Transport Decarbonization and Data-to-Deal

Lecture 5 Hands-on Exercise: Transport Modelling in OSeMOSYS: Building a Model

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Useful Links:

1. OSeMOSYS software
2. OSeMOSYS e-learning course
3. OSeMOSYS documentation
4. OSeMOSYS Discourse forum

Learning outcomes

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

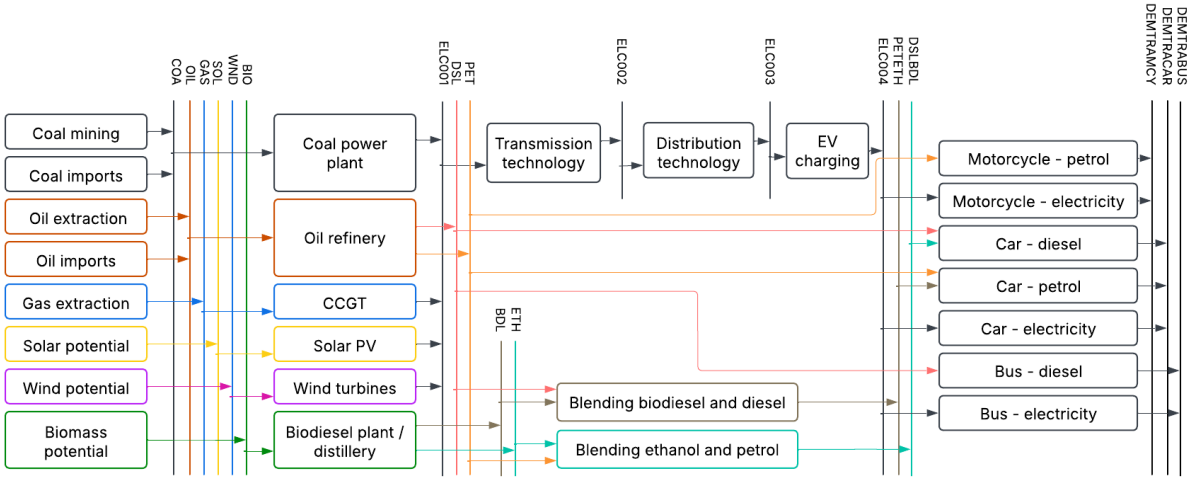
1. Create a Reference Energy System (RES) for the Transport Sector
2. Build a model on OSeMOSYS based on the RES
    a. Model configuration
    b. Commodities
    c. Technologies
    d. Emissions
3. View your OSeMOSYS model diagram.

1. Create a Reference Energy System (RES)

1. We first need to **define the boundaries and scope**. In this example, let's model the transport and power sector on a national and long-term scale (2020 to 2050). This will include electricity generation, transmission, and demand.
2. **Identify and categorise the energy sources in the model**. In this example, let's include the following resources and technologies:
    a. Resources: coal, oil, gas, solar, wind, biomass

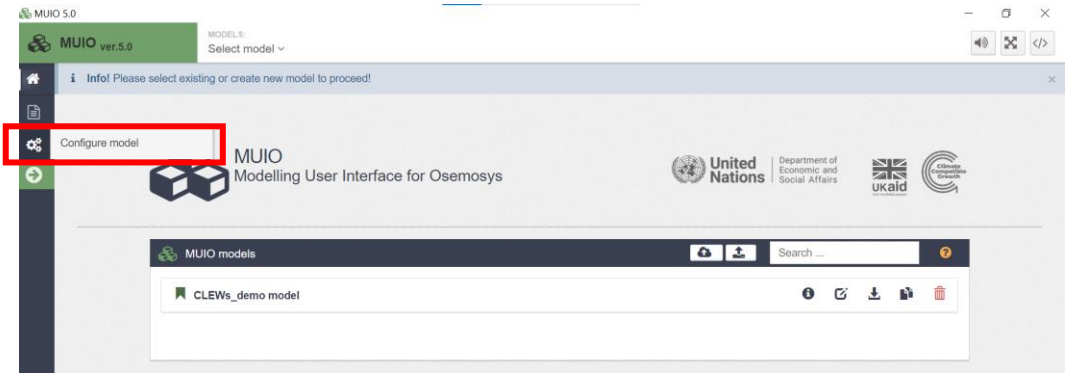
b. Technologies: coal power plant, oil refinery, combined cycle gas turbine, solar power plant, wind power plant, biomass plant/distillery

4. **Identify any imports and exports**. In this example, let's include coal and crude oil imports.
5. **Define end-use sectors, demand, and technologies**. In this example, let's only include passenger road transport:
    a. Motorcycle: petrol, electricity
    b. Car: petrol, diesel, electricity, biodiesel
    c. Bus: diesel, electricity
6. Now let's **map it out** – bring all the resources, conversion technologies, energy carriers, and demands together. We will use this RES to build our model on OSeMOSYS.



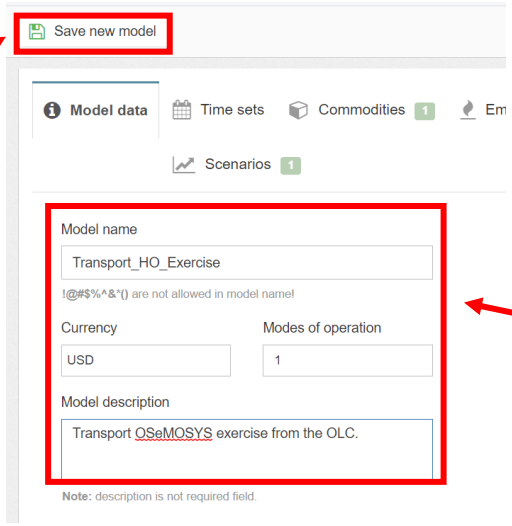
2.a. Building a Model: Configuration

1. Open the Model User Interface for OSeMOSYS (MUIO) and click on 'Configure model' to set up a new OSeMOSYS model.



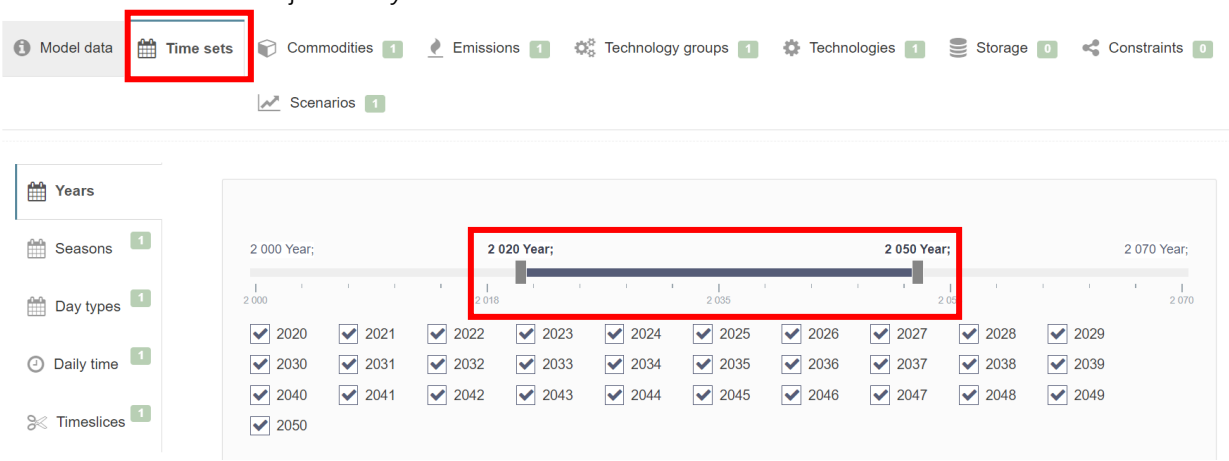
2. In 'Model data', type in a name for your model (*Transport_HO_Exercise*) and a description. Select **USD** as the currency and put down **1** in 'Modes of operation'. Remember to click on 'Save new model'.

(2) Save your model

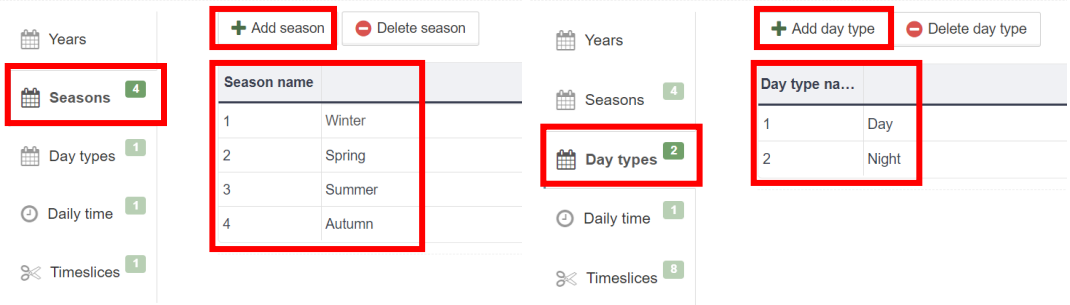


(1) Fill in the information based on the step above

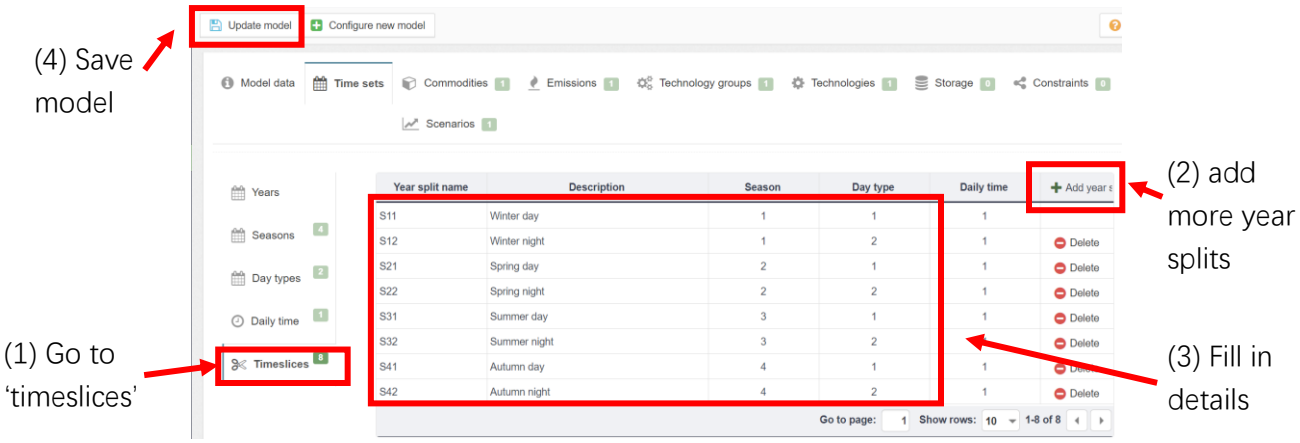
3. Go to 'time sets'. Choose a period of **2020-2050** to analyse the long-term period. You can use the sliders to adjust the years.



4. Go to 'seasons' and create **4** season types with the 'add season' button – Winter, Spring, Summer, and Autumn. Then, go to 'day types' and create **2** day types with the 'add day type' button – Day and Night. The 4 seasons types and 2 day types will give us 8 timeslices (4*2=8).



5. Go to 'timeslices' to view the timeslices. Following the above step, create 8 timeslices and assign each one a distinct combination of season and day type using the 'season' and 'day type' columns. No timeslice should be the same i.e., you cannot have two types of season 2, day type 1. After this, you can give it a new year split name and description, following the screenshot below. Remember to save your model by clicking on 'update model'.

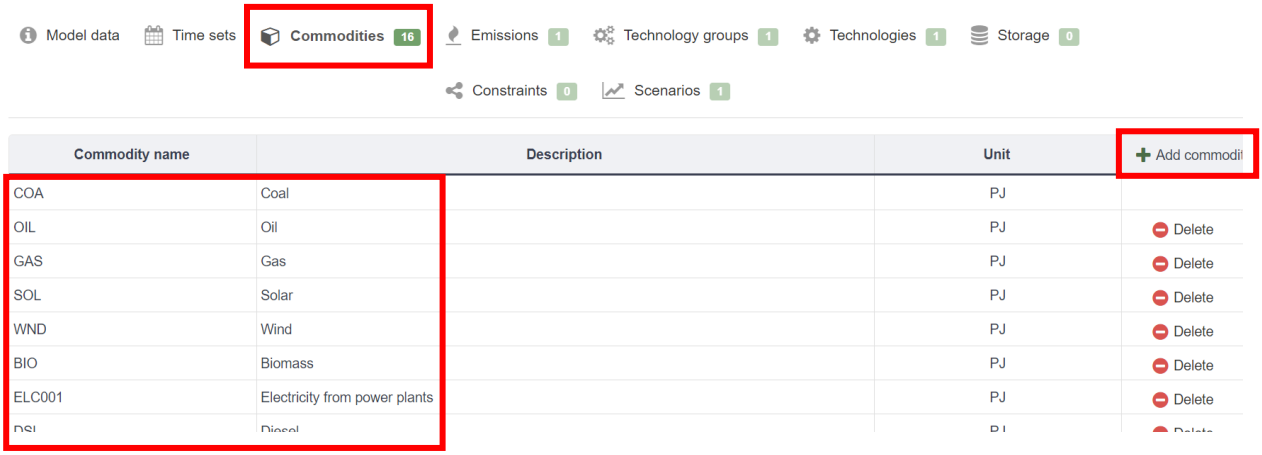


2.b. Building a Model: Commodities

1. Based on Section 1's RES, we have **16** commodities. These are listed in the table below.

Commodity description	Commodity name	Commodity description	Commodity name
Coal	COA	Ethanol	ETH
Oil	OIL	Electricity after transmission	ELC002
Gas	GAS	Electricity for use	ELC003
Solar	SOL	Electricity for EVs	ELC004
Wind	WND	Blended petrol and ethanol	PETETH
Biomass	BIO	Blended diesel and biodiesel	DSLBDL
Electricity from power plants	ELC001	Motorcycle demand	DEMTRAMCY
Diesel	DSL	Car demand	DEMTRACAR
Petrol	PET	Bus demand	DEMTRABUS
Biodiesel	BDL		

2. Fill in these 19 commodities in the 'commodities' tab with the 'add commodities' button. Type in the commodity name and description.



3. We need to ensure the units are correct. For the power commodities, the unit should be **PJ**. For transport commodities (demand), the unit should be in **billion passenger-km**. This should be done for DEMTRAMCY, DEMTRACAR, and DEMTRABUS.

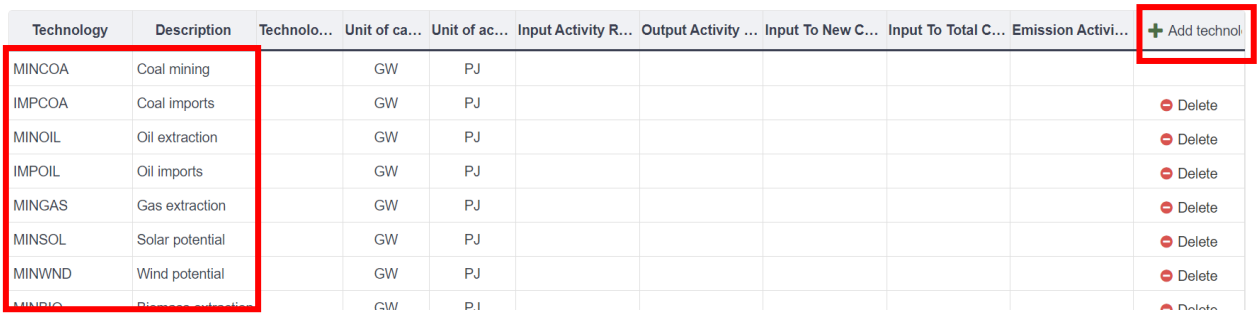
4. Save your model.

2.c. Building a Model: Technologies

1. Based on Section 1's RES, we have **26** technologies. These are listed in the table below.

Commodity description	Commodity name	Commodity description	Commodity name
Coal mining	MINCOA	Biomass plant/distillery	REFBIO
Coal imports	IMPCOA	Transmission technology	PWRTRN
Oil extraction	MINOIL	Distribution technology	PWRDIS
Oil imports	IMPOIL	EV charging	PWREVC
Gas extraction	MINGAS	Blending diesel and biodiesel	BLDDSLBDL
Solar potential	MINSOL	Blending petrol and ethanol	BLDPETETH
Wind potential	MINWND	Petrol motorcycle	TRAMCYPET
Biomass extraction	MINBIO	Electric motorcycle	TRAMCYELC
Coal power plant	PWRCOA	Diesel car	TRACARDSL
Oil refinery	REFOIL	Petrol car	TRACARPET
CCGT	PWRGAS	Electric car	TRACARELC
Solar PV	PWRSOL	Diesel bus	TRABUSDSL
Wind turbines	PWRWND	Electric bus	TRABUSELC

2. Fill in these 26 commodities in the 'technologies' tab with the 'add technologies' button. Type in the technology name and description, following the table and RES above.



3. We need to ensure that the units are correct as we will be modelling both the power and transport sector. For the power sector, units should be in **PJ** for activity and **GW** for capacity. For the transport sector, units should be in **billion passenger-km** for activity and **1,000** for capacity. Click on the cells to change the units for the 7 transport technologies in the model.

Technology	Description	Technolo…	Unit of ca…	Unit of ac…	Input Activity R…	Output Activity …	Input To New C…	Input To Total C…	Emission Activi…	Add technol
TRAMCYELC	Electric motorcycle		10^3	10^9passen…						Delete
TRACARDSL	Diesel car		10^3	10^9passen…						Delete
TRACARPET	Petrol car		10^3	10^9passen…						Delete
TRACARELC	Electric car		10^3	10^9passen…						Delete
TRABUSDSL	Diesel bus		10^3	10^9passen…						Delete
TRABUSELC	Electric bus		10^3	10^9passe						Delete

4. We now need to link the technologies and commodities together. Following the RES carefully, indicate the 'input' energy carrier and the 'output' energy carrier. Note that there may be more than 1 input and/or output – this is the case for refineries and transport vehicles that take in multiple fuel types (biodiesel).

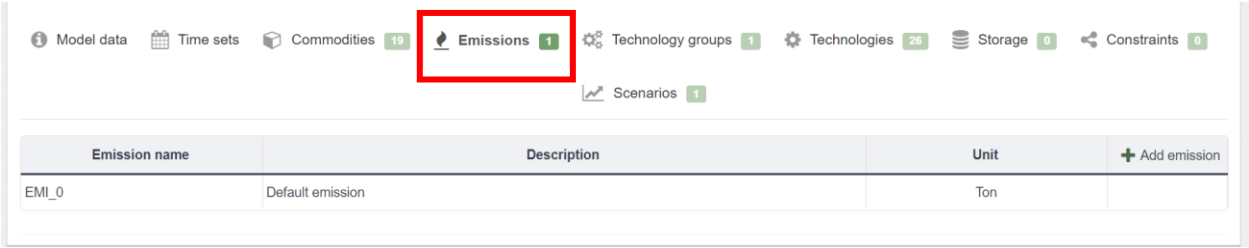
Technology	Description	Technolo…	Unit of ca…	Unit of ac…	Input Activity R…	Output Activity …	Input To New C…	Input To Total C…	Emission Activi…	Add technol
MINCOA	Coal mining		GW	PJ		COA				
IMPCOA	Coal imports		GW	PJ		COA				Delete
MINOIL	Oil extraction		GW	PJ		OIL				Delete
IMPOIL	Oil imports		GW	PJ		OIL				Delete
MINGAS	Gas extraction		GW	PJ		GAS				Delete
MINSOL	Solar potential		GW	PJ		SOL				Delete
MINWND	Wind potential		GW	PJ		WND				Delete
MINBIO	Biomass extraction		GW	PJ		BIO				Delete
PWRCOA	Coal power plant		GW	PJ	COA	ELC001				Delete
REFOIL	Oil refinery		GW	PJ	OIL	DSL,PET				Delete
PWRGAS	Gas power plant		GW	PJ	GAS	ELC001				Delete
PWRSOL	Solar power plant		GW	PJ	SOL	ELC001				Delete
PWRWND	Wind power plant		GW	PJ	WND	ELC001				Delete
REFBIO	Biomass refinery		GW	PJ	BIO	BDL,ETH				Delete
PWRTRN	Transmission te…		GW	PJ	ELC001	ELC002				Delete
PWRDIS	Distribution tech		GW	PJ	ELC002	ELC003				Delete

Note that some technologies will have more than inputs or outputs

5. Save your model.

2.d. Building a Model: Emissions

1. Let's say we want to model the CO2 emissions associated with the transport and power sector. To do this, go to the 'emissions' tab.



2. We need to define this emission. Type in **EMI_CO2** as the emission name, with 'carbon dioxide' as its description. Its unit should be MTon.

Emission name	Description	Unit	+ Add emission
EMI_CO2	Carbon dioxide	MTon	

3. We now need to link the emissions to the technologies that emit carbon dioxide emissions. Go back to the 'technologies' tab. In the 'emission activity ratio' column, choose **EMI_CO2** for the polluting technologies – PWRCOA, PWRGAS, TRAMCYPET, TRACARDSL, TRACARPET, TRABUSDSL.

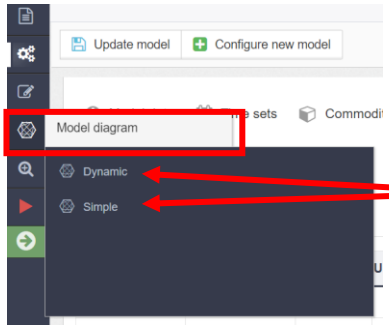
Technology	Description	Technolo…	Unit of ca…	Unit of ac…	Input Activity R…	Output Activity …	Input To New C…	Input To Total C…	Emission Activi…	+ Add technol
TRAMCYELC	Electric motorcycle		10^3	10^9passen…	ELC004	DEMTRAMCY				Delete
TRACARDSL	Diesel car		10^3	10^9passen…	DSL,DSLBDL	DEMTRACAR			EMI_CO2	Delete
TRACARPET	Petrol car		10^3	10^9passen…	PET,PETETH	DEMTRACAR			EMI_CO2	Delete
TRACARELC	Electric car		10^3	10^9passen…	ELC004	DEMTRACAR				Delete
TRABUSDSL	Diesel bus		10^3	10^9passen…	DSL	DEMTRABUS			EMI_CO2	Delete
TRABUSELC	Electric bus		10^3	10^9passen…	ELC004	DEMTRABUS				Delete

Go to page: 2 Show rows: 20 21-26 of 26

4. Save your model.

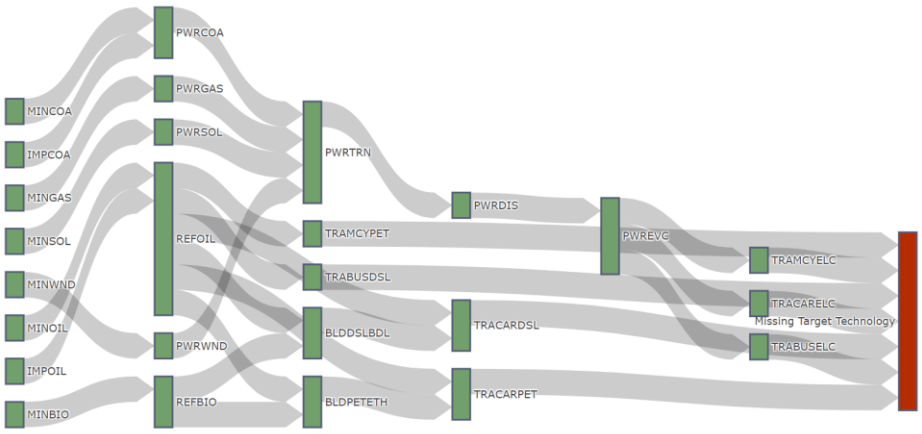
3. View the Model Diagram

1. To view the model diagram, navigate to the left sidebar and click on the 'model diagram' button. You can click on 'dynamic' or 'simple' to view. Viewing the model diagram allows the user to check that the model configuration is correct.

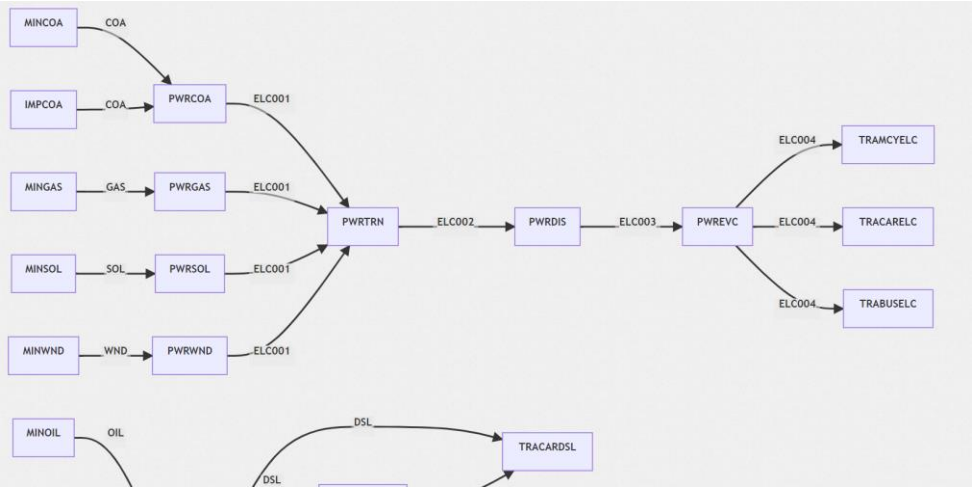


Two options to view the model diagram

2. Dynamic view will produce the below.



3. **Simple** view will produce the below.



Well done! You have built an OSeMOSYS model for the passenger road transport sector. Continue to Hands-on Exercise 6 to fill in data and complete the model.