The goal: clean the air

Problem of air pollution from automobile emissions:

- How to solve? Facilitate new technology
Policy strategies in technology development

☑ Standards

- Technology Forcing (TF) - Clean Air Act
  is a strategy where a regulator specify a standard that
can not be met with existing technology, at least at an acceptable
cost
- Regulatory - Corporate Average Fuel Economy
  or CAFE standard can be achieved with cost-effective or
  nearly cost-effective tech. innovations

☑ Incentives - Tax credits, Department of Energy
  (DOE) grants, purchasing (Government fleet
  purchases)
1970 Clean Air Act

- The Clean Air Act (CAA) is the comprehensive federal law that regulates air emissions from stationary and mobile sources.
- 1970 CAA mandated 90% reduction in tailpipe emissions over 4-5 years: TF
- TF delivers new innovations, but risks and challenges

TF: risks and challenges

- Targets are too hard to achieve ⇒ need intermediate steps of progress

- Industry could push back saying technology is impossible to achieve ⇒ competitive pressure from foreign companies

- Uncertain strategy with no guarantees of a technological breakthroughs

CAFE

- The CAFE legislation regulates the average fuel economy of new vehicles sales in US
- It establishes required fuel economy for the entire fleet of new vehicles (in mpg), with separate standards established for passenger cars and light trucks.
- Vehicle manufacturers are required to have average fuel economy that meets or exceeds these fuel economy targets or pay a penalty.

Arguments against CAFE

- The rebound effect: higher efficiency means lower cost per mile. Therefore, people will drive more, nullifying the fuel savings from efficiency.

- Lighter vehicles are less safe.

CAFE worked!

- 50% increase in on-road fuel economy for light-duty vehicles from 1975 to 1995
- Would it have happened from then existing market forces? Greene: No, since net cost+benefit of fuel economy improvement is +/- $100, not enough to motivate car buyer

CAFE (Corporate Average Fuel Economy)

CAFE: How is a manufacturer’s CAFE determined for a given model year?

- Fleet fuel economy is calculated using a harmonic mean.
  - For a fleet composed of four kinds of vehicle A, B, C and D, produced in numbers $n_A$, $n_B$, $n_C$ and $n_D$ with fuel economies $f_A$, $f_B$, $f_C$ and $f_D$, the CAFE (in mpg):
    $$\frac{n_A + n_B + n_C + n_D}{\frac{n_A}{f_A} + \frac{n_B}{f_B} + \frac{n_C}{f_C} + \frac{n_D}{f_D}}$$

**ACTIVITY:**

- Manufacturer X produces 3 passenger car models in 2006:

<table>
<thead>
<tr>
<th>Model</th>
<th>MPG</th>
<th>Production Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>28</td>
<td>150,000</td>
</tr>
<tr>
<td>B</td>
<td>27</td>
<td>50,000</td>
</tr>
<tr>
<td>C</td>
<td>18</td>
<td>10,000</td>
</tr>
</tbody>
</table>

- Is the manufacturer compliant with 2006 model-year CAFE standard (27.5 mpg)?
  
  No, CAFE is 27 mpg < 27.5 mpg
ACTIVITY:

Now suppose that manufacturer X has quit making model C and introduced a new model D in 2007:

<table>
<thead>
<tr>
<th>Model</th>
<th>MPG</th>
<th>Production Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>28</td>
<td>70,000</td>
</tr>
<tr>
<td>B</td>
<td>27</td>
<td>30,000</td>
</tr>
<tr>
<td>D</td>
<td>31</td>
<td>120,000</td>
</tr>
</tbody>
</table>

Is the manufacturer compliant with 2007 model-year CAFE standard (27.5 mpg)?

Yes, CAFE is 29.4 mpg > 27.5 mpg
Alternative fuels: barriers to broad consumers acceptance

- Lack of refueling infrastructure
- High cost
- Lack of vehicles engineered to operate on the fuel
- Difficulty breaking into an established market
- Perceived or real issues of safety and reliability
- Lack of driving range

Lessons from alternative fuels (1988 - 2003 policies)

- Range limitation and slow refueling may be the most critical technical barriers
- Niche markets don’t lead to mainstream consumer markets (fleets vs. consumers)
- Incremental benefits to consumers are small relative to conventional vehicle fuels (thus need policy to stimulate interest)
- Infrastructure may limit adoption; why would private sector invest? Clear stimulus from government is needed