CLEWs

Hands-on lecture 11: Climate change and policies

Useful links:

1) Link to open Momani in the local computer
2) Discussion forum for OSeMOSYS
3) Results from this Hands-on

Pre-requisites:

1) Successful completion of all the activities under Hands-on lecture 9

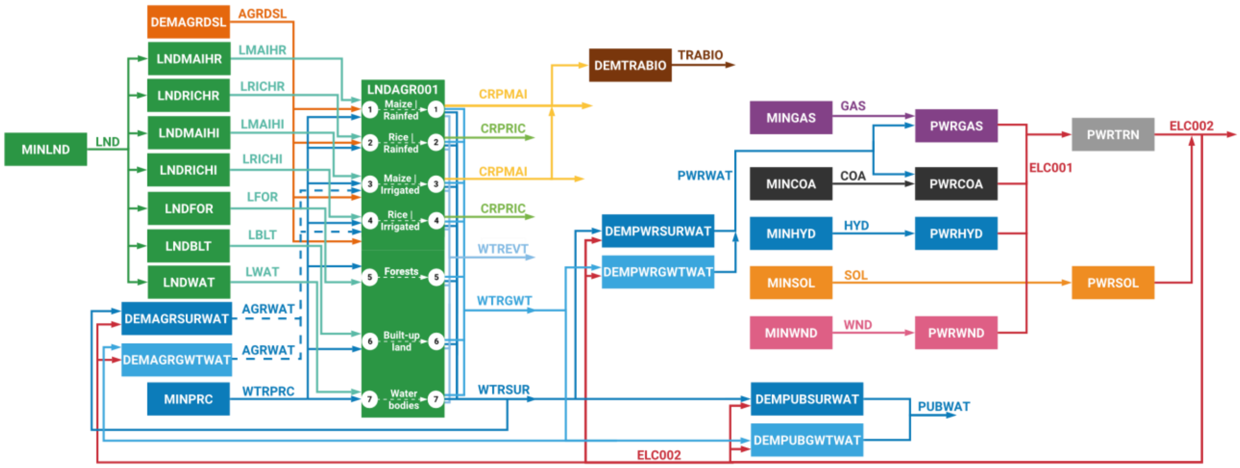
Learning outcomes

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

1) Implement carbon emission reduction policies such as emission targets.
2) Implement renewable energy policies such as wind power deployment targets
3) Explore climate change impacts

Overview

Previous activities focused on building an integrated model that captures the biophysical charactersitics of energy, water, land, and climate systems. This provides a useful foundation to then explore the impacts of different approaches to achieve user-defined objectives.



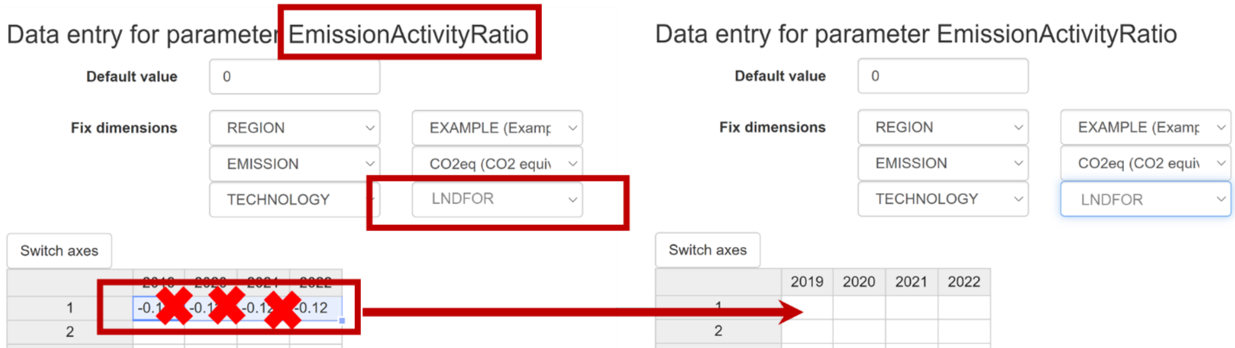
Activity 1 – Emission reduction policies

This activity will focus on the use of CLEWs models to explore the impact of setting emission reduction targets on different sectors. It introduces the parameter '**ModelPeriodEmissionLimit**', which can be used to set a limit on the total emissions over the entire model period for a specific type of emission. This approach can be used to represent carbon budgets, for instance.

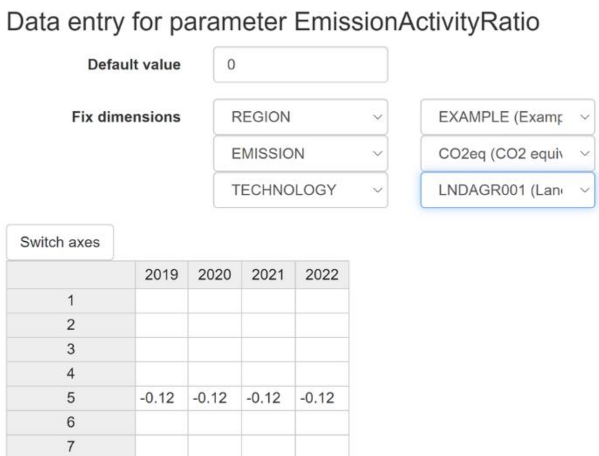
Before setting this in the model, we need to slightly alter the model structure. The current structure of negative emissions for **LNDFOR** gives the model an 'out'. With a carbon cap, this will allow the model to create fake forests and 'offset' carbon emissions. Therefore, this needs to be switched to **LNDAGR001** in **mode 5** (which represents forests).

To do this, move the values for '**EmissionActivityRatio**' for **LNDFOR** (in mode 1) to **LNDAGR001** (in mode 5). After giving all the inputs, run the model and check the results.

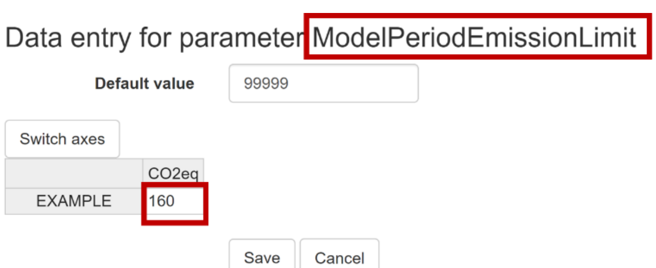
<u>BEFORE CHANGE</u>



AFTER CHANGE

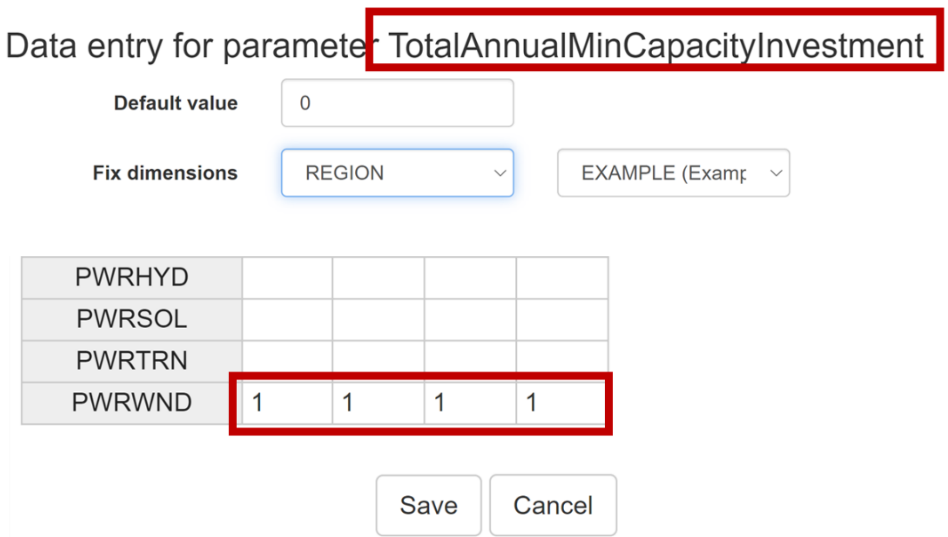


Now add the total **ModelPeriodEmissionLimit** of 160 GtCO2.



Activity 2 – Renewable energy policy

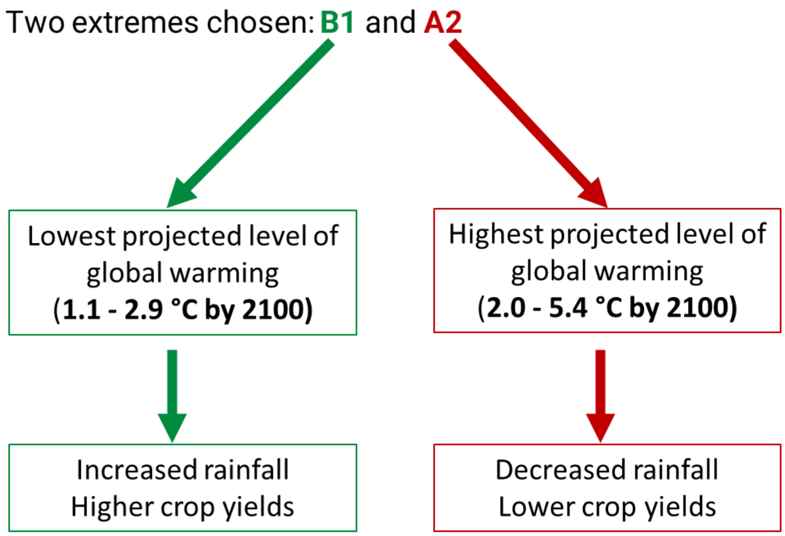
In this activity, we introduce a plan to invest in 1GW of wind power in each of the four years, from 2019 – 2022. This can be done by using the parameter '**TotalAnnualMinCapacityInvestment**'.



After this change, run the model and check the results.

Activity 3 and 4 – Climate change scenarios

Next, we look at how climate change impacts can be represented in a CLEWs model. Here this is done by considering two of the IPCC's climate change scenarios: B1 and A2. These two scenarios represent two extremes of potential climate futures. In particular, they represent different future rainfall patterns and attainable crop yields.



This is done by creating two different clones of the previous version of the model. Each one will be modified to represent a different climate scenario. The data to be updated for each of the climate scenarios is shown below.

Depending on whether a commodity is an input or output, the InputActivityRatio or OutputActivityRatio for that commodity should be updated respectively.

CLIMATE SCENARIO B1

Technology	Value	Parameter
LNDAGR001	1 unit of land (1000 sq. km) produces 0.9 million tonnes of **CRPMAI in mode 1**	**OutputActivityRatio**
LNDAGR001	1 unit of land (1000 sq. km) produces 0.3 million tonnes of **CRPRIC in mode 2**	**OutputActivityRatio**
LNDAGR001	1 unit of land (1000 sq. km) produces 1.1 million tonnes of **CRPMAI in mode 3**	**OutputActivityRatio**
LNDAGR001	1 unit of land (1000 sq. km) produces 0.5 million tonnes of **CRPRIC in mode 4**	**OutputActivityRatio**

Input water commodities		**Mode**	**Output water commodities**		
WTRPRC	**AGRWAT**		**WTREVT**	**WTRGWT**	**WTRSUR**
1.4		**1 (Maize, Rain-fed)**	**0.47**	**0.09**	**0.84**

1.4		2 (Rice, Rain-fed)	0.7	0.07	0.63
1.4	0.1	3 (Maize, Irrigated)	0.5	0.10	0.90
1.4	0.25	4 (Rice, Irrigated)	0.75	0.09	0.81
1.4		5 (Forests)	0.99	0.04	0.37
1.4		6 (Built-up land)	0.88	0.05	0.48
1.4		7 (Water bodies)	0.47	0.09	0.84

Note that the values in the above table are for the technology LNDAGR001 and they are in Billion m^3 per 1000 sq.km (i.e. units of water supply per units of land).

CLIMATE SCENARIO A2

Technology	Value	Parameter
LNDAGR001	1 unit of land produces 0.6 million tonnes of CRPMAI in mode 1	OutputActivityRatio
LNDAGR001	1 unit of land produces 0.1 million tonnes of CRPRIC in mode 2	OutputActivityRatio
LNDAGR001	1 unit of land produces 0.8 million tonnes of CRPMAI in mode 3	OutputActivityRatio
LNDAGR001	1 unit of land produces 0.3 million tonnes of CRPRIC in mode 4	OutputActivityRatio

Input water commodities		Mode	Output water commodities		
WTRPRC	AGRWAT		WTREVT	WTRGWT	WTRSUR
1.0		1 (Maize, Rain-fed)	0.33	0.07	0.60

1.0		2 (Rice, Rain-fed)	0.5	0.05	0.45
1.0	0.5	3 (Maize, Irrigated)	0.5	0.10	0.90
1.0	0.65	4 (Rice, Irrigated)	0.75	0.09	0.81
1.0		5 (Forests)	0.71	0.03	0.27
1.0		6 (Built-up land)	0.63	0.03	0.34
1.0		7 (Water bodies)	0.33	0.07	0.60

Note that the values in the above table are for the technology LNDAGR001 and they are in Billion m^3 per 1000 sq.km (i.e. units of water supply per units of land).

After entering all these values, run the two models separately and check the results.