Hydrogen Infrastructure in California

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California by the numbers

GSP ~$1.9 Trillion (2009)

Electricity Consumption
~287,000 GWh (2008)

Peak Demand
~64,000 MW (2006)

Energy Expenditures (2008)
~$33.5B Electricity
~$17.6B Natural Gas
~$80B Petroleum/products
California’s Plan for Transportation

**Low-Carbon Fuels**
Diversify fuel supply toward alternative and renewable fuels

**Cleaner Vehicles**
Efficient, low/zero emission vehicles for passenger travel and goods movement

**Efficient Mobility**
Better land use planning, walking, biking and transit infrastructure

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**Well-to-Wheel Greenhouse Gases**

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Greenhouse Gas Emissions (g CO₂e/km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline (Today's Vehicle)</td>
<td>150</td>
</tr>
<tr>
<td>Gasoline</td>
<td>140</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>135</td>
</tr>
<tr>
<td>Cellulosic Ethanol (E85)</td>
<td>185</td>
</tr>
<tr>
<td>Gasoline &amp; U.S. Grid Mix</td>
<td>90</td>
</tr>
<tr>
<td>Cellulosic Ethanol (E85) &amp; U.S. Grid Mix</td>
<td>270</td>
</tr>
<tr>
<td>U.S. Grid Mix</td>
<td>230</td>
</tr>
<tr>
<td>Ultra-low Carbon Renewable H₂</td>
<td>0</td>
</tr>
<tr>
<td>H₂ - Distributed Natural Gas</td>
<td>200</td>
</tr>
<tr>
<td>H₂ - Biomass Gasification</td>
<td>37*</td>
</tr>
</tbody>
</table>

Source: USDOE, 2010
Government Role in Enabling Energy Technologies

The “Pipeline” Strategy to drive innovation

- **Research and Development**
  - Emerging technology development and demonstration
  - Economic and engineering analysis

- **Deployment Incentives**
  - Programs and incentives for most efficient products
  - Energy-efficient economic development incentives

- **Codes, Standards, and Permits**
  - Require minimum standards for appliances and buildings
  - Promote reach standards
  - CEQA for Power Generation

- **Fiscal Policies** “Leveling the playing field”
  - Cap and Trade
  - Tax policy (e.g. Mfg. tax credits)
Funding and Objectives

- ~$150 million/year for 7 Years
- Invest in a portfolio of alternative low-carbon and renewable fuels and advanced vehicles in California to help meet our energy, environmental, and economic goals.
- Fuel production, distribution and dispensing
- Component and vehicle development and manufacturing
- Workforce training
- Education and outreach
- Environmental, market and technology assessments
Hydrogen Infrastructure

Example: Northern California Bus Station

- Emeryville
- 60 kg/day from solar
- 180 kg/day from reformer
- 6 buses & 20 cars daily
Example: Two LA-area Stations

- **Los Angeles (CSULA)**
  - 60 kg/day
  - On-site solar electrolysis
  - Open Q1 2011

- **Fountain Valley**
  - 100 kg/day
  - Hydrogen from biogas
  - Open Q1 2011

California Solicitation “Firsts”

- Public access and "retail-like" design
- Detailed automaker commitment letters
- Multiple stations per award
- Additional incentives provided for:
  - lower cost=higher % cost share
  - Fast construction (<18 months)
  - Exceed the GHG/Renewables Requirement
- Funded stations eligible for:
  - Station upgrades
  - Operation beyond three-year contract
What if?

- Energy Independence
- Preserve Rainforests
- Sustainability
- Green Jobs
- Livable Cities
- Renewables
- Clean Water, Air
- Healthy Children
- Etc., Etc.

THANK YOU!

How about you spend LESS time studying how MY generation destroyed the environment and MORE time figuring out a magical solution?
Resources

- California Energy Commission Website:  
  - http://www.energy.ca.gov
- Energy Action Plan:  
  - http://www.energy.ca.gov/energy_action_plan/index.html
  - http://www.energy.ca.gov/energypolicy/
- California Climate Change Efforts:  
  - http://www.climatechange.ca.gov/

Public Stations – Retail Ready