Appendix A

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The “REDIFUEL database” as well as the scripts to generate the “Superstructure database” and the “Truck database” are available online: <https://github.com/EVERGi-Brightway/REDIFUEL/tree/main>.

The “REDIFUEL database” is in spreadsheet format, which contains all assumptions and data sources used for the modelling, and it can directly be imported in brightway2 or the Activity-Browser.

This Appendix explains which processes were selected from the databases for the scenarios described in “Prospective Life Cycle Assessment of alternatively fueled heavy-duty trucks”.

Diagram

Description automatically generated

Figure A 1: System boundary and data sources of the inventories. The REDIFUEL database and the truck database are linked to the superstructure database. Legend: RF93UCOME7 is a mixture of 93% REDIFUEL and 7% UCOME, RME = Rapeseed methyl ester, UCOME = Used cooking oil methyl ester, ICET = internal combustion engine truck, PHET = plugin hybrid electric truck, BET = battery electric truck.

The general structure of each inventory block in the system boundary of Energy carrier production & distribution (Figure A 1) consists of an energy carrier production process and a refueling process (Figure A 2). Table A 1 and Table A 2 give an overview of the selected activities of the energy carrier production processes and the refueling processes.

Diagram

Description automatically generated

Figure A 2: General structure of Energy carrier production & distribution.

Table A 1: References to energy carrier production inventories in the respective databases selected for each scenario.

|  |  |  |  |
| --- | --- | --- | --- |
| Dataset name in Figure A1 | Dataset name(s) in the database | Database name | Notes |
| RF93UCOME7 | 1. REDIFUEL production, Worst  2. Biodiesel, from used cooking oil, at fuelling station, RER | 1. REDIFUEL database  2. Superstructure database | RF93UCOME7 consists of 93% REDIFUEL and 7% biodiesel from used cooking oil (UCOME). |
| Diesel (B0) | Market for diesel, low-sulfur, Europe without Switzerland | Superstructure database |  |
| RME | Biodiesel, from rapeseed oil, at fuelling station, RER | Superstructure database |  |
| UCOME | Biodiesel, from used cooking oil, at fuelling station, RER | Superstructure database |  |
| Electricity | Market group for electricity, low voltage, RER | Superstructure database |  |

Table A 2: References to refueling inventories in the respective databases selected for each scenario.

|  |  |  |  |
| --- | --- | --- | --- |
| Dataset name in Figure A1 | Dataset name(s) in the database | Database name | Notes |
| RF93UCOME7 | Fuel supply for biodiesel vehicles | Truck database |  |
| Diesel (B0) | Fuel supply for diesel vehicles | Truck database |  |
| RME | Fuel supply for biodiesel vehicles | Truck database |  |
| UCOME | Fuel supply for biodiesel vehicles | Truck database |  |
| Electricity |  | - | Losses due to charging are accounted for in the use-phase. |

The selected activities for truck construction and End-of-Life (EoL), the infrastructure construction and EoL, and the use-phase are given in Tables A 3, A 4, and A 5.

Table A 3: References to truck inventories in the respective databases selected for each scenario.

|  |  |  |  |
| --- | --- | --- | --- |
| Dataset name in Figure A1 | Dataset name(s) in the database | Database name | Notes |
| ICET | 1. Heavy duty truck, diesel, 40t gross weight, 2030, EURO-VI, long haul, 8.8t 2. Heavy duty truck, diesel, 40t gross weight, 2030, EURO-VI, long haul, 19.3t 3. Heavy duty truck, biodiesel, 40t gross weight, 2030, EURO-VI, long haul, 8.8t 4. Heavy duty truck, biodiesel, 40t gross weight, 2030, EURO-VI, long haul, 19.3t 5. Heavy duty truck, diesel, 40t gross weight, 2050, EURO-VI, long haul, 8.8t 6. Heavy duty truck, diesel, 40t gross weight, 2050, EURO-VI, long haul, 19.3t 7. Heavy duty truck, biodiesel, 40t gross weight, 2050, EURO-VI, long haul, 8.8t 8. Heavy duty truck, biodiesel, 40t gross weight, 2050, EURO-VI, long haul, 19.3t | Truck database |  |
| PHET | 1. Heavy duty truck, plugin diesel hybrid, 40t gross weight, 2030, EURO-VI, long haul, 8.8t 2. Heavy duty truck, plugin diesel hybrid, 40t gross weight, 2030, EURO-VI, long haul, 19.3t 3. Heavy duty truck, plugin diesel hybrid, 40t gross weight, 2050, EURO-VI, long haul, 8.8t 4. Heavy duty truck, plugin diesel hybrid, 40t gross weight, 2050, EURO-VI, long haul, 19.3t | Truck database |  |
| BET | 1. Heavy duty truck, battery electric, NMC-622 battery, 40t gross weight, 2030, long haul, 8.8t 2. Heavy duty truck, battery electric, NMC-622 battery, 40t gross weight, 2030, long haul, 19.3t 3. Heavy duty truck, battery electric, NMC-622 battery, 40t gross weight, 2050, long haul, 8.8t 4. Heavy duty truck, battery electric, NMC-622 battery, 40t gross weight, 2050, long haul, 19.3t | Truck database |  |

Table A 4: References to the infrastructure inventories in the respective databases selected for each scenario.

|  |  |  |  |
| --- | --- | --- | --- |
| Dataset name in Figure A1 | Dataset name(s) in the database | Database name | Notes |
| Road | 1. Market for road, GLO 2. Market for road maintenance, RER | Superstructure database |  |
| Charging | EV charger, level 3, plugin, 200 kW | Truck database |  |

Table A 5: References to the use-phase inventories in the respective databases selected for each scenario.

|  |  |  |  |
| --- | --- | --- | --- |
| Dataset name in Figure A 1 | Dataset name(s) in the database | Database name | Notes |
| ICET-RF / ICET-B0 | 1. Transport, freight, lorry, diesel, 40t gross weight, 2030, EURO-VI, long haul, 8.8t 2. Transport, freight, lorry, diesel, 40t gross weight, 2030, EURO-VI, long haul, 19.3t 3. Transport, freight, lorry, diesel, 40t gross weight, 2050, EURO-VI, long haul, 8.8t 4. Transport, freight, lorry, diesel, 40t gross weight, 2050, EURO-VI, long haul, 19.3t | Truck database | For ICET-RF, copies of these datasets were made with the following adaptations:   * Fuel consumption was decreased by 1.9% * CO2 emissions were decreased by 4.5% * Hydrocarbon emissions were reduced by 33% * Particulate matter emissions were decreased by 30% * CO emissions were increased by 4.7% |
| ICET-RME/ICET-UCOME | 1. Transport, freight, lorry, biodiesel, 40t gross weight, 2030, EURO-VI, long haul, 8.8t 2. Transport, freight, lorry, biodiesel, 40t gross weight, 2030, EURO-VI, long haul, 19.3t 3. Transport, freight, lorry, biodiesel, 40t gross weight, 2050, EURO-VI, long haul, 8.8t 4. Transport, freight, lorry, biodiesel, 40t gross weight, 2050, EURO-VI, long haul, 19.3t | Truck database |  |
| PHET-RF/PHET-B0 | 1. Transport, freight, lorry, plugin diesel hybrid, 40t gross weight, 2030, EURO-VI, long haul, 8.8t 2. Transport, freight, lorry, plugin diesel hybrid, 40t gross weight, 2030, EURO-VI, long haul, 19.3t 3. Transport, freight, lorry, plugin diesel hybrid, 40t gross weight, 2050, EURO-VI, long haul, 8.8t 4. Transport, freight, lorry, plugin diesel hybrid, 40t gross weight, 2050, EURO-VI, long haul, 19.3t | Truck database | For ICET-RF, copies of these datasets were made with the following adaptations:   * Fuel consumption was decreased by 1.9% * CO2 emissions were decreased by 4.5% * Hydrocarbon emissions were reduced by 33% * Particulate matter emissions were decreased by 30% * CO emissions were increased by 4.7% |
| BET | 1. Transport, freight, lorry, battery electric, NMC-622 battery, 40t gross weight, 2030, long haul, 8.8t 2. Transport, freight, lorry, battery electric, NMC-622 battery, 40t gross weight, 2030, long haul, 19.3t 3. Transport, freight, lorry, battery electric, NMC-622 battery, 40t gross weight, 2050, long haul, 8.8t 4. Transport, freight, lorry, battery electric, NMC-622 battery, 40t gross weight, 2050, EURO-VI, long haul, 19.3t | Truck database |  |