Technology Options to Reduce Truck Idling

Frank Stodolsky, Linda Gaines, and Anant Vyas

Center for Transportation Research
Argonne National Laboratory

Truck Maintenance Council
Nashville, TN
March 15, 2001
Argonne has completed a truck idling study

- Idling overnight has impacts
  - wasted money
  - excess petroleum use
  - more air pollution
  - extra noise
- Report is available
- Results summarized here
- Applicable to locomotives
- Potential benefits estimated
This presentation outlines...

• The extent of truck diesel engine idling

• Technology options to reduce idling

• Estimated energy and emissions impacts

• Estimated costs
Why is the truck’s engine idled?

- To keep the cab/sleeper heated or cooled
- To mask out noises
- To keep the fuel warm in winter
- To keep the engine warm to avoid cold starting it in winter
- Because all the other drivers do it
- Safety
Current practice for trucks

- 458,000 combination trucks travel >500 miles from home daily
- Good idling statistics not available
- Industry source estimates 6 hours/d
  - 10 h/d winter, 4.5 h/d summer
  - total 1830 h/y
  - ~840 million gallons of diesel fuel consumed annually in U.S. by idling long-haul trucks
Current practice (cont.)

• Actual practice varies
  – from 1-2 night/week (<1000 h/y)
  – to never turning off (>5000 h/y)

• About 238,000 places to park
  – So some trucks park during the day or on the side of the road
Alternative devices have pros and cons, but...

<table>
<thead>
<tr>
<th>Technology</th>
<th>Benefits</th>
<th>Drawbacks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct-fired heater</td>
<td>Heat anywhere; small</td>
<td>Cannot supply cooling; requires battery power</td>
</tr>
<tr>
<td>Auxiliary power unit</td>
<td>HVAC and power anywhere</td>
<td>Heavier, larger, more expensive than heater</td>
</tr>
<tr>
<td>Thermal storage</td>
<td>HVAC for cab/sleeper only, anywhere</td>
<td>Large mass of storage medium; requires battery power</td>
</tr>
<tr>
<td>Direct heat with storage cooling</td>
<td>HVAC and engine heat anywhere</td>
<td>Requires battery power</td>
</tr>
<tr>
<td>Truck stop electrification</td>
<td>HVAC and power</td>
<td>Only at limited locations; not commercial</td>
</tr>
</tbody>
</table>
Alternatives reduce operating costs

- Less diesel fuel is burned
  - idling typically 1 gal/h
  - alternatives typically ~0.2 gal/h
  - at $1.75/gal, saving $1.40/h
  - this is the major saving
- Less frequent oil changes
- More miles until overhaul required
  - not seen if vehicles replaced before overhaul
  - second owner reaps benefit
Reducing truck idling saves fuel

- A truck traveling 500 mi/d @ 7 mpg uses 71.4 gal
- If the engine idles the remaining 14 h @ >1 gal/h, fuel use is 85.4 gal
- If APU runs instead @ <0.18 gal/h, total fuel use 73.9 gal
- Fuel use is reduced 13% with no loss of driver comfort
- Savings are less if fewer idling hours are replaced
Idling and loading affect ton-mi/gal

- Full load (28 t), idle
- Full load, APU
- Part load (17 t), idle
- Part load, APU
- Empty

Argonne National Laboratory
Transportation Technology R&D Center
Estimate of typical maintenance saving

- If oil change costs $150 and is required every 15,000 miles, cost/mile = $.01
- If overhaul costs $5000 and is done after 500,000 miles, cost/mile = $.01
- Maintenance thus totals $.02/mile
- If each hour idled equals 7 miles, then maintenance $.14/h (wear based on fuel use)
- Need industry input to verify conversion from idling hours to miles
Payback times are short

<table>
<thead>
<tr>
<th>Type</th>
<th>Cost ($)</th>
<th>Y @1000 h</th>
<th>Y @ 3000 h</th>
<th>Y @ 5000 h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct-fired heater</td>
<td>3200</td>
<td>2.5</td>
<td>0.85</td>
<td>0.51</td>
</tr>
<tr>
<td>Thermal storage</td>
<td>2700</td>
<td>1.9</td>
<td>0.63</td>
<td>0.38</td>
</tr>
<tr>
<td>Direct heat with storage cooling</td>
<td>4200</td>
<td>3.8</td>
<td>1.3</td>
<td>0.75</td>
</tr>
<tr>
<td>APU</td>
<td>7100</td>
<td>6.0</td>
<td>2.0</td>
<td>1.2</td>
</tr>
<tr>
<td>Truck stop electrification</td>
<td>1700 + 2500/spot</td>
<td>3.8</td>
<td>1.3</td>
<td>0.76</td>
</tr>
</tbody>
</table>
All alternatives reduce impacts

<table>
<thead>
<tr>
<th>Technology</th>
<th>Energy Use ($10^{12}$ Btu)</th>
<th>Petroleum ($10^6$ gal)</th>
<th>CO$_2$ Emissions ($10^6$ tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truck Engine Idling</td>
<td>107.5</td>
<td>838.1</td>
<td>9.6</td>
</tr>
<tr>
<td>Direct-fired heater plus idle cooling</td>
<td>64.7</td>
<td>504.4</td>
<td>5.8</td>
</tr>
<tr>
<td>Direct-fired heater plus thermal storage cooling</td>
<td>10.2</td>
<td>79.2</td>
<td>0.9</td>
</tr>
<tr>
<td>Auxiliary power unit</td>
<td>19.3</td>
<td>150.9</td>
<td>1.7</td>
</tr>
<tr>
<td>Truck stop electrification</td>
<td>34.2</td>
<td>2.1</td>
<td>2.5</td>
</tr>
</tbody>
</table>

(National totals @ 1830 h/y)
Alternatives to idling do

• Reduce energy use and diesel fuel consumption
• Reduce air pollution
• Achieve acceptable payback times

• Conclusions are based on typical technologies and best data available
• No endorsements are implied
What should be done

• Get better data on current practice
• Get better data on emissions
• Check mileage equivalent to idling
• Continue information dissemination
• Consider governmental incentives
  – tax credits
  – low-interest loans
Acknowledgments

- Sid Diamond, DOE-OHVT
- Argonne CTR Staff
- Jules Routbort, Argonne
- Equipment manufacturers
- Trucking industry