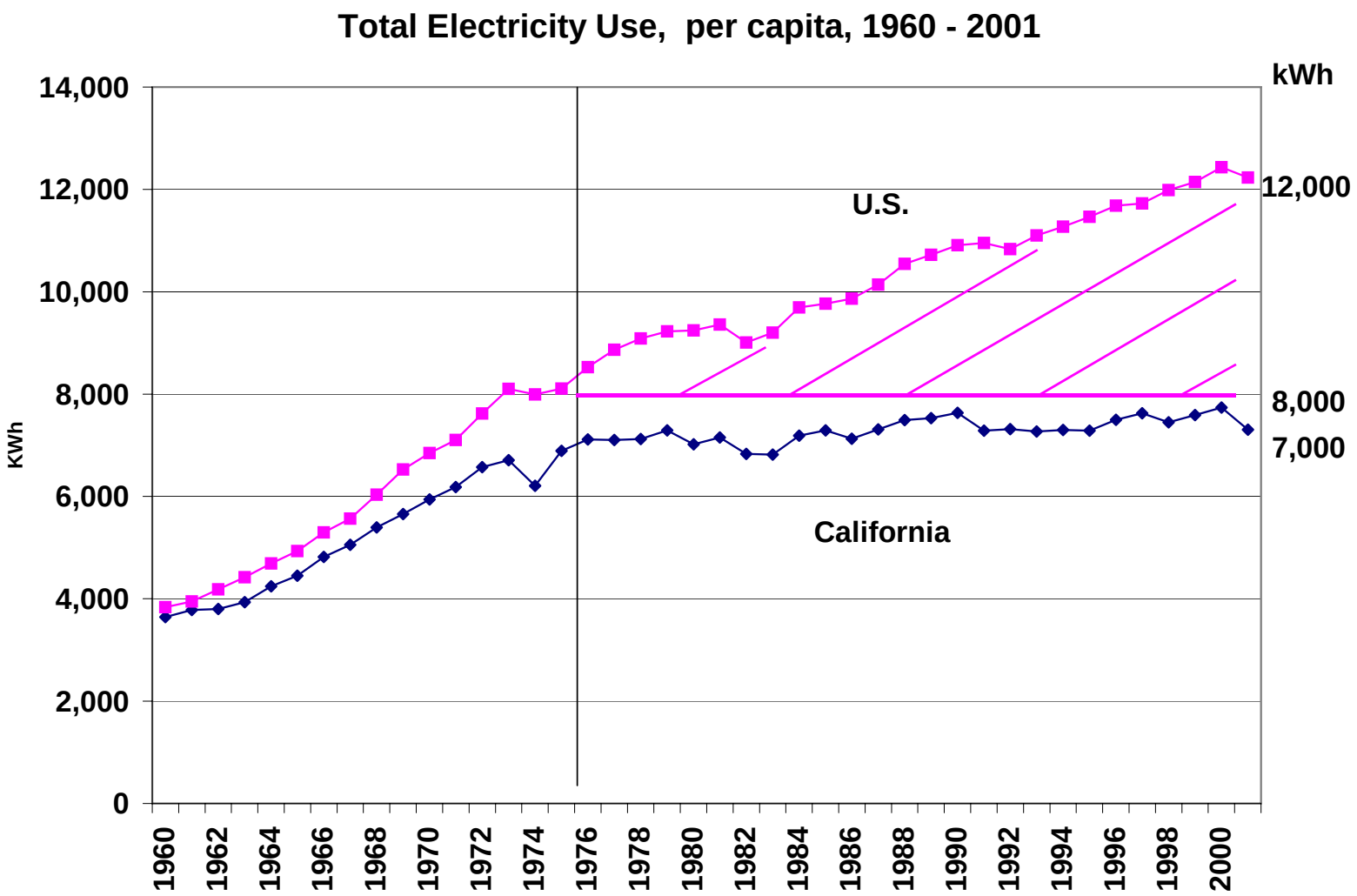
California's 2005 Standards (how they came about and how they raise the bar)

Architectural Energy Corporation

Peter C. Jacobs, PE,
Architectural Energy Corporation

Per Capita Energy Use in California



A Short History

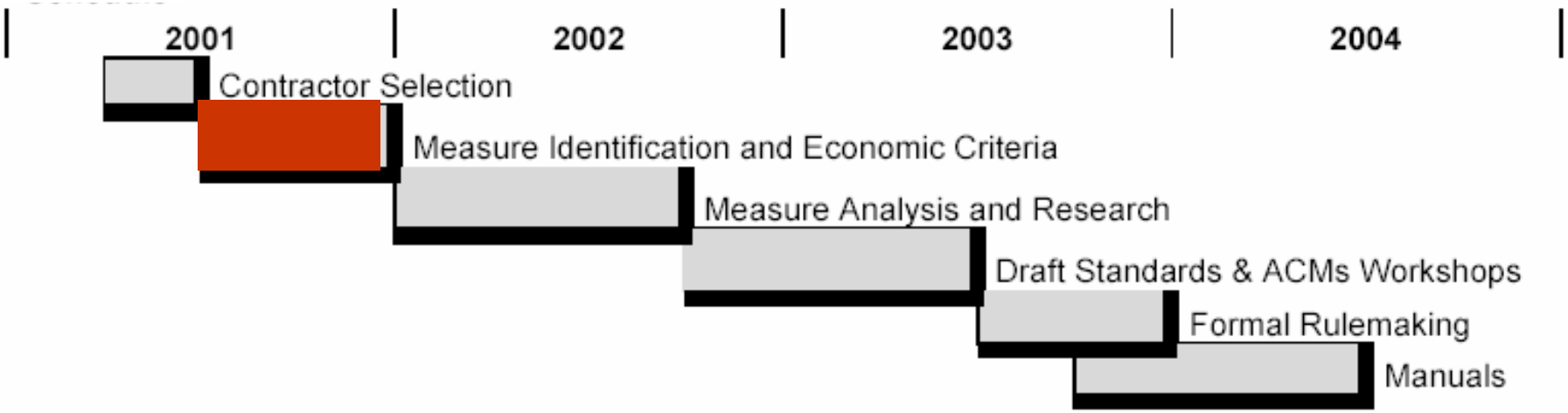
- ***1977 Energy Commission created***
- ***1978 First standards adopted***
- ***1980's Jerry Brown Commission pushes solar.***
- ***1984 AB 163 standards take effect***
- ***1985-1988 Standards adopted for separate occupancies***
- ***1988 Custom budget approach adopted for residential***
- ***1992 Nonresidential reorganized and updated***
- ***1995 Minor Changes***
- ***1998 Lighting power limits lowered to be consistent with electronic ballasts and T-8 lamps***
- ***2001 AB 970 emergency regulations adopted and enforced***
- ***2003 The 2005 standards adopted***
- ***2005 The 2005 standards become effective***

A Breakdown of the 2005 Savings

		Electricity		Demand		Gas	
		Savings (GWh)	Percent of Total	Savings (MW)	Percent of Total	Savings (millions therms)	Percent of Total
Newly Constructed Buildings	Low-Rise Residential	98.7	20.6%	66.4	36.4%	5.5	62.5%
	Nonresidential	143.0	29.9%	44.0	24.1%	0.5	5.7%
	Relocatable Classrooms	3.1	0.7%	n. a.	n. a.	0.0	0.0%
	Outdoor Lighting	17.1	3.6%	0.0	0.0%	0.0	0.0%
	Total	262.0	54.7%	110.3	60.5%	6.0	68.2%
Alterations	Low-Rise Residential	41.4	8.7%	26.7	14.7%	3.0	34.0%
	Nonresidential	175.0	36.5%	44.3	24.3%	-0.2	-2.3%
	Total	216.4	45.2%	71.0	39.2%	2.8	31.8%
Grand Total		478.5	100.0%	181.4	100.0%	8.8	100.0%

- ***2004-2005 Efficiency Program Portfolio: 3913 GWh, 792 MW, 56 Mth***

Standards Change Process



Template for Standards Change Ideas

- Energy and non-energy benefits
- How Time Dependent Valuation (TDV) would affect the benefits
- Any potential adverse environmental impacts
- Type of change (e.g., mandatory measure, prescriptive requirement, compliance option, or modeling procedure)
- Market availability of the measure and cost estimate
- Useful life, persistence, and maintenance implications of the measure
- Performance verification that would be needed to ensure that the measure is properly installed and/or performs as designed
- Analysis that would be necessary to evaluate the cost effectiveness of the measure
- Analysis tools would be needed to quantify the energy savings and peak demand reductions
- Relationship of this measure to other measures
- Existing research studies or reports on the measure, research that is currently underway and additional research/analysis that would be needed.

Screening the Proposals

- A total of 270 code changes were proposed
- About 1 in 10 were selected based on methodical screening
- Screening criteria developed, including:
  - Energy savings
  - Demand savings
  - Commitments and previous investments
  - Market availability
  - Resources
- Responsibility for analysis and development of measures shared with CEC contractor, utility partners and other interested parties

Criteria for Cost Effectiveness Established

- Two methods permitted: hourly life-cycle cost method or annual life-cycle cost method
- Assumptions agreed to:
  - 3% discount rate
  - 15 year life assumed for nonresidential lighting and HVAC measures
  - 30 years assumed for residential and nonresidential building envelope
  - Price projections for electricity and natural gas are taken from the CEC forecasting group.
- Present value of electricity savings $1.37/kWh and $7.30/therm for 15 years and $2.10/kWh and $12.64/therm for 30 years

Feedback on the Process

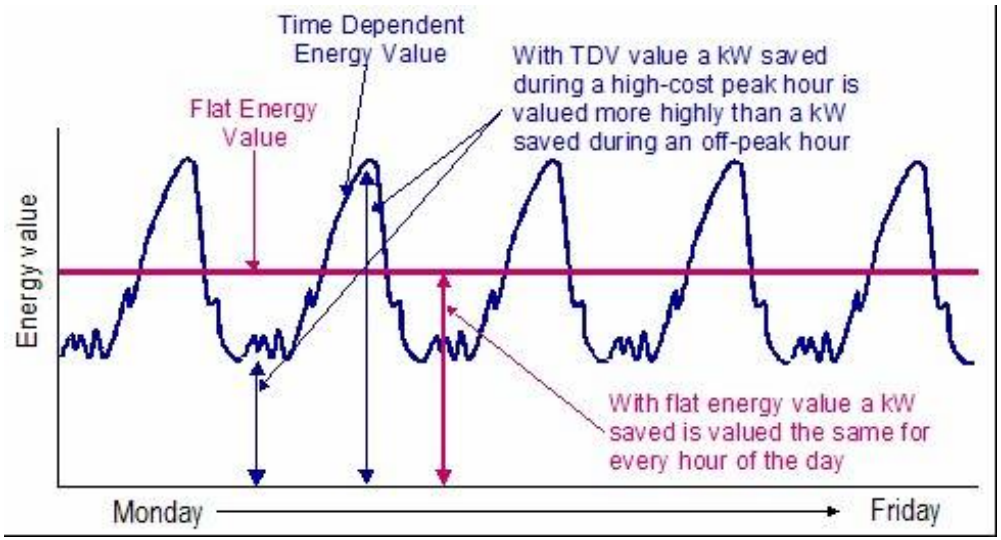
- "the CEC has set a whole new precedent where the proposals that were put forth were asked to not only be cost effective, they were asked to account for market conditions, demonstrate that the measures were ready for prime time, that the market was mature enough. ."
- "It's been extremely well organized, considering the vast number of questions, different issues, and everything else that have come up. ."
- "This has been a long road and I think it's been actually a very positive and cooperative road …"
- "The changes that are proposed are very comprehensive, covering all areas of energy use including the building shell, the lighting, HVAC, and building controls … "

Collaborating with the Utilities

- PG&E Codes and Standards Enhancements (CASE) Program sponsored many of the code change initiatives, including Time Dependent Valuation (TDV)
- Model for collaboration between policy makers and utilities
- Measures encouraged by utility programs until they are “mature” and then they are incorporated in codes and standards
- CPUC policy shifting (information to rebates to resource acquisition to market transformation)

Highlights – All Buildings

- Time Dependent Valuation (TDV)
- New Water Heater and Air-Conditioner Standards



Highlights – Residential Buildings

- Efficient Lighting
- Duct Insulation
- Pipe Insulation
- Loopholes Closed
- Replacement Windows
- Duct Sealing
- Compliance Credit
- Third-Party Field Verification

Highlights – Nonresidential Buildings

- Water Cooled Chillers
- Cooling Towers
- Cool Roofs
- Acceptance Requirements
- Demand Control Ventilation
- T-Bar Ceilings
- Relocatable Public School Buildings
- Duct Efficiency
- Indoor Lighting
- Skylights for Daylighting in Buildings
- Thermal Breaks for Metal Building Roofs
- Efficient Space Conditioning Systems
- Unconditioned Buildings
- Compliance Credits

Cool Roofs

- In 2001, a credit for cool roofs was added that can be used with both the prescriptive overall envelope approach and the whole building performance method
- In 2005, Cool roofs will became a prescriptive requirement for low-slope applications

Skylights in Large Open Spaces

- Applies to spaces larger than 25,000 ft^2
- Automatic controls required
- Minimum area depends on light transmission of the glazing and well factor

Performance Verification of Nonresidential Systems and Equipment

Outdoor Air Systems

- Variable Air Volume Systems
- Constant Volume System
- Constant Volume Packaged HVAC Systems

Air Distribution Systems

Lighting Control Systems

- Automatic/Manual Daylighting Controls
- Occupancy Sensor
- Automatic Time Switch

Air Economizer Controls

Demand Control Ventilation

Variable Frequency Drives

Hydronic System Controls

- Variable Flow Controls
- Automatic Isolation Controls
- Supply Water Temperature Reset Controls
- Water-loop Heat Pump Controls
- Variable Frequency Drive Controls

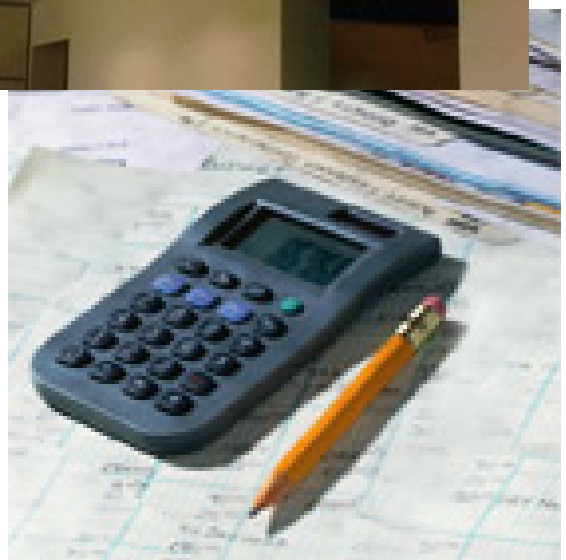
Cooling Towers and Hydronic Measures

New in 2005

- Chilled water plants ≥ 300 tons may have no more than 100 ton air cooled chillers
- Variable fluid flow required for CHW and HW systems serving more than three control valves.
- VFDs on CHW pumps ≥ 5 hp in variable flow systems

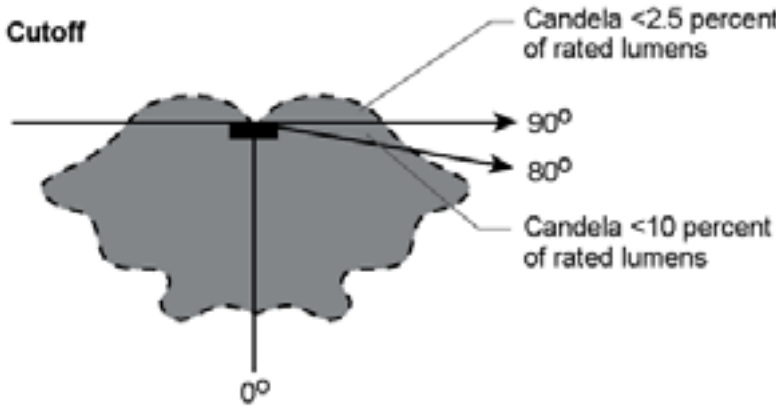
Update of Lighting Power Densities

- Efficacy of fluorescent lighting is improved with premium T-8 and T-5 lamps and ballasts
- Ceramic metal halide lamps are available that may be used in display lighting applications.
- Pulse start metal halide is the industry standard.



Outdoor Lighting

- Lighting Power Limits
  - LZ1 - State and national parks, recreational areas, wildlife preserves,
  - LZ2 – U.S. Census rural areas.
  - LZ3 - US Census urban areas
  - LZ4 - special districts
- Shielding



Signs

Type	Allowed Lighting Power
Internally Illuminated	12 W/ft^2
Externally Illuminated	2.3 W/ft^2

Summary

- New power plant is deferred every nine months
- California 2001 is about 12% more stringent than ASHRAE 1999/2001
- California 2005 is about 11% more stringent than California 2001
- California 2005 is estimated to be about 20% more stringent than ASHRAE 1999/2001

Raising the bar

Where to Get More Information

General Title 24 Information:
http://www.energy.ca.gov/title24/index.html

2005 Title 24 Update:
http://www.energy.ca.gov/2005_standards/index.html

Outdoor Lighting:
http://www.energy.ca.gov/outdoor_lighting/index.html

Support Documents for the AB 970 Changes:
http://www.energy.ca.gov/title24/associated_documents/index.html