User Guide for the Diesel Emissions Quantifier (DEQ)

*July 15, 2021*

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Section 1: About the DEQ

The Diesel Emissions Quantifier (DEQ) is a web-based, data-driven estimator that enables you to evaluate replacement projects and upgrade options for heavy-duty diesel engines. It does so by asking for project specifics, (e.g. fleet information, usage, upgrade or replacement details). Using this information and EPA-approved data sources, the DEQ estimates annual and lifetime baseline (pre-upgrade) emissions, post-upgrade emissions reductions, and cost effectiveness of the project. Diesel emissions and reductions are estimated for fine particulate matter (PM2.5), nitrogen oxides (NOx), hydrocarbons (HC), carbon monoxide (CO) and carbon dioxide (CO2).

Section 2: Your Account

Section 2.1: Create an Account

The Diesel Emissions Quantifier is best used by logging into an account so that you may save your projects. To create an account, navigate to the DEQ login screen (https://cfpub.epa.gov/quantifier/), and click the blue "**Create User Account**" link.

Figure 1: Create User Account
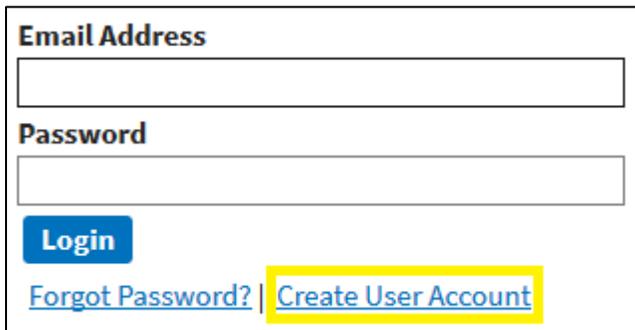
This will bring you to a page where you must provide some basic information to create the account. Your email address and password will be used to sign in. The email address will also be used to provide a temporary password in the case that you cannot remember your password.

Fill out the form and click "**Register**" to create the account. You will be automatically logged in to your new account.

Section 2.2: Forgot Password

If you have forgotten your password, navigate to the DEQ login screen (https://cfpub.epa.gov/quantifier/), and click the blue "**Forgot Password?**" link.

Figure 2: Forgot Password

On the "Reset Your Password" page, enter the email address associated with your DEQ account. You will receive an automated email at this address from DEQHelp@epa.gov providing an auto-generated password and instructions on how to use it. You must change your password the next time you log in.

Section 2.3: Update Account

Once you are logged in, you can access your user profile by clicking on your first name at the top right-hand side of the screen.

Figure 3: Update Account

Once on this page, you can update your profile information in the **User Information** section or update your password in the **Reset Password** section. Make sure you hit "Update Profile" in order to save your changes.

Figure 4: Update User Account

Section 3: Data Entry for Emissions Quantification

Section 3.1: Getting Started

To use the DEQ, begin by logging into your account. If you need to create an account, see **Section 2.1: Create an Account**. If you forgot your password, see **Section 2.2: Forgot Password**. Alternatively, you may use the DEQ without logging in by clicking the link at the bottom right of the login page.

On the right side of the home screen there is a green box with information about recent changes to the DEQ that you may find helpful.

Figure 5: DEQ Log In Screen

Section 3.2: Create a Project

Once you log in, you will be taken to the "**My Projects in the DEQ**" page. In the Diesel Emissions Quantifier, all quantifications are performed at the project level. A project contains all vehicles and/or engines that you would like to quantify together. To estimate emissions and emissions reductions, you must first create a project. To begin, click the "**Create New Project**" button.

Figure 6: Create New Project Button

This will take you to the "**Create New Project**" page. On this page, enter a name for your project as well as the total costs for your project (this includes EPA funds, applicant funds, administrative costs, etc.) then hit "**Save Project**". If you wish to change these values at a later time, see **Section 3.8: Edit a Project**.

Create New Project

Project Name Sample Project

To estimate Total Cost Effectiveness for this project, enter total costs in the field below. Total costs reflect all costs related to this project, including capital and administrative costs.

Total Project Costs $ 138,000

To estimate Capital Cost Effectiveness for an upgrade, enter the unit and labor costs on the 'Add Upgrade' or 'Edit Upgrade' screen. These costs are also used to estimate annualized capital costs for comparison with annual health benefits.

You may estimate both Total Cost and Capital Cost Effectiveness.

Save Project Cancel

Figure 7: Create New Project page

This will take you to the "**Update Project Information**" page, which includes details about your project.

Section 3.3: Add an Engine Group

Once you've created your project, you will see a blue bar that says "**Add a Vehicle or Engine Group**" from the "Update Project Information" page. Click the blue bar to display the vehicle and engine type options.

Important Note: Each Project in the DEQ can contain multiple Vehicle or Engine Groups. Each Vehicle or Engine Group can contain any quantity of similar vehicles/engines with similar usage.

Figure 8: Add a Vehicle or Engine Group

For definitions of the different vehicle/equipment types, see **Section B.1: Vehicle/Equipment Types** in **Appendix B: Glossary of Terms**. Once you click on your desired vehicle or engine type, you will be taken to the "**New Vehicle Group**" page. Information requested will differ dependent on the applicable vehicle group selected. Below is an example of the "New Vehicle Group" page for a school bus. You must enter information about the group, about the vehicle specifics, and about the usage of the vehicles.

Vehicle groups may contain a single vehicle or multiple vehicles. Multiple vehicles of same or similar type, age and usage may be combined into a vehicle group. The same inputs will be applied to each vehicle in a single group, with average values entered for age and usage. Alternatively, each vehicle may be entered as its own vehicle group in order to capture specific or differing age and usage information. For more detailed information about each entry field, see **Section B.2: Data Entry Terms** in **Appendix B: Glossary of Terms**.

New Vehicle Group

Group Name	Sample Group [?]
Type	Onroad
Target Fleet	School Bus ⌄
Quantity	5
Baseline Engine Model Year	2005 ⌄
Baseline Fuel Type	ULSD (diesel) ⌄ [?]

Please enter your actual or estimated per vehicle usage. If you do not have this information, some defaults are available.

Annual Fuel Gallons	1,500	Get Default Value
Diesel-equivalent Gallons	1,500	
Annual Miles Traveled	15,000	Get Default Value
Annual Idling Hours	250	Get Default Value [?]

Upgrade Year 2020 ⌄ [?]

DEQ uses 'Remaining Life' to calculate lifetime emission reductions. Remaining life is the fleet owner's estimate of the number of years until the unit would have been retired from service if the unit were not being upgraded or scrapped, even if the unit were to be rebuilt or sold to another fleet. The remaining life estimate depends on the current age and condition of the vehicle at the time of upgrade, as well as things like usage, maintenance and climate.

Remaining Life of Baseline Engine/Vehicle 5
(in years at time of upgrade)

Save Group Cancel

Figure 9: New Vehicle Group page for a school bus

Once you have completed the required fields, hit "**Save Group**". You will be returned to the page for your project and you can see your newly saved group, with the Group Name above, and the details entailed in a box.

Update Project Information

Project Name Sample Project

Edit Project | Delete Project

Total Project Costs $ 138,000

Add a Vehicle or Engine Group +

Group Name: Sample Group

Type Onroad	**Engine Model Year** 2005	**Fuel Type** ULSD (diesel)
Target Fleet School Bus	**Upgrade Year** 2020	**Annual Fuel Gallons** 1,500
Quantity 5	**Remaining Life** 5	**Diesel-equivalent Gallons** 1,500
		Annual Miles Traveled 15,000
		Annual Idling Hours 250

Edit Group **Copy This Group** Delete

Figure 10: Sample Group details

If you'd like to add another engine group, you can find the same blue "Add a Vehicle or Engine Group" bar at both the top and the bottom of the page.

Section 3.4: Copy an Engine Group

If you'd like to enter multiple engine groups for engines that share many similar characteristics (e.g. two cranes that are utilized similarly, however possess different model years) you may wish to utilize the "**Copy This Group**" feature. This button will create a copy of the selected group, allowing you to assign a new name before saving, by clicking "Go". You may then edit this copy (or the original) to make changes that differentiate the two groups (e.g. updating model year). All groups within the saved project can be viewed on the same webpage.

Figure 11: Copy an Engine Group

Section 3.5: Edit an Engine Group

If you'd like to edit any saved group, click the "**Edit Group"** button within the appropriate group box.

Figure 12: Edit an Engine Group

Section 3.6: Add an Upgrade

In order to quantify the benefits of replacing or upgrading your baseline vehicle/engine, you must add an upgrade in the DEQ. Below the "Upgrades to [Group Name]" section, select the blue "**Add an Upgrade**" bar. Once clicked, the bar will expand, prompting you to select upgrade options. Upgrade options and criteria are dependent on engine types (e.g. upgrade options differ between refuse haulers and long haul combination trucks).

Group Name: Sample Group

Type Onroad	**Engine Model Year** 2005	**Fuel Type** ULSD (diesel)
Target Fleet School Bus	**Upgrade Year** 2020	**Annual Fuel Gallons** 1,500
Quantity 5	**Remaining Life** 5	**Diesel-equivalent Gallons** 1,500
		Annual Miles Traveled 15,000
		Annual Idling Hours 250

Edit Group | **Copy This Group** | Delete

Upgrades to Sample Group

Action	Upgrade	Cost per Unit		Percent Reduction				
		Upgrade	Labor	NO$_x$	PM2.5	HC	CO	CO$_2$
No upgrades have been applied.								

Add an Upgrade   −

Emission Control Devices are verified for ULSD-fueled vehicle groups only.
Fuel Options are for vehicle groups fueled with ULSD or biodiesel only. **For other fuel types,** select Engine or Vehicle Replacement.
For guidance on **Truck Stop Electrification Facilities,** see Truck Stop Electrification Facility: Emission Reduction Calculation (PDF) (1 pg, 118 K, About PDF)

Idling Control Strategies:
Fuel Operated Heater
Other Idling Control Strategy

Emission Control Devices:
Diesel Oxidation Catalyst
Diesel Oxidation Catalyst + Closed Crankcase Ventilation
Diesel Oxidation Catalyst + Diesel Particulate Filter
Diesel Particulate Filter
Exhaust Gas Recirculation + Diesel Particulate Filter
Selective Catalytic Reduction + Diesel Particulate Filter
Other Emission Control Device

Replacements:
Engine Replacement
Vehicle Replacement

Fuel Options: ?
Biodiesel (B5)
Biodiesel (B20)
Other Fuel Option

Figure 13: Add an Upgrade button

Once you click on your desired upgrade, you will be taken to the "**Add an Upgrade**" page. Different information is required depending on the type of upgrade you selected (e.g., fuel use, horsepower, etc.). Once you have completed the required fields, hit "**Save Upgrade**".

***Important Note:** If quantifying a future vehicle/engine replacement, you can estimate New Annual Fuel Volume with expected usage and manufacturer-provided fuel efficiency (including for alternative fuel vehicles). Prospective vehicle/engine replacements can be quantified or estimated as follows:*

Onroad Vehicles:

$$Fuel\ gallons = \frac{expected\ miles\ traveled}{new\ vehicle\ mpg}$$

Nonroad Vehicles:

$$Fuel\ gallons = (expected\ usage\ hours) \times (new\ vehicle\ \frac{gal}{hr})$$

Alternately, you may select "Use Baseline Fuel-Equivalent." This will automatically input the New Annual Fuel Volume as the equivalent of the baseline fuel volume. However, this will result in zero CO_2 or Fuel reductions for that upgrade.

Figure 14: Add an Upgrade page

> *Important Note: Upgrade Cost represents the cost of each upgrade. Labor Cost represents the cost of labor to install each upgrade. If using the DEQ to quantify a grant project, these fields should be filled out with the total upgrade and labor costs per unit, irrespective of any cost shares associated with the grant.*

You will be returned to the page for your project and you can see your newly saved upgrade under "**Upgrades to [Group Name]**". You will also see the same blue bar giving you the option to add more upgrades to your group.

Group Name: Sample Group

Type Onroad	**Engine Model Year** 2005	**Fuel Type** ULSD (diesel)
Target Fleet School Bus	**Upgrade Year** 2020	**Annual Fuel Gallons** 1,500
Quantity 5	**Remaining Life** 5	**Diesel-equivalent Gallons** 1,500
		Annual Miles Traveled 15,000
		Annual Idling Hours 250

Edit Group **Copy This Group** Delete

Upgrades to Sample Group

Action	Upgrade	Cost per Unit		Percent Reduction				
		Upgrade	Labor	NO$_x$	PM2.5	HC	CO	CO$_2$
Edit Delete	Diesel Oxidation Catalyst + Closed Crankcase Ventilation	$567	$189	0	28	50	34	0

Add an Upgrade	+

Figure 15: Upgrade details

If you need to edit your entered values for an upgrade, click the "Edit" button at the beginning of the upgrade row.

Section 3.7: Copy a Project

If you would like to enter multiple projects that share many of the same or similar aspects (e.g., you would like to test which upgrade or combination of upgrades would give you the highest emission reductions), you may wish to utilize the **"Copy"** feature. To copy a project, you must navigate to the "**My Projects in the DEQ**" page, which is the same page you are directed to upon logging in, by clicking the "**Back to My Projects**" button (or the "**My Projects**" breadcrumb above it) at the top of the page.

Figure 16: Navigate to "My Projects in the DEQ" page

Clicking the "**Copy**" button will create a copy of the existing project, prompting you to assign a new name before saving. You may then edit this copy (or the original) to make changes that differentiate the two projects.

Figure 17: Copy a Project

Section 3.8: Edit a Project

In order to edit an existing project, you will want to access the "**Update Project Information**" page. From your home "**My Projects in the DEQ**" page, click the blue "**Update**" button next to the project you would like to edit.

Figure 18: Update a Project

On this page, you can add a vehicle or engine group and/or upgrades. You may also edit the **"Project Name"** and "**Total Project Costs**" fields by selecting the "**Edit Project**" button on the "**Update Project Information**" screen. This will bring you back to the "**Create New Project**" page for that project.

*Figure 19: Edit Project Information*

Be sure to hit "**Save Project**" when your edits are complete.

Section 4: Emissions Quantification

Section 4.1: Quantify Project Emissions

Once you have finished adding engine groups and their upgrades to your project, you can quantify your project to see baseline emissions, emissions reductions, and cost effectiveness. There are several ways to quantify your emissions.

From your home "My Projects in the DEQ" page, click the blue "**Quantify**" button next to the project you would like to quantify.
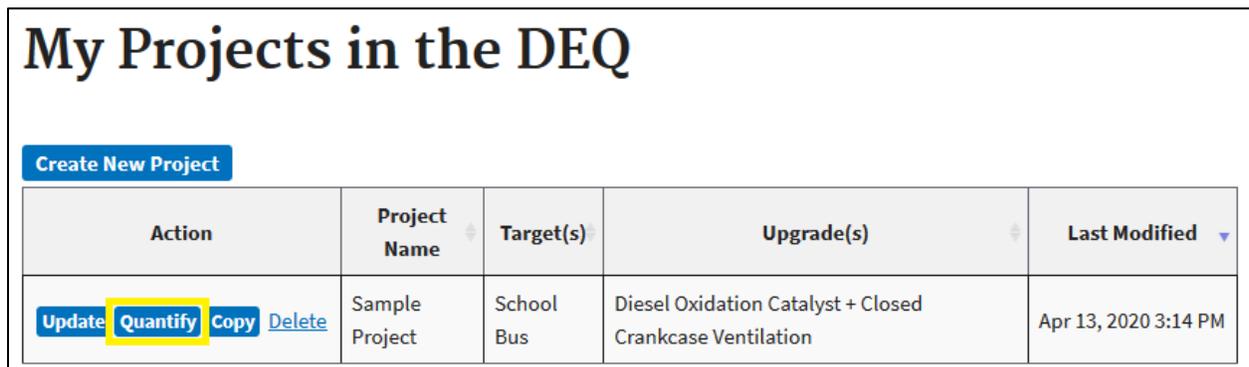
Figure 20: Quantify from "My Projects in the DEQ" page

You may also quantify from the "**Update Project Information**" page. At both the top and the bottom of the page, you can click the "**Quantify Project Emissions**" button.

Figure 21: Quantify from "Update Project Information" page

Clicking either button will direct you to the "**Emission Results and Health Benefits**" page for your quantified project.

Section 4.2: Emissions Results

On the emission results page, you see overall baseline emissions, emissions reductions, and cost effectiveness for your project. Emissions calculations are broken down into Annual Results

(expected values for each year) and Lifetime Results (calculated with the user-entered Remaining Life value).

For more detailed information about each output field, see **Section B.3: Data Output Terms** in **Appendix B: Glossary of Terms**.

Emission Results and Health Benefits for Project: Sample Project

Emission Results   Health Benefits

Emission Results [?]

Here are the combined results for all groups and upgrades entered for your project.[1]

Annual Results (short tons)[2]	NOx	PM2.5	HC	CO	CO$_2$	Fuel[3]
Baseline for Upgraded Vehicles/Engines	0.550	0.049	0.079	0.285	84.4	7,500
Amount Reduced After Upgrades	0.000	0.014	0.039	0.097	0.0	0
Percent Reduced After Upgrades	0.0%	28.0%	50.0%	34.0%	0.0%	0.0%
Lifetime Results (short tons)[2]						
Baseline for Upgraded Vehicles/Engines	2.748	0.247	0.394	1.426	421.9	37,500
Amount Reduced After Upgrades	0.000	0.069	0.197	0.485	0.0	0
Percent Reduced After Upgrades	0.0%	28.0%	50.0%	34.0%	0.0%	0.0%
Lifetime Cost Effectiveness ($/short ton reduced)						
Capital Cost Effectiveness[4] (unit & labor costs only)	$0	$54,751	$19,175	$7,796	$0	
Total Cost Effectiveness[4] (includes all project costs)	$0	$1,998,860	$700,032	$284,599	$0	

Figure 22: Emission Results for Sample Project

> *Important Note: Not seeing the CO$_2$ emission reduction results you expected? In some cases (e.g., replacements), the DEQ uses fuel consumption changes to calculate changes in CO$_2$ emissions. Be sure your upgrade or replacement properly characterizes changes in fuel usage that will result from your upgrade/replacement.*

Vehicle/engine group-level results can be downloaded as an xls file using the "**Spreadsheet**" link at the bottom of the page. For a csv file, use the "**Importable Spreadsheet**" link.

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Downloading Spreadsheets

Results may be downloaded as a:
- Spreadsheet showing DEQ results and your inputs (click on 'yes' if you get an error message).
- Importable CSV for EPA staff loading results into DRIVER (please download and save without opening).

Figure 23: Downloading Spreadsheet

__Important Note:__ This User Guide does not provide instructions on using the Health Benefits calculations in the DEQ tool. EPA cautions that the data supporting the Health Benefits calculations are out of date.

Appendix A: List of Figures

Appendix B: Glossary of Terms

Below is a glossary of terms you may encounter in the Diesel Emissions Quantifier. The entry and output terms are listed in the general order you will encounter them in the DEQ.

Section B.1: Vehicle/Equipment Types

Locomotive – Diesel engines certified to EPA locomotive emission standards

Marine – Diesel engines certified to Category 2 and smaller EPA marine emission standards

Nonroad – Compression-ignition (CI) and spark-ignition (SI) engines certified to EPA nonroad emission standards

Onroad – Compression-ignition (CI) and spark-ignition (SI) engines certified to EPA heavy-duty highway emission standards

Section B.2: Data Entry Terms

Total Project Costs – The total costs for your DEQ project, including EPA funds, applicant/recipient funds, administrative costs, etc.

Baseline – Fields that start with "Baseline" describe the attributes of your original engine or vehicle, before any upgrades were applied.

New – Fields that start with "New" describe the attributes of your vehicle post-upgrade. For example, when applying an Idling Control Strategy, New Annual Idling Hours describes the hours your vehicle spends idling annually once that idling control strategy is in use.

Quantity – The number of vehicles or engines in your DEQ vehicle or engine group.

Sector – The industry which the vehicle(s) or equipment are serving.

Target Fleet – The type of vehicle(s), engine(s), or equipment.

Class – (Onroad only) The truck(s) classification, based on Gross Vehicle Weight Rating (GVWR).

Vocation – (Onroad and Marine only) The purpose which the vehicle(s) or marine engine(s) are serving; for Marine, this corresponds to the vessel type.

Model Year – The engine(s) model year, as designated by the manufacturer.

Tier – (Nonroad, Marine, and Locomotive only) The federal emission standards to which the engine(s) is certified.

Fuel Type – The type of fuel used by the engine(s) or vehicle(s) in the engine or vehicle group.

Default Value – An average (either mean or most common) value for the given vehicle/equipment type(s), based on real-world usage.

Annual Miles Traveled – (Onroad only) The average of the distance (in miles) each vehicle in the group travels per year.

Annual Idling Hours – (Onroad only) The average of the hours each vehicle in the group spends short-term idling (e.g., at a stop light) per year.

Annual Hoteling Hours – (Long-Haul Combination trucks only) The average of the hours each truck in the group spends hoteling per year.

Annual Fuel Gallons – The average of the volume (in gallons*) of fuel used by each engine or vehicle in the group per year (*Note: Exception of CNG, where the unit is chosen by the user).

Diesel-equivalent Gallons – If a fuel other than Ultra-Low Sulfur Diesel (ULSD) is chosen by the user, the entered fuel volume is converted to diesel-equivalent gallons.

Annual Usage Hours – (Nonroad, Marine, and Locomotive only) The average of the hours each engine or vehicle in the group is used per year.

Horsepower – (Nonroad, Marine, and Locomotive only) The rated horsepower of the engine(s).

Cylinder Displacement – (Marine only) The total cylinder volume (in liters) per engine.

Load Factor – (Nonroad, Marine, and Locomotive only) The ratio of the actual (average) amount of engine power used to the maximum possible (the capacity).

Tier 4 Standards – (Nonroad Tier 4 only) The phase of Tier 4 standard (interim or final) to which the engine(s) is certified.

After-Treatment Configuration – (Nonroad Tier 4 only) The after-treatment configuration (relating to Diesel Particulate Filter and Selective Catalytic Reduction) of the engine.

Upgrade Year – The year in which the upgrade(s) were or will be applied.

Remaining Life – The estimated number of years until the unit(s) would have been retired from service if the unit(s) were not being upgraded or scrapped.

Upgrade – A technology (including retrofits, cleaner engines, cleaner fuels, etc.) that is applied to an engine or vehicle in order to reduce emissions.

Upgrade Cost Per Unit – The cost of each described upgrade. If using the DEQ to quantify a grant project, this field should be filled out with the upgrade costs per unit, irrespective of any cost shares associated with the grant.

Labor Cost Per Unit – The cost of labor to install each described upgrade, regardless of funding. If using the DEQ to quantify a grant project, this field should be filled out with the labor costs per unit, irrespective of any cost shares associated with the grant.

Section B.3: Data Output Terms

Annual Results – Expected baseline emissions and emissions reductions for one year.

Lifetime Results – Expected baseline emissions and emissions reductions for the lifetime of the vehicles/equipment in the project; Annual Results are multiplied by the user-entered Remaining Life value.

Baseline of Entire Project – The emissions and diesel-equivalent fuel usage for the entire project before upgrades were applied. This field will only appear if there is at least one vehicle/engine group without an upgrade applied.

Baseline for Upgraded Vehicles/Engines – The total emissions and diesel-equivalent fuel usage for your upgraded vehicle/engine groups before upgrades were applied.

Amount Reduced After Upgrades – Expected emission and fuel reductions from applied upgrades.

Percent Reduced After Upgrades – Expected reductions from applied upgrades, relative to baseline emissions and fuel usage.

Capital Cost Effectiveness – The amount of money (USD) spent on upgrade units and labor in order to reduce one short ton of pollutant over the lifetime of the vehicles/engines in your project.

Total Cost Effectiveness – The total amount of money (USD) spent on the project (including administration costs) in order to reduce one short ton of pollutant over the lifetime of the vehicles/engines in your project.