

Introduction to CLEWs

Hands-on lecture 7: Introducing land constraints and technoeconomic parameters

V2.0

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Tags: CLEWs; Climate; Land; Energy; Water; Systems Modelling; Integrated; Policy Coherence; Installation; Hands-on; Climate Compatible Growth; Open Source; Teaching Kit.

Useful links:

- 1) Energy Modelling Community (EMC) <u>Discourse Forum</u> please use this for any CLEWs-related discussions, especially troubleshooting queries!
- 2) EMC LinkedIn.
- 3) CCG YouTube.
- 4) Data file here
- 5) Results File <u>here</u>

Pre-requisites:

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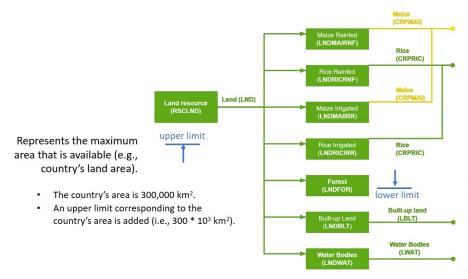
1) Successful completion of all the activities under Hands-on lecture 6.

Learning outcomes

In this exercise, you will apply various constraints and add cost parameters for different land technologies:

- 1) Limit the **activity and capacity** of technologies with OSeMOSYS parameters
- 2) Use different types of constraints for land uses and apply cost parameters to different land technologies.
- 3) Represent existing land use (practices) and impose activity expansion constraints.

Activity 1 – Introducing land constraints

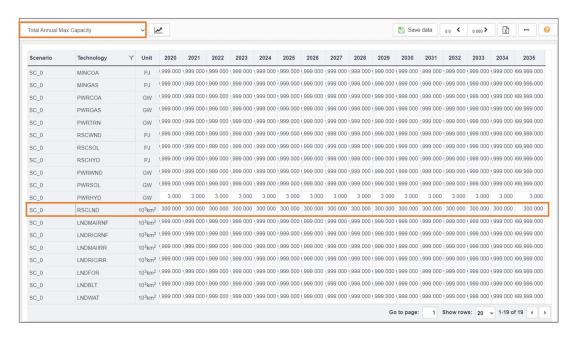


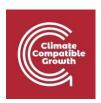
Represents the minimum area to be allocated to forests.

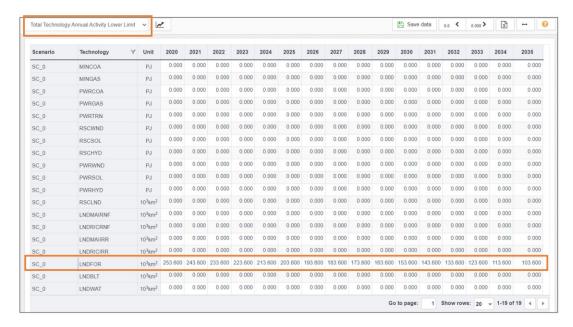
- Forest area will be allowed to decrease 10 thousand km² yearly, starting from 253.6 * 10³ km² (2020, 84.5% country area).
- In 2035, the forest area should cover at least 103.6 *10³ km² (or 34.5% of the country's area).



- 1. Open your "CLEWs OU Data File", and in the **sheet "4.2. Land"**, go to the technology RSCLND and find the **Total Annual Max Capacity**.
- 2. Add these data in the respective parameters using the "Data Entry" in MUIO. "Save data" after the edits.
- 3. Proceed similarly for the "**Total Technology Annual Activity Lower Limit**" for the forest technology (LNDFOR). Find the technology in the "4.2. Land" sheet in the "CLEWs model data" Excel file. Add the values in the "Total Technology Annual Activity Lower Limit" parameter line to the model. **Save data** once you have finished editing.







- 4. Now, RUN THE MODEL! This is the first time running energy and land in a model together... You should look at the following results:
- Use by Technology By Mode: This shows the use of input commodities to a technology by mode of operation. The results inform on the amount of land resource used by the different land covers.
- Question: You set the Max Capacity of Land to 300 (10^3km2), but is all of that land area being used up in your model?

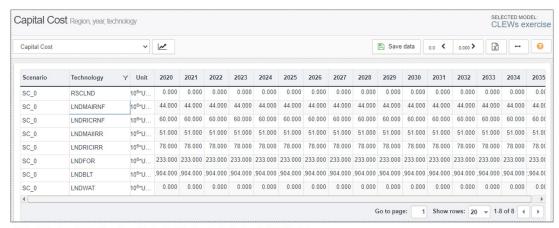


Activity 2– Introducing technoeconomic parameters for land

1. Enter data for the listed parameters by searching for and selecting the respective parameter in "**Data Entry**" in the left-hand side menu. Click on "**Save Data**" after editing each parameter. The data will be entered for all years of the modelling period, i.e., 2020-2035, except for the "Operational Life" and "Capacity To Activity Unit", which have one value for the entire time domain.

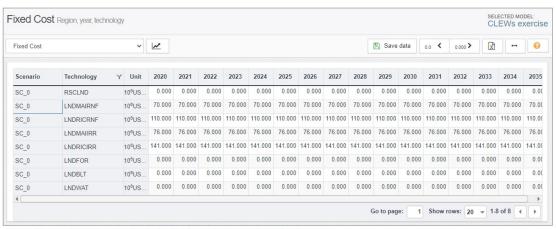
Parameter		Capital Cost	Fixed Cost	Variable Cost	Operational Life	Capacity to Activity Unit
Units		M\$/10 ³ km ²	M\$/10 ³ km ²	M\$/10 ³ km ²	Years	10 ³ km ² /10 ³ km ²
Technology	RSCLND	0.001*	0.001*	0.001*	100	1*
	LNDMAIRNF	44	70	42	15	1*
	LNDRICRNF	60	110	57	15	1*
	LNDMAIIRR	51	76	53	15	1*
	LNDRICIRR	78	141	77	15	1*
	LNDFOR	233	0.001*	-29.4	50	1*
	LNDBLT	2904	0.001*	0.001*	20	1*
	LNDWAT	0.001*	0.001*	0.001*	100	1*

^{*} Default value

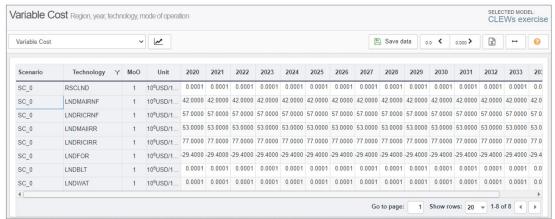


 $\textbf{Note:} \ A \ filter \ is \ applied \ to \ the \ column \ "Technology" \ to \ show \ technologies \ with \ "LND" \ in \ their \ name.$

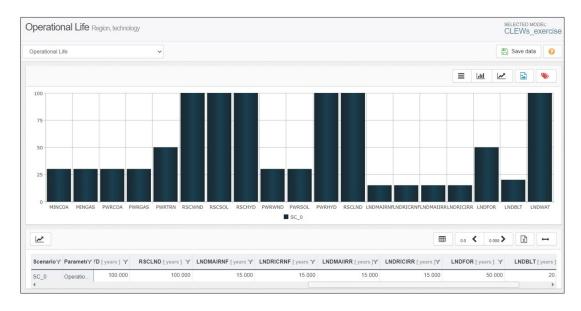




 $\textbf{Note:} \ \textbf{A filter is applied to the column "Technology" to show technologies with "LND" in their name.}$

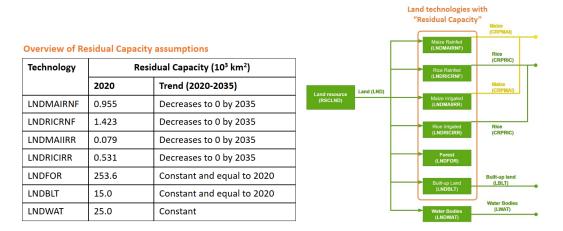


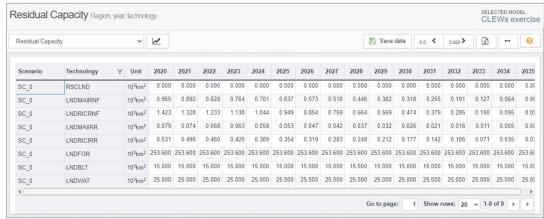
Note: A filter is applied to the column "Technology" to show technologies with "LND" in their name.





2. Enter data for the parameter "Residual Capacity" for land technologies using the data in the CLEWs data Excel file in the sheet "4.2. Land". Click on "Save data" after adding the values.





 $\textbf{Note:} \ \textbf{A filter is applied to the column "Technology" to show technologies with "LND" in their name.}$

3. It is assumed that irrigated land cannot expand more than 5% yearly. This assumption is introduced in the parameter "**Technology Activity Increase By Mode Limit**" as a fraction of 1, i.e., a 5% limit corresponds to 0.05.

To add the parameter data, go to "Data Entry" and search for "Technology Activity Increase By Mode Limit", and the irrigated cropland technologies LNDMAIIRR and LNDRICIRR. Add the number for all years!



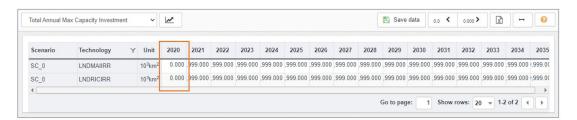
Technology	Technology Activity Increase By Mode Limit (2020 – 2035)
LNDMAIIRR	0.05
LNDRICIRR	0.05

4. "Save data" to save your edits.



Note: A filter is applied to the column "Technology" to show technologies with "IRR" in their name.

5. The investments in the first year (2020) should be restricted so that there is no investment in that year. To do so, go to "Data entry" and search for the parameter "Total Annual Max Capacity Investment". In the irrigated cropland technologies, set the investments to "0" in the first year (2020). Do not change values for the other years.



6. DO NOT FORGET TO SAVE YOUR MODEL!



Activity 3 - Running the Model

This is the first time running the model containing both the energy system and the full representation of the land system (before interlinkages) of the CLEWs model.

NOTE: Refer back to the previous hands-on if you have forgotten how to view results.

In this activity, you should explore the results for **these variables**:

- 1. **Total Capacity By Technology**: Shows the total capacity per, land, technology in one year.
- Use by Technology By Mode: This shows the use of input commodities to a technology by mode of operation. The results inform on the amount of land resource used by the different land covers.
- 3. **Production By Technology By Mode**: Shows the number of outputs produced by technology. This exercise provides information on the number of crops produced by cropland technologies.
- 4. **Capital Investment:** The total investment in every single year.
- 5. **Annualized Investment Costs:** The annualised (yearly) costs of an investment.