



Energy and Flexibility Modelling

Hands-on 2 (macOS)

Please use the following citation for:

- **This exercise**

Tan, N., Cannone, C., Kell, A., Howells, M. (2022, January). Hands-on 2 (macOS): Energy and Flexibility Modelling. <http://doi.org/10.5281/zenodo.5920425>

- **clicSANDMac Software**

Cannone, C., Tan, N., Kell, A., de Wet, N., Howells, M., Yeganyan, R. (2021). clicSANDMac [computer software]. <http://doi.org/10.5281/zenodo.5879056>

- **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:

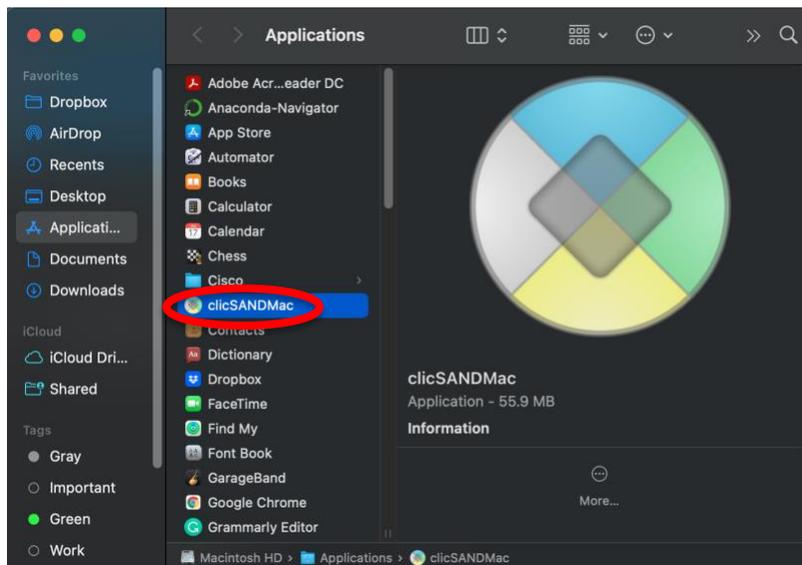
1. Create a new model in the SAND Interface
2. Learn the main functionalities of the SAND Interface
3. Define the duration of Timeslices
4. Add Year Split values
5. Check Depreciation Method and Discount Rate values



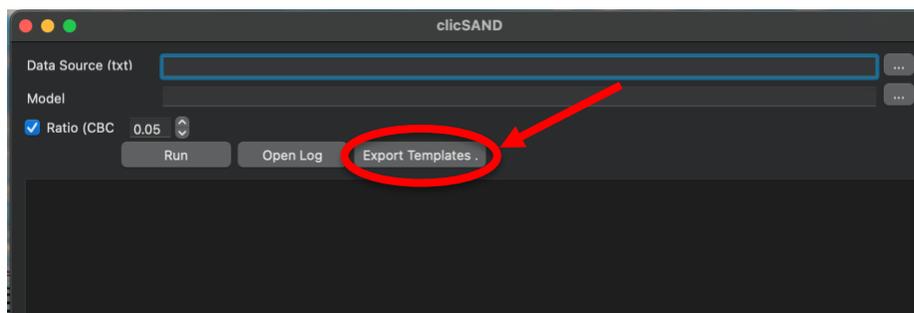
Create a new model

After installing the software and downloading the files needed (as in [Hands-on 1](#)), you can now create your first model in OSeMOSYS using the interface named SAND. This is an Excel-based (Macro-Enabled) file where you can input the data needed for OSeMOSYS to find the optimal solution to your problem. Let's learn how to save and manage your files.

1. Create a folder called **"HO2"** for this Hands-On 2.
2. Go to your 'Applications' folder and double-click on 'cllcSANDMac' to open the software.

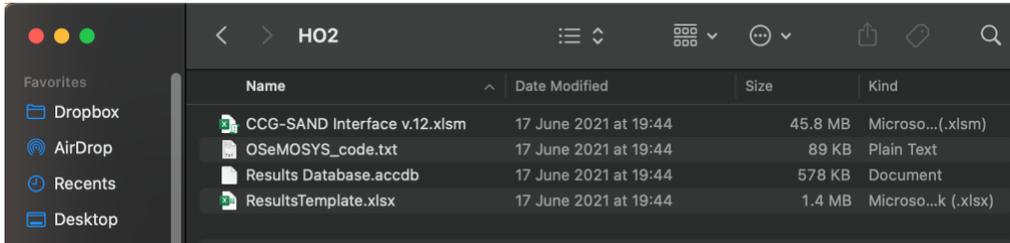


3. This screen will show up. Click on 'Export Templates' and direct it to the HO2 folder you created in Step 1.





4. This will automatically save a blank copy of four files:



File name	Description	Action to take
CCG-SAND Interface v.12.xlsm	Excel Macro Enabled Workbook	Rename the file to SAND_Interface_HO2
OSeMOSYS_code.txt	Text file. This is the code needed to run your models	Nothing. We do not need to change it
Results Database.accdb	Access database to store the results obtained	Nothing. We will not use this file
ResultsTemplate.xlsx	Excel Macro Enabled Workbook	Nothing. We will not use this file

Tip: Every time you make substantial changes to your model, save it as a new version in the correspondent folder. For example, if I want to test different options on my Hands-On 2 file, I will create a new file in the folder “**HO2**” called “**SAND_Interface_HO2_v2**” and so on.

Repeat these steps for each Hands-On (New Hox folder -> Open clicSANDMac -> Export Templates in the HOx folder)

Important: The files should not be saved or synced in One Drive for clicSAND to work

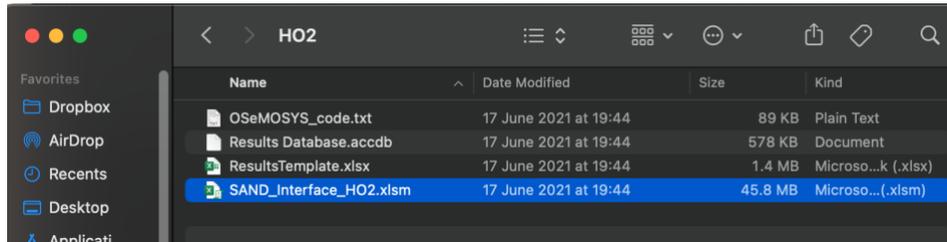
You now know how to manage your folders and files!



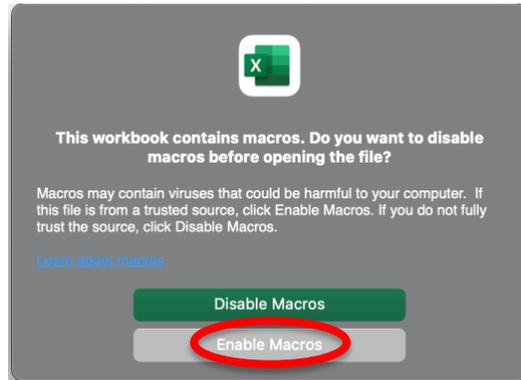
Main functionalities of SAND Interface

The next step is to learn how to use the SAND Interface. **Don't worry**, it looks more complicated than it really is.

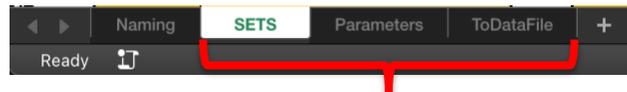
1. Open the renamed file **SAND_Interface_HO2**



2. A pop-up will appear. Click on 'Enable Macros'.



3. You will now see an Excel Workbook with four Sheets – **Naming**, **SETS**, **Parameters**, and **ToDataFile**. The Sheets **SETS**, **Parameters**, and **ToDataFile** represent the core of the Interface, and they are entirely interconnected to one another.



Core Sheets

4. Go to **SETS** - this is the place where you can define the name of your **Technologies** (in column B), **Commodities** (in column E) and **Emissions** (in column H).

	A	B	C	D	E	F	G	H	I
1			Technologies			Commodities			Emissions
2		Code	Description		Code	Description		Code	Description
3		TEC000	Additional Technology		COM001	Additional Fuel		EMIC02	Emission factor for CO2
4		TEC001	Additional Technology		COM002	Additional Fuel		EMICH4	Emission factor for methane
5		TEC002	Additional Technology		COM003	Additional Fuel		EMIFGA	Emission factor for Fluorinated gases
6		TEC003	Additional Technology		COM004	Additional Fuel		EMIN2O	Emission factor for Nitrous Oxide
7		TEC004	Additional Technology		COM005	Additional Fuel		EMIREN	Emission factor for RET targets
8		TEC005	Additional Technology		COM006	Additional Fuel		Region	
9		TEC006	Additional Technology		COM007	Additional Fuel		RE1	Region 1
10		TEC007	Additional Technology		COM008	Additional Fuel		ResultsPath "C:\...\res.csv" (change it before running)	
11		TEC008	Additional Technology		COM009	Additional Fuel		="C:\Users\Carla\Desktop\runs\2020\UN\CLEW50\2\res.csv";	
12		TEC009	Additional Technology		COM010	Additional Fuel			
13		TEC010	Additional Technology		COM011	Additional Fuel			
14		TEC011	Additional Technology		COM012	Additional Fuel			
15		TEC012	Additional Technology		COM013	Additional Fuel			

These three columns are linked to the 'ToDataFile' Sheet that has the format needed by the solver to find the optimal solution. Therefore, whenever you specify the name of a Technology, Commodity, or Emission in these columns, it is automatically reported in their respective cells in the 'ToDataFile' Sheet.

You have the freedom to change the names **as many times as necessary** without losing the data previously added for that specific entry.

Important: Technologies, Commodities and Emissions codes in your model should be named following the guidelines explained in **Lecture 3**.

3.1 Naming Convention



3.1.5 OSeMOSYS Naming Convention Part 2

Sectors

Power: PWR
 Industry: IND
 Residential: RES
 Transport: TRA
 Agriculture: AGR
 Commerce: COM
 Cooking Stoves: STV
 Mining/Extraction: MIN
 Transformation: UPS
 Imports: IMP

Commodities

Biomass: BIO Geothermal: GEO
 Coal: COA Heat: HET
 Natural gas: NGS Hydro: HYD
 Diesel: DSL Bagasse: BAG
 Fuel oil: HFO Kerosene: KER
 Uranium: URN Solar energy: SOL
 Waste: WAS Wind energy: WND
 Charcoal: CHC Liquid petroleum gas: LNG
 Crude Oil: CRU Other hydrocarbons: OHC

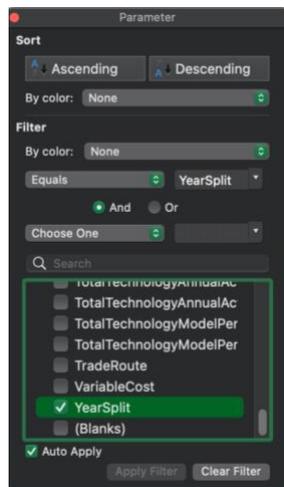
Electricity before transmission: ELC001
 Electricity after transmission: ELC002



5. Go to **Parameters** - this is a giant Sheet where you will be adding data for each OSeMOSYS parameter. To make things easier and faster for you, there are filters at the top of each column where you can filter for either **Parameter (column A)**, **Technology (Column C)**, **Commodities/Fuel (Column F)**. Columns K to BN is where you can insert data from 2015 to 2070.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
	Parameter	REGION	TECHNOLOGY	EMISSION	MODE_OF_OPERATION	FUEL	TIME_SLICE	STORAGE	REGION2	Time Independent variable	2015	2016	2017	2018	2019	2020	2021
1	AccumulatedAnnualDemand	REI				COM001					0	0	0	0	0	0	0
2	AccumulatedAnnualDemand	REI				COM002					0	0	0	0	0	0	0
3	AccumulatedAnnualDemand	REI				COM003					0	0	0	0	0	0	0
4	AccumulatedAnnualDemand	REI				COM004					0	0	0	0	0	0	0
5	AccumulatedAnnualDemand	REI				COM005					0	0	0	0	0	0	0
6	AccumulatedAnnualDemand	REI				COM006					0	0	0	0	0	0	0
7	AccumulatedAnnualDemand	REI				COM007					0	0	0	0	0	0	0
8	AccumulatedAnnualDemand	REI				COM008					0	0	0	0	0	0	0
9	AccumulatedAnnualDemand	REI				COM009					0	0	0	0	0	0	0
10	AccumulatedAnnualDemand	REI				COM010					0	0	0	0	0	0	0
11	AccumulatedAnnualDemand	REI				COM011					0	0	0	0	0	0	0
12	AccumulatedAnnualDemand	REI				COM012					0	0	0	0	0	0	0
13	AccumulatedAnnualDemand	REI				COM013					0	0	0	0	0	0	0
14	AccumulatedAnnualDemand	REI				COM014					0	0	0	0	0	0	0
15	AccumulatedAnnualDemand	REI				COM015					0	0	0	0	0	0	0
16	AccumulatedAnnualDemand	REI				COM016					0	0	0	0	0	0	0
17	AccumulatedAnnualDemand	REI				COM017					0	0	0	0	0	0	0
18	AccumulatedAnnualDemand	REI				COM018					0	0	0	0	0	0	0
19	AccumulatedAnnualDemand	REI				COM019					0	0	0	0	0	0	0
20	AccumulatedAnnualDemand	REI				COM020					0	0	0	0	0	0	0
21	AccumulatedAnnualDemand	REI				COM021					0	0	0	0	0	0	0
22	AccumulatedAnnualDemand	REI				COM022					0	0	0	0	0	0	0
23	AccumulatedAnnualDemand	REI				COM023					0	0	0	0	0	0	0
24	AccumulatedAnnualDemand	REI				COM024					0	0	0	0	0	0	0
25	AccumulatedAnnualDemand	REI				COM025					0	0	0	0	0	0	0
26	AccumulatedAnnualDemand	REI				COM026					0	0	0	0	0	0	0
27	AccumulatedAnnualDemand	REI				COM027					0	0	0	0	0	0	0
28	AccumulatedAnnualDemand	REI				COM028					0	0	0	0	0	0	0
29	AccumulatedAnnualDemand	REI				COM029					0	0	0	0	0	0	0
30	AccumulatedAnnualDemand	REI				COM030					0	0	0	0	0	0	0
31	AccumulatedAnnualDemand	REI				COM031					0	0	0	0	0	0	0
32	AccumulatedAnnualDemand	REI				COM032					0	0	0	0	0	0	0
33	AccumulatedAnnualDemand	REI				COM033					0	0	0	0	0	0	0
34	AccumulatedAnnualDemand	REI				COM034					0	0	0	0	0	0	0
35	AccumulatedAnnualDemand	REI				COM035					0	0	0	0	0	0	0
36	AccumulatedAnnualDemand	REI				COM036					0	0	0	0	0	0	0
37	AccumulatedAnnualDemand	REI				COM037					0	0	0	0	0	0	0
38	AccumulatedAnnualDemand	REI				COM038					0	0	0	0	0	0	0
39	AccumulatedAnnualDemand	REI				COM039					0	0	0	0	0	0	0
40	AccumulatedAnnualDemand	REI				COM040					0	0	0	0	0	0	0
41	AccumulatedAnnualDemand	REI				COM041					0	0	0	0	0	0	0
42	AccumulatedAnnualDemand	REI				COM042					0	0	0	0	0	0	0
43	AccumulatedAnnualDemand	REI				COM043					0	0	0	0	0	0	0
44	AccumulatedAnnualDemand	REI				COM044					0	0	0	0	0	0	0
45	AccumulatedAnnualDemand	REI				COM045					0	0	0	0	0	0	0
46	AccumulatedAnnualDemand	REI				COM046					0	0	0	0	0	0	0
47	AccumulatedAnnualDemand	REI				COM047					0	0	0	0	0	0	0
48	AccumulatedAnnualDemand	REI				COM048					0	0	0	0	0	0	0
49	AccumulatedAnnualDemand	REI				COM049					0	0	0	0	0	0	0
50	AccumulatedAnnualDemand	REI				COM050					0	0	0	0	0	0	0

6. In **Parameters (Column A)**, filter for **YearSplit**. You will see that only data associated with the parameter called YearSplit are shown. You can add as many filters as you want. Play around with the filters and get confident with this functionality!





This is what you will see if you filter out for the Parameter **Year Split**:

Parameter	REGION	TECHNOLOGY	EMISSION	MODE_OF_OPERATION	FUEL	THRESHOLD	STORAGE	REGION2	Time Independent variable	2015	2016	2017	2018	2019	2020	2021
48802 YearSplit									S101	0	0	0	0	0	0	0
48803 YearSplit									S102	0	0	0	0	0	0	0
48804 YearSplit									S103	0	0	0	0	0	0	0
48805 YearSplit									S104	0	0	0	0	0	0	0
48806 YearSplit									S105	0	0	0	0	0	0	0
48807 YearSplit									S106	0	0	0	0	0	0	0
48808 YearSplit									S107	0	0	0	0	0	0	0
48809 YearSplit									S108	0	0	0	0	0	0	0
48810 YearSplit									S109	0	0	0	0	0	0	0
48811 YearSplit									S110	0	0	0	0	0	0	0
48812 YearSplit									S111	0	0	0	0	0	0	0
48813 YearSplit									S112	0	0	0	0	0	0	0
48814 YearSplit									S113	0	0	0	0	0	0	0
48815 YearSplit									S114	0	0	0	0	0	0	0
48816 YearSplit									S115	0	0	0	0	0	0	0
48817 YearSplit									S116	0	0	0	0	0	0	0
48818 YearSplit									S117	0	0	0	0	0	0	0
48819 YearSplit									S118	0	0	0	0	0	0	0
48820 YearSplit									S119	0	0	0	0	0	0	0
48821 YearSplit									S120	0	0	0	0	0	0	0
48822 YearSplit									S121	0	0	0	0	0	0	0
48823 YearSplit									S122	0	0	0	0	0	0	0
48824 YearSplit									S123	0	0	0	0	0	0	0
48825 YearSplit									S124	0	0	0	0	0	0	0
48826 YearSplit									S201	0	0	0	0	0	0	0
48827 YearSplit									S202	0	0	0	0	0	0	0
48828 YearSplit									S203	0	0	0	0	0	0	0
48829 YearSplit									S204	0	0	0	0	0	0	0
48830 YearSplit									S205	0	0	0	0	0	0	0
48831 YearSplit									S206	0	0	0	0	0	0	0
48832 YearSplit									S207	0	0	0	0	0	0	0
48833 YearSplit									S208	0	0	0	0	0	0	0
48834 YearSplit									S209	0	0	0	0	0	0	0
48835 YearSplit									S210	0	0	0	0	0	0	0
48836 YearSplit									S211	0	0	0	0	0	0	0
48837 YearSplit									S212	0	0	0	0	0	0	0
48838 YearSplit									S213	0	0	0	0	0	0	0
48839 YearSplit									S214	0	0	0	0	0	0	0
48840 YearSplit									S215	0	0	0	0	0	0	0
48841 YearSplit									S216	0	0	0	0	0	0	0
48842 YearSplit									S217	0	0	0	0	0	0	0
48843 YearSplit									S218	0	0	0	0	0	0	0
48844 YearSplit									S219	0	0	0	0	0	0	0
48845 YearSplit									S220	0	0	0	0	0	0	0
48846 YearSplit									S221	0	0	0	0	0	0	0
48847 YearSplit									S222	0	0	0	0	0	0	0
48848 YearSplit									S223	0	0	0	0	0	0	0
48849 YearSplit									S224	0	0	0	0	0	0	0
48850 YearSplit									S301	0	0	0	0	0	0	0
48851 YearSplit									S302	0	0	0	0	0	0	0

You see that from column K to column BN there are default values added. In this case, it is 0. We will add data for YearSplit at the end of this Hands-On.

- Go to **ToDataFile** - this Sheet has the format needed by the solver to find the optimal solution to your problem.

Parameter	REGION	TECHNOLOGY	EMISSION	MODE_OF_OPERATION	FUEL	THRESHOLD	STORAGE	REGION2	Time Independent variable	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
48852 YearSplit									S303	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48853 YearSplit									S304	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48854 YearSplit									S305	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48855 YearSplit									S306	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48856 YearSplit									S307	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48857 YearSplit									S308	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48858 YearSplit									S309	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48859 YearSplit									S310	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48860 YearSplit									S311	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48861 YearSplit									S312	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48862 YearSplit									S313	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48863 YearSplit									S314	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48864 YearSplit									S315	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48865 YearSplit									S316	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48866 YearSplit									S317	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48867 YearSplit									S318	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48868 YearSplit									S319	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48869 YearSplit									S320	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48870 YearSplit									S321	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48871 YearSplit									S322	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48872 YearSplit									S323	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48873 YearSplit									S324	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48874 YearSplit									S325	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48875 YearSplit									S326	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48876 YearSplit									S327	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48877 YearSplit									S328	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48878 YearSplit									S329	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48879 YearSplit									S330	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48880 YearSplit									S331	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48881 YearSplit									S332	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48882 YearSplit									S333	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48883 YearSplit									S334	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48884 YearSplit									S335	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48885 YearSplit									S336	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48886 YearSplit									S337	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48887 YearSplit									S338	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48888 YearSplit									S339	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48889 YearSplit									S340	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48890 YearSplit									S341	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48891 YearSplit									S342	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48892 YearSplit									S343	0																	



Important: never add data to this **ToDataFile** Sheet - data should only be added to the **Parameters** and **SETS** sheets. The interface is made up in a way that all the entries will be automatically read by the **ToDataFile** sheet.

8. **Go to Naming** – here you will find the description of the parameters used in SAND Interface. Note that we are not going to use all the parameters listed here.

Name	Description	Index
YEAR	It represents the time frame of the model, it contains all the years to be considered in the study.	1
TECHNOLOGY	It includes any element of the energy system that changes a commodity from one form to another, uses it or supplies it. All system components are set up as a 'technology' in OSeMOSYS. As the model is an abstraction, the modeller is free to interpret the role of a technology as well, where relevant. It may for example represent a single root technology (such as a power plant) or can represent a nested/ aggregated collection of technologies (such as the stock of several nuclear light bulbs), or may even simply be a dummy technology, perhaps used for accounting purposes.	2
TIMEslice	It represents the time split of each modelled year, therefore the time resolution of the model. Common to several energy systems modelling tools (i.e. MESSAGE / MARKAL / TIMES), the annual demand is 'sliced' into representative fractions of the year. It is necessary to assess times of the year when demand is high separately from times when demand is low, for fuels that are expensive to store. In order to reduce the computation time, these 'slices' are often grouped. Thus, the annual demand may be split into aggregate seasons where demand levels are similar (such as 'summer, winter and intermediate'). These seasons may be subdivided into aggregate 'day types' (such as 'workdays and weekends'), and the day further sub-divided (such as into day and night) depending on the level of demand.	3
FUEL	It includes any energy vector, energy service or process entering or exiting technologies. These can be aggregate groups, individual flows or artificially separated, depending on the requirements of the analysis.	4
EMISSION	It includes any kind of emission potentially deriving from the operation of the defined technologies. Typical examples would include atmospheric emissions of greenhouse gases, such as CO2.	5
MODE_OF_OPERATION	It defines the number of modes of operation that the technologies can have. If a technology can have various input or output fuels and it can choose the mix (i.e. any linear combination) of these input or output fuels, each mix can be accounted as a separate mode of operation. For example, a CHP plant may produce heat in one mode of operation and electricity in another.	6
REGION	It sets the regions to be modelled, e.g. different countries. For each of them, the supply-demand balances for all the energy vectors are ensured, including trades with other regions. In some occasions it might be convenient to model different countries within the same region and differentiate them simply by creating sub-regions and technologies for each of them.	7
SEASON	It gives indication (by successive numerical values) of how many seasons (e.g. winter, intermediate, summer) are accounted for and in which order. This set is needed if storage facilities are included in the model.	8
DAYTYPE	It gives indication (by successive numerical values) of how many day types (e.g. workday, weekend) are accounted for and in which order. This set is needed if storage facilities are included in the model.	9
DAILYTIMEBRACKET	It gives indication (by successive numerical values) of how many parts the day is split into (e.g. night, morning, afternoon, evening) and in which order these parts are sorted. This set is needed if storage facilities are included in the model.	10
STORAGE	It includes storage facilities in the model.	11

Define the duration of time slices

To carry out a modelling exercise with OSeMOSYS, it is necessary to assign values to the set called **Timeslices**, which represents periods of the year with a similar demand. In this model, the year was initially divided into 4 timeslices representing two periods of 6 months (two representative seasons), each of which would have similar demand. This was then further sub-divided into day and night periods, called: **Summer Day (SD)**, **Summer Night (SN)**, **Winter Day (WD)**, **Winter Night (WN)**.

However, in the SAND Interface it is possible to define up to 96 timeslices, so these initial data were manipulated to obtain a 24-hour representation of a reference day for each of SD, SN, WD, and WN (24 hours each * 4 = 96 timeslices). Therefore, each year is divided into 96 periods instead of the previous 4.



It was assumed each season has an equal length, with an average hourly split per season (24hr representative), therefore obtaining:

$$4 \text{ Seasons/year} * 24\text{hr of a representative day/season} = 96 \text{ Timeslices/Year}$$

Each Timeslice represents an equal fraction of the Year in the following way, defined as the Year Split:

$$1 \text{ Year} / 96 \text{ Timeslices} = 0.0104$$

Therefore, you should add this number to the Year Split column for each year.

Tip: To help you deal with all the data, there is a [Data Preparation Spreadsheet](#) that will allow you to copy-paste the data in a faster way.

Add Year Split values

After defining the duration of each time slice and calculating the Year Split profile we need to add these values in the SAND Interface.

1. Go to the Parameters Sheet and filter for **YearSplit** (in Column A).
2. Click on this link to open the [Data Preparation Spreadsheet](#).
3. At the bottom of the webpage, you will see a tab called 'Files'. Click on Download beside **Data_Prep_HO2.xlsx**

The screenshot shows the OpenAIRE interface for the resource 'Energy and Flexibility Modelling Hands-on 2 (macOS)'. The 'Files' tab is active, displaying a table of files. The file 'Data_prep_HO2.xlsx' (15.5 kB) is highlighted, and its 'Download' button is circled in red. Other files include 'HO2_macOS.pdf' (2.0 MB). The interface also shows the OpenAIRE logo, publication date (January 30, 2022), DOI (10.5281/zenodo.5920445), and license (Creative Commons Attribution 4.0 International). A 'Versions' section lists three versions of the resource, all dated January 30, 2022.

Name	Size	Download
Data_prep_HO2.xlsx	15.5 kB	Download
HO2_macOS.pdf	2.0 MB	Preview Download



4. Open **Data_Prep_HO2.xlsx** once downloaded. You will see this Excel Workbook. Copy the data in Column C of the **Data Preparation File** (click on cell C2 and press on the **command key (⌘) + shift + down arrow**).

	A	B	C	D
1			Year Split	
2	WN	S101	0.0104	
3	WN	S102	0.0104	
4	WN	S103	0.0104	
5	WN	S104	0.0104	
6	WN	S105	0.0104	
7	WN	S106	0.0104	
8	WD	S107	0.0104	
9	HD	S108	0.0104	
10	WD	S109	0.0104	
11	WD	S110	0.0104	
12	HD	S111	0.0104	
13	WD	S112	0.0104	
14	WD	S113	0.0104	
15	HD	S114	0.0104	
16	WD	S115	0.0104	
17	WD	S116	0.0104	
18	HD	S117	0.0104	
19	WD	S118	0.0104	
20	WN	S119	0.0104	
21	WN	S120	0.0104	
22	WN	S121	0.0104	
23	WN	S122	0.0104	
24	WN	S123	0.0104	
25	WN	S124	0.0104	
26	BN	S201	0.0104	
27	BN	S202	0.0104	
28	BN	S203	0.0104	
29	BN	S204	0.0104	
30	BD	S205	0.0104	
31	BD	S206	0.0104	
32	BD	S207	0.0104	
33	BD	S208	0.0104	
34	BD	S209	0.0104	
35	BD	S210	0.0104	
36	BD	S211	0.0104	
37	BD	S212	0.0104	
38	BD	S213	0.0104	
39	BD	S214	0.0104	
40	BD	S215	0.0104	
41	BD	S216	0.0104	
42	BD	S217	0.0104	
43	BD	S218	0.0104	
44	BD	S219	0.0104	
45	BD	S220	0.0104	
46	BD	S221	0.0104	
47	BD	S222	0.0104	
48	BD	S223	0.0104	
49	BD	S224	0.0104	
50	BD	S225	0.0104	
51	BD	S226	0.0104	
52	BD	S227	0.0104	
53	BD	S228	0.0104	
54	BD	S229	0.0104	
55	BD	S230	0.0104	
56	BD	S231	0.0104	
57	BD	S232	0.0104	
58	BD	S233	0.0104	
59	BD	S234	0.0104	
60	BD	S235	0.0104	
61	BD	S236	0.0104	
62	BD	S237	0.0104	
63	BD	S238	0.0104	
64	BD	S239	0.0104	
65	BD	S240	0.0104	
66	BD	S241	0.0104	
67	BD	S242	0.0104	
68	BD	S243	0.0104	
69	BD	S244	0.0104	
70	BD	S245	0.0104	
71	BD	S246	0.0104	
72	BD	S247	0.0104	
73	BD	S248	0.0104	
74	BD	S249	0.0104	
75	BD	S250	0.0104	
76	BD	S251	0.0104	
77	BD	S252	0.0104	
78	BD	S253	0.0104	
79	BD	S254	0.0104	
80	BD	S255	0.0104	
81	BD	S256	0.0104	
82	BD	S257	0.0104	
83	BD	S258	0.0104	
84	BD	S259	0.0104	
85	BD	S260	0.0104	
86	BD	S261	0.0104	
87	BD	S262	0.0104	
88	BD	S263	0.0104	
89	BD	S264	0.0104	
90	BD	S265	0.0104	
91	BD	S266	0.0104	
92	BD	S267	0.0104	
93	BD	S268	0.0104	
94	BD	S269	0.0104	
95	BD	S270	0.0104	
96	BD	S271	0.0104	
97	BD	S272	0.0104	
98	BD	S273	0.0104	
99	BD	S274	0.0104	
100	BD	S275	0.0104	
101	BD	S276	0.0104	
102	BD	S277	0.0104	
103	BD	S278	0.0104	
104	BD	S279	0.0104	
105	BD	S280	0.0104	
106	BD	S281	0.0104	
107	BD	S282	0.0104	
108	BD	S283	0.0104	
109	BD	S284	0.0104	
110	BD	S285	0.0104	
111	BD	S286	0.0104	
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113	BD	S288	0.0104	
114	BD	S289	0.0104	
115	BD	S290	0.0104	
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118	BD	S293	0.0104	
119	BD	S294	0.0104	
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121	BD	S296	0.0104	
122	BD	S297	0.0104	
123	BD	S298	0.0104	
124	BD	S299	0.0104	
125	BD	S300	0.0104	
126	BD	S301	0.0104	
127	BD	S302	0.0104	
128	BD	S303	0.0104	
129	BD	S304	0.0104	
130	BD	S305	0.0104	
131	BD	S306	0.0104	
132	BD	S307	0.0104	
133	BD	S308	0.0104	
134	BD	S309	0.0104	
135	BD	S310	0.0104	
136	BD	S311	0.0104	
137	BD	S312	0.0104	
138	BD	S313	0.0104	
139	BD	S314	0.0104	
140	BD	S315	0.0104	
141	BD	S316	0.0104	
142	BD	S317	0.0104	
143	BD	S318	0.0104	
144	BD	S319	0.0104	
145	BD	S320	0.0104	
146	BD	S321	0.0104	
147	BD	S322	0.0104	
148	BD	S323	0.0104	
149	BD	S324	0.0104	
150	BD	S325	0.0104	
151	BD	S326	0.0104	
152	BD	S327	0.0104	
153	BD	S328	0.0104	
154	BD	S329	0.0104	
155	BD	S330	0.0104	
156	BD	S331	0.0104	
157	BD	S332	0.0104	
158	BD	S333	0.0104	
159	BD	S334	0.0104	
160	BD	S335	0.0104	
161	BD	S336	0.0104	
162	BD	S337	0.0104	
163	BD	S338	0.0104	
164	BD	S339	0.0104	
165	BD	S340	0.0104	
166	BD	S341	0.0104	
167	BD	S342	0.0104	
168	BD	S343	0.0104	
169	BD	S344	0.0104	
170	BD	S345	0.0104	
171	BD	S346	0.0104	
172	BD	S347	0.0104	
173	BD	S348	0.0104	
174	BD	S349	0.0104	
175	BD	S350	0.0104	
176	BD	S351	0.0104	
177	BD	S352	0.0104	
178	BD	S353	0.0104	
179	BD	S354	0.0104	
180	BD	S355	0.0104	
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182	BD	S357	0.0104	
183	BD	S358	0.0104	
184	BD	S359	0.0104	
185	BD	S360	0.0104	
186	BD	S361	0.0104	
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188	BD	S363	0.0104	
189	BD	S364	0.0104	
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197	BD	S372	0.0104	
198	BD	S373	0.0104	
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201	BD	S376	0.0104	
202	BD	S377	0.0104	
203	BD	S378	0.0104	
204	BD	S379	0.0104	
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206	BD	S381	0.0104	
207	BD	S382	0.0104	
208	BD	S383	0.0104	
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210	BD	S385	0.0104	
211	BD	S386	0.0104	
212	BD	S387	0.0104	
213	BD	S388	0.0104	
214	BD	S389	0.0104	
215	BD	S390	0.0104	
216	BD	S391	0.0104	
217	BD	S392	0.0104	
218	BD	S393	0.0104	
219	BD	S394	0.0104	
220	BD	S395	0.0104	
221	BD	S396	0.0104	
222	BD	S397	0.0104	
223	BD	S398	0.0104	
224	BD	S399	0.0104	
225	BD	S400	0.0104	
226	BD	S401	0.0104	
227	BD	S402	0.0104	
228	BD	S403	0.0104	
229	BD	S404	0.0104	
230	BD	S405	0.0104	
231	BD	S406	0.0104	
232	BD	S407	0.0104	
233	BD	S408	0.0104	
234	BD	S409	0.0104	
235	BD	S410	0.0104	
236	BD	S411	0.0104	
237	BD	S412	0.0104	
238	BD	S413	0.0104	
239	BD	S414	0.0104	
240	BD	S415	0.0104	
241	BD	S416	0.0104	
242	BD	S417	0.0104	
243	BD	S418	0.0104	
244	BD	S419	0.0104	
245	BD	S420	0.0104	
246	BD	S421	0.0104	
247	BD	S422	0.0104	
248	BD	S423	0.0104	
249	BD	S424	0.0104	
250	BD	S425	0.0104	
251	BD	S426	0.0104	
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253	BD	S428	0.0104	
254	BD	S429	0.0104	
255	BD	S430	0.0104	
256	BD	S431	0.0104	
257	BD	S432	0.0104	
258	BD	S433	0.0104	
259	BD	S434	0.0104	
260	BD	S435	0.0104	
261	BD	S436	0.0104	
262	BD	S437	0.0104	
263	BD	S438	0.0104	
264	BD	S439	0.0104	
265	BD	S440	0.0104	
266	BD	S441	0.0104	
267	BD	S442	0.0104	
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272	BD	S447	0.0104	
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276	BD	S451	0.0104	
277	BD	S452	0.0104	
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281	BD	S456	0.0104	
282	BD	S457	0.0104	
283	BD	S458	0.0104	
284	BD	S459	0.0104	
285	BD	S460	0.0104	
286	BD	S461	0.0104	
287	BD	S462	0.0104	
288	BD	S463	0.0104	
289	BD	S464	0.0104	
290	BD	S465	0.0104	
291	BD	S466	0.0104	
292	BD	S467	0.0104	
293	BD	S468	0.0104	
294	BD	S469	0.0104	
295	BD	S470	0.0104	
296	BD	S471	0.0104	
297	BD	S472	0.0104	
298	BD	S473	0.0104	
299	BD	S474	0.0104	



To help you with this task, check the blue cells in the Data Preparation file that highlight the data you need to change every time.

Parameter	REGION	TECHNOLOGY	EMISSION	MODE_OF_OPERATION	FUEL	EMBLICE	STORAGE	REGION2	Time Independent variable	2015	2016	2017	2018	2019	2020	2070
S101									0.0104167	0	0	0	0	0	0	0
S102									0.0104167	0	0	0	0	0	0	0
S103									0.0104167	0	0	0	0	0	0	0
S104									0.0104167	0	0	0	0	0	0	0
S105									0.0104167	0	0	0	0	0	0	0
S106									0.0104167	0	0	0	0	0	0	0
S107									0.0104167	0	0	0	0	0	0	0
S108									0.0104167	0	0	0	0	0	0	0
S109									0.0104167	0	0	0	0	0	0	0
S110									0.0104167	0	0	0	0	0	0	0
S111									0.0104167	0	0	0	0	0	0	0
S112									0.0104167	0	0	0	0	0	0	0
S113									0.0104167	0	0	0	0	0	0	0
S114									0.0104167	0	0	0	0	0	0	0
S115									0.0104167	0	0	0	0	0	0	0
S116									0.0104167	0	0	0	0	0	0	0
S117									0.0104167	0	0	0	0	0	0	0
S118									0.0104167	0	0	0	0	0	0	0
S119									0.0104167	0	0	0	0	0	0	0
S120									0.0104167	0	0	0	0	0	0	0
S121									0.0104167	0	0	0	0	0	0	0
S122									0.0104167	0	0	0	0	0	0	0
S123									0.0104167	0	0	0	0	0	0	0
S124									0.0104167	0	0	0	0	0	0	0
S201									0.0104167	0	0	0	0	0	0	0
S202									0.0104167	0	0	0	0	0	0	0
S203									0.0104167	0	0	0	0	0	0	0
S204									0.0104167	0	0	0	0	0	0	0
S205									0.0104167	0	0	0	0	0	0	0
S206									0.0104167	0	0	0	0	0	0	0
S207									0.0104167	0	0	0	0	0	0	0
S208									0.0104167	0	0	0	0	0	0	0
S209									0.0104167	0	0	0	0	0	0	0
S210									0.0104167	0	0	0	0	0	0	0
S211									0.0104167	0	0	0	0	0	0	0
S212									0.0104167	0	0	0	0	0	0	0
S213									0.0104167	0	0	0	0	0	0	0
S214									0.0104167	0	0	0	0	0	0	0
S215									0.0104167	0	0	0	0	0	0	0
S216									0.0104167	0	0	0	0	0	0	0
S217									0.0104167	0	0	0	0	0	0	0
S218									0.0104167	0	0	0	0	0	0	0
S219									0.0104167	0	0	0	0	0	0	0
S220									0.0104167	0	0	0	0	0	0	0

- Go to Cell K48662; press on the **command key (⌘) + shift + down arrow** to select only the data in column K. Navigate to the bottom right corner of the selected data until you see a '+' symbol. Now press and drag to the right to copy the data until column BK (year 2070).

STORAGE	REGION2	Time Independent variable	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
S101		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S102		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S103		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S104		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S105		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S106		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S107		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S108		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S109		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S110		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S111		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S112		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S113		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S114		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S115		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S116		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S117		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S118		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S119		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S120		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S121		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S122		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S123		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S124		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S201		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S202		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S203		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S204		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S205		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S206		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S207		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S208		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S209		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S210		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S211		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S212		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S213		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S214		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S215		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S216		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S217		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S218		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S219		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S220		0.0104167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

You have now added the Year Split values for all 96 time slices available in the SAND Interface for every model year from 2015-2070.



Name	Description
YearSplit	Duration of a modelled time slice, expressed as a fraction of the year. The sum of each entry over one modelled year should equal 1.
DiscountRate	Region specific value for the discount rate, expressed in decimals (e.g. 0.1)
DepreciationMethod	Binary parameter defining the type of depreciation to be applied. It has value 1 for sinking fund depreciation, value 2 for straight-line depreciation.

2. Save your **SAND_Interface_HO2** file. We will continue with file in Hands-On 3.
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