CPUC, CEC, ARB Electricity & Natural Gas GHG Modeling
AB32 Economic Analysis Technical Stakeholder Working Group
January 28, 2008

Energy and Environmental Economics, Inc. (E3)
- San Francisco-based firm established in 1993
- Electric and natural gas utility sectors
- Practice areas
  - Energy efficiency and building standards
  - Distributed generation, demand response and CHP
  - Integrated resource planning
  - Transmission planning and pricing
  - Retail rate design

CPUC, CEC, ARB Project Team
- Energy and Environmental Economics, Inc.
  - Prime, Development of the non-proprietary tool, Integration, GHG Policy
- PLEXOS Solutions LLC
  - State-of-the-art production simulation model
- Schiller Associates, Steven Schiller Lead
  - Advisor on California GHG policy and energy efficiency
- Dr. Ben Hobbs, Johns Hopkins University
  - Academic advisor, World-renowned electricity simulation expert
- Dr. Yihsu Chen, UC Merced
  - Academic advisor, Emerging capability at UC Merced

Project Overview
- Joint CPUC, CEC, ARB effort to evaluate AB32 compliance options in California’s electricity and natural gas sectors
- Model estimates the cost and rate impact of a variety of compliance strategies relative to two reference cases
- Project timeline designed to fit into 2008 Scoping Plan process for AB32
- Deliverables
  - Non-proprietary, transparent, spreadsheet-based model using publicly available data
  - Report on results and sensitivities / scenarios
  - Stakeholder process leading to CPUC/CEC proposed decision
  - Model output to be used as an input to the ARB economic models
Two Stages

- Stage 1 (through 2/08): Impacts on Statewide Electricity and Natural Gas Sector
  - Develop data, methodology and test analysis tool
  - Informs CPUC/CEC February 2008 interim decision on electricity and natural gas GHG sector targets for 2020
  - Stakeholder comments / reply comments January 2008
  - Revisions to Stage 1 results following stakeholder comments

- Stage 2 (12/07 – 8/08): Impacts on LSEs
  - Allocation of GHG permits or auction revenues among LSEs
  - LSE-specific rate and cost impacts of different policy approaches
  - Cross-sector trading issues
  - Informs CARB June 2008 decision for ‘burden sharing’ of GHG reductions among all CA sectors and future decisions on allocation of GHG permits within the electricity sector

Stage 1 Key Qs
- How much will various policy options reduce CO2 emissions?
- How will these policy options affect electricity rates?
- Underlying question: At what electricity sector target level do incremental improvements get expensive?

Stage 2 Key Qs
- What is the cost to California of complying with AB32 under different policy options for the electricity sector?
- What is the cost to different LSEs and their customers of these options?
- Underlying question: What option has the best combination of cost, fairness and enforceability?

Project Timeline

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<th>Summary of Activities</th>
<th>CARB Scenarios Workshop</th>
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<td>Agency Leadership Group Meets</td>
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<td>Stage 1 Model Development</td>
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<td>Comment Period</td>
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<td>CPUC/CEC Interim Decision</td>
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<td>Working Group Meets</td>
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<td>Develop Final Model (Stage 2)</td>
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<td>Expans Policy Options</td>
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<td>Evaluate Additional Scenarios</td>
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<td>Comment Period</td>
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<td>Decision</td>
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E3 GHG Calculator Approach

Case Inputs
- Loads (MW, MWh)
- Resources (MW, MWh)
- Resource Costs
- PLEXOS Dispatch

Case Results
- Emissions Level
- Cost Levels
- Rate Levels
- Renewable %, Others

Calculations
Modeling Progress

- Preliminary Stage 1 Results Delivered
  - Public Kick-off Meeting at CPUC, Sept. 21st
  - Stage 1 Methodology Presented at CPUC Workshop, Nov. 14th
- PLEXOS Model Runs Complete
- Stage 1 GHG Calculator Delivered
- Stakeholder Comments
  - Opening Comments Submitted Jan. 4th
  - Reply Comments Submitted Jan. 18th
- Stage 2 Beginning

GHG Calculator

- Based in Excel
- Uses only publicly available data
- Calculates scenarios rapidly
- Non-proprietary

Next Steps

- Model improvements incorporating stakeholder comments
- Model allocation or auction of GHG permits in electricity and natural gas sectors
- Model impacts of offsets/cross-sector trading on compliance in electricity and natural gas sectors
- Sensitivity Analyses
  - Load growth forecast, costs of renewable energy and EE, etc.
- Coordination with ARB modeling

Highlights of Modeling Progress

- Project Website
- Workshop updates & past presentations
- Calculator available for download
- Documentation of methodology and inputs
- www.ethree.com
Measuring CO2 Change from Reference to Target Cases

2020 Reference Cases

<table>
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<tr>
<th>Policies</th>
<th>Business-as-Usual</th>
<th>Aggressive Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable Energy</td>
<td>20% RPS (7,404 MW)</td>
<td>33% RPS (16,119 MW)</td>
</tr>
<tr>
<td>Energy Efficiency</td>
<td>“BAU” energy efficiency embedded in CEC load forecast (~35% economic potential)</td>
<td>100% of economic energy efficiency potential achieved</td>
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<tr>
<td>California Solar Initiative and Demand Response</td>
<td>1,091 MW of PV installed</td>
<td>3,000 MW of PV installed</td>
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<tr>
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<td>0% demand response</td>
<td>5% demand response</td>
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<tr>
<td>GHG Emissions</td>
<td>170 MMTCO2e</td>
<td>138 MMTCO2e</td>
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Resource Options Modeled
- Energy Efficiency by LSE
- Solar PV, Demand Response, Small CHP by LSE
- Large Scale Renewable Energy
  - Developed by zone
  - Developed by transmission size and configuration
- Large Scale Generation
  - Gas CCCT, Gas CT, Nuclear, Coal IGCC, Coal IGCC w/ CCS, Coal ST, Large CHP

Energy Efficiency Supply Curves
- Created 7 LSE-specific EE supply curves of economic potential: relating energy savings to levelized total resource cost
- Data available from 2006 Itron EE potential studies
- Itron data available for 3 IOUs and SMUD. Relied on AB 2021filings for POU economic potential and 2016 EE targets to scale EE supply curves to the POUs
**Renewables Modeled by Zone**

- User selects transmission capacity to each zone
- Calculator estimates costs of renewables
  - Busbar cost
  - Transmission
  - Integration
  - Firming

**Example CO2 Reduction Portfolio**

**Reductions from BAU Reference Case**

**Thank You Any Questions?**