CRA’s MRN-NEEM Model is a Well-Documented, Peer-Reviewed State-of-the-Art System

- State-of-the-art treatment of economy-wide and electric sector issues
- Used extensively in prior studies of climate legislation and in development of SO$_2$, NO$_x$ and mercury regulations
- Used in CRA/EPRI study of California climate policies and by State of California for analyzing implementation alternatives
  - Expert panel created by EPRI reviewed model development and study
  - This model was originally selected by Cal/EPA for its study: “Updated Macroeconomic Analysis of March 2006 Climate Action Team Report Strategies.”
- Documented through publications in peer-reviewed literature and open access to assumptions
  - “Equity and the Kyoto Protocol: measuring the distributional effects of alternative emissions trading regimes.” Global Environmental Change 2000
  - Documentation of Scenarios Used in Dr. Anne E. Smith’s Testimony of November 8, 2007 Before the Senate Environment and Public Works Committee Regarding the Economic Impacts of S.2191: Response to a request by Senator Lieberman dated November 16, 2007
Capabilities Included in MRN-NEEM

• **Sound treatment of economic decisions and markets**
  – Household and business decisions based on rational economic calculations
  – Complete accounting for factor inputs so that all costs are accounted for
  – Supply and demand equilibrium that supports efficient use of limited resources unless there are specific market failures represented in the model

• **Detail sufficient to differentiate the impacts of alternative proposals**
  – Detailed representation of the electricity sector since this sector is the subject of complex regulatory interventions, especially in the near-term
  – Explicit treatment of key technologies whose availability influences costs of meeting targets, such as nuclear power, CCS and low-carbon fuels

• **Dynamics suitable to climate policy analysis**
  – Time horizon long enough to account for effects of policies on investment decisions
  – Impossibility of outsmarting agents about future price trends and policies

• **Sufficient regional and sectoral detail to describe impacts in familiar terms**
Integration of MRN and NEEM Provides a Unique Capability for Analysis of GHG Policy Impacts

- Supply and demand for electricity
- Carbon permit sales to non-utility sectors
- Gas used in generation
- Oil used in generation

MRN
Econ-wide macro-econ. impacts model

NEEM
National electricity generation model

Costs/Impacts to units and electric sector
In 29 NEEM regions

Impacts to coal supply regions
In 13 mining regions

Impacts to all sectors (incl. transport)
In 9 MRN regions & by state

Cost/Impacts to consumers
In 9 MRN regions & by state

- Electricity price
- Natural gas price
- Carbon price
The Multi-Region National Model (MRN)

MRN is a forward-looking, dynamic computable general equilibrium (CGE) model of region-specific impacts and regional interaction in the US economy.

**Inputs**
- New IMPLAN data including 2002 input-output matrices and trade flow data
- EIA state-level energy production, consumption and price data

**CGE Model**

**Flexible Sectoral and Regional Coverage**
- Five Energy Sectors - electricity, coal, crude oil, natural gas, refined petroleum products
- 29 Non-Energy Sectors – can be aggregated based on analysis needs
- Adaptable Regional Aggregation – down to the state level

**Key Economic Mechanisms**
- Possibility of premature retirement of capital
- Impacts on government budgets, tax interaction and “double dividend” effects
- Improvement in technology over time or in response to policies
- Sufficiently long time horizon to capture anticipation of future policies

**Analysis**
- Simulates patterns of investment and consumption behavior that maximize consumer welfare over time
- Captures changes in energy demand and fuel prices that cannot be modeled without modeling the entire US energy sector
Offset curves considered

- EPRI base case – jumping off point
- Sensitivity analysis around this case
  - EPRI analysis assumed only offsets from CA sources as described by CAT

<table>
<thead>
<tr>
<th>Scenario Name</th>
<th>Availability of Offsets</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA_Only</td>
<td>California only</td>
</tr>
<tr>
<td>US_All</td>
<td>California + Rest of US</td>
</tr>
<tr>
<td>US_Restricted</td>
<td>California + Limited Offsets from rest of US</td>
</tr>
<tr>
<td>International-1%</td>
<td>California + International 1% rise</td>
</tr>
<tr>
<td>International-5%</td>
<td>California + International 5% rise</td>
</tr>
</tbody>
</table>
Offset Supply Curves in 2020

- **Restricted US Offsets**
- **All US Offsets**
- **International-1%**
- **International-5%**
- **CA_Only**

The graph shows the supply curves for different categories of offsets in 2020, with the x-axis representing MM Short Tons of CO2 and the y-axis showing 2003$ per Short Ton of CO2.
Results

Depending on availability of offsets, the inclusion of offsets can:

– Dramatically reduce program costs by up to 80%

– Minimize economic loss to the economy by up to $40 billion/year by 2035 (2003$)

– Prevent leakage of more than 300,000 jobs

– Cut consumption losses by 50% in 2015 and by as much as 80% in 2020.
Change in Employment (‘000s of jobs)

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>CA_Only</th>
<th>US Restricted</th>
<th>International-5%</th>
<th>International-1%</th>
<th>US All</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>-600</td>
<td>-500</td>
<td>-400</td>
<td>-300</td>
<td>-200</td>
</tr>
<tr>
<td>2035</td>
<td>-500</td>
<td>-400</td>
<td>-300</td>
<td>-200</td>
<td>-100</td>
</tr>
</tbody>
</table>
Change in CA’s gross state product in 2020 and 2035 (Billions of 2003$s)
Change in Statewide Gross State Product (2020 and 2035)

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>2020</th>
<th>2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA Only</td>
<td>-1.6%</td>
<td>-1.6%</td>
</tr>
<tr>
<td>US Restricted</td>
<td>-1.4%</td>
<td>-1.4%</td>
</tr>
<tr>
<td>International-5%</td>
<td>-1.2%</td>
<td>-1.2%</td>
</tr>
<tr>
<td>International-1%</td>
<td>-1.0%</td>
<td>-1.0%</td>
</tr>
<tr>
<td>US All</td>
<td>-0.8%</td>
<td>-0.8%</td>
</tr>
<tr>
<td>International-1%</td>
<td>0.0%</td>
<td>0.0%</td>
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<tr>
<td>International-1%</td>
<td>-0.4%</td>
<td>-0.4%</td>
</tr>
<tr>
<td>International-1%</td>
<td>-0.2%</td>
<td>-0.2%</td>
</tr>
<tr>
<td>US All</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>
Conclusion

• The analysis shows unequivocally that including offsets lowers the economic costs of complying with AB 32
  – Could reduce overall welfare impacts by 80%
  – Placing arbitrary restrictions on the availability of offsets raises compliance costs
• The importance of offsets depends greatly on the availability of low emitting technologies
  – In the near-term, when the availability of these technologies is likely to be small, the availability of offsets is critical to contain costs.
  – If or when these technologies are prevalent, the demand for offsets will decline.
• Unlike a safety-valve where total emissions can increase, offsets (assuming they are real, additional, and permanent) will leave global emissions unchanged
• Therefore regulators need to focus on developing rules to allow offsets and to ensure that they are “real, additional, independently verifiable, permanent, enforceable, and transparent.”
Thank You