Energy and Flexibility Modelling

Hands-on 6 (macOS)

Please use the following citation for:

- **This exercise**

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- **clicSANDMac Software**

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- **OSeMOSYS Google Forum**

Please sign up to the help Google forum here. If you are stuck, please ask questions here. If you get ahead, please answer questions in the same forum. Please state that you are using the 'clicSAND' Interface.

Learning outcomes

By the end of this exercise, you will be able to represent the following in OSeMOSYS:

1) Biomass-fueled power plants and biomass primary supply

2) Geothermal power plants and geothermal energy primary supply

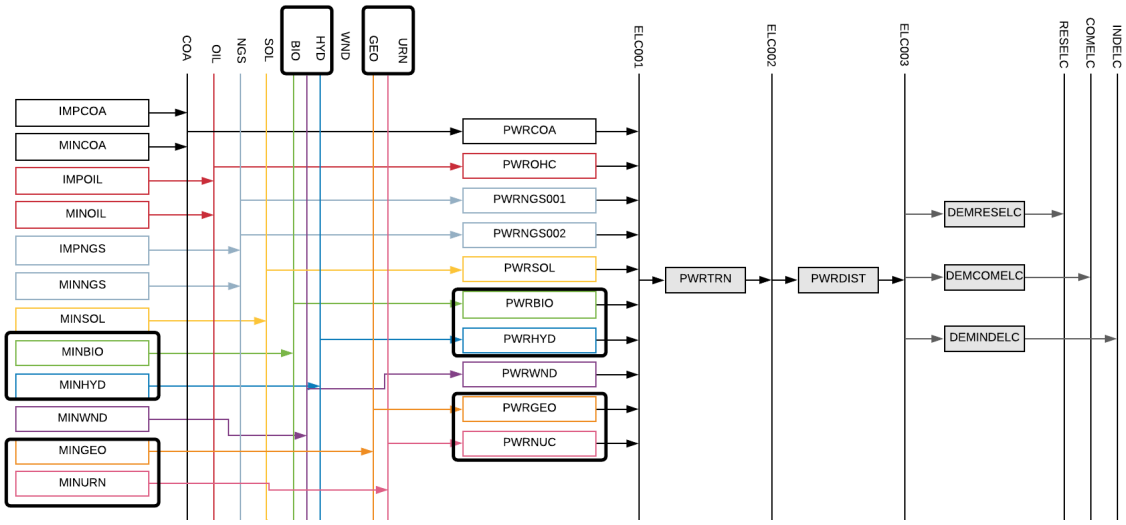
3) Hydropower technologies and hydropower primary supply

4) Nuclear power plants and uranium primary supply

Define the Hydropower Primary Supply Technology

In Lecture 7 we learnt how to represent a technology in OSeMOSYS and which parameters characterize biomass-fueled, geothermal, hydropower, and nuclear power plants. In this Hands-On, we will focus on an example for Hydropower Plants. The same process should be used for Biomass, Geothermal, and Nuclear power plants.

In this Hands-on, we will add 8 technologies in total: 4 power plants (**PWRBIO, PWRHYD, PWRGEO, PWRNUC**) and 4 primary supply technologies (**MINBIO, MINHYD, MINGEO** and **MINURN**). Four new fuels will be added to the model: **BIO** (Biomass), **HYD** (Hydro), **GEO** (Geothermal) and **URN** (Uranium). We will build the highlighted parts of the RES:



In order to represent a primary supply technology, remember that the following **parameters** must be considered:

- **OutputActivityRatio**: defines the fuel provided (i.e. Biomass)
- **CapacityToAcitivityUnit**: used to convert data related to the Capacity of technology into the Activity it can generate. For primary supply technology, this value should be set to 1.
- **Fixed Cost**: defines the fixed Operation & Maintenance cost ($/kW)
- **CapitalCost**: defines the overnight investment cost of the plant ($/kW)
- **OperationalLife**: defines the lifetime of the technology (in years)

Let's add **MINHYD** - the technology representing the primary supply of water **MINHYD** (Hydro Potential) and the correspondent fuel **HYD** (Hydro) following the steps explained in Hands-On 4.

Repeat the same steps for:

1) **MINBIO** - Biomass Extraction
2) **MINGEO** – Geothermal Potential
3) **MINURN** – Uranium Extraction

using the data provided in the DataPrep file.

You have now added 4 primary supply technologies (**MINBIO, MINHYD, MINGEO, MINURN**) and 4 fuels (**BIO, HYD, GEO, URN**) to your model.

Add a Hydropower plant

In order to represent a power plant, remember that the following **parameters** must be considered:

- **InputActivityRatio**: defines the rate of fuel consumed (i.e. Hydro)
- **OutputActivityRatio**: defines the fuel provided (i.e. Electricity)
- **CapacityToAcitivityUnit**: used to convert data related to the Capacity of technology into the Activity it can generate. For primary supply technology, this value should be set to 1.
- **Fixed Cost**: defines the fixed Operation & Maintenance cost ($/kW)
- **CapitalCost**: defines the overnight investment cost of the plant ($/kW)
- **OperationalLife**: defines the lifetime of the technology (in years)
- **ResidualCapacity**: defines the existing capacity of the technology (in GW) and its expected decommissioning
- **Capacity Factors**: represents the variability in generation at each point in time.

Let's add **PWRHYD** - the technology representing a hydro power plant, following the steps presented in **Hands-On 5**.

The only new parameter that needs to be added compared to those instructions in **Hands-On 5** is the **Capacity Factor**. This represents the variability in generation at each point in time. You need to define capacity factors values for all the modelling years from 2015 to

2070. Therefore, copy-paste the 96 values available in the Data Prep file for year 2015 to **Cell K1797 of SAND**. You will see that those values change depending on the time slice. Then copy paste the **same** values for all the years until **column BN** correspondent to 2070.

	Parameter	TECHNOLOGY	TIMESLICE	2015	2016	2017	2018
1697	CapacityFactor	PWRBIO	S421	0.5	0.5	0.5	
1698	CapacityFactor	PWRBIO	S422	0.5	0.5	0.5	
1699	CapacityFactor	PWRBIO	S423	0.5	0.5	0.5	
1700	CapacityFactor	PWRBIO	S424	0.5	0.5	0.5	
1797	CapacityFactor	PRWHYD	S101	0.396239	0.396239	0.396239	0.396
1798	CapacityFactor	PRWHYD	S102	0.396239	0.396239	0.396239	0.396
1799	CapacityFactor	PRWHYD	S103	0.396239	0.396239	0.396239	0.396
1800	CapacityFactor	PRWHYD	S104	0.396239	0.396239	0.396239	0.396
1801	CapacityFactor	PRWHYD	S105	0.396239	0.396239	0.396239	0.396
1802	CapacityFactor	PRWHYD	S106	0.396239	0.396239	0.396239	0.396
1803	CapacityFactor	PRWHYD	S107	0.396239	0.396239	0.396239	0.396
1804	CapacityFactor	PRWHYD	S108	0.396239	0.396239	0.396239	0.396
1805	CapacityFactor	PRWHYD	S109	0.396239	0.396239	0.396239	0.396
1806	CapacityFactor	PRWHYD	S110	0.396239	0.396239	0.396239	0.396
1807	CapacityFactor	PRWHYD	S111	0.396239	0.396239	0.396239	0.396
1808	CapacityFactor	PRWHYD	S112	0.396239	0.396239	0.396239	0.396
1809	CapacityFactor	PRWHYD	S113	0.396239	0.396239	0.396239	0.396
1810	CapacityFactor	PRWHYD	S114	0.396239	0.396239	0.396239	0.396
1811	CapacityFactor	PRWHYD	S115	0.396239	0.396239	0.396239	0.396
1812	CapacityFactor	PRWHYD	S116	0.396239	0.396239	0.396239	0.396
1813	CapacityFactor	PRWHYD	S117	0.396239	0.396239	0.396239	0.396
1814	CapacityFactor	PRWHYD	S118	0.396239	0.396239	0.396239	0.396
1815	CapacityFactor	PRWHYD	S119	0.396239	0.396239	0.396239	0.396
1816	CapacityFactor	PRWHYD	S120	0.396239	0.396239	0.396239	0.396
1817	CapacityFactor	PRWHYD	S121	0.396239	0.396239	0.396239	0.396
1818	CapacityFactor	PRWHYD	S122	0.396239	0.396239	0.396239	0.396
1819	CapacityFactor	PRWHYD	S123	0.396239	0.396239	0.396239	0.396
1820	CapacityFactor	PRWHYD	S124	0.396239	0.396239	0.396239	0.396
1821	CapacityFactor	PRWHYD	S201	0.672067	0.672067	0.672067	0.672
1822	CapacityFactor	PRWHYD	S202	0.672067	0.672067	0.672067	0.672
1823	CapacityFactor	PRWHYD	S203	0.672067	0.672067	0.672067	0.672
1824	CapacityFactor	PRWHYD	S204	0.672067	0.672067	0.672067	0.672
1825	CapacityFactor	PRWHYD	S205	0.672067	0.672067	0.672067	0.672
1826	CapacityFactor	PRWHYD	S206	0.672067	0.672067	0.672067	0.672
1827	CapacityFactor	PRWHYD	S207	0.672067	0.672067	0.672067	0.672
1828	CapacityFactor	PRWHYD	S208	0.672067	0.672067	0.672067	0.672
1829	CapacityFactor	PRWHYD	S209	0.672067	0.672067	0.672067	0.672
1830	CapacityFactor	PRWHYD	S210	0.672067	0.672067	0.672067	0.672
1831	CapacityFactor	PRWHYD	S211	0.672067	0.672067	0.672067	0.672
1832	CapacityFactor	PRWHYD	S212	0.672067	0.672067	0.672067	0.672
1833	CapacityFactor	PRWHYD	S213	0.672067	0.672067	0.672067	0.672
1834	CapacityFactor	PRWHYD	S214	0.672067	0.672067	0.672067	0.672
1835	CapacityFactor	PRWHYD	S215	0.672067	0.672067	0.672067	0.672
1836	CapacityFactor	PRWHYD	S216	0.672067	0.672067	0.672067	0.672
1837	CapacityFactor	PRWHYD	S217	0.672067	0.672067	0.672067	0.672
1838	CapacityFactor	PRWHYD	S218	0.672067	0.672067	0.672067	0.672
1839	CapacityFactor	PRWHYD	S219	0.672067	0.672067	0.672067	0.672
1840	CapacityFactor	PRWHYD	S220	0.672067	0.672067	0.672067	0.672
1841	CapacityFactor	PRWHYD	S221	0.672067	0.672067	0.672067	0.672
1842	CapacityFactor	PRWHYD	S222	0.672067	0.672067	0.672067	0.672
1843	CapacityFactor	PRWHYD	S223	0.672067	0.672067	0.672067	0.672
1844	CapacityFactor	PRWHYD	S224	0.672067	0.672067	0.672067	0.672
1845	CapacityFactor	PRWHYD	S301	0.29054	0.29054	0.29054	0.29
1846	CapacityFactor	PRWHYD	S302	0.29054	0.29054	0.29054	0.29
1847	CapacityFactor	PRWHYD	S303	0.29054	0.29054	0.29054	0.29
1848	CapacityFactor	PRWHYD	S304	0.29054	0.29054	0.29054	0.29
1849	CapacityFactor	PRWHYD	S305	0.29054	0.29054	0.29054	0.29
1850	CapacityFactor	PRWHYD	S306	0.29054	0.29054	0.29054	0.29
1851	CapacityFactor	PRWHYD	S307	0.29054	0.29054	0.29054	0.29
1852	CapacityFactor	PRWHYD	S308	0.29054	0.29054	0.29054	0.29
1853	CapacityFactor	PRWHYD	S309	0.29054	0.29054	0.29054	0.29

Naming | SETS | **Parameters** | ToDataFile

Repeat the same steps for:

1) **PWRBIO** - Biomass Power Plant

2) **PWRGEO** – Geothermal Power Plant

3) **PWRNUC** – Nuclear Power Plant

using the data provided in the DataPrep file.

You have now added 4 primary supply technologies (**PWRBIO, PWRHYD, PWRGEO, PWRNUC**) to your model.

Run the model and check the results

This is the graph of Annual Production by Technology in PJ that you should obtain at the end of this Hands-On exercise.

Remember to filter for the Technologies modelled in this Hands-On – **PWRHYD, PWRBIO, PWROHC, PWRNGS002, PWRNGS001, PWRCOA**, and **PWRGEO**.