

Model for Analysis of Energy Demand (MAED)

Hands-on 6: Base Year Reconstruction Part II

Learning outcomes

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

- 1) Point at the specific requirements of the Manufacturing Sector
- 2) Point at the specific requirement of the Household Sector.

Activity 1: Specific requirements of the Manufacturing Sector

As previously explained, the Manufacturing sector which is part of the Industry sector has a similar structure to the Agriculture, Mining and Construction (AMC) which we have seen in the previous Hands-on. There are a couple of additions: a) the demands for thermal uses are split into High Temperature, Medium Temperature and Low Temperature and b) we need to collect additional cogeneration factors. In Zenodo, you can find an updated Excel template here with a super simple fictitious example for the reconstruction of the Manufacturing sector.

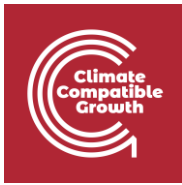
<https://doi.org/10.5281/zenodo.7750263>



As previously done, now go to **IND_MAN_RawData Sheet**. You can see that the **Final Energy Demands** have been divided into three temperatures level as well as the **Efficiencies**. Then, the cogeneration data have been collected as well as the **Driving Parameter which is the GDP** for Manufacturing.

	A	B	C	D	E	F	G	H
1	Final Energy Demand (GWh)	Specific Electricity Use	Motive Power	Thermal Total	Low Temperature (fraction)	Medium Temperature (fraction)	High Temperature (fraction)	
2	Traditional Fuels	0	0	0	0.428571429	0.142857143	0.428571429	
3	Modern Biomass	0	0	0	0.08	0.04	0.88	
4	Fossil Fuels	0	0	0	0.067039106	0.245810056	0.687150838	
5	Electricity	0	0	100	0.328244275	0.251908397	0.419847328	
6	Heat Pumps	0	0	0	0.666666667	0.333333333	0	
7	Solar Thermal	0	0	0	0.820895522	0.179104478	0	
8	District Heating	0	0	0	0.923076923	0.076923077	0	
9	Motor Fuels	0	0	0	0	0	0	
10	Cogeneration	0	0	0	0.7	0.3	0	
11								
12	Efficiency	Specific Electricity Use	Motive Power	Low Temperature	Medium Temperature	High Temperature		
13	Traditional Fuels	0	0	0.7	0.6	0.4		
14	Modern Biomass	0	0	0.8	0.7	0.65		
15	Fossil Fuels	0	0	0.9	0.9	0.9		
16	Electricity	1	0	1	1	1		
17	Heat Pumps COP	0	0	3.5	3.5	0		
18	Solar Thermal	0	0	1	1	0		
19	District Heating	0	0	1	1	0		
20	Motor Fuels	0	1	0	0	0		
21								
22								
23	Cogeneration - Efficiency	%	80					
24	Cogeneration - Heat/Electricity Ratio	ratio	0.317460317					
25	Cogeneration - Biomass Share	%	10					
26								
27	GDP	Units	2022					
28	Manufacturing	US\$ Million	472					
29	Total	US\$ Million	1230					

Then move to **IND_MAN_Reco Sheet** to repeat the calculation for obtaining the Useful Energy Demand and the Penetration of the Energy Forms.



Finally you should be able to fill in the table on the **Specific Energy Consumption** as shown below:

	Specific Electricity Use (fraction)	Motive Power (fraction)	Low Temperature (fraction)	Medium Temperature (fraction)	High Temperature (fraction)	Thermal Total (fraction)	Share of Thermal Low Temp %	Share of Thermal Med Temp (%)	Share of Thermal High Temp (%)
Specific Energy Consumption (kWh/USD)	0	0	0.069543279	0.053370423	0.088950705	0.211864407	32.82442748	25.19083969	41.98473282

Then move to IND_MAN_Inp sheet to copy paste the data into MAED and update the data in the picture below to tell MAED about the Temperature level in Manufacturing.

Energy intensities
Name of the case study **Demo MAEDD 2**

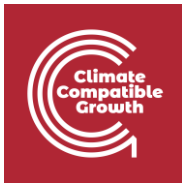
El-Motive Power El-Specific Electricity use El-Thermal use Penetration of Energy Forms in ACM Efficiencies in ACM **Temperature level in Manufacturing** Per Mai

Share of useful thermal energy demand by temperature level in Manufacturing

Item	Unit	2030	2035	2040	Chart
Manufacturing		195.00000	100.00000	100.00000	<input type="checkbox"/>
High Level	%	100.00000	80.00000	80.00000	<input type="checkbox"/>
Medium Level	%	80.00000	15.00000	15.00000	<input type="checkbox"/>
Low Level	%	15.00000	5.00000	5.00000	<input type="checkbox"/>

Data notes

Then, you need to add the **Penetration of Energy Forms in Manufacturing** for 2030 and with your own data.



MAED Model for Analysis of Energy Demand

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Manage case studies

General Information

Social economic data

Energy intensities

- Industry
- Transport
- Household
- Services

Calculate

Results

Penetration of Energy Carriers into Useful Thermal Energy Demand in Manufacturing

Item	Unit	2030	2035	2040	Chart
Manufacturing					
High Level					
Traditional Fuels	%	1.00000	1.00000	1.00000	<input type="checkbox"/>
Modern Biomass	%	10.00000	10.00000	10.00000	<input type="checkbox"/>
Electricity	%	14.00000	14.00000	14.00000	<input type="checkbox"/>
Fossil Fuels	%	75.00000	75.00000	75.00000	<input type="checkbox"/>
Medium Level					
Traditional Fuels	%	2.00000	2.00000	2.00000	<input type="checkbox"/>
Modern Biomass	%	10.00000	10.00000	10.00000	<input type="checkbox"/>
Electricity	%	2.00000	2.00000	2.00000	<input type="checkbox"/>
(of which Heat Pumps)	%	60.00000	60.00000	60.00000	<input type="checkbox"/>
Solar Thermal	%	0.00000	0.00000	0.00000	<input type="checkbox"/>
Fossil Fuels	%	51.00000	51.00000	51.00000	<input type="checkbox"/>
District Heating	%	16.00000	16.00000	16.00000	<input type="checkbox"/>
Cogeneration	%	19.00000	19.00000	19.00000	<input type="checkbox"/>
Low Level					
Traditional Fuels	%	2.00000	2.00000	2.00000	<input type="checkbox"/>
Modern Biomass	%	10.00000	10.00000	10.00000	<input type="checkbox"/>
Electricity	%	10.00000	10.00000	10.00000	<input type="checkbox"/>
(of which Heat Pumps)	%	60.00000	60.00000	60.00000	<input type="checkbox"/>
Solar Thermal	%	6.00000	6.00000	6.00000	<input type="checkbox"/>
Fossil Fuels	%	41.00000	41.00000	41.00000	<input type="checkbox"/>
District Heating	%	17.00000	17.00000	17.00000	<input type="checkbox"/>
Cogeneration	%	14.00000	14.00000	14.00000	<input type="checkbox"/>

Finally, you will need to add data for the Efficiencies in Manufacturing as shown in the example.

Analysis of Energy Demand

MAED D About

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Name of the case study Demo MAEDD 2

El-Motive Power El-Specific Electricity use El-Thermal use Penetration of Energy Forms in ACM Efficiencies in ACM Temperature level in Manufacturing Penetration of Energy Forms in Manufacturing

Efficiencies in Manufacturing

Average Efficiencies of energy forms in Thermal uses, Ratios and Factors in Manufacturing

Item	Unit	2030	2035	2040	Chart
Efficiencies					
Manufacturing					
High Level					
Traditional Fuels	%	40.00000	40.00000	40.00000	<input type="checkbox"/>
Modern Biomass	%	50.00000	50.00000	50.00000	<input type="checkbox"/>
Fossil Fuels	%	65.00000	65.00000	65.00000	<input type="checkbox"/>
Medium Level					
Traditional Fuels	%	40.00000	40.00000	40.00000	<input type="checkbox"/>
Modern Biomass	%	50.00000	50.00000	50.00000	<input type="checkbox"/>
Fossil Fuels	%	75.00000	75.00000	75.00000	<input type="checkbox"/>
Low Level					
Traditional Fuels	%	35.00000	35.00000	35.00000	<input type="checkbox"/>
Modern Biomass	%	45.00000	45.00000	45.00000	<input type="checkbox"/>
Fossil Fuels	%	65.00000	65.00000	65.00000	<input type="checkbox"/>
Factors and ratios in Manufacturing					
Manufacturing					
COP of Heat Pumps	ratio	5.00000	5.00000	5.00000	<input type="checkbox"/>
Solar Thermal Share	%	40.00000	40.00000	40.00000	<input type="checkbox"/>
Cogeneration - Efficiency	%	80.00000	80.00000	80.00000	<input type="checkbox"/>
Cogeneration - Heat/Electricity ratio	ratio	3.00000	3.00000	3.00000	<input type="checkbox"/>
Cogeneration - Biomass Share	%	15.00000	15.00000	15.00000	<input type="checkbox"/>



Then as done for the Agriculture sector, you will have to check that your MAED results are the same as the data in your Excel Template. Go to Results, then to 2.3.4. Total Final Energy Demand in Manufacturing (absolute) in 2030. If the results are the same, you have successfully reconstructed the Base Year for Manufacturing.

Activity 2: Specific requirements of the Household Sector

The first thing we need to do is to add the Socio-Economic Data for the Household sector for **Demography**. In particular, for the Demography data you will have to fill in all the white cells such as **Urban Population, Person/ urban Household, Person/ rural Household** etc, specific to your case study.

Then we move on to the **Energy Intensities data**.

The Household sector is divided into two subsectors: Urban and Rural. Then, we have six end-uses: Specific Electricity Use, Lightening, Air Conditioning, Cooking, Space Heating and Water Heating.

Sectors & Clients														
		Agriculture	Construction	Mining	Manufacturing	Energy	Service	Household	Transport					
								Add new	Specific Electricity use	Lighting	Air Conditioning	Cooking	Space Heating	Water Heating
Urban								+	✓	✓	✓	✓	✓	✓
urban_house_type1								×						
urban_house_type1								×						
urban_house_type1								×						
Rural								+	✓	✓	✓	✓	✓	✓
rural_house_type1								×						
rural_house_type1								×						
rural_house_type1								×						

Please download the updated template with the structure needed to collect and reconstruct the Household sector Urban and Rural. As an example we will see the Urban, but the same applies to Rural.



The first data we'll have to collect are the **Shares by dwelling type**, so for example how many apartments (in percentage) there are compared to the total number of dwellings? Then we need to add the **Dwelling sizes by dwelling type** in m2, so how big is each type of dwelling?

MAED Model for Analysis of Energy Demand

Urban Rural

En Es Fr

Manage case studies

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- Services

Item	Unit	2030	2035	2040	Chart
Urban					[-]
Shares by dwelling type					[-]
urban_house_type1	%				[]
urban_house_type2	%				[]
urban_house_type3	%				[]
Dwelling sizes by dwelling type					[-]
urban_house_type1	m2				[]
urban_house_type2	m2				[]
urban_house_type3	m2				[]

Now we need to move on to collect and calculate the data required by each end use. Let's start from Space Heating. Firstly, we need to know the **Dwelling Factors for Space Heating**, so how many dwelling in percentage require Space Heating and the Degree Days. Then we move on to the **Area Heated in percentage** and the **Heat Losses Rate per each type of dwelling in Wh/m2/C/h**. Then, as done in the past we will have to calculate (using the Excel template as a support) the **Penetration of Energy Forms** which now are: Traditional fuels, Modern Biomass, , District heating, Substitutable Fossils, Solar Thermal and Electricity (of which a certain percentage will be used for Heat Pumps). Finally, we input data for Efficiencies and other factors for Traditional Fuels, Modern Biomass, Fossil Fuels, Solar Thermal Share and the Coefficient of Performance (COP) for the Heat Pumps.

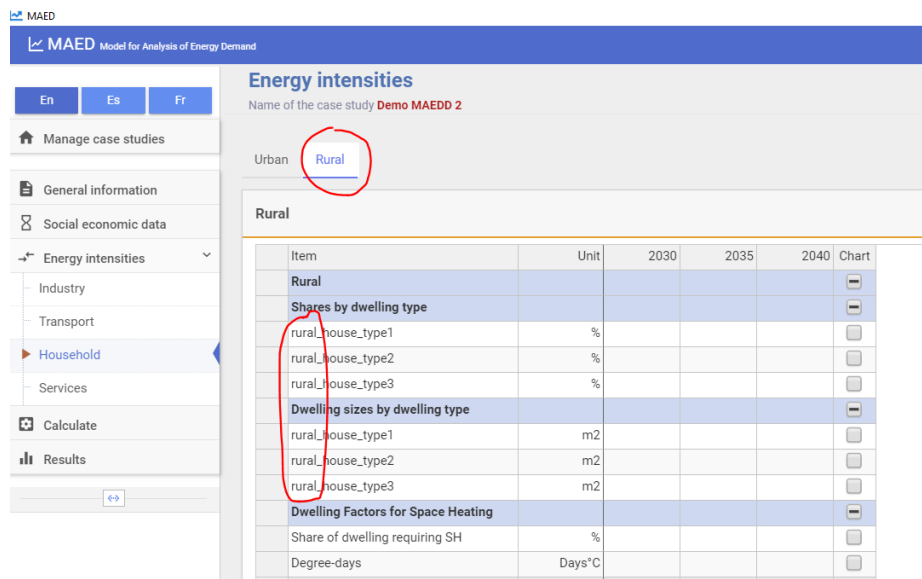
General information		Social economic data		Energy intensities	
Industry		Transport		Household	
Services		Calculate		Results	
Dwelling Factors for Space Heating		Share of dwelling requiring SH		%	
Degree-days		Days°C			
Area heated		urban_house_type1		%	
		urban_house_type2		%	
		urban_house_type3		%	
Heat losses rate		urban_house_type1		Wh/m2/C/h	
		urban_house_type2		Wh/m2/C/h	
		urban_house_type3		Wh/m2/C/h	
Penetration of energy forms		Traditional fuels		%	
		Modern Biomass		%	
		Electricity		%	
		-- thereof: heat pump		%	
		District heating		%	
		Substitutable Fossils		%	
		Solar Thermal		%	
Efficiencies and other factors		Eff. Traditional Fuels		%	
		Eff. Modern Biomass		%	
		COP Heat Pumps		ratio	
		Eff. Fossil Fuels		%	
		Solar Thermal Share		%	

Similarly we move on and input all the data for the other end uses of the Household Sector (Urban) such as Water Heating, Cooking, Air Conditioning, Appliances and Lightening.

Remember to SAVE before leaving this page!

Dwelling Factors for Space Heating			
Share of dwelling requiring SH		%	
Degree-days		Days°C	
Area heated			
urban_house_type1		%	
urban_house_type2		%	
urban_house_type3		%	
Heat losses rate			
urban_house_type1		Wh/m2/C/h	
urban_house_type2		Wh/m2/C/h	
urban_house_type3		Wh/m2/C/h	
Penetration of energy forms			
Traditional fuels		%	
Modern Biomass		%	
Electricity		%	
-- thereof: heat pump		%	
District heating		%	
Substitutable Fossils		%	
Solar Thermal		%	
Efficiencies and other factors			
Eff. Traditional Fuels		%	
Eff. Modern Biomass		%	
COP Heat Pumps		ratio	
Eff. Fossil Fuels		%	
Solar Thermal Share		%	

Now repeat the same steps for the Rural Subsector, which is really like the Urban one.



MAED Model for Analysis of Energy Demand

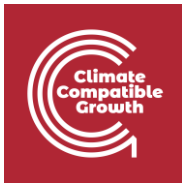
Energy intensities

Name of the case study Demo MAEDD 2

Urban **Rural**

Rural

Item	Unit	2030	2035	2040	Chart
Rural					
Shares by dwelling type					
rural_house_type1	%				
rural_house_type2	%				
rural_house_type3	%				
Dwelling sizes by dwelling type					
rural_house_type1	m2				
rural_house_type2	m2				
rural_house_type3	m2				
Dwelling Factors for Space Heating					
Share of dwelling requiring SH	%				
Degree-days	Days°C				



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