Diesel Emissions Quantifier (DEQ)

Presentation to NASEO

Jeffra Rockwell, US EPA
Office of Transportation and Air Quality
March 29, 2017
What is DEQ?

• Estimator for evaluating clean diesel projects and upgrade options for medium-heavy and heavy-heavy duty diesel engines
• Interactive, web-based tool for users without modeling experience
• New release coming in April 2017
What DEQ Does

• Assesses onroad, nonroad, locomotive and marine projects
• Accepts user-specific inputs for engine specs and usage
• Allows for multiple upgrades (emission control devices, idle reduction, replacements, alternative fuels, etc.)
• Provides annual and lifetime estimates for
  – Baseline emissions (in short tons)
  – Reduced emissions (in short tons and % of baseline)
  – Cost effectiveness (total project and/or capital costs)
  – PM related health benefits (needs updating)
What DEQ Doesn’t Do

• Does not estimate
  – Emissions from C3 marine engines
  – GHG reductions except for CO₂ when fuel usage is reduced
  – Offsets for emissions from power plants
  – Black carbon emissions
  – Health benefits from NOx, HC and CO reductions

• Cannot be used for SIPs or Conformity
How DEQ works

• For engine or vehicle replacements:
  *DEQ estimates emissions from both the old and new engines. The difference is the estimated emission reduction resulting from the replacement.*

• For other upgrades (emission controls, idle reduction, etc.):
  *DEQ applies EPA or CARB verified emission reduction factors to the baseline emissions. The result is the estimated emission reduction from the upgrade.*
Assumptions in DEQ

- CNG, LNG and LPG engine/vehicle replacements use diesel criteria pollutant factors as a surrogates.
  - No good data source for alternative fuel & engine factors
  - Alternative fuel engines must meet diesel standards
  - Converts alternate fuel to diesel-equivalent gallons for CO$_2$

- Median life is used in estimating lifetime reductions; this may be edited, but the value is capped.

- For nonroad, locomotive and marine, assigns baseline engine year or tier when only one of these is entered.
Data sources for DEQ

- Onroad – MOVES2014a (in-use data)
- Nonroad
  - Factors & formulas from the NONROAD model
  - EPA regulatory documents
- Locomotive – EPA regulatory documents
- Marine – EPA regulatory documents
- Emission reductions from EPA and CARB verification and certification programs
Strengths of DEQ

- Easy to use
- Projects can be saved for later editing and review
- Inputs and results are downloadable in Excel format
- Historic baseline data
  - Onroad beginning 1985
  - Nonroad, locomotive and marine beginning 1973
- Specific emission factors for running, duty-cycle idling & hoteling for onroad vehicles
- Duty-cycle specific factors for line haul locomotives
Limitations of DEQ

• No NOx reduction with switch from ULSD to alternative fuel (may see reductions from newer engine or other upgrade)
  – *Uses ULSD factors for criteria pollutants*
  – *Have factors for B5 and B20 for onroad vehicles*

• No offset of power plant emissions for electric engine/vehicle replacements or electrified parking spots

• Health benefits module needs updating
Create New Project – onroad, nonroad or locomotive

To estimate total cost for this project, enter funding amounts in the fields below. Total costs reflect all funding related to this project, including capital and administrative costs.

- EPA Awarded Funds $0
- Mandatory Cost Share $0
- Voluntary Cost Share $0
- Leveraged Funds $0
- Other $0

To estimate capital cost effectiveness for each upgrade, enter the unit and labor costs on the ‘Add Upgrade’ or ‘Edit Upgrade’ screen. You may estimate both total cost effectiveness and capital cost effectiveness.
Add Vehicle or Engine Group – onroad, nonroad or locomotive

<table>
<thead>
<tr>
<th>Onroad Vehicle:</th>
<th>Nonroad Equipment:</th>
<th>Locomotive:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long Haul - Combination</td>
<td>Agriculture</td>
<td>Line Haul Locomotive</td>
</tr>
<tr>
<td>Long Haul - Single Unit</td>
<td>Construction</td>
<td>Passenger Locomotive</td>
</tr>
<tr>
<td>Refuse Hauler</td>
<td>Ports and Airports</td>
<td>Switch Locomotive</td>
</tr>
<tr>
<td>School Bus</td>
<td>Rail</td>
<td></td>
</tr>
<tr>
<td>Short Haul - Combination</td>
<td>Stationary</td>
<td></td>
</tr>
<tr>
<td>Short Haul - Single Unit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transit Bus</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Define a Vehicle Group - onroad
Define a Vehicle Group – nonroad and locomotive
Add an Upgrade – onroad, nonroad or locomotive

<table>
<thead>
<tr>
<th>Action</th>
<th>Upgrade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Idling Control Strategies:</strong></td>
</tr>
<tr>
<td></td>
<td>Auxiliary Power Unit</td>
</tr>
<tr>
<td></td>
<td>Electrified Parking Space</td>
</tr>
<tr>
<td></td>
<td>Fuel Operated Heater</td>
</tr>
<tr>
<td></td>
<td>Other Idling Control Strategies</td>
</tr>
<tr>
<td></td>
<td><strong>Emissions Control Devices:</strong></td>
</tr>
<tr>
<td></td>
<td>Diesel Oxidation Catalyst</td>
</tr>
<tr>
<td></td>
<td>Diesel Oxidation Catalyst + Closed Crankcase Ventilation</td>
</tr>
<tr>
<td></td>
<td>Diesel Oxidation Catalyst + Diesel Particulate Filter</td>
</tr>
<tr>
<td></td>
<td>Diesel Particulate Filter</td>
</tr>
<tr>
<td></td>
<td>Exhaust Gas Recirculation + Diesel Particulate Filter</td>
</tr>
<tr>
<td></td>
<td>Selective Catalytic Reduction + Diesel Particulate Filter</td>
</tr>
<tr>
<td></td>
<td>Other Emissions Control Devices</td>
</tr>
<tr>
<td></td>
<td><strong>Replacements:</strong></td>
</tr>
<tr>
<td></td>
<td>Engine Replacements</td>
</tr>
<tr>
<td></td>
<td>Vehicle Replacements</td>
</tr>
<tr>
<td></td>
<td><strong>Fuel Options:</strong></td>
</tr>
<tr>
<td></td>
<td>Biodiesel (R5)</td>
</tr>
<tr>
<td></td>
<td>Biodiesel (B20)</td>
</tr>
<tr>
<td></td>
<td>Other Fuel Options</td>
</tr>
<tr>
<td></td>
<td><strong>Aerodynamic Devices:</strong></td>
</tr>
<tr>
<td></td>
<td>Trailer Bubble / Tails</td>
</tr>
<tr>
<td></td>
<td>Trailer side skirts</td>
</tr>
<tr>
<td></td>
<td><strong>Tire Technology:</strong></td>
</tr>
<tr>
<td></td>
<td>Single Wide Tires</td>
</tr>
<tr>
<td></td>
<td>Other Fuel Efficient Tire</td>
</tr>
</tbody>
</table>

No upgrades have been applied.
Add an Upgrade - onroad

For best cost effectiveness results, enter the costs for every upgrade in your project. Your results will be skewed if you enter costs for only some of the upgrades.

- New Engine Model Year
- Annual Gallons Fuel Reduced (for group)

Percent of Emissions Reduced:
- NOx
- PM2.5
- HC
- CO
- CO₂

Annual Idling Hours Reduced (per vehicle)
Annual Hoteling Hours Reduced (per vehicle)

Upgrade Cost Per Unit
Labor Cost Per Unit

Percent of Emissions Reduced:
- NOx 94%
- PM2.5 81%
- HC 0%
- CO 0%
- CO₂ 75%
Add an Upgrade – nonroad and locomotive

For best cost effectiveness results, enter the costs for every upgrade in your project. Your results will be skewed if you enter costs for only some of the upgrades.

Upgrade Type
- Engine or Vehicle Replacement
- Engine Replacement - Diesel

Upgrade
- Select

New Engine Model Year
- Select

And/or New Tier
- Select

New Horsepower
- 

Annual Gallons Fuel Reduced (for group)
- 

Upgrade Cost Per Unit $
- 

Labor Cost Per Unit $
- 

Percent of Emissions Reduced
- NOx 65 %
- PM2.5 0 %
- HC 90 %
- CO 85 %
- CO2 0 %
Create New Project – marine
Add Engine Group – marine

Add an Engine Group

Propulsion
Auxiliary

<< Back to My Projects  Quantify Project Emissions
Define an Engine Group - marine
### Emission Results

Here are the combined results for all groups and updates entered for your fleet.¹

#### Annual Results (short tons)

<table>
<thead>
<tr>
<th></th>
<th>NOₓ</th>
<th>PM2.5</th>
<th>HC</th>
<th>CO</th>
<th>CO₂</th>
<th>Fuel²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline for Upgraded Vehicles</td>
<td>2.314</td>
<td>0.091</td>
<td>0.164</td>
<td>0.759</td>
<td>192.6</td>
<td>17,349</td>
</tr>
<tr>
<td>Amount Reduced After Upgrades</td>
<td>0.000</td>
<td>0.018</td>
<td>0.082</td>
<td>0.303</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Percent Reduced After Upgrades</td>
<td>0.0%</td>
<td>20.0%</td>
<td>50.0%</td>
<td>40.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

#### Lifetime Results (short tons)

<table>
<thead>
<tr>
<th></th>
<th>NOₓ</th>
<th>PM2.5</th>
<th>HC</th>
<th>CO</th>
<th>CO₂</th>
<th>Fuel²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline for Upgraded Vehicles</td>
<td>4.627</td>
<td>0.182</td>
<td>0.328</td>
<td>1.517</td>
<td>385.1</td>
<td>34,698</td>
</tr>
<tr>
<td>Amount Reduced After Upgrades</td>
<td>0.000</td>
<td>0.036</td>
<td>0.164</td>
<td>0.607</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Percent Reduced After Upgrades</td>
<td>0.0%</td>
<td>20.0%</td>
<td>50.0%</td>
<td>40.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>
Cost Effectiveness

**Lifetime Cost Effectiveness ($/short ton reduced)**

<table>
<thead>
<tr>
<th></th>
<th>$0</th>
<th>$68,580</th>
<th>$15,248</th>
<th>$4,120</th>
<th>$0</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capital Cost Effectiveness</strong> (unit &amp; labor costs only)</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td><strong>Total Cost Effectiveness</strong> (includes all project costs)</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
</tbody>
</table>

1. Emissions from the electrical grid are not included in the results.
2. In gallons; fuels other than ULSD have been converted to ULSD-equivalent gallons.

**Remaining Life**

<table>
<thead>
<tr>
<th>long haul: Long Haul - Combination</th>
<th>Class 8</th>
<th>2.0 years</th>
</tr>
</thead>
</table>

Health Benefits

Note: For comparison purposes only. The Health Benefits module data is out of date and will be updated when resources become available.

This section estimates the health benefits resulting from your project’s reduction of PM 2.5, based on the inputs you have entered.

You may select up to five counties where the emission reductions will take place and allocate a percentage of the reductions to each of the counties selected. The percentages must total 100 percent.

<table>
<thead>
<tr>
<th>State</th>
<th>County</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michigan</td>
<td>Washtenaw</td>
<td>30</td>
</tr>
<tr>
<td>Michigan</td>
<td>Wayne</td>
<td>70</td>
</tr>
</tbody>
</table>

Total 100
Health Benefit Results

The table below shows the estimated PM2.5 reductions and health benefits by county and as a total for your project. Results are based on the inputs you have entered.

Annual Benefits represent the dollar value of health benefits resulting from reduced exposure to PM2.5. These benefits include the reduction of premature mortality, chronic bronchitis, asthma attacks, non-fatal heart attacks, and other health problems. The dollar values are based on studies used by EPA when estimating the health benefits of environmental rules.

Annualized Costs are based on the unit and labor costs you have entered. They have been annualized over the remaining life of the upgraded fleet.

<table>
<thead>
<tr>
<th>County and State</th>
<th>Annual Diesel PM2.5 Reduction (short tons)</th>
<th>Annual Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washtenaw, Michigan</td>
<td>0.032</td>
<td>$20,000</td>
</tr>
<tr>
<td>Wayne*, Michigan</td>
<td>0.074</td>
<td>$99,000</td>
</tr>
<tr>
<td>Total</td>
<td>0.106</td>
<td>$120,000</td>
</tr>
</tbody>
</table>

Annualized Unit & Labor Costs for the Project: $0
For More Information

DEQ website

www.epa.gov/cleandiesel/diesel-emissions-quantifier-deq

Questions about DEQ or the DERA option

cleandiesel@epa.gov

877-623-2322