Financing Energy Efficiency in California, The First Priority

ACEEE/ FRA ROSENFELD Session
April 24, 2009

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http://www.energy.ca.gov/commissioners/rosenfeld.html
or just Google “Art Rosenfeld”
Does Anyone See A Problem With This Picture?

If intensity dropped at pre-1973 rate of 0.4%/year

Actual (E/GDP drops 2.1%/year)

12% of GDP = $1.7 Trillion in 2005

7% of GDP = $1.0 Trillion in 2005
Per Capita Electricity Sales (not including self-generation)
(kWh/person) (2008 is forecast data)

United States

California

~19% of Residential and Commercial Electricity Use in California in 2006

Includes Utility Efficiency Programs

Program, Price, and Market Effects

Title 24 Building Standards

Title 20 Appliance Standards

GWh


US Greenhouse Gas Abatement Mapping Initiative

December 12, 2007

McKinsey&Company
Abatement cost <$50/ton

U.S. mid-range abatement curve – 2030

Source: McKinsey analysis
Global CO2 Abatement Curve - 2030

Abatement beyond 'business as usual,' GtCO₂e¹ per year in 2030

* 8% 17% 25% 33% 42% 50% 58%
AB 811 – Background

- Governor signed AB 811 (Levine) as an urgency measure
- Program enters into agreement with property owner to fund energy and water improvements to existing residential and commercial property
- Property owner agrees to a contractual assessment on property tax bill for up to 20 years
- Criteria for loan approval
  - No “Clouds” on Property Title
  - Current on Property Taxes
  - Current on Mortgage(s)
- Property secures the loan and stays with property

Source: Rod Dole – Auditor, Controller, Treasurer, Tax Collector, Sonoma County
Loans to participants; 
*Interest will cover administration costs plus Treasury note.*

Locally Operated Energy Program

**Treasury Note**

Property Tax System

**Bonds; when loan volume reaches threshold.**

Source: Rod Dole – ACTTC, Sonoma County
AB 811 – Finances

- Treasury invests in a series of notes
- Proceeds of the notes are used to finance loans to participants
- Participant payments come in via property tax system, paying the loan principal plus an interest rate to cover program operational expenses – analogous to a bank loan
- Bonds or other long term investment repays the note in full
- With long term financing, Treasury can invest in a new series of notes

Source: Rod Dole – ACTTC, Sonoma County
AB 811 – TECHNOLOGY

- Energy Efficiency
  - High-efficiency HVAC
  - High-efficiency windows & Insulation

- Renewables
  - Photovoltaic (PV)
  - Fuel Cells
  - Geothermal exchanges

- Water Conservation
  - Tankless water heaters
  - Low-flow devices
  - Rain cisterns
  - Smart irrigation systems (e.g. moisture sensors)

Source: Rod Dole – ACTTC, Sonoma County
<table>
<thead>
<tr>
<th>DOE</th>
<th>US ($Million)</th>
<th>CA ($Million)</th>
<th>Administered By</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weatherization (low income)</td>
<td>5,000</td>
<td>186*</td>
<td>Community Services Development (CSD)</td>
</tr>
<tr>
<td>SEP (State energy Program)</td>
<td>3,000</td>
<td>226</td>
<td>Energy Comm’n (CEC)</td>
</tr>
<tr>
<td>EERE (Energy Eff. And Renewables)</td>
<td>7,000</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>EEC BG (EE &amp; Conservation Block Grants)</td>
<td>---</td>
<td>352</td>
<td>Large Cities, Counties, CEC</td>
</tr>
</tbody>
</table>

* California IOU’s (Investor-Owned Utilities’s) Low-Income Weatherization funding is $200 M/yr
AB 811 – Benefits

- Enabling Residential/Commercial/Industrial Property Owners to make responsible and affordable energy and resource conservation improvements to existing structures
- Provide unique financing and repayment vehicle to the Property Owner to fund Improvements
- Provide job opportunities in the energy and resource conservation improvement fields

Source: Rod Dole – ACTTC, Sonoma County
AB 811 – How Can We Sweeten the Deal?

- Current programs like weatherization have income tests (<200% of poverty level)
  - How do we reach the next income tier who may fall in the gaps?
  - How do we deal with landlord-tenant problems?
  - What about repossessed/empty homes?
  - What about using performance-based (M&V) incentives?
“Berkeley First” Program
<table>
<thead>
<tr>
<th>Project type</th>
<th>Annual energy price escalation</th>
<th>EIA forecast (inflation only)</th>
<th>+2%</th>
<th>+4%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar installation only</td>
<td></td>
<td>($2,690)</td>
<td>($1,492)</td>
<td>$87</td>
</tr>
<tr>
<td>Energy-efficiency improvement only</td>
<td></td>
<td>$185</td>
<td>$1,017</td>
<td>$2,120</td>
</tr>
<tr>
<td>Solar installation and energy-efficiency improvement</td>
<td></td>
<td>($2,812)</td>
<td>($852)</td>
<td>$1,738</td>
</tr>
<tr>
<td>Solar installation, energy-efficiency improvement, and $30/ton carbon dioxide</td>
<td></td>
<td>($1,818)</td>
<td>$142</td>
<td>$2,732</td>
</tr>
</tbody>
</table>

**NOTE:** EIA=Energy Information Administration. Parentheses indicate negative net present value, base case highlighted.

“Berkeley First” Per Home Assumptions

- Baseline assumptions based on EIA data for 2006:
  - 7000 kWh/yr electricity
  - 276 therms/yr natural gas
- Savings assumptions are:
  - 5% Electricity and 25% Natural Gas from the first $4000 spent on homes (minimum required for program participation)
  - Higher payback measures such as resetting thermostats, replacing light bulbs, or purchasing high efficiency appliances are not included in this study.
White is ‘cool’ in Bermuda
and in Santorini, Greece
and in Hyderabad, India

...and in Gujarat, India
• Global Cooling: Increasing World-wide Urban Albedos to Offset CO2

July 28, 2008

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• A First Step In Geo-Engineering Which Saves Money and Has Known Positive Environmental Consequences
100m$^2$ (~1000 ft$^2$) of a white roof, replacing a dark roof, offset the emission of 10 tonnes of CO$_2$
How to Relate to 10 Tons of CO2

• First – This is 10 tons ONCE, not 10 tons/year;
• But familiar measures are usually in terms of tons/year;
• So we will look at how many years of emissions 10 tons will offset

<table>
<thead>
<tr>
<th></th>
<th>Tons CO2/Yr</th>
<th>Years Equivalent to 10 Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average US House Emits</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Average US Car Emits</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Average Global Car Emits</td>
<td>4</td>
<td>2.5</td>
</tr>
<tr>
<td>Average CFL Saves</td>
<td>.05=1/20</td>
<td>200</td>
</tr>
</tbody>
</table>
CO$_2$ Equivalency of Cool Roofs World-wide (Tropics+Temperate)

- Cool Roofs alone could offset a total of 24 Billion Tons (Gt) CO$_2$, = world emissions this year !!!!
- Worth > €240 Billion (Pre-recession was €600B)
- To Convert 24 Gt CO$_2$ one-time into a rate
- Assume 20 Year Program, thus 1.2 Gt CO$_2$/year
- Average World Car emits 4 tCO$_2$/year, equivalent to 300 Million Cars off the Road for 20 years.
  (600 million cars in the world)
Solar Reflective Surfaces Also Cool the Globe

Source: IPCC
California Appliance and Buildings Efficiency Standards (Title 20 and 24)
How Much of The Savings Come from Efficiency

- Some examples of estimated savings in 2009 based on 1974 efficiencies minus 2009 efficiencies
  
<table>
<thead>
<tr>
<th></th>
<th>Billion $/Yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space Heating</td>
<td>40</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>30</td>
</tr>
<tr>
<td>Refrigerators</td>
<td>15</td>
</tr>
<tr>
<td>Fluorescent Tube Lamps</td>
<td>5</td>
</tr>
<tr>
<td>Compact Fluorescent Lamps</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

- Beginning in 2007 in California, reduction of “vampire” or stand-by losses
  - This will save $10 Billion when finally implemented, nationwide

- Out of a total $700 Billion, a crude summary is that 1/3 is structural, 1/3 is from transportation, and 1/3 from buildings and industry.
Per Capita Electricity Sales (not including self-generation)
(kWh/person)

Californian w/out stds and programs

United States

California
New United States Refrigerator Use v. Time
and Retail Prices

Source: David Goldstein

- ~ 100 gallons Gasoline/year
- ~ 1 Ton CO2/year
- Refrigerator Price in 1983: $1,270
- Refrigerator Price in 1983: $462

Refrigerator Price

Refrigerator Volume (cubic feet)

Energy Use per Refrigerator (kWh/Year)

Refrigerator Size (cubic ft)
In the United States

Value of Energy to be Saved (at 8.5 cents/kWh, retail price) vs.
Several Sources of Supply in 2005 (at 3 cents/kWh, wholesale price)
Air Conditioning Energy Use in Single Family Homes in PG&E
The effect of AC Standards (SEER) and Title 24 standards

- If only increases in house size -- no efficiency gains
- Change due to SEER improvements
- SEER plus Title 24
Comparison of 3 Gorges to Refrigerator and AC Efficiency Improvements

Savings calculated 10 years after standard takes effect. Calculations provided by David Fridley, LBNL
TV Power Trend

• Sales of conventional (CRT) televisions are rapidly declining in favor of flat screen technology (LCD).

• TV load is now 5-10% of total residential electricity load and is growing ~ 3-4% per year.

• Standards will cap or reverse growth!
## Power Consumption by TV vs Total Residential in CA

<table>
<thead>
<tr>
<th></th>
<th>Power Use (W) by Average Size TV</th>
<th>CA Energy Consumption Per Year in BkWh/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRT (Cathode Ray Tube)</td>
<td>101</td>
<td>4</td>
</tr>
<tr>
<td>LCD (Liquid Crystal Display)</td>
<td>144</td>
<td>3</td>
</tr>
<tr>
<td>Other</td>
<td>---</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>245</td>
<td>9</td>
</tr>
<tr>
<td>Total Residential Power Consumption</td>
<td></td>
<td>90</td>
</tr>
</tbody>
</table>
Proposed Standards and Energy Star Data

Max "On" Mode Power (W) vs. Screen Area (square inches)

- LCD
- Plasma
- Projection/Other

Tier 1 - proposed (Jan 1, 2011)
Tier 2 - proposed (Jan 1, 2013)

Energy Star (Nov 1, 2008)

- 70 diagonal cm (28 diagonal inches)
- 100 cm (40"")
- 125 cm (50"")

- 50 diagonal cm
- 125 cm
- 100 cm
- 70 diagonal cm
- 100 cm
- 125 cm
- 50 diagonal cm
Incandescent Lamp Plot
California IOU’s Investment in Energy Efficiency

Profits decoupled from sales

2% of 2004 IOU Electric Revenues

Performance Incentives

Market Restructuring

Crisis

Forecast

Public Goods Charges

2002 per Year

Millions of $2002 per Year

Possible Strategies to Reduce Electricity Sector Carbon Emissions in California, ignoring ramp up times and other implementation issues -- The ELECTRICITY Perspective

Source: Pat McAuliffe
Possible Strategies to Reduce Electricity Sector Carbon Emissions in California, ignoring ramp up times and other implementation issues -- The CARBON Perspective

Source: Pat McAuliffe
The End

For More Information:

http://www.energy.ca.gov/commissioners/rosenfeld_docs/index.html

or just Google “Art Rosenfeld”
Methodology: Energy and Air-Quality Analysis

Strategies

- Cooler Roofs
- Shade Trees

Processes

- Direct
  - Reduces A/C Use
  - Reduces Demand at Power Plants
- Indirect
  - Area Sources Emit Less
  - Slows Reaction Rates

Results

- Less Energy Consumed
- Lower CO₂, NOₓ, and VOC Levels
- Lower Ozone Levels
Cool Roof Technologies

Old

flat, white

New

pitched, cool & colored

pitched, white
Cool Colors Reflect Invisible Near-Infrared Sunlight

**Solar Energy Distribution**
- 5% ultraviolet (300-400 nm)
- 43% visible (400-700 nm)
- 52% near-infrared (700-2500 nm)
Cool and Standard Brown Metal Roofing Panels

- Solar reflectance ~ 0.2 higher
- Afternoon surface temperature ~ 10°C lower

Courtesy BASF Coatings

**cool**

- Solar reflectance = 0.27
- Thermal emittance = 0.85
- Roof temp – air temp = 36°C (65°F)

**standard**

- Solar reflectance = 0.08
- Thermal emittance = 0.85
- Roof temp – air temp = 45°C (81°F)