California’s Clean Energy Future
Where do we go from here?

U.S Department of Energy
Annual Merit Review
May 9th, 2011
Key Takeaways

- Many of the greatest business opportunities in the 21st century will be associated with the ‘new energy economy’.

- Those nations, states, institutions, and companies that aggressively pursue the right portfolio of policies and strategies will be the winners.

- Our energy system is massive, achieving our goals will take time and sustained effort, and there will be many bumps along the way.
California by the numbers

GSP ~$1.9 Trillion (2009)

Electricity Consumption
~287,000 GWh (2008)

Peak Demand
~64,000 MW (2006)

Energy Expenditure
~$33.5B Electric
~$17.6B Natural
~$80B Petroleum

Total ~ $360Mill
California GSP and State Revenue ($M)
California Clean Tech Investment/Patents

California Clean Tech Investment/Patents

California’s Major Energy Policy Initiatives

- **Energy Efficiency (Standards and Incentives)**
  - 2010: All cost effective energy efficiency (~20,000+ GWH by 2020)
  - 2020: Renewables 33% of retail sales (~78,000 - 102,000 GWh)

- **Renewable Portfolio Standard**
  - 2010: Renewables 20% of retail sales (~55,000 GWh)
  - 2020: Renewables 33% of retail sales (~78,000 - 102,000 GWh)

- **Clean Vehicles/Low Carbon Fuels/Petroleum Reduction**
  - PHEV + ZEV = 67,500+ by 2014
  - New Vehicles = 30% reduction in GHG’s by 2016;
  - 10% reduction in life-cycle carbon intensity; 20% Alternative Non-Petroleum Fuel Use

- **GHG Reduction Targets**
  - 1990 levels by 2020 (AB32); 80% below 1990 levels by 2050
  - To be achieved by portfolio of policies including Efficiency, Renewables, Low-carbon fuels, Vehicles, Cap and Trade, etc.
Government Role in Enabling Energy Technologies

The “Pipeline” Policy Strategy to drive innovation

- Research and Development
- Deployment Incentives
- Codes and Standards
- Fiscal Policies
“Energy Carrier” du jour Phenomenon

- 30 years ago – Synfuels (oil shale, coal)
- 25 years ago – Methanol
- 18 years ago – Electricity (Battery EVs)
- 8 years ago – Hydrogen (Fuel cells)
- 4 years ago – Ethanol/Biofuels
- Today – Electricity again (EV+PHEV)
- Next year?

Conclusion – we need a new strategy!
GHG (and Petroleum) Reduction strategies

GHG (MTCO2e per Year) = \( \frac{\text{GHG (MTCO2e)}}{\text{Energy}} \times \frac{\text{Energy}}{\text{Widget}} \times \frac{\text{Widgets}}{\text{year}} \)

- Low Carbon Fuels
- Vehicle Standards
- Land Use/Transportation Planning
## Performance Standards for Fuels

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Land use emissions</th>
<th>Vehicle efficiency</th>
<th>Adjusted fuel carbon intensity (gCO2e/MJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline (CaRFG)</td>
<td></td>
<td></td>
<td>90</td>
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<tr>
<td>Ultra low sulfur diesel (ULSD)</td>
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<tr>
<td>Compressed Natural Gas (CNG)</td>
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<tr>
<td>Ethanol - conventional corn</td>
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<tr>
<td>Ethanol - low-C corn</td>
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<tr>
<td>Ethanol - cellulosic</td>
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<tr>
<td>Ethanol - sugarcane</td>
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<tr>
<td>Soybean</td>
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<tr>
<td>Waste derived</td>
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<td>90</td>
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<tr>
<td>Electricity California average</td>
<td></td>
<td></td>
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<tr>
<td>Hydrogen natural gas reforming</td>
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<tr>
<td>Bio-methane</td>
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</tbody>
</table>

*10% below the current average fuel GHG intensity*
Performance Standards for Vehicles
Performance Standards for Communities
Public Support for Portfolio of Clean Vehicle/Fuel Development and Deployment
Getting to 2050 – One Scenario

LDV On-Road Vehicles

- 2000
- 2010
- 2020
- 2030
- 2040
- 2050

- HEVs
- PHEVs
- FCVs + BEVs
- All ICEs (SI, CI, FFV)

79%
THANK YOU!
Leading indicators

ENERGY CONSUMPTION (Per Capita)

GDP & EMISSIONS (Per Capita)