Energy and Flexibility Modelling

Hands-on 3

Please use the following citation for:

- **This exercise**

Cannone, Carla, Allington, Lucy, & Howells, Mark. (2021, March). Hands-on 3: Energy and Flexibility Modelling (Version 3.1.). Zenodo. https://doi.org/10.5281/zenodo.4605358

- **clicSAND Software**

Cannone, C., Allington, L., De Wet, N., Shivakumar, A., Goyns, P., Valderrama, C., Howells, M. (2021). clicSAND [computer software]. http://doi.org/10.5281/zenodo.4593100

- **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. Draw a RES with a Backstop and a demand
2. Define fuels
3. Define energy demands for a specific fuel
4. Define the temporal profile of energy demands
5. Define a simple technology that satisfies the demand (Backstop)
6. Run the model and check results

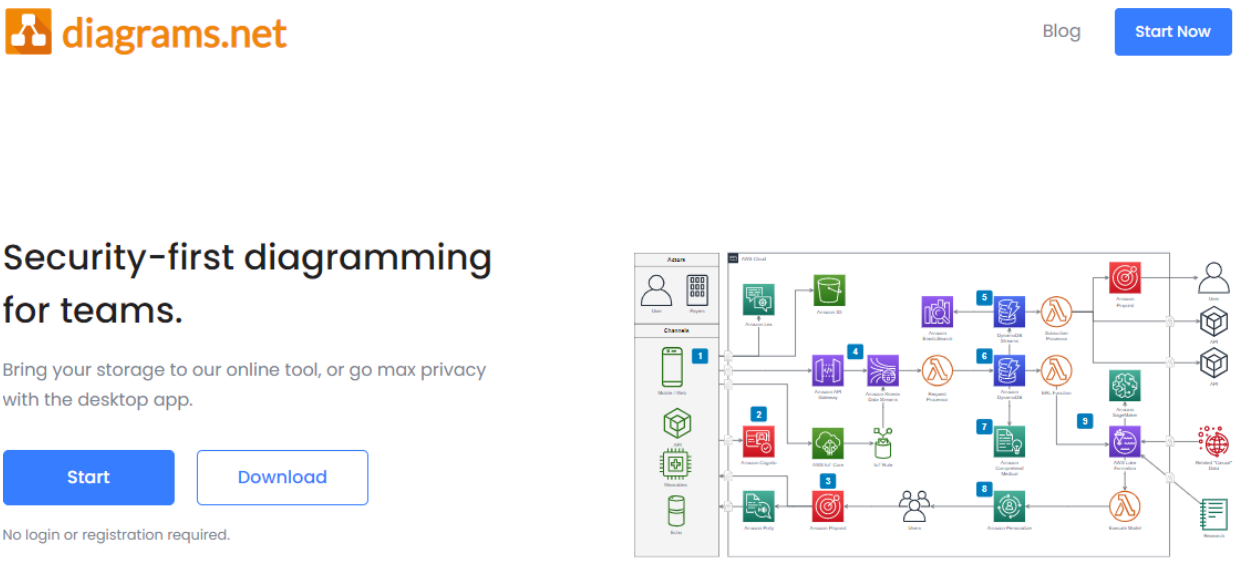
Draw RES with a Backstop and a demand

The first skill you will train during this exercise is drawing Reference Energy Systems. As explained in Lecture 2, a Reference Energy System (RES) is a conventional aggregated representation of a real energy system.

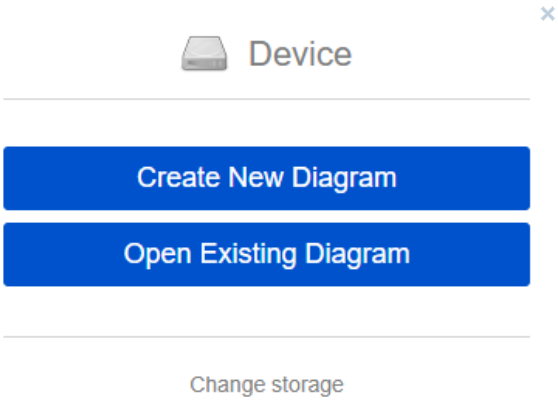
Different tools are available for this purpose, but they vary in price and functionality. For this course, we will choose Diagram.net which is **free** software for diagramming.

Try It: Let's draw the first piece of your RES:

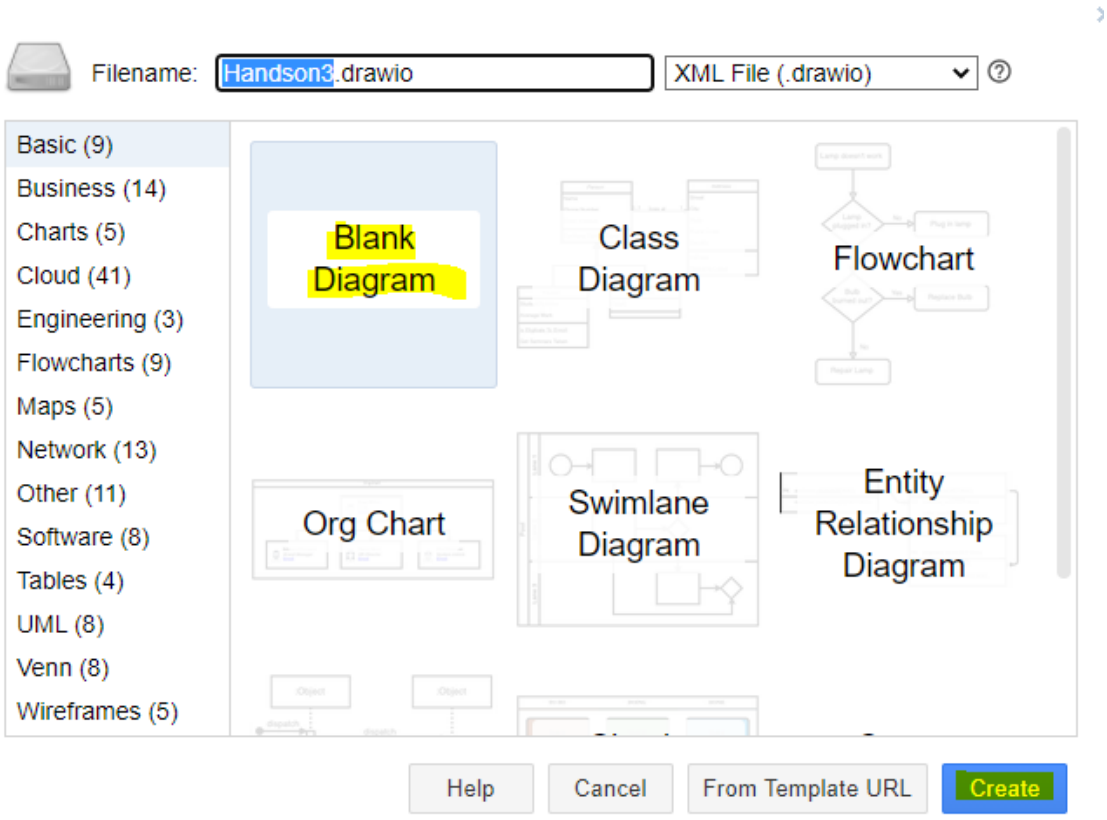
1. Open Diagram.net in your browser and click **Start.**



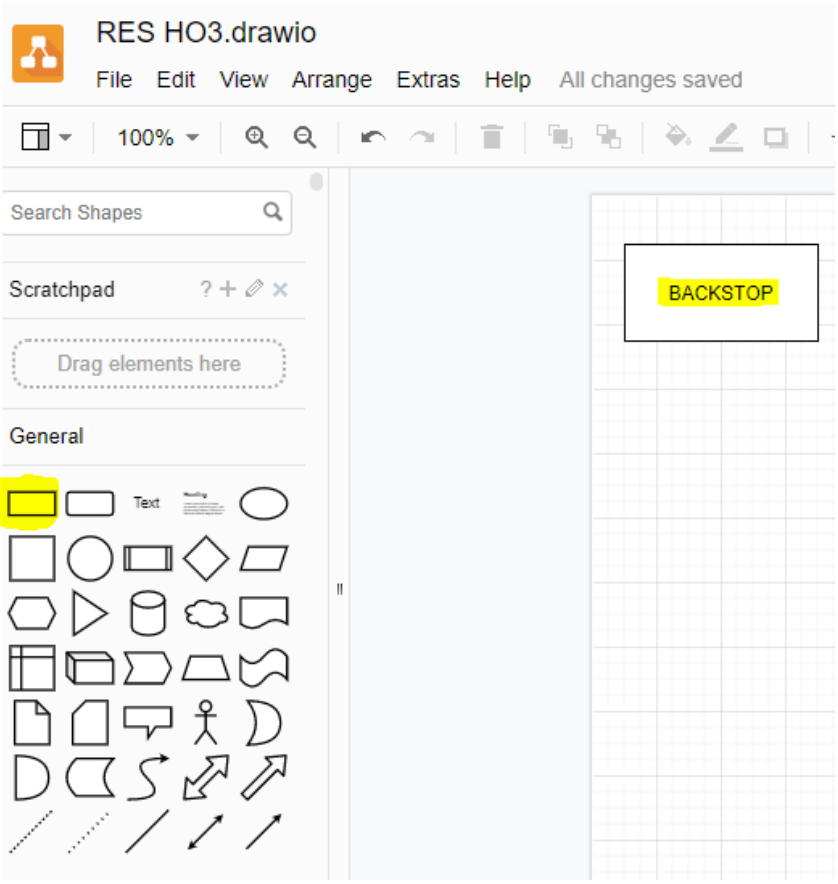
2. Click **Create New diagram**



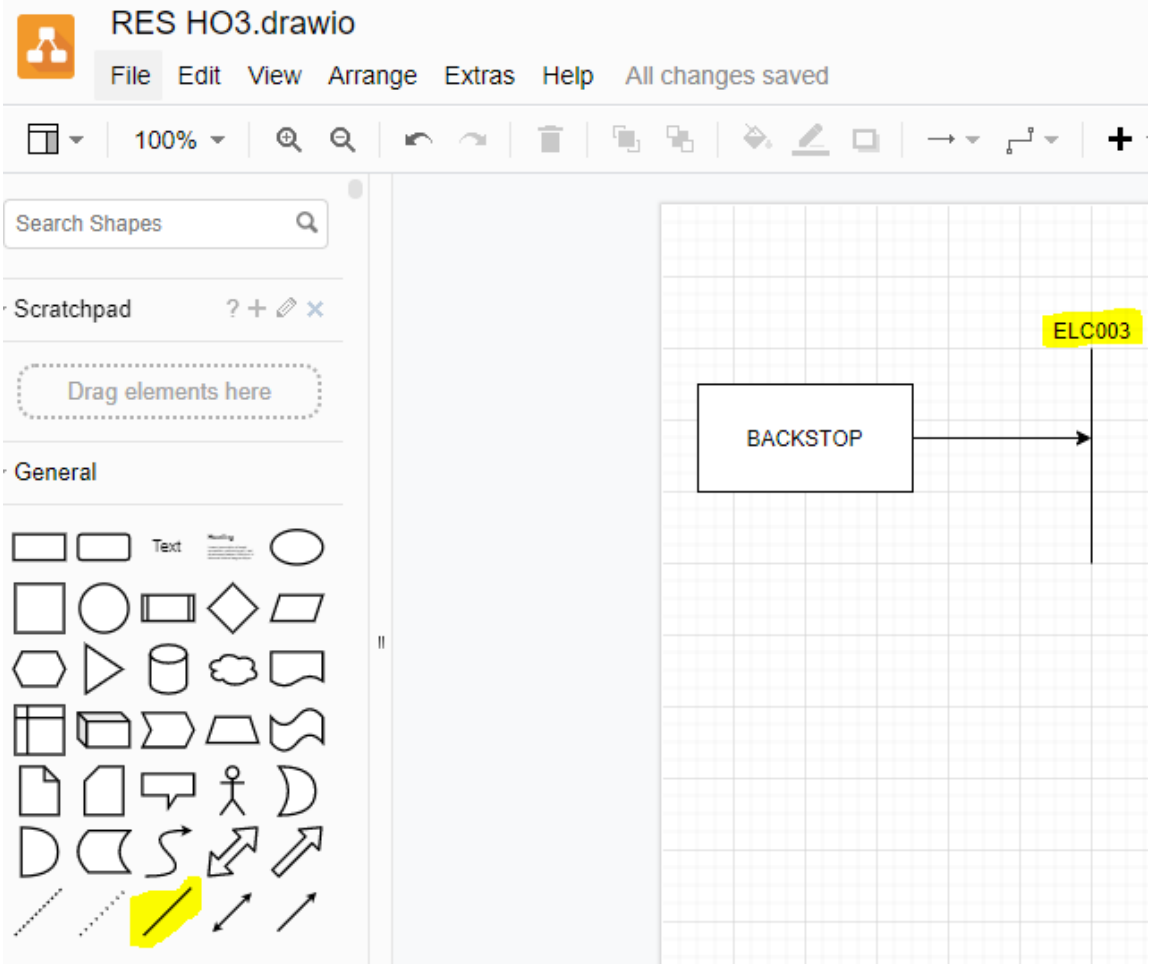
3. Select **Blank Diagram** -> Change the name to "**HandsOn3.drawio**" and save it in a folder of preference. **Watch out**: create a folder for each hands-on exercise of this course and keep building your RES, adding every piece proposed in the exercises.



4. On the left side of the tool, select a Rectangle from the General Group. Drag and drop it on the screen.
5. Double click in the middle of the **Rectangle** to add Text. Write **BACKSTOP**.



6. Let's draw the electricity demand. Select a **line** and drag and drop it on the right side of the Backstop technology. Bring your pointer on the line on the right side of the rectangle and some **blue points** will appear. Click and drag until you reach the demand line drawing an **arrow**. Double click on top of the demand line to add the code for the electricity demand: **ELC003** as for the **naming convention** guidelines explained in **Lecture 3**.



Voilà: you now have drawn the first technology called **Backstop** and the final electricity demand (**ELC003**). The arrow that connects the two means that the output of the Backstop technology will address the final electricity demand (**ELC003**).

Define commodities

The next step is to add the names of our fuels in SAND Interface.

Try It:

1. In folder HO2, make a copy of "**SAND_Interface_HO2".**

2. **Rename it as "SAND_Interface_HO3" and move it to HO3 folder** (by copying this file in the next hands-on folder we will avoid having to re-add the data already saved in Hands-on 2). Therefore, after Hands On exercise 1, you will not use the SAND Interface template created by clicSAND, but you will keep adding data to what you have previously done.

   IMPORTANT: make copies when you move to the next HO and do not make edits on the same file. In this way if there is a problem, there is always a back-up version to easily find the error.

3. Go to **SETS** Sheet. Click on Cell E3 and change the code from "**COM001**" to "**ELC003**"

4. Add a description in Cell F3 changing the text from "**Additional Fuel**" to "**Electricity after distribution**".

Commodities	
Code	*Description*
ELC003	Electricity after distribution
COM002	Additional Fuel
COM003	Additional Fuel
COM004	Additional Fuel
COM005	Additional Fuel

Watch out: Repeat this process in the future to add names for other Commodities (Fuels).

Define energy demands for a specific fuel

Your next task will be to choose the demand type. You have two options for demand type:

- **SpecifiedAnnualDemand** -used for fuels whose demand varies within the year/day. E.g. electricity
- **AccumulatedAnnualDemand** –used for fuels that do not necessarily have to be provided at an exact point in time. E.g. gasoline

Try It: Add the demand for Electricity after distribution (**ELC003**).

1. Go to Parameters Sheet in SAND and filter out for **SpecifiedAnnualDemand** parameter.
2. Go on Cell K41971 correspondent to ELC003 (Fuel Column F).
3. Copy-paste the ELC003 demand data for the years 2015-2070. You can find the data in this Data_prep file (copy-paste only the data from column J to column BN).

	A	F	K	L	M	N	O	P	Q	R	S	T
1	Parameter	FUEL	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
41971	SpecifiedAnnualDemand	ELC003	28.5228	29.7936	32.166	34.5385	36.9109	39.28334	41.4087	43.68493	46.12041	48.72429
41972	SpecifiedAnnualDemand	COM002	0	0	0	0	0	0	0	0	0	0
41973	SpecifiedAnnualDemand	COM003	0	0	0	0	0	0	0	0	0	0
41974	SpecifiedAnnualDemand	COM004	0	0	0	0	0	0	0	0	0	0
41975	SpecifiedAnnualDemand	COM005	0	0	0	0	0	0	0	0	0	0
41976	SpecifiedAnnualDemand	COM006	0	0	0	0	0	0	0	0	0	0
41977	SpecifiedAnnualDemand	COM007	0	0	0	0	0	0	0	0	0	0
41978	SpecifiedAnnualDemand	COM008	0	0	0	0	0	0	0	0	0	0
41979	SpecifiedAnnualDemand	COM009	0	0	0	0	0	0	0	0	0	0

Watch out: For the same Commodity (Fuel) you should never add data for both **SpecifiedAnnualDemand** and **AccumulatedAnnualDemand**. Choose the type of demand associated with that fuel following the indications given in **Lecture 4**.

Voilà: now you know how to add a **SpecifiedAnnualDemand**.

Define the temporal profile of energy demands

As said before, **SpecifiedAnnualDemand** is the parameter used to define a demand that changes within the year, as for the final electricity demand just seen (ELC003). Therefore, it now important to represent this time variability, and to do so we will use the **SpecifiedDemandProfile** parameter (as explained in Lecture 3).

If interested to know how the SpecifiedDemandProfile was calculated read here below

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We originally divided the year into four representative seasons (Winter, Spring, Summer and Autumn), further specifying the day-type (Day and Night for each of the four seasons). These eight representative day types were considered to have an equal length.

Therefore, the Year Split values for just 8 time slices are equal to ⅛ (0.125) for each time slice and reported on the left side of the table below. Then as seen previously, we modified these 8 numbers to obtain the Year split values for all the 96 timeslices available in SAND.

Year Split			**Specified demand profile for electricity**	
TimeSlice	value		TimeSlice	ELC003
Winter Day	0.125		Winter Day	0.136
Winter Night	0.125		Winter Night	0.110
Spring Day	0.125		Spring Day	0.136
Spring Night	0.125		Spring Night	0.109
Summer Day	0.125		Summer Day	0.14
Summer Night	0.125		Summer Night	0.111
Autumn Day	0.125		Autumn Day	0.144
Autumn Night	0.125		Autumn Night	0.115

Following the same procedure, we will now need to understand how the data for the SpecifiedDemandProfile are calculated for 8 time slices and then how to manipulate them to obtain a 96 time slices representation in SAND.

The data reported on the right side of the table were obtained from free hourly demand dataset called PLEXOS.

From these data we can see that the demand is higher during the Days and lower during Nights. Therefore, by using our data preparation spreadsheet we will calculate the percentage of average demand in each Time slice using the following formula:

[Specified demand profile (SD) / Year split (SD)] * Bennett Factor =

= [0.14/0.125] *0.999=112%

Data Manipulation					
Making adjustments for CCG SAND					
We'll assume equal season legnths (3 months each) and an average hourly split per season (24h)					
S1 will be winter, S2 will be spring, S3 will be summer, S4 will be autumn					
50%	or	12.0	hrs are in a summer night		
50%	or	12.0	hrs are in a winter night		
50%	or	12.0	hrs are in winter day		
50%	or	12.0	hrs are in summer day		
		% of average demand in each timeslice			
	Winter Day	109%			
	Winter Night	88%			
	Spring Day	109%			
	Spring Night	87%			
	Summer Day	112%			
	Summer Night	89%			
	Autumn Day	115%			

Now we need to pass from 8 time slices to 96 in SAND. To do so, calculations were made for you this time: you need to multiply the average percentage of demand in each time slice for the year split duration of that time slice.

To give you an example:

21			% of average demand in each timeslice		
22		Winter Day	109%		
23		Winter Night	88%		
24		Spring Day	109%		
25		Spring Night	87%		
26		Summer Day	112%		
27		Summer Night	89%		
28		Autumn Day	115%		
29		Autumn Night	92%		
30					
31		Bennett Factor		0.999	
32		Sum	1.0000	1.0000	
33			Year Split	Specified Demand Profile	
34	Winter Night	S101	0.0104	=C34*C23	
35	Winter Night	S102	0.0104	0.0092	

You will find the SpecifiedDemandProfile already calculated for you in the Data Preparation File (for all the 96 time slices that we are using in SAND).

Try it: Let's add the demand profile to SAND.

1. Go to Parameters Sheet and filter out for SpecifiedDemandProfile parameter.
2. Go to Column F of the fuels and filter out for ELC003.
3. Go to Cell K42021 and copy-paste the data for the specified demand profile as for this spreadsheet (the data you need is in Cell D34 to D129)
4. Drag and drop until year 2070.
5. Save.

	A	F	G	K	L	M
1	Parameter	FUEL	TIMESLICE	2015	2016	2017
42021	SpecifiedDemandProfile	ELC003	S101	0.00919	0.00919	0.00919
42022	SpecifiedDemandProfile	ELC003	S102	0.00919	0.00919	0.00919
42023	SpecifiedDemandProfile	ELC003	S103	0.00919	0.00919	0.00919
42024	SpecifiedDemandProfile	ELC003	S104	0.00919	0.00919	0.00919
42025	SpecifiedDemandProfile	ELC003	S105	0.00919	0.00919	0.00919
42026	SpecifiedDemandProfile	ELC003	S106	0.00919	0.00919	0.00919
42027	SpecifiedDemandProfile	ELC003	S107	0.01132	0.01132	0.01132
42028	SpecifiedDemandProfile	ELC003	S108	0.01132	0.01132	0.01132
42029	SpecifiedDemandProfile	ELC003	S109	0.01132	0.01132	0.01132
42030	SpecifiedDemandProfile	ELC003	S110	0.01132	0.01132	0.01132
42031	SpecifiedDemandProfile	ELC003	S111	0.01132	0.01132	0.01132
42032	SpecifiedDemandProfile	ELC003	S112	0.01132	0.01132	0.01132
42033	SpecifiedDemandProfile	ELC003	S113	0.01132	0.01132	0.01132
42034	SpecifiedDemandProfile	ELC003	S114	0.01132	0.01132	0.01132
42035	SpecifiedDemandProfile	ELC003	S115	0.01132	0.01132	0.01132
42036	SpecifiedDemandProfile	ELC003	S116	0.01132	0.01132	0.01132
42037	SpecifiedDemandProfile	ELC003	S117	0.01132	0.01132	0.01132
42038	SpecifiedDemandProfile	ELC003	S118	0.01132	0.01132	0.01132
42039	SpecifiedDemandProfile	ELC003	S119	0.00919	0.00919	0.00919
42040	SpecifiedDemandProfile	ELC003	S120	0.00919	0.00919	0.00919
42041	SpecifiedDemandProfile	ELC003	S121	0.00919	0.00919	0.00919
42042	SpecifiedDemandProfile	ELC003	S122	0.00919	0.00919	0.00919
42043	SpecifiedDemandProfile	ELC003	S123	0.00919	0.00919	0.00919
42044	SpecifiedDemandProfile	ELC003	S124	0.00919	0.00919	0.00919
42045	SpecifiedDemandProfile	ELC003	S201	0.00905	0.00905	0.00905
42046	SpecifiedDemandProfile	ELC003	S202	0.00905	0.00905	0.00905
42047	SpecifiedDemandProfile	ELC003	S203	0.00905	0.00905	0.00905
42048	SpecifiedDemandProfile	ELC003	S204	0.00905	0.00905	0.00905
42049	SpecifiedDemandProfile	ELC003	S205	0.00905	0.00905	0.00905
42050	SpecifiedDemandProfile	ELC003	S206	0.00905	0.00905	0.00905
42051	SpecifiedDemandProfile	ELC003	S207	0.0113	0.0113	0.0113
42052	SpecifiedDemandProfile	ELC003	S208	0.0113	0.0113	0.0113
42053	SpecifiedDemandProfile	ELC003	S209	0.0113	0.0113	0.0113
42054	SpecifiedDemandProfile	ELC003	S210	0.0113	0.0113	0.0113
42055	SpecifiedDemandProfile	ELC003	S211	0.0113	0.0113	0.0113
42056	SpecifiedDemandProfile	ELC003	S212	0.0113	0.0113	0.0113
42057	SpecifiedDemandProfile	ELC003	S213	0.0113	0.0113	0.0113
42058	SpecifiedDemandProfile	ELC003	S214	0.0113	0.0113	0.0113
42059	SpecifiedDemandProfile	ELC003	S215	0.0113	0.0113	0.0113
42060	SpecifiedDemandProfile	ELC003	S216	0.0113	0.0113	0.0113
42061	SpecifiedDemandProfile	ELC003	S217	0.0113	0.0113	0.0113
42062	SpecifiedDemandProfile	ELC003	S218	0.0113	0.0113	0.0113
42063	SpecifiedDemandProfile	ELC003	S219	0.00905	0.00905	0.00905
42064	SpecifiedDemandProfile	ELC003	S220	0.00905	0.00905	0.00905
42065	SpecifiedDemandProfile	ELC003	S221	0.00905	0.00905	0.00905
42066	SpecifiedDemandProfile	ELC003	S222	0.00905	0.00905	0.00905
42067	SpecifiedDemandProfile	ELC003	S223	0.00905	0.00905	0.00905
42068	SpecifiedDemandProfile	ELC003	S224	0.00905	0.00905	0.00905
42069	SpecifiedDemandProfile	ELC003	S301	0.00925	0.00925	0.00925
42070	SpecifiedDemandProfile	ELC003	S302	0.00925	0.00925	0.00925
42071	SpecifiedDemandProfile	ELC003	S303	0.00925	0.00925	0.00925
42072	SpecifiedDemandProfile	ELC003	S304	0.00925	0.00925	0.00925

Naming | SETS | **Parameters** | ToDataFile

Watch out: the sum of all the Year Split values for the 96 time slices should always be 1. The same is valid for the SpecifiedDemandProfile values.

Define a simple technology that satisfies the demand (Backstop)

As explained in Lecture 4, Backstop technologies are a last resort option for the optimization solver, being fictitious technologies with extremely high cost. We will add a backstop technology with an output of electricity (ELC003) demand. Therefore, the backstop will be the only technology in the model able to supply the ELC003 demand we have added. To add the backstop, we need to add the data available here in the right place.

Try it: Add backstop technology

1. Go to Parameters Sheet and clear all the filters in case you didn't yet.
2. Go to SETS and in Cell B3 change "**TEC000**" to "**BACKSTOP**", and "**Additional Technology**" to "**Backstop Technology**".

	A	B	C	D	E	F
1		**Technologies**			**Commodities**	
2		*Code*	*Description*		*Code*	*Description*
3		BACKSTOP	Backstop Technology		ELC003	Electricity after distribution
4		TEC001	Additional Technology		COM002	Additional Fuel
		TEC002	Additional Technology		COM003	Additional Fuel

3. Go to the Parameters Sheet and filter out in Column C (Technology) for "BACKSTOP". You will now see all the parameters associated only to this technology.
4. You will need to add data in SAND as presented in the BACKSTOP Sheet of the data preparation file. Remember to copy paste the values until 2070.

	A	B	C	D	E	F	G	H	I	J	K	L
143	CapacityFactor	RE1	BACKSTOP				S424			1	1	
144	CapacityOfOneT	RE1	BACKSTOP							0	0	
145	CapacityToActivi	RE1	BACKSTOP						1			
146	CapitalCost	RE1	BACKSTOP							9999999	9999999	999
147	EmissionActivity	RE1	BACKSTOP	EMICO2	1					0	0	
148	EmissionActivity	RE1	BACKSTOP	EMI002	1					0	0	
149	EmissionActivity	RE1	BACKSTOP	EMI003	1					0	0	
150	EmissionActivity	RE1	BACKSTOP	EMI004	1					0	0	
151	EmissionActivity	RE1	BACKSTOP	EMI005	1					0	0	
152	FixedCost	RE1	BACKSTOP							9999999	9999999	999
153	InputActivityRat	RE1	BACKSTOP		1	ELC003				0	0	
154	InputActivityRat	RE1	BACKSTOP		1	COM002				0	0	
155	InputActivityRat	RE1	BACKSTOP		1	COM003				0	0	
156	InputActivityRat	RE1	BACKSTOP		1	COM004				0	0	
157	InputActivityRat	RE1	BACKSTOP		1	COM005				0	0	
158	InputActivityRat	RE1	BACKSTOP		1	COM006				0	0	
159	InputActivityRat	RE1	BACKSTOP		1	COM007				0	0	
160	InputActivityRat	RE1	BACKSTOP		1	COM008				0	0	

Raw Data | (0) SETS | (2) Specified Annual Demand | (3) YearSplit & Profiles | BACKSTOP

5. Save your Excel file.

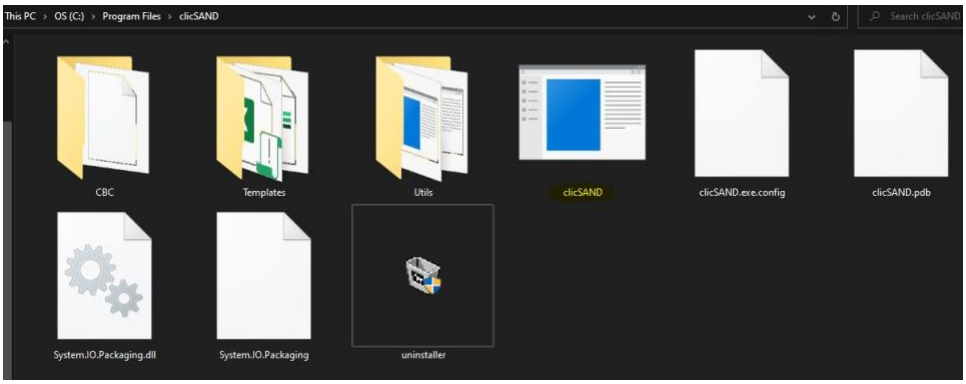
Hint: check cells highlighted in blue and be sure that the correspondent cell in SAND has that number! Make use of as many filters as needed for the input data process.

Run the model and check results on production by technology

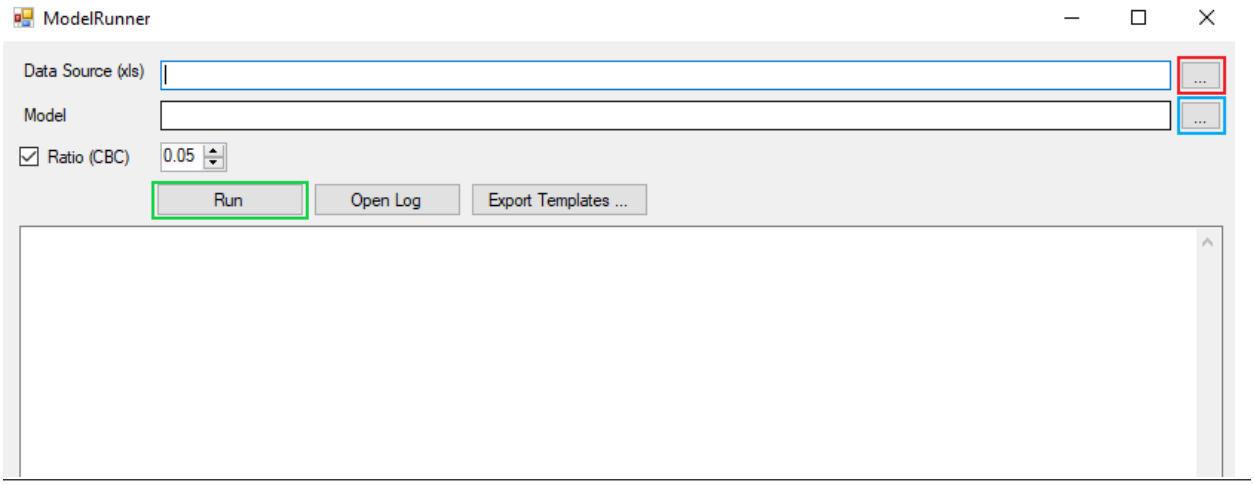
It's time to run our first model.

Try it:

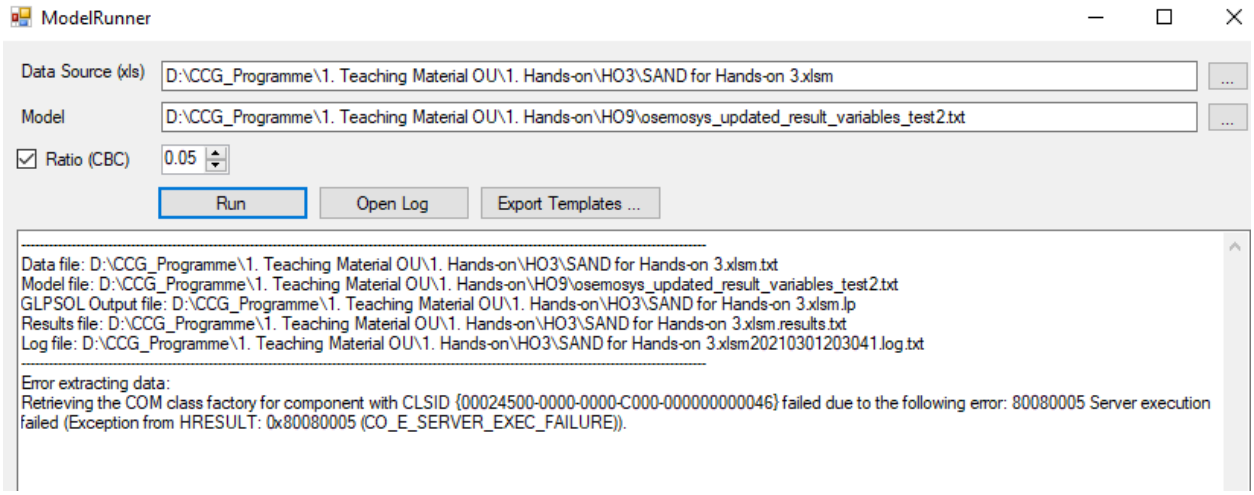
1. Go to C:\Program Files -> **clickSAND** Folder -> double click on **clicSAND.exe**



2. The button highlighted in red allows you to select the Excel file you want to run, while the button highlighted in blue allows you to select the OSeMOSYS code. You can obtain the code clicking on export templates and select the HO_3 folder - as explained in Hands-on 2.
3. TIPS: Close any high memory (or disk) consuming programs.
4. When you have selected these two files, click on RUN.



5. If you get this error, open the .xlsm file on your laptop and Enable Content -> Enable Editing -> **Run again**



6. Wait…. The solvers (glpsol and cbc) will run the Excel file with the code to find the optimal solution. You will first see the black screen below (for glpsol) and then the same for cbc.

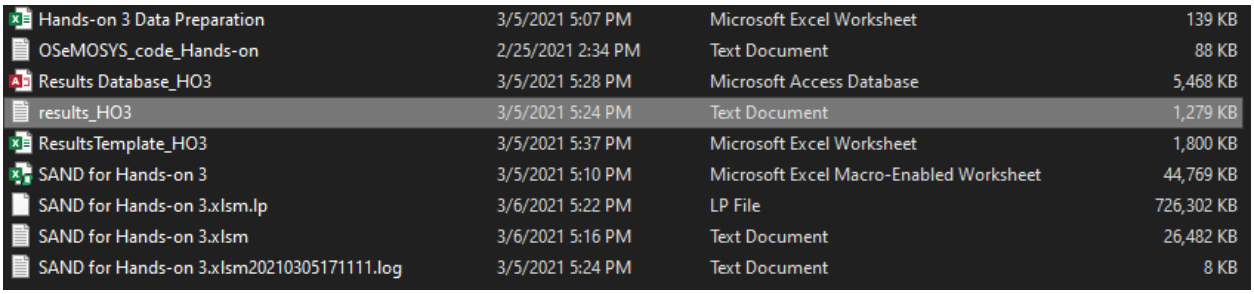
7. If everything works well, you should see this on the clicSAND Model Runner:

Running CBC\bin\cbc.exe "D:\CCG_Programme\1. Teaching Material OU\1. Hands-on\HO4\SAND_Interface_HO4 with Macro .xlsm.lp" ratio 0.05 solve -solu "D:\CCG_Programme\1. Teaching Material OU\1. Hands-on\HO4\SAND_Interface_HO4 with Macro .xlsm.results.txt"

Welcome to the CBC MILP Solver
Version: 2.7.5
Build Date: Nov 10 2011
Revision Number: 1759

command line - CBC\bin\cbc.exe D:\CCG_Programme\1. Teaching Material OU\1. Hands-on\HO4\SAND_Interface_HO4 with Macro .xlsm.lp ratio 0.05 solve -solu D:\CCG_Programme\1. Teaching Material OU\1. Hands-on\HO4\SAND_Interface_HO4 with Macro .xlsm.results.txt (default strategy 1)
ratioGap was changed from 0 to 0.05
Presolve 163 (-6441361) rows, 56 (-5098328) columns and 4780 (-5596428) elements
0 Obj 1.0721696e+010 Primal inf 2.1293547e+011 (108)
55 Obj 1.5754355e+010
Optimal - objective value 1.5754355e+010
After Postsolve, objective 1.5754355e+010, infeasibilities - dual 0 (0), primal 0 (0)
Optimal objective 1.575435541e+010 - 55 iterations time 5.712, Presolve 5.71
Total time (CPU seconds): 40.44 (Wallclock seconds): 40.44

8. In your folder called HO3 there should now be the following files (renamed here for simplicity):

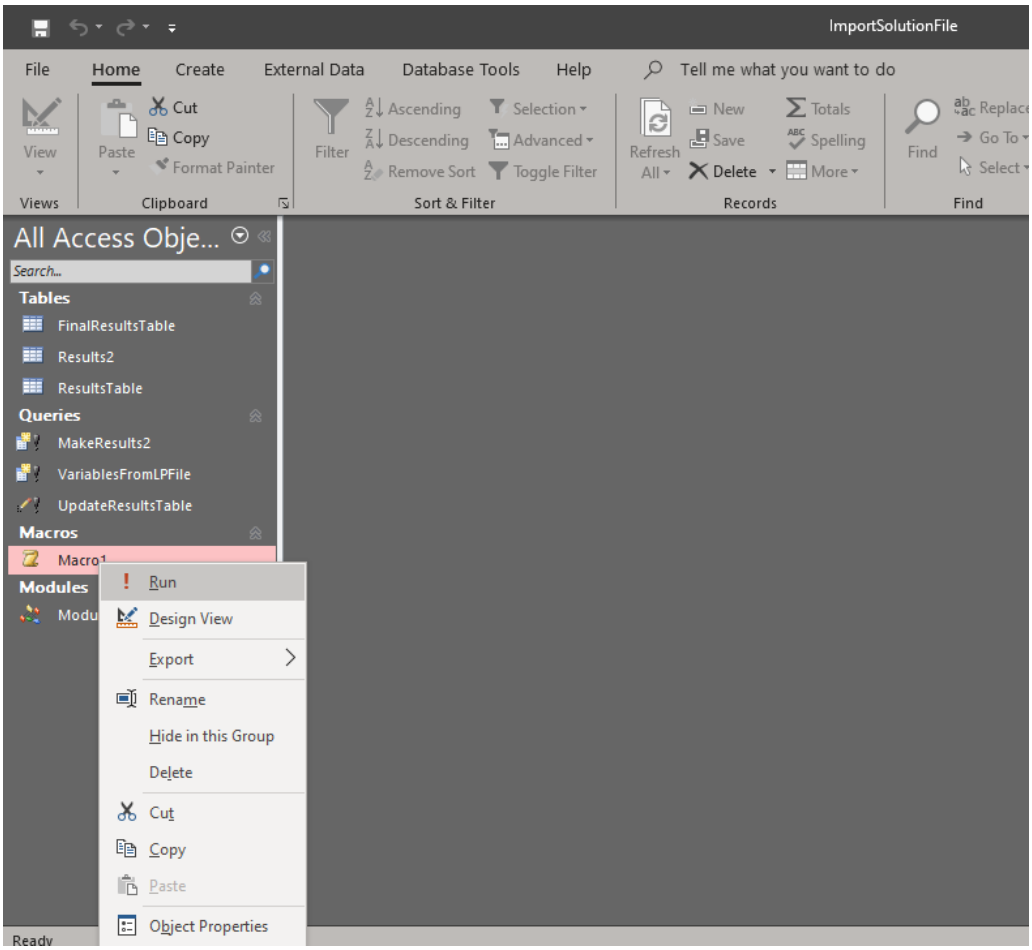


Hands-on 3 Data Preparation	3/5/2021 5:07 PM	Microsoft Excel Worksheet	139 KB
OSeMOSYS_code_Hands-on	2/25/2021 2:34 PM	Text Document	88 KB
Results Database_HO3	3/5/2021 5:28 PM	Microsoft Access Database	5,468 KB
results_HO3	3/5/2021 5:24 PM	Text Document	1,279 KB
ResultsTemplate_HO3	3/5/2021 5:37 PM	Microsoft Excel Worksheet	1,800 KB
SAND for Hands-on 3	3/5/2021 5:10 PM	Microsoft Excel Macro-Enabled Worksheet	44,769 KB
SAND for Hands-on 3.xlsm.lp	3/6/2021 5:22 PM	LP File	726,302 KB
SAND for Hands-on 3.xlsm	3/6/2021 5:16 PM	Text Document	26,482 KB
SAND for Hands-on 3.xlsm20210305171111.log	3/5/2021 5:24 PM	Text Document	8 KB

Results Visualization

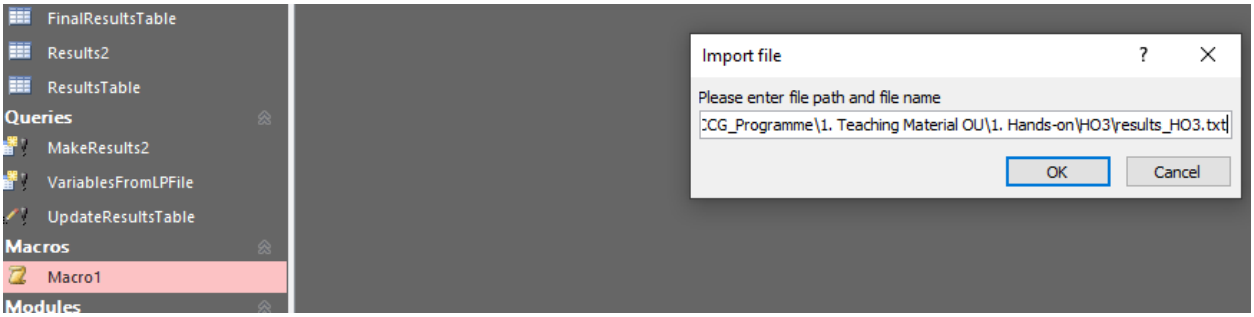
Try it:

1. Go to your folder **HO_3**.
2. Double click on "**Results_Database_HO3**" (Access Database) -> Enable Content
3. Right click on **Macro** -> **Run**

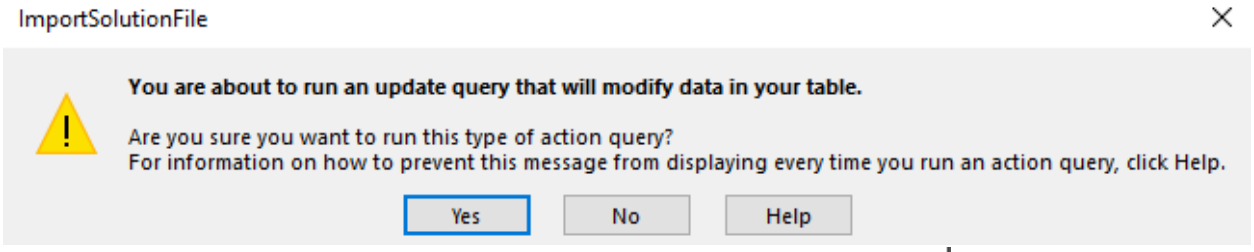


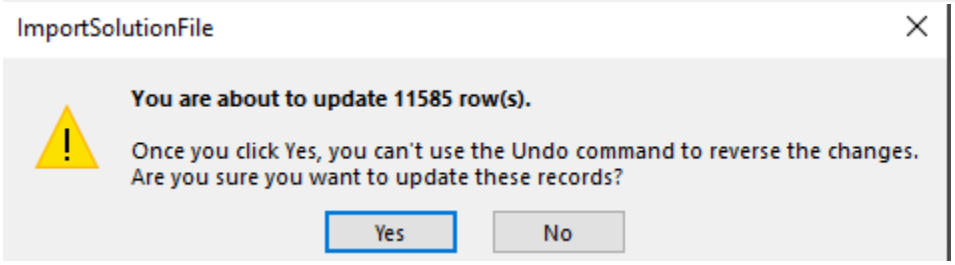
4. A window will pop-up. You need to copy paste the path to your results_HO3 file (I renamed it like this for simplicity)

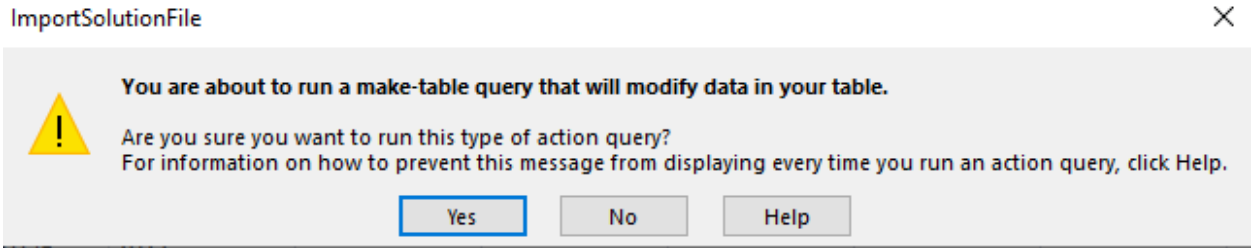
C:\..\HO3\results_HO3.**txt** (don't forget to add .txt at the end)

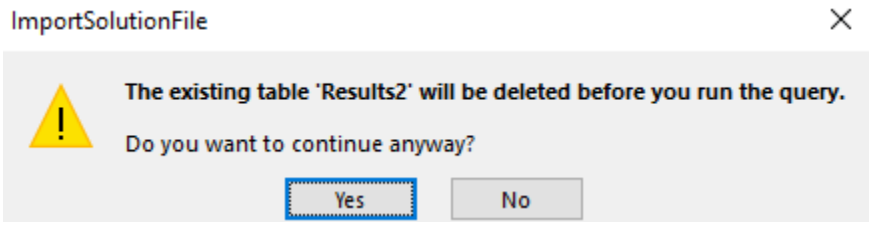


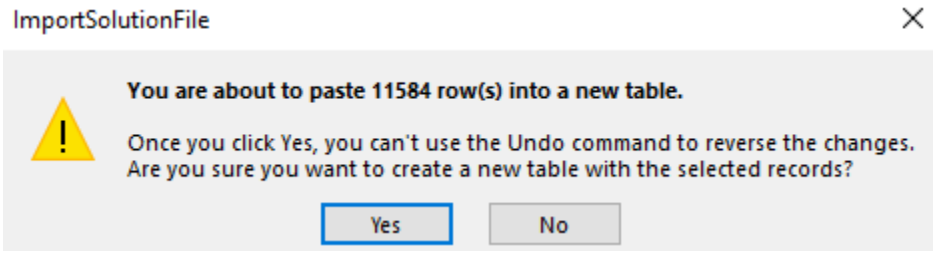
5. Click OK. Answer YES to ALL the pop-up windows that will appear and then the results will be imported. SAVE it and close the **Results_Database_HO3**

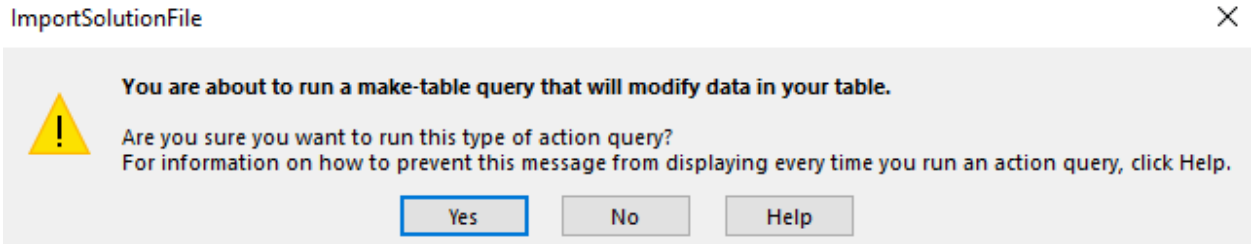

ImportSolutionFile
You are about to run an update query that will modify data in your table.
Are you sure you want to run this type of action query?
For information on how to prevent this message from displaying every time you run an action query, click Help.
Yes
No
Help

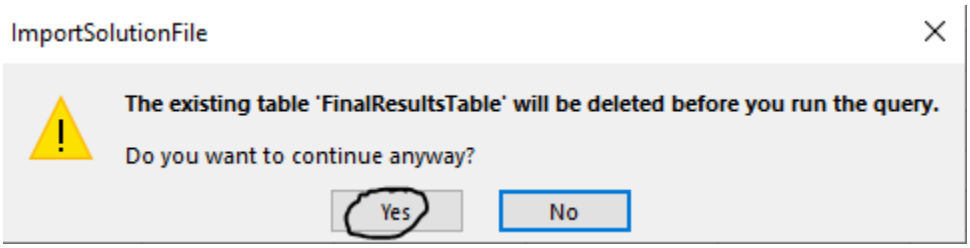

ImportSolutionFile
You are about to update 11585 row(s).
Once you click Yes, you can't use the Undo command to reverse the changes.
Are you sure you want to update these records?
Yes
No

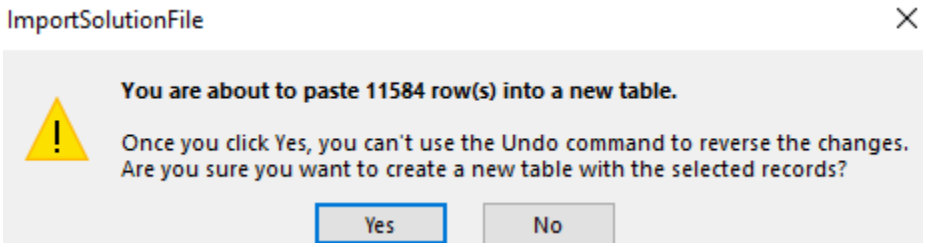

ImportSolutionFile
You are about to run a make-table query that will modify data in your table.
Are you sure you want to run this type of action query?
For information on how to prevent this message from displaying every time you run an action query, click Help.
Yes
No
Help


ImportSolutionFile
The existing table 'Results2' will be deleted before you run the query.
Do you want to continue anyway?
Yes
No


ImportSolutionFile
You are about to paste 11584 row(s) into a new table.
Once you click Yes, you can't use the Undo command to reverse the changes.
Are you sure you want to create a new table with the selected records?
Yes
No


ImportSolutionFile
You are about to run a make-table query that will modify data in your table.
Are you sure you want to run this type of action query?
For information on how to prevent this message from displaying every time you run an action query, click Help.
Yes
No
Help

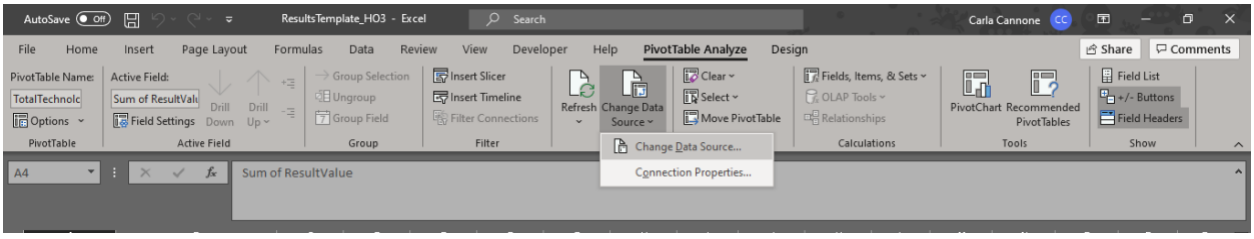




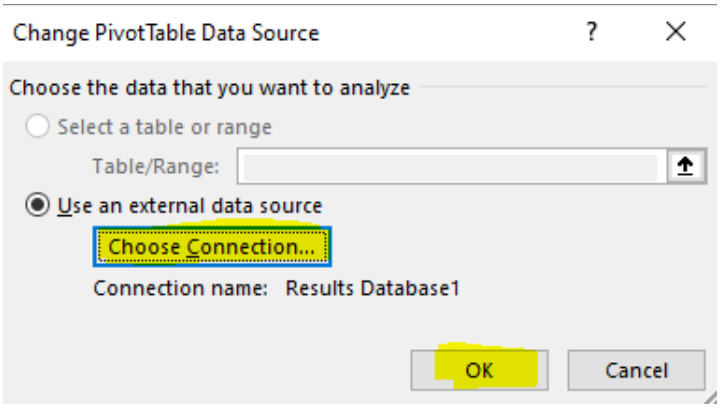
6. Open Results_Template_HO3 (Excel Macro Enabled file) and select Enable Content. This file is made of a Sheet per each of the variable we want to obtain results for:

Annual Electricity Production	Electricity Production by Timeslice	Total Capacity Annual	Demand
Annual Fixed Operating Costs	Annual Variable Operating Costs	Capital Investment	Cooking & Heat
Transport	Annual CO2	Annual CO2 by Technology	

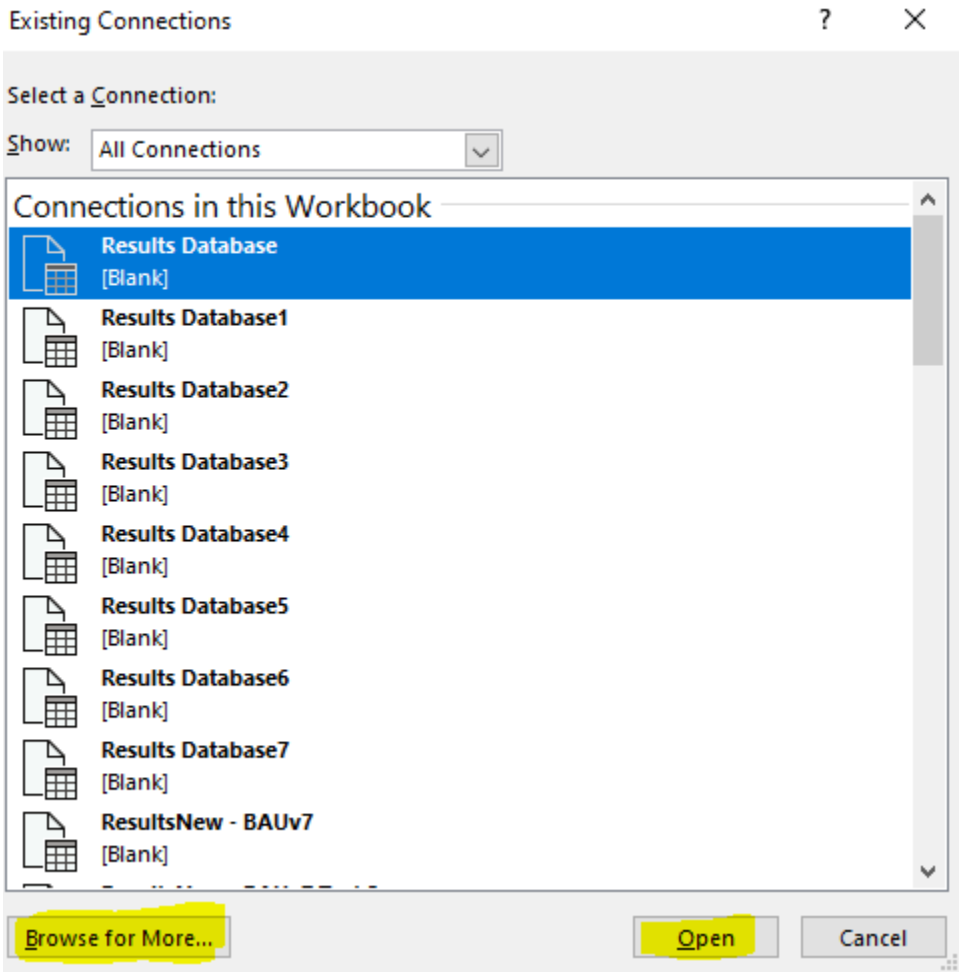
7. We will explain here how to visualize the “Annual Electricity Production” graph. The steps are the same for all the other graphs. Click on A4 Sum of ResultValue
8. Go to the PivotTable Analyze Tab -> Click on Change Data Source



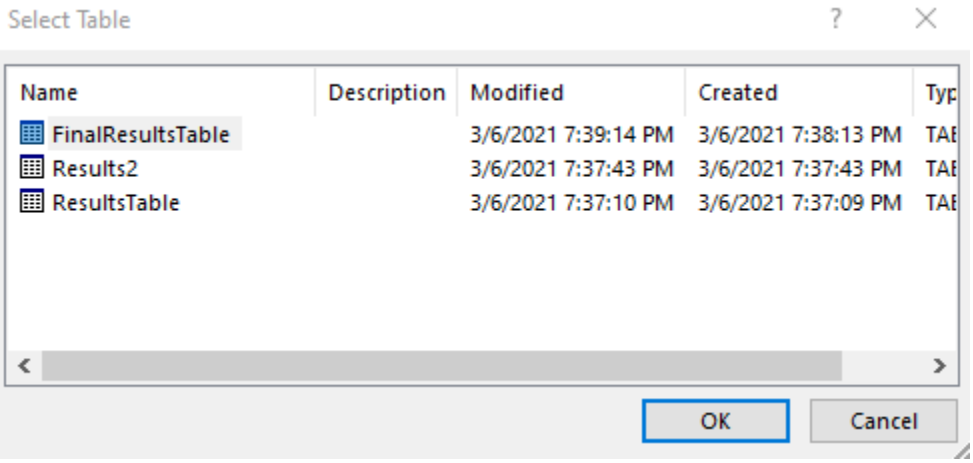
9. Click on Change Data Source -> Use External Data source -> Choose connection



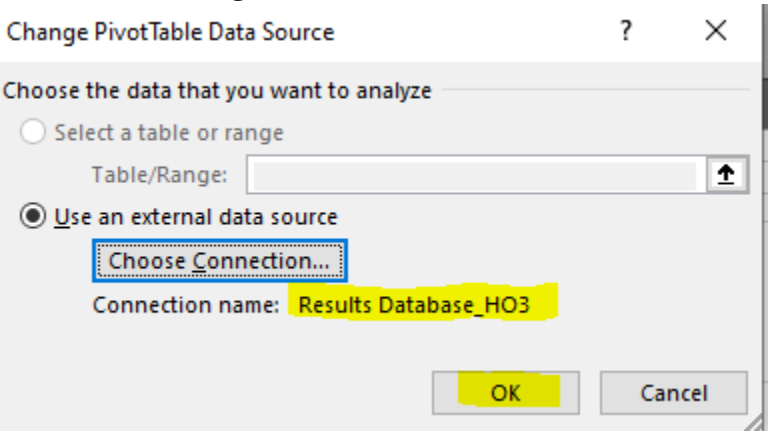
10. Click Browse for More -> Open



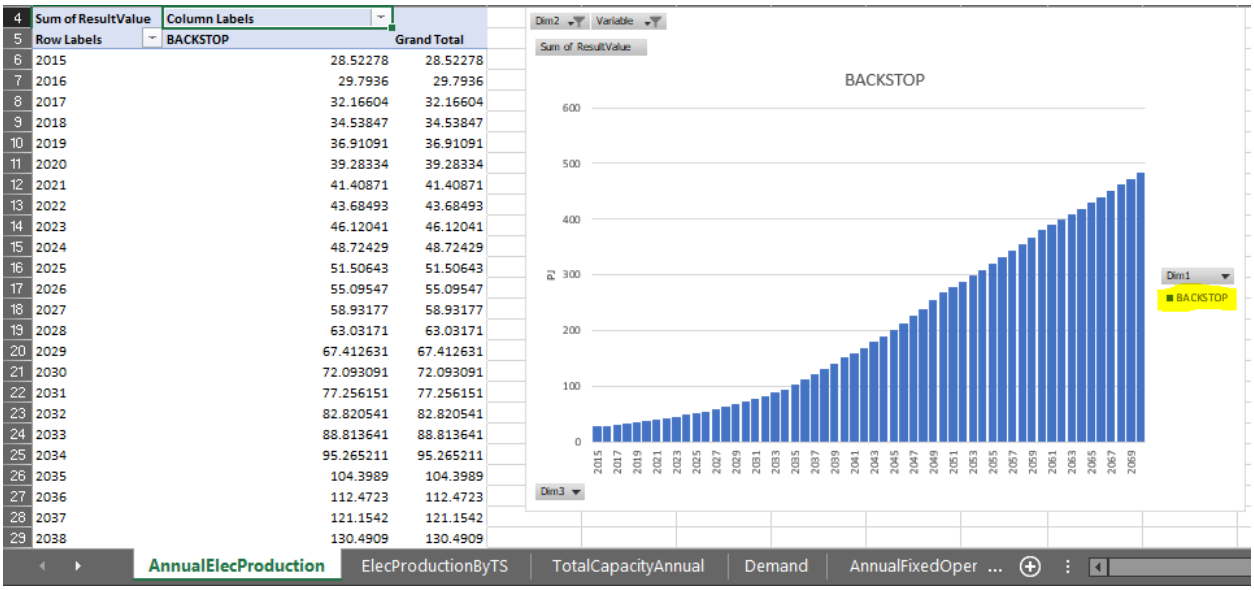
11. Select the Results_Database_HO3 file in your HO3 folder (the Access file). On the pop-up window click OK.



12. Click OK again



13. The graph for Annual Electricity Production should be automatically visualized. In case it does not, click on B4 Columns Labels and SELECT ALL -> OK.



Sum of ResultValue	Column Labels	
Row Labels	BACKSTOP	Grand Total
2015	28.52278	28.52278
2016	29.7936	29.7936
2017	32.16604	32.16604
2018	34.53847	34.53847
2019	36.91091	36.91091
2020	39.28334	39.28334
2021	41.40871	41.40871
2022	43.68493	43.68493
2023	46.12041	46.12041
2024	48.72429	48.72429
2025	51.50643	51.50643
2026	55.09547	55.09547
2027	58.93177	58.93177
2028	63.03171	63.03171
2029	67.412631	67.412631
2030	72.093091	72.093091
2031	77.256151	77.256151
2032	82.820541	82.820541
2033	88.813641	88.813641
2034	95.265211	95.265211
2035	104.3989	104.3989
2036	112.4723	112.4723
2037	121.1542	121.1542
2038	130.4909	130.4909

And here you will see that the only technology producing electricity is the BACKSTOP as is the only technology that we added in our energy system able to provide ELC003.