Introduction to CLEWs
Hands-on lecture 4: Technology parameters

Abhishek Shivakumar[a,b,c], Vignesh Sridharan[d], Francesco Gardumi[e], Taco Niet[f], Thomas Alfstad[a]

[a]United Nations Department of Economic and Social Affairs, New York

[b]University College London, United Kingdom

[c]Loughborough University, United Kingdom

[d]Imperial College London, United Kingdom

[e]KTH Royal Institute of Technology, Sweden

[f]Simon Fraser University, Canada

V1.2.0

Cite as: A. Shivakumar, V. Sridharan, F. Gardumi, T. Niet, T. Alfstad, 'Introduction to CLEWs Hands on lecture 4: Technology parameters', Climate Compatible Growth, 2020. DOI: 10.5281/zenodo.6350142.

Tags: CLEWs; Climate; Land; Energy; Water; Systems Modelling; Integrated; Policy Coherence; Techno-economic; Technology; Parameters; Energy system model; Optimisation; Hands-on; Climate Compatible Growth; Open Source; Teaching Kit;

Useful links:
1) Discussion forum for CLEWs
2) Results from this Hands-on

Pre-requisites:
1) Successful completion of Hands-on lecture 3

Learning outcomes

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

1) Define key techno-economic parameters playing a role in the analysis of an energy system
2) Use several techno-economic parameters in an energy system model
3) Understand the role of techno-economic parameters of various technologies in the least-cost planning of the energy system
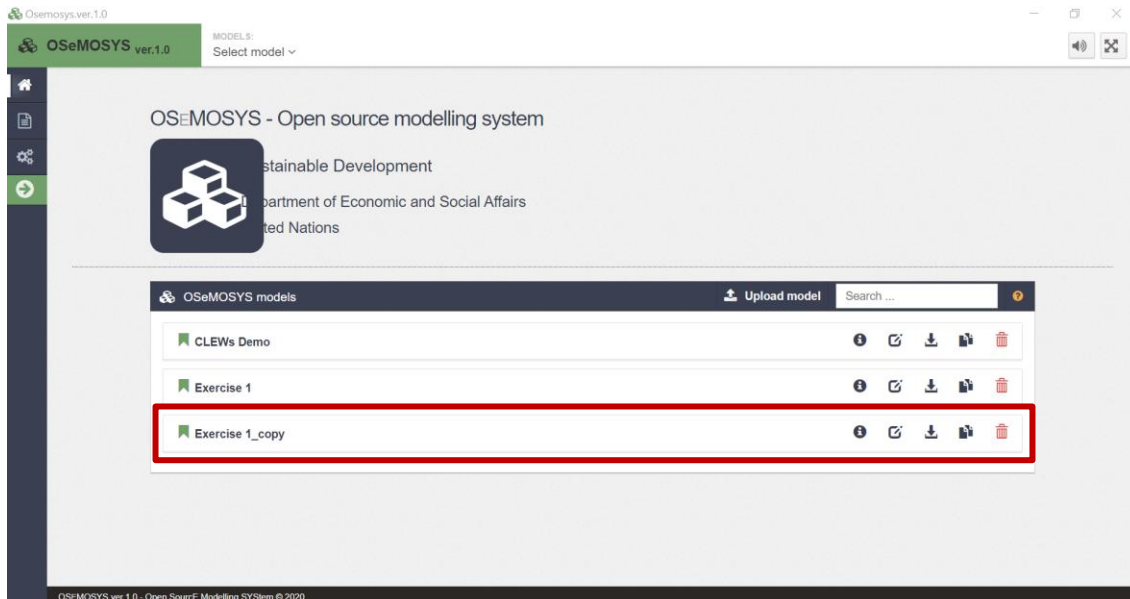
Activity 1 – Introduce techno-economic parameters

Before starting this activity, we strongly suggest that you copy the model you worked on in the previous activities. In this way, if something goes wrong in this exercise, you will be able to go back to the model you worked on before. We recommend you do this **before any activity where you introduce new elements in the model**. We will be reminding you to copy your model through all hands-on sessions. Here how you copy the model:

- On OSeMOSYS UI, in the home tab, next to the name of your model, click on the icon for copying the model as shown in the below figure (your model may be called differently from Exercise 1)
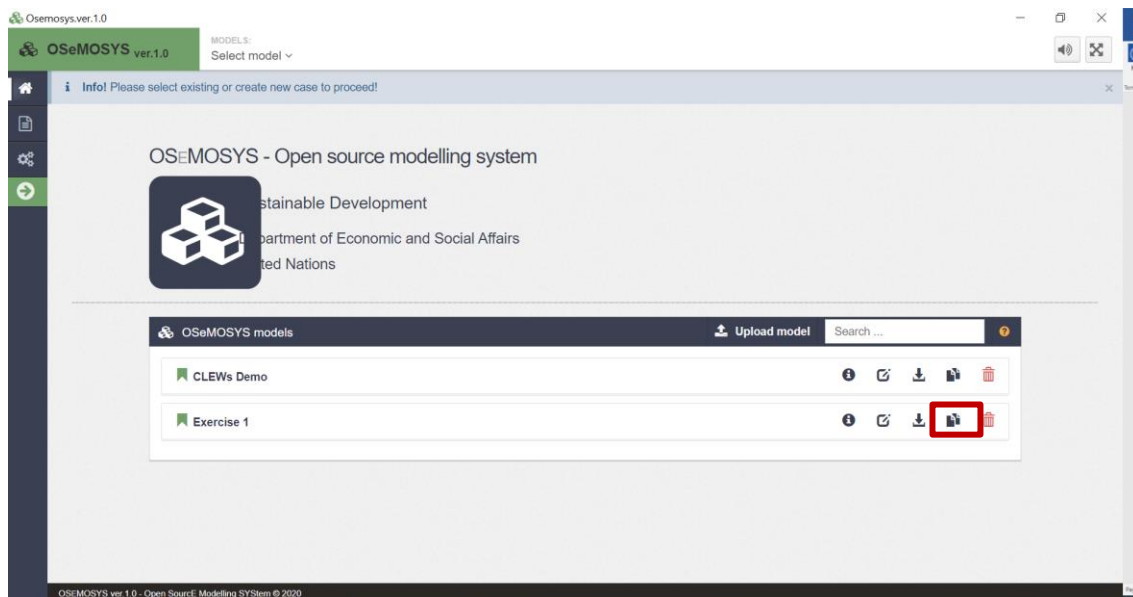
- This will generate a model called '***yourmodelname_copy***' as shown in the figure.

- Now you're set for the activity. In the next steps of this exercise, when asked to modify SETs or parameters do so only for this new model!

Having learnt about the main techno-economic parameters linked to technologies, you will now introduce them into the model you initiated in Hands-on lecture 3. The structure of the model will not change this time: you will work with the technologies and commodities you defined in Hands-on lecture 3 and will not add more. You will only introduce numerical values for the parameters related to them. Below is a brief description of the parameters you will use.

The parameters for which you will need to add values are shown in the table below. In the rows you see the list of parameters; in the columns you see for which technologies you need to define the parameters; in the cells you see the values you need to assign. Bear in mind that the values below need to be assigned **for all years**. Note that the VariableCost of the technologies MINCOA and MINGAS has been introduced to represent the fuel cost for coal and gas, respectively.

Parameter	Units	MINCOA	MINGAS	PWRCOA	PWRGAS	PWRTRN
AvailabilityFactor	Fraction	1	1	1	1	1
CapitalCost	$/kW	0	0	2200	1250	8000
FixedCost	$/kW/yr	0	0	75	30	0
VariableCost	$/GJ	5	10	0	0	0
OperationalLife	Years	30	30	30	30	50

CapacityTo-ActivityUnit	PJ/GW	1	1	31.536	31.536	31.536

Here, we will guide you on how to modify a parameter. We will use the example of the VariableCost. You will have to repeat similar steps, although with few small differences, for the other parameters. We do not show the steps for the other parameters, since part of the learning process for this exercise is for you to become independent in the process of modifying the parameters of a model.

Here the steps for the **VariableCost**:
1. In the OSeMOSYS UI, on the home page, choose your model from the list and click ´**Data entry'** on left list in left side of the window
2. Search for the parameter's name (in this case, VariableCost) and click on it. Scroll down to the table to enter the data
3. Enter the data as per table below
4. **Save!**

Technology	2019	2020	2021	2022
MINCOA	5	5	5	5
MINGAS	10	10	10	10
PWRCOA	0	0	0	0
PWRGAS	0	0	0	0
PWRTRN	0	0	0	0

NOTE: What do the different columns in the data entry tab in the OSeMOSYS UI mean?

This is linked to algebra more than the UI. It depends on the fact that each parameter is actually a multi-dimensional matrix. For instance, the VariableCost has 4 indices, i.e. it is defined for every REGION, MODE_OF_OPERATION, TECHNOLOGY and YEAR in the model. You are already familiar by now with what TECHNOLOGY, YEAR and MODE_OF_OPERATION mean. You will learn more about the use of the MODE_OF_OPERATION also in the following hands-on sessions. The set REGION is present to allow users to define more countries, or more regions within a country. In this course, we will have only one country. If we want to display the values of the VariableCost on a table with only TECHNOLOGY and YEAR (that is, a matrix of only 2 dimensions), we will have to fix a value first for the other two dimensions, REGION

and MODE_OF_OPERATION. You can do this in the interface by dragging the column to the top of the table as shown in the figure below. When you clik on a column name, you will find three lines on the right side of the column name. Click on it and drag the column to the top of the table.
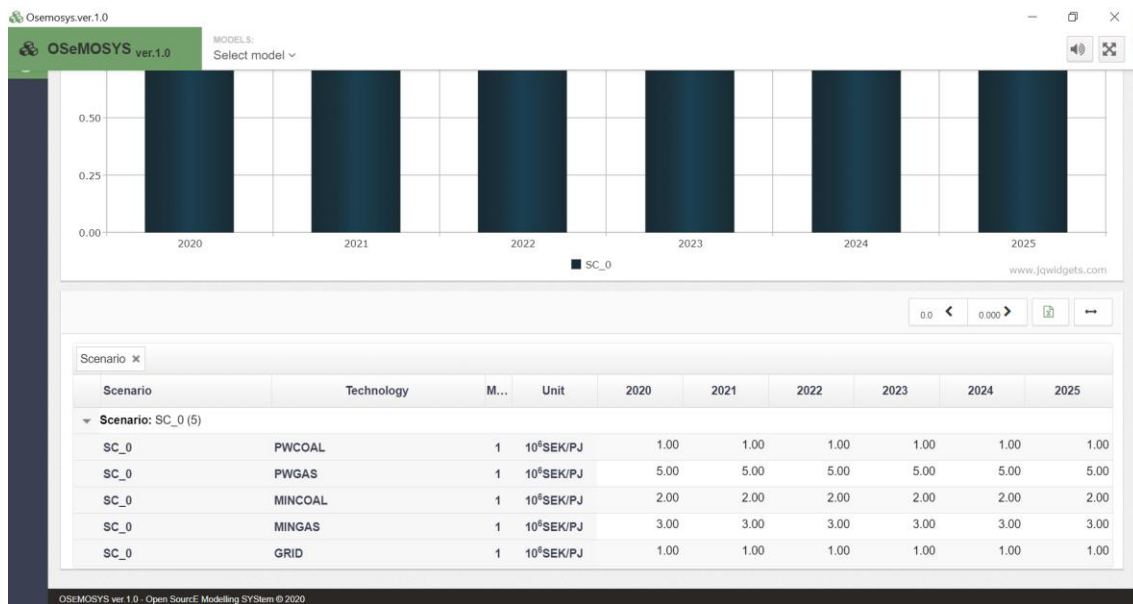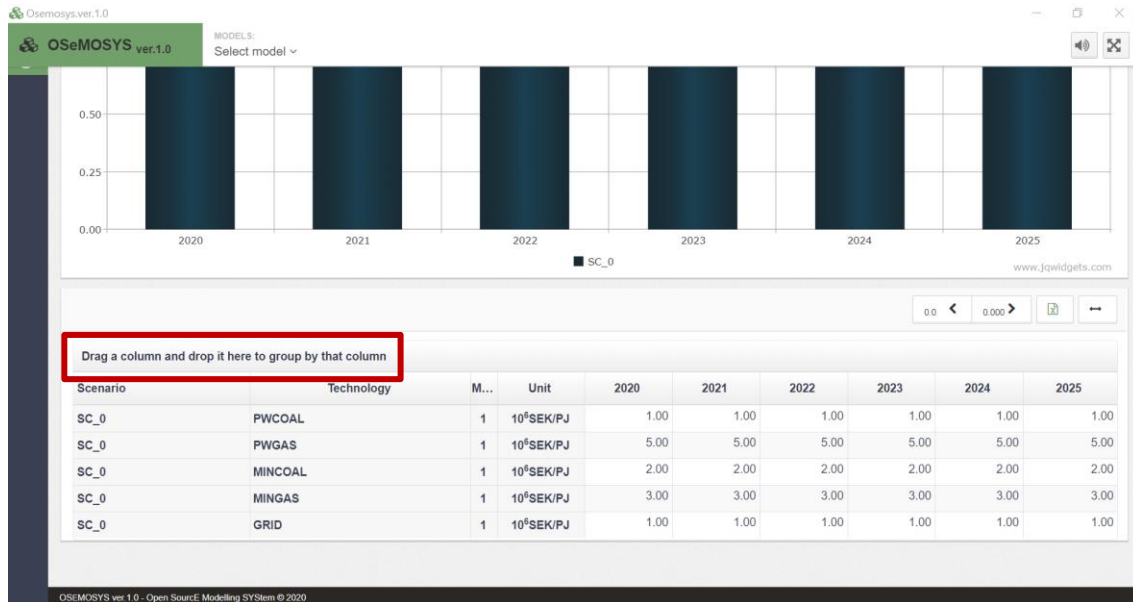
Which dimensions should we group by?

The short answer is: those that you **do not** need to see on the table. If we suggest to put values for all TECHNOLOGIES and YEARS, then you should fix the other dimensions (in the case of variable cost case SCENARIO and MODE_OF_OPERATION). However, here we only have one region and one mode of operation. Thus it is not

needed to group by any dimensions. However, when we have multiple regions and modes of operation, we will have to group by one of them for each dimension.

For VariableCost, if you group by the SCENARIO first and then the MODE_OF_OPERATION, the two remaining dimensions, TECHNOLOGY and YEAR, are displayed on the table and you can easily insert values for all technologies and all years in one go. This is the fastest way of providing all values, because anyway there is only one SCENARIO and one MODE_OF_OPERATION. If you group by the values for SCENARIO and MODE_OF_OPERATION, you do not have to change them. That is, once you have inserted the values, you will not have to insert them again for another SCENARIO or another MODE_OF_OPERATION.

Activity 2 – Run the model

Now, generate a Case for this model, download the data file and run it (if you do not recall how, kindly go back to Activity 3 of Hands-on lecture 3).

Own reflection

Optional (no deliverable needed)

- What type of situation is your model representing now? What demands are included? What supply options are included?
- Which power plant(s) provide(s) electricity now?
- Is there a difference with the previous case?
- Is there a reason for that? Do you think some of the newly given inputs (e.g. some cost) is driving the change in solution?