

# Model for Analysis of Energy Demand (MAED)

## Hands-on 4: Setting Up the Structure Part III

### Learning outcomes

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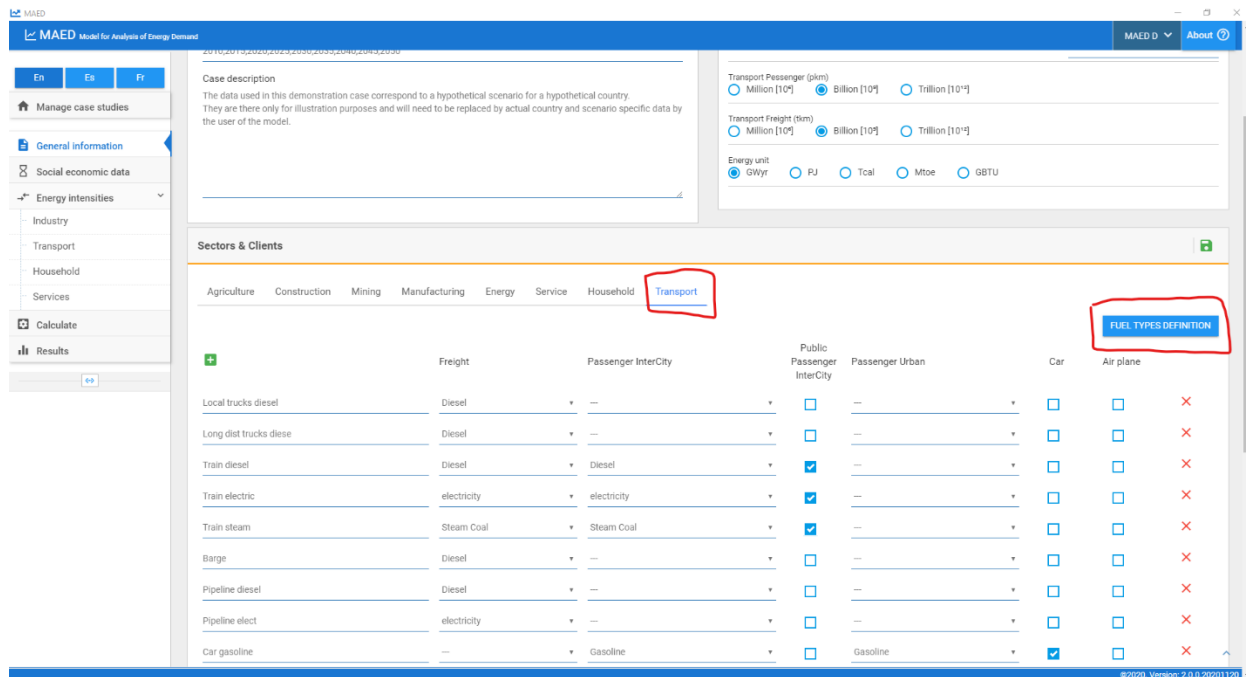
By the end of this exercise, you will be able to:

1. Define the structure of the transport sector
2. Configure the end-use categories

### Activity 1: Transport Sector - Fuel Types Definition

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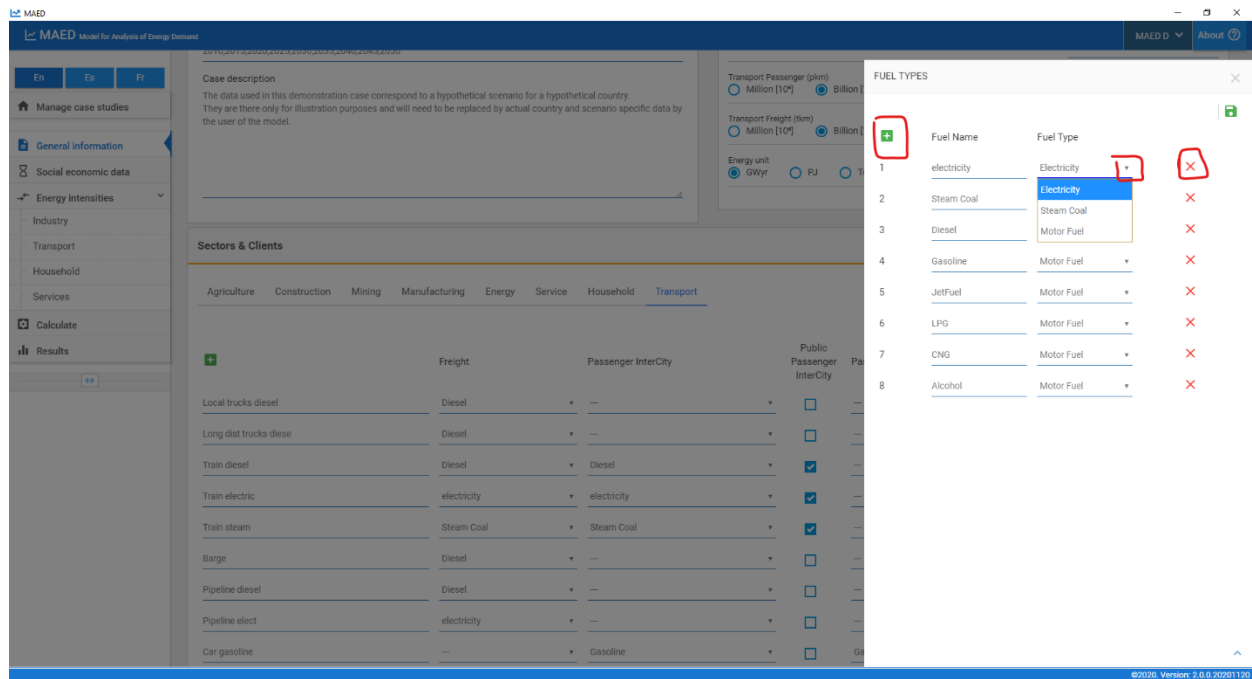
Now, let us move on to define the structure of the **transportation sector**. We must first specify the fuels we want to model. To access the fuel types, click the [Fuel Types Definition](#) button in the Transport tab.



The screenshot shows the MAED (Model for Analysis of Energy Demand) software interface. The top navigation bar includes 'MAED' and 'Model for Analysis of Energy Demand'. The left sidebar contains a 'Manage case studies' section with options for 'General information', 'Social economic data', 'Energy intensities' (with a dropdown menu showing 'Industry', 'Transport', 'Household', and 'Services'), 'Calculate', and 'Results'. The main content area is titled 'Case description' and contains a text box with a disclaimer. To the right of the case description are settings for 'Transport Passenger (plm)' and 'Transport Freight (tkm)', both with radio buttons for 'Million [10<sup>6</sup>]', 'Billion [10<sup>9</sup>]', and 'Trillion [10<sup>12</sup>]', and an 'Energy unit' section with radio buttons for 'GWyr', 'PJ', 'Tcal', 'Mtoe', and 'GBTU'. Below these settings is a 'Sectors & Clients' section with a horizontal tab bar. The 'Transport' tab is selected and highlighted with a red box. To the right of the 'Transport' tab is a 'FUEL TYPES DEFINITION' button, also highlighted with a red box. The main table lists various transport modes and their associated fuel types. The table has columns for 'Freight', 'Passenger InterCity', 'Public Passenger InterCity', 'Passenger Urban', 'Car', and 'Air plane'. Each row represents a transport mode, and the cells contain fuel type names and checkboxes. The table is as follows:

|                        | Freight     | Passenger InterCity | Public Passenger InterCity          | Passenger Urban | Car                                 | Air plane                           |
|------------------------|-------------|---------------------|-------------------------------------|-----------------|-------------------------------------|-------------------------------------|
| Local trucks diesel    | Diesel      | —                   | <input type="checkbox"/>            | —               | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| Long dist trucks diese | Diesel      | —                   | <input type="checkbox"/>            | —               | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| Train diesel           | Diesel      | Diesel              | <input checked="" type="checkbox"/> | —               | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| Train electric         | electricity | electricity         | <input checked="" type="checkbox"/> | —               | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| Train steam            | Steam Coal  | Steam Coal          | <input checked="" type="checkbox"/> | —               | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| Barge                  | Diesel      | —                   | <input type="checkbox"/>            | —               | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| Pipeline diesel        | Diesel      | —                   | <input type="checkbox"/>            | —               | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| Pipeline elect         | electricity | —                   | <input type="checkbox"/>            | —               | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| Car gasoline           | —           | Gasoline            | <input type="checkbox"/>            | Gasoline        | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |

You can add or delete fuels using the respective buttons from this menu. Each fuel specified needs to be associated with a fuel type using the drop-down menu. The MAED methodology groups fuel into three fuel types: **electricity, steam coal, and motor fuel**.



**MAED Model for Analysis of Energy Demand**

**Case description**  
The data used in this demonstration case correspond to a hypothetical scenario for a hypothetical country. They are there only for illustration purposes and will need to be replaced by actual country and scenario specific data by the user of the model.

**Sectors & Clients**  
Agriculture Construction Mining Manufacturing Energy Service Household **Transport**

**FUEL TYPES**

|   | Fuel Name   | Fuel Type   |   |
|---|-------------|-------------|---|
| 1 | electricity | Electricity | + |
| 2 | Steam Coal  | Electricity | × |
| 3 | Diesel      | Steam Coal  | × |
| 4 | Gasoline    | Motor Fuel  | × |
| 5 | JetFuel     | Motor Fuel  | × |
| 6 | LPG         | Motor Fuel  | × |
| 7 | CNG         | Motor Fuel  | × |
| 8 | Alcohol     | Motor Fuel  | × |

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Now change your list of Fuels to be the same as the one showed in the picture below. Then click **Save**.

| FUEL TYPES |             |             |   |
|------------|-------------|-------------|---|
|            | Fuel Name   | Fuel Type   |   |
| 1          | electricity | Electricity | × |
| 2          | Steam Coal  | Steam Coal  | × |
| 3          | Diesel      | Motor Fuel  | × |
| 4          | Gasoline    | Motor Fuel  | × |
| 5          | JetFuel     | Motor Fuel  | × |
| 8          | Alcohol     | Motor Fuel  | × |

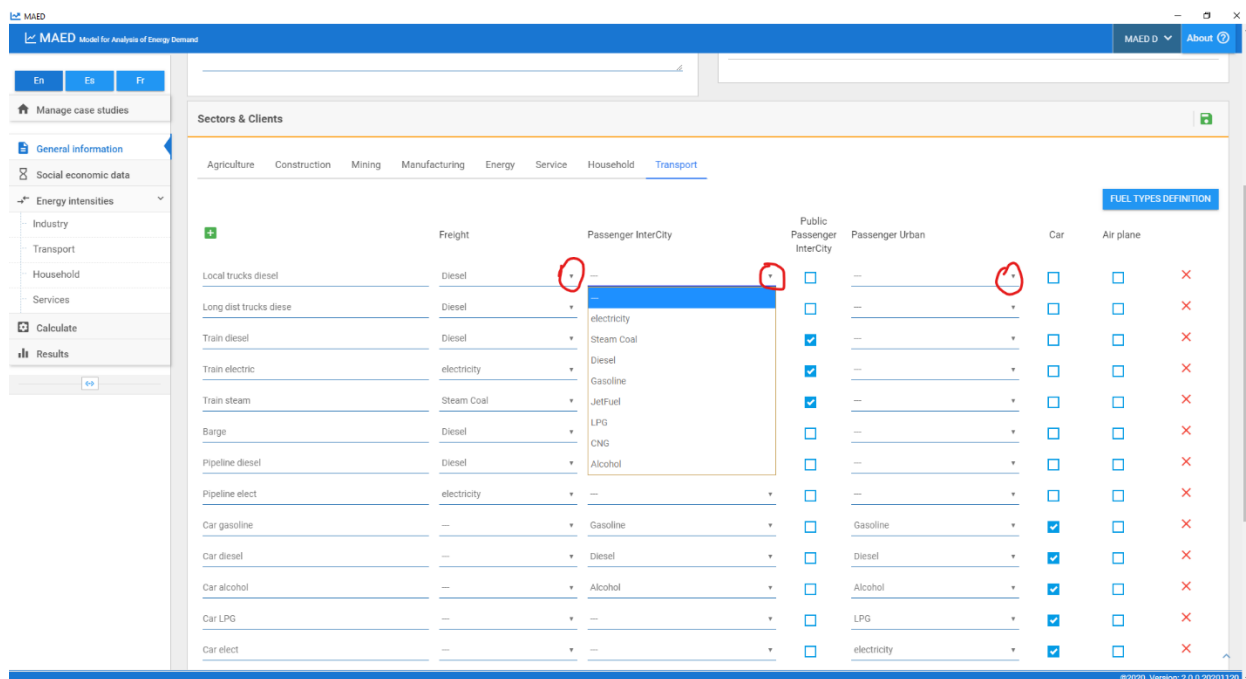
## Activity 2: Transport Modes

The next step is to define the transport modes. The transport modes can be accessed using the Transport tab in the Sectors & Clients block in the General Information page. Each transport mode can be associated with the three transport subsectors: **Freight, Passenger InterCity, and Passenger Urban**.

With the buttons, add, or delete, the user creates or deletes transport modes. And with the check boxes the user decides in which subsector the transport mode defined belongs to.

For example, long-distance trucks belong to freight transport. Each transport mode can be associated with any of the subsectors but must be associated with at least one subsector. We can associate a transport mode with a subsector by selecting the fuel type used for that subsector for that transport mode; this is done using the drop-down menu.

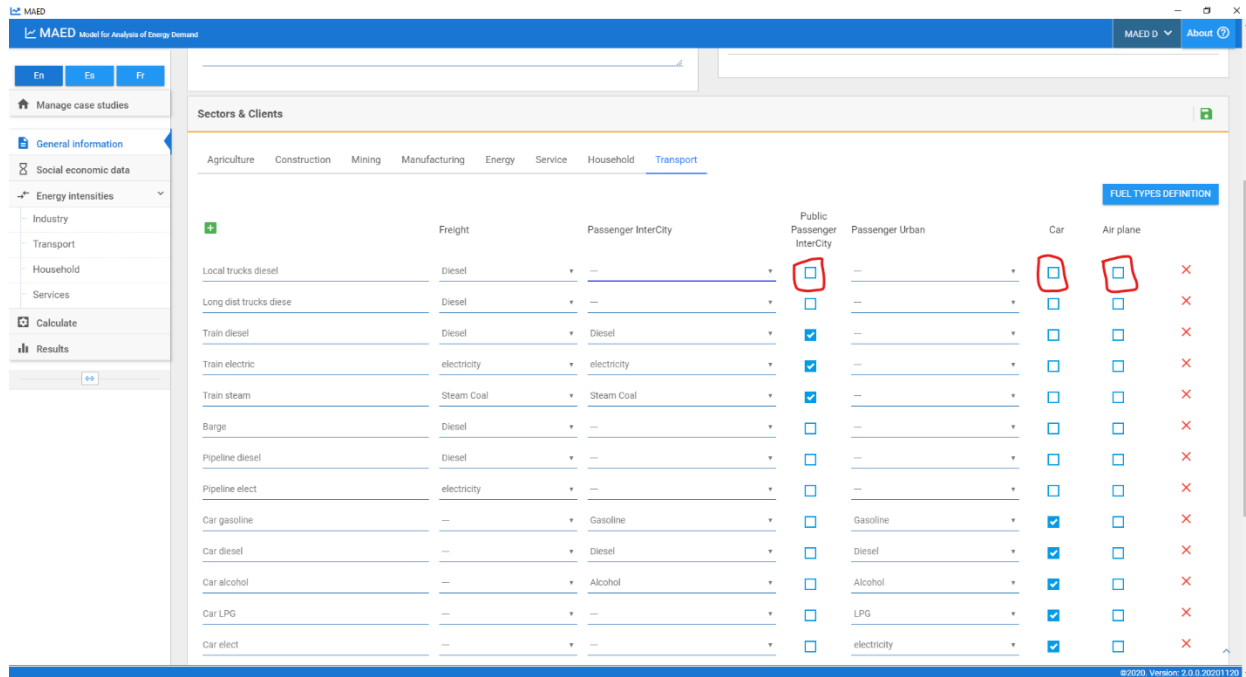
If no fuel type is selected for a transport subsector, then that transport mode will not be modelled for that transport subsector.



| Transport Mode          | Freight     | Passenger InterCity | Public Passenger InterCity | Passenger Urban | Car | Air plane |
|-------------------------|-------------|---------------------|----------------------------|-----------------|-----|-----------|
| Local trucks diesel     | Diesel      | ---                 | ---                        | ---             | --- | ---       |
| Long dist trucks diesel | Diesel      | ---                 | ---                        | ---             | --- | ---       |
| Train diesel            | Diesel      | ---                 | ---                        | ---             | --- | ---       |
| Train electric          | electricity | ---                 | ---                        | ---             | --- | ---       |
| Train steam             | Steam Coal  | ---                 | ---                        | ---             | --- | ---       |
| Barge                   | Diesel      | ---                 | ---                        | ---             | --- | ---       |
| Pipeline diesel         | Diesel      | ---                 | ---                        | ---             | --- | ---       |
| Pipeline elect          | electricity | ---                 | ---                        | ---             | --- | ---       |
| Car gasoline            | ---         | Gasoline            | ---                        | Gasoline        | --- | ---       |
| Car diesel              | ---         | Diesel              | ---                        | Diesel          | --- | ---       |
| Car alcohol             | ---         | Alcohol             | ---                        | Alcohol         | --- | ---       |
| Car LPG                 | ---         | ---                 | ---                        | LPG             | --- | ---       |
| Car elect               | ---         | ---                 | ---                        | electricity     | --- | ---       |

Finally, we must tell the programme which transport modes are cars or airplanes. We must also tell the programme if the transport mode for intercity passengers is considered public.

These can be done by using the checkboxes. There is no limit to the number of modes you want to use.



| Sectors & Clients      |             | FUEL TYPES DEFINITION |                                     |                 |                                     |                          |   |
|------------------------|-------------|-----------------------|-------------------------------------|-----------------|-------------------------------------|--------------------------|---|
|                        | Freight     | Passenger InterCity   | Public Passenger InterCity          | Passenger Urban | Car                                 | Air plane                |   |
| Local trucks diesel    | Diesel      | —                     | <input type="checkbox"/>            | —               | <input type="checkbox"/>            | <input type="checkbox"/> | × |
| Long dist trucks diese | Diesel      | —                     | <input type="checkbox"/>            | —               | <input type="checkbox"/>            | <input type="checkbox"/> | × |
| Train diesel           | Diesel      | Diesel                | <input checked="" type="checkbox"/> | —               | <input type="checkbox"/>            | <input type="checkbox"/> | × |
| Train electric         | electricity | electricity           | <input checked="" type="checkbox"/> | —               | <input type="checkbox"/>            | <input type="checkbox"/> | × |
| Train steam            | Steam Coal  | Steam Coal            | <input checked="" type="checkbox"/> | —               | <input type="checkbox"/>            | <input type="checkbox"/> | × |
| Barge                  | Diesel      | —                     | <input type="checkbox"/>            | —               | <input type="checkbox"/>            | <input type="checkbox"/> | × |
| Pipeline diesel        | Diesel      | —                     | <input type="checkbox"/>            | —               | <input type="checkbox"/>            | <input type="checkbox"/> | × |
| Pipeline elect         | electricity | —                     | <input type="checkbox"/>            | —               | <input type="checkbox"/>            | <input type="checkbox"/> | × |
| Car gasoline           | —           | Gasoline              | <input type="checkbox"/>            | Gasoline        | <input checked="" type="checkbox"/> | <input type="checkbox"/> | × |
| Car diesel             | —           | Diesel                | <input type="checkbox"/>            | Diesel          | <input checked="" type="checkbox"/> | <input type="checkbox"/> | × |
| Car alcohol            | —           | Alcohol               | <input type="checkbox"/>            | Alcohol         | <input checked="" type="checkbox"/> | <input type="checkbox"/> | × |
| Car LPG                | —           | —                     | <input type="checkbox"/>            | LPG             | <input checked="" type="checkbox"/> | <input type="checkbox"/> | × |
| Car elect              | —           | —                     | <input type="checkbox"/>            | electricity     | <input checked="" type="checkbox"/> | <input type="checkbox"/> | × |

Now edit this list based on the picture below and make sure are the same. Then click **Save**.

| Agriculture Construction Mining Manufacturing Energy Service Household <u>Transport</u> |             |                     |                                     |                 |                                     |                                     |  |  |   |
|-----------------------------------------------------------------------------------------|-------------|---------------------|-------------------------------------|-----------------|-------------------------------------|-------------------------------------|--|--|---|
| FUEL TYPES DEFINITION                                                                   |             |                     |                                     |                 |                                     |                                     |  |  |   |
|                                                                                         | Freight     | Passenger InterCity | Public Passenger InterCity          | Passenger Urban | Car                                 | Air plane                           |  |  |   |
| Local trucks diesel                                                                     | Diesel      | ---                 | <input type="checkbox"/>            | ---             | <input type="checkbox"/>            | <input type="checkbox"/>            |  |  | × |
| Long dist trucks diese                                                                  | Diesel      | ---                 | <input type="checkbox"/>            | ---             | <input type="checkbox"/>            | <input type="checkbox"/>            |  |  | × |
| Train diesel                                                                            | Diesel      | Diesel              | <input checked="" type="checkbox"/> | ---             | <input type="checkbox"/>            | <input type="checkbox"/>            |  |  | × |
| Train electric                                                                          | electricity | electricity         | <input checked="" type="checkbox"/> | ---             | <input type="checkbox"/>            | <input type="checkbox"/>            |  |  | × |
| Barge                                                                                   | Diesel      | ---                 | <input type="checkbox"/>            | ---             | <input type="checkbox"/>            | <input type="checkbox"/>            |  |  | × |
| Pipeline diesel                                                                         | Diesel      | ---                 | <input type="checkbox"/>            | ---             | <input type="checkbox"/>            | <input type="checkbox"/>            |  |  | × |
| Pipeline elect                                                                          | electricity | ---                 | <input type="checkbox"/>            | ---             | <input type="checkbox"/>            | <input type="checkbox"/>            |  |  | × |
| Car gasoline                                                                            | ---         | Gasoline            | <input type="checkbox"/>            | Gasoline        | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |  |  | × |
| Car diesel                                                                              | ---         | Diesel              | <input type="checkbox"/>            | Diesel          | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |  |  | × |
| Car elect                                                                               | ---         | ---                 | <input type="checkbox"/>            | electricity     | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |  |  | × |
| Bus large diesel                                                                        | ---         | Diesel              | <input checked="" type="checkbox"/> | Diesel          | <input type="checkbox"/>            | <input type="checkbox"/>            |  |  | × |
| Bus small diesel                                                                        | ---         | Diesel              | <input checked="" type="checkbox"/> | ---             | <input type="checkbox"/>            | <input type="checkbox"/>            |  |  | × |
| Metro electric                                                                          | ---         | ---                 | <input type="checkbox"/>            | electricity     | <input type="checkbox"/>            | <input type="checkbox"/>            |  |  | × |
| Tramway electric                                                                        | ---         | ---                 | <input type="checkbox"/>            | electricity     | <input type="checkbox"/>            | <input type="checkbox"/>            |  |  | × |
| Trolleybus electric                                                                     | ---         | ---                 | <input type="checkbox"/>            | electricity     | <input type="checkbox"/>            | <input type="checkbox"/>            |  |  | × |
| Air Plane                                                                               | ---         | JetFuel             | <input checked="" type="checkbox"/> | ---             | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |  |  | × |

## Activity 3: End-Use Categories

The final step in defining the structure of the model is the configuration of end-use categories. We must remember that, in MAED, there are 3 end-use categories in the Industry Sector: **motive power, thermal uses, and specific uses of electricity**. However, some end-use categories may not exist or may not be significant in some subsectors. Furthermore, even if that end-use exists, the data for that end-use may not be available for some subsectors. We can define which categories of end-uses are present in each subsector. This is done by using check boxes. Let us focus, for instance, on the farming subsector of the agriculture sector. Note that all end-uses have been chosen in the sector definition block.

MAED Model for Analysis of Energy Demand

MAED D About

Manage case studies

General information

Social economic data

Energy intensities

Industry

Transport

Household

Services

Calculate

Results

General information

Name of the case study **Demo MAEDD 1**

Definitions (name, years, description)

Name of the case study  
Demo MAEDD 1

Years  
2010,2015,2020,2025,2030,2035,2040,2045,2050

Case description  
The data used in this demonstration case correspond to a hypothetical scenario for a hypothetical country. They are there only for illustration purposes and will need to be replaced by actual country and scenario specific data by the user of the model.

Units

Population  
☐ Thousand ☒ Million

GDP  
☒ Million [10<sup>9</sup>] ☐ Billion [10<sup>9</sup>] ☐ Trillion [10<sup>12</sup>] US Dollar

Transport Passenger (pkm)  
☐ Million [10<sup>6</sup>] ☒ Billion [10<sup>9</sup>] ☐ Trillion [10<sup>12</sup>]

Transport Freight (tkm)  
☐ Million [10<sup>6</sup>] ☒ Billion [10<sup>9</sup>] ☐ Trillion [10<sup>12</sup>]

Energy unit  
☒ GWyr ☐ PJ ☐ Tcal ☐ Mtoe ☐ GBTU

Sectors & Clients

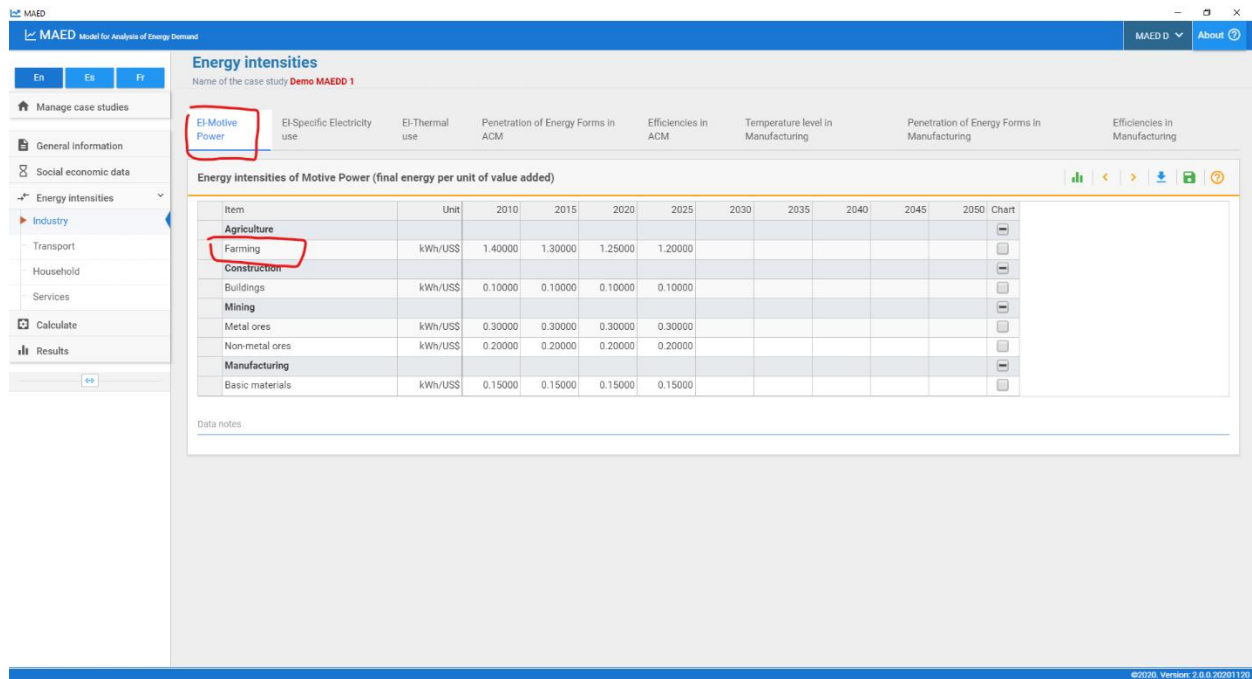
Agriculture Construction Mining Manufacturing Energy Service Household Transport

Specific Electricity use Thermal use Motive Power

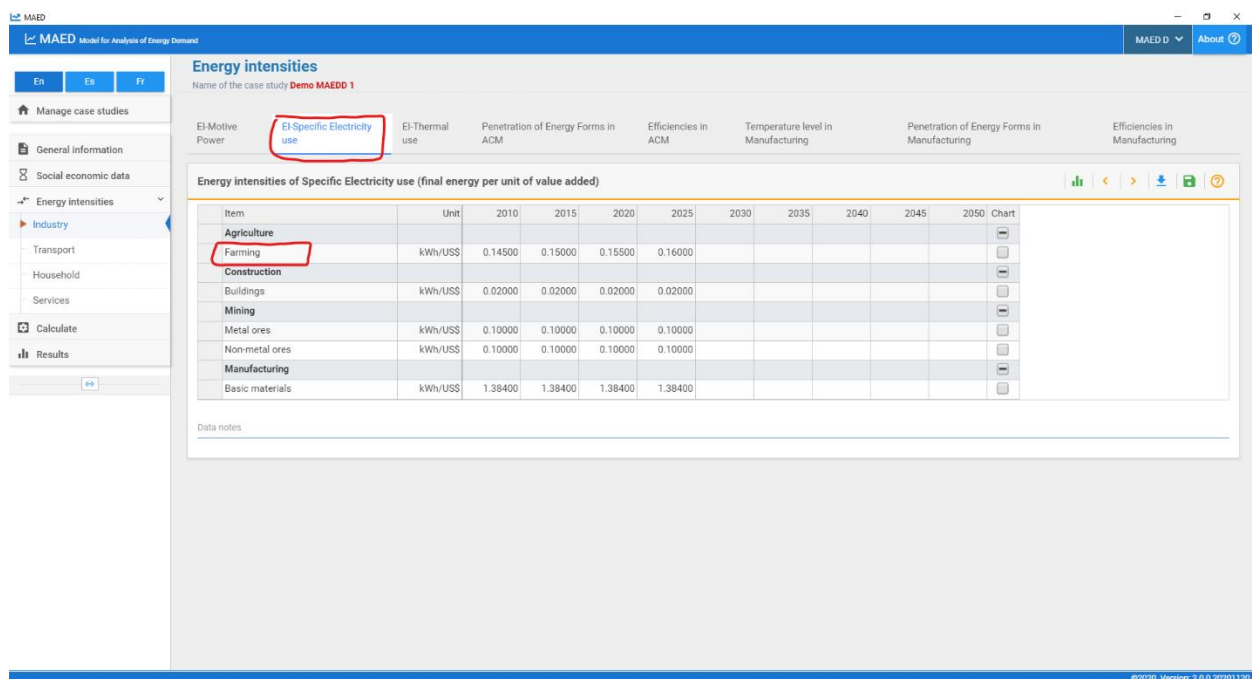
Farming

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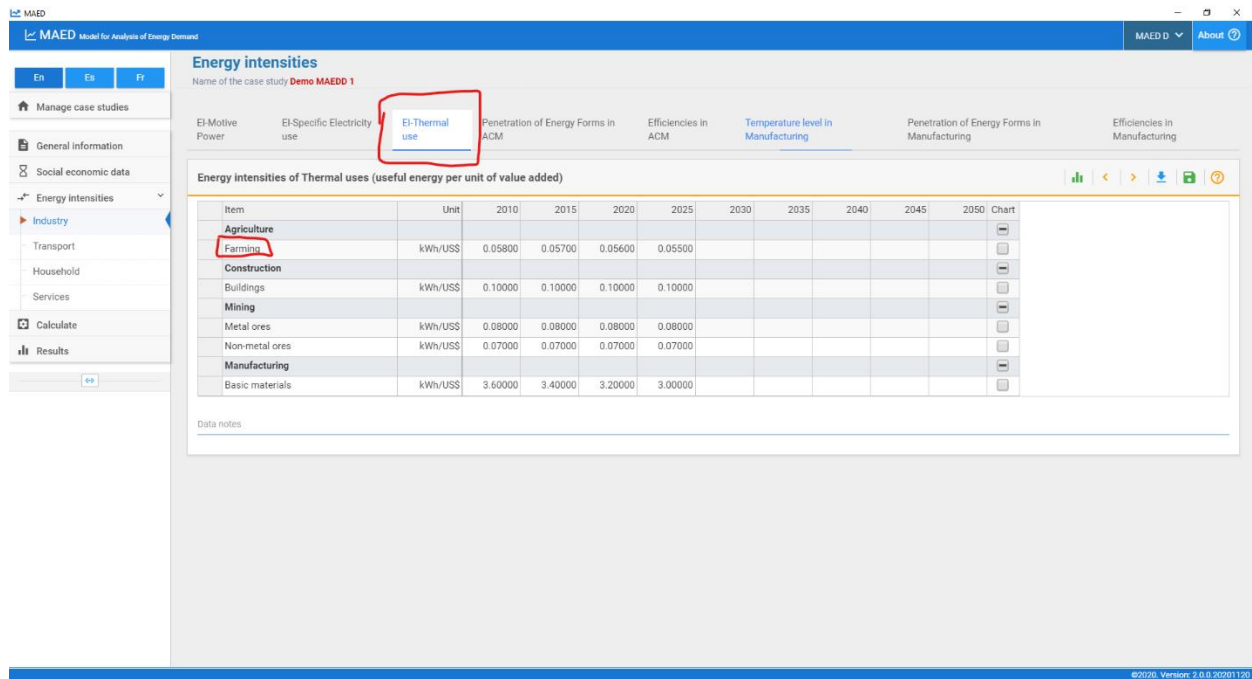
We should now be able to enter energy usage data for each of the three end-use categories. Let us confirm this by looking at the usage tables of the three end-use categories. Let us first look at the energy intensities of motive power.



Let us now look at energy intensities of specific electricity use.



Let us finally look at energy intensities of thermal use.



**Energy intensities**

Name of the case study: **Demo MAED0 1**

☐ EI-Motive Power   
 ☐ EI-Specific Electricity use   
 ☒ EI-Thermal use   
 Penetration of Energy Forms in ACM   
 Efficiencies in ACM   
 Temperature level in Manufacturing   
 Penetration of Energy Forms in Manufacturing   
 Efficiencies in Manufacturing

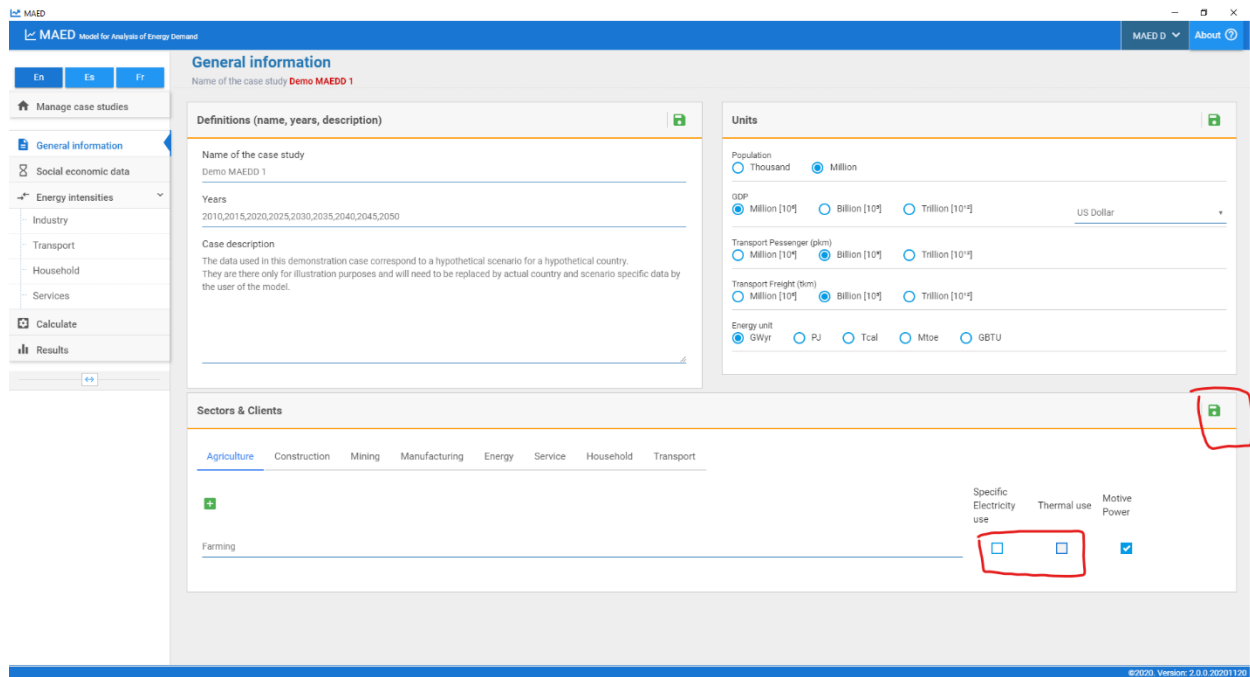
**Energy intensities of Thermal uses (useful energy per unit of value added)**

| Item                 | Unit     | 2010    | 2015    | 2020    | 2025    | 2030 | 2035 | 2040 | 2045 | 2050 | Chart |
|----------------------|----------|---------|---------|---------|---------|------|------|------|------|------|-------|
| <b>Agriculture</b>   |          |         |         |         |         |      |      |      |      |      |       |
| Farming              | kWh/US\$ | 0.05800 | 0.05700 | 0.05600 | 0.05500 |      |      |      |      |      |       |
| <b>Construction</b>  |          |         |         |         |         |      |      |      |      |      |       |
| Buildings            | kWh/US\$ | 0.10000 | 0.10000 | 0.10000 | 0.10000 |      |      |      |      |      |       |
| <b>Mining</b>        |          |         |         |         |         |      |      |      |      |      |       |
| Metal ores           | kWh/US\$ | 0.08000 | 0.08000 | 0.08000 | 0.08000 |      |      |      |      |      |       |
| Non-metal ores       | kWh/US\$ | 0.07000 | 0.07000 | 0.07000 | 0.07000 |      |      |      |      |      |       |
| <b>Manufacturing</b> |          |         |         |         |         |      |      |      |      |      |       |
| Basic materials      | kWh/US\$ | 3.60000 | 3.40000 | 3.20000 | 3.00000 |      |      |      |      |      |       |

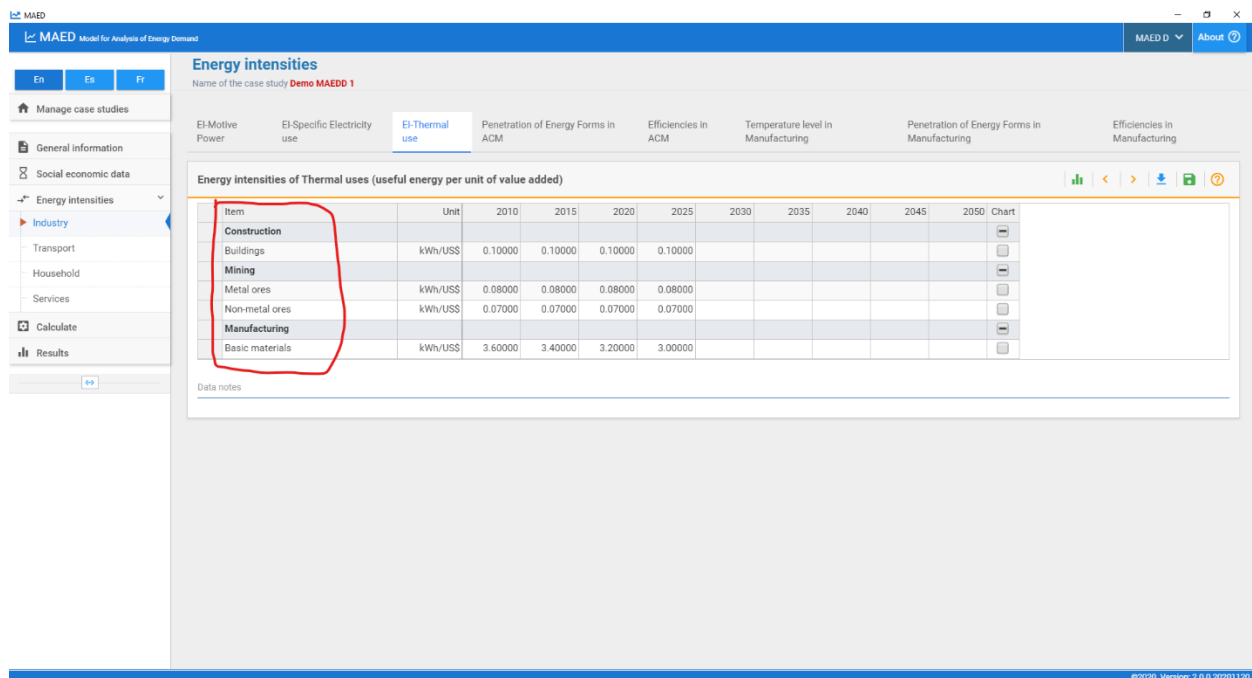
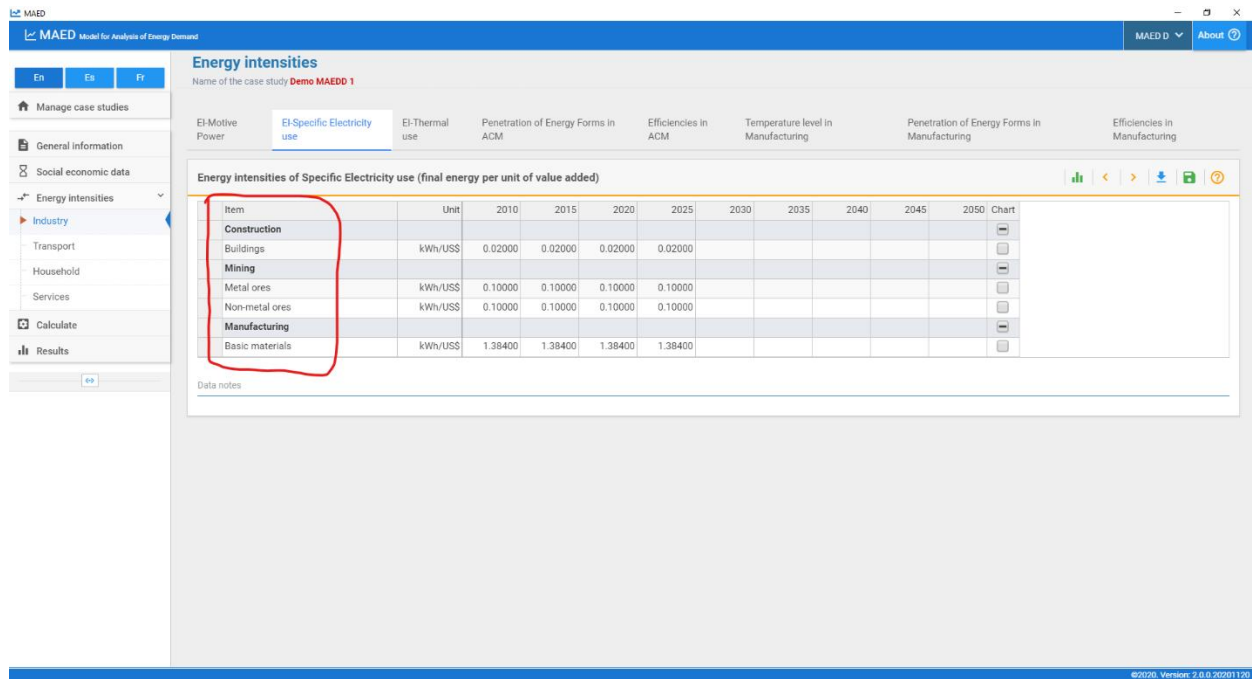
Data notes

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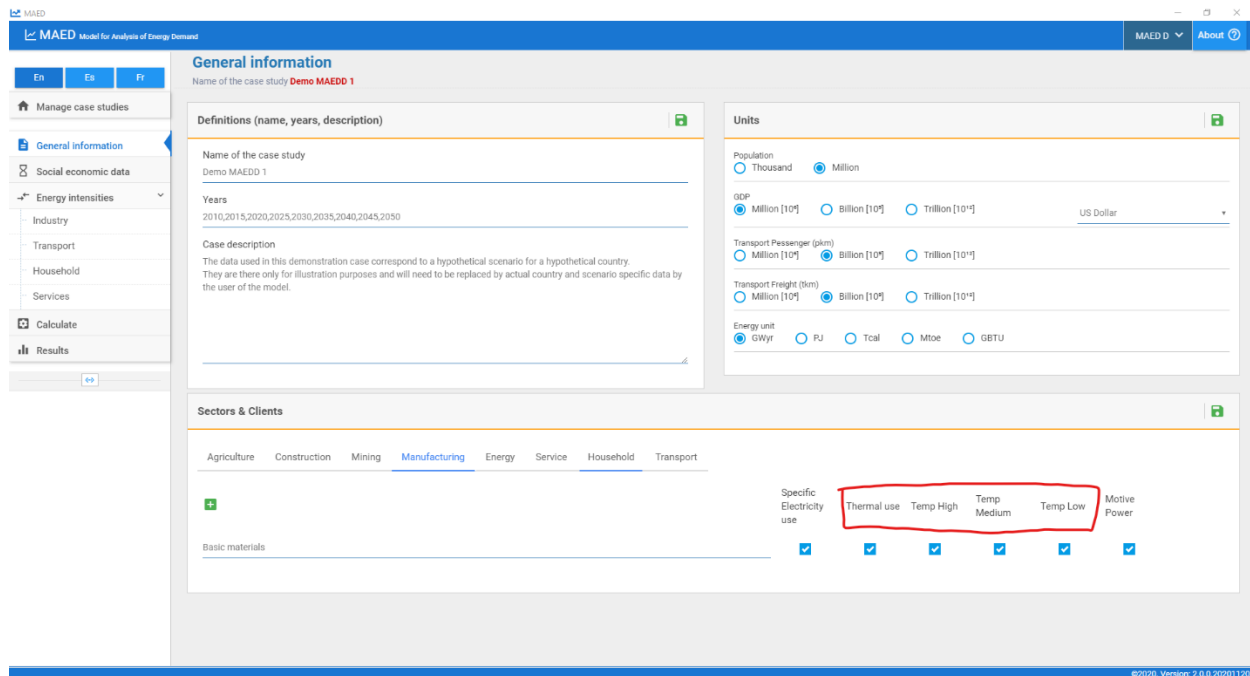
Let us consider the scenario where the specific uses of electricity and thermal uses are not present in the farming subsector. To model this, we uncheck the Specific Electricity Use and Thermal Use boxes and click save.



Let us now look at the three energy usage tables again. Farming is still present in the energy intensity of motive power. However, it is no longer present in the energy intensities of specific electricity use and the energy intensities of thermal use.



In the **Manufacturing sector (part of the Industry Sector)**, thermal usage is further divided into three temperature ranges: **High Temperature, Medium Temperature, and Low Temperature**. When modelling thermal use of subsectors in the manufacturing sector, we also need to select which temperature ranges of thermal use to model for each subsector. In this case study, all three temperature ranges have been chosen for Basic Materials.



The screenshot displays the MAED web interface. The 'General information' tab is active, showing the case study name 'Demo MAED 1', years '2010,2015,2020,2025,2030,2035,2040,2045,2050', and a case description. The 'Units' section shows various units for population, GDP, transport, and energy. The 'Sectors & Clients' section shows a table for 'Basic materials' with checkboxes for 'Thermal use', 'Temp High', 'Temp Medium', and 'Temp Low', all of which are checked. A red box highlights the 'Thermal use' column header.

The model structure is now configured. And all input data tables, and output tables, correspond to the defined structure.

The model is ready to be loaded with the input data.



**This document was updated on 01.11.2024**