



Model for Analysis of Energy Demand (MAED)

Hands-on 10: Reviewing results and case study in MAED-EL

Learning outcomes

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

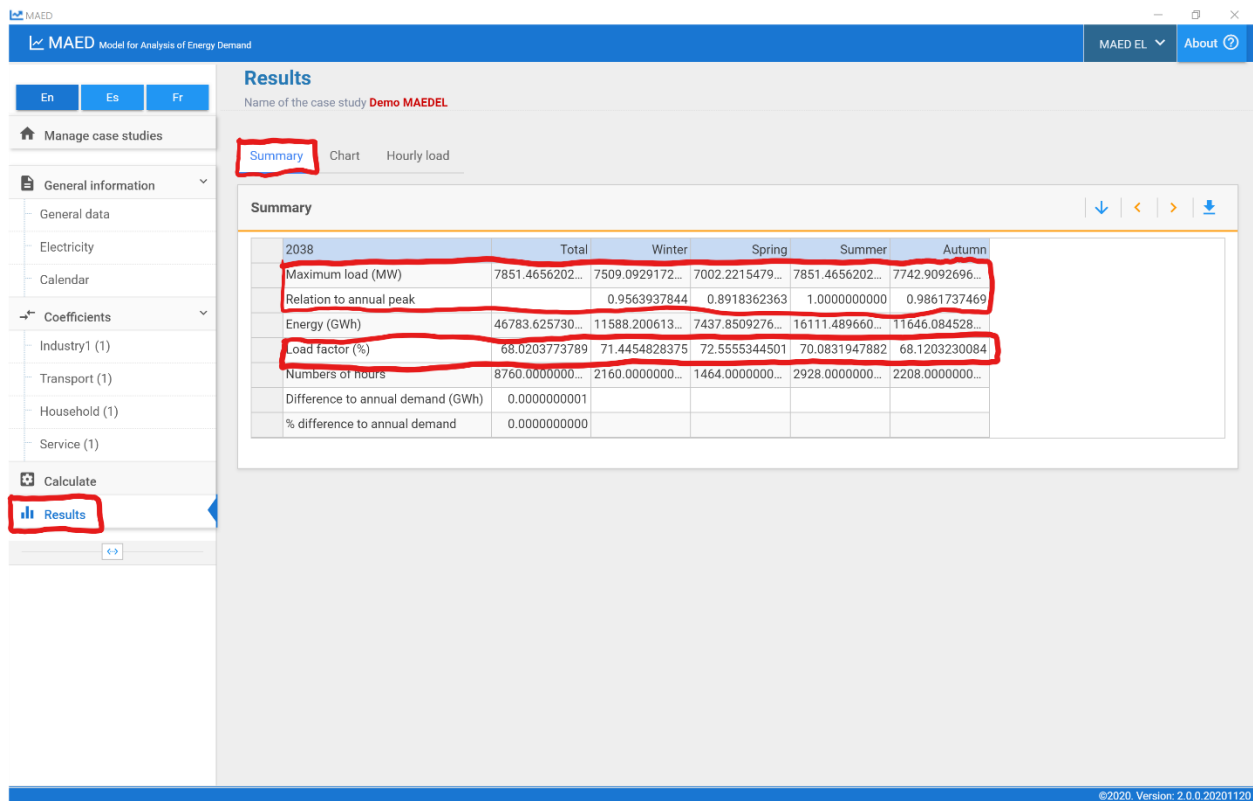
- 1) Check base year and future year results
- 2) Adjust scenario assumptions to match base year results with hourly demand data
- 3) Add projected years to the model
- 4) Explore the effect of changing scenario assumptions on hourly demand data

Activity 1: Reviewing base year results

This hands-on session will give you a brief introduction to results analysis, the final step of an hourly demand study in MAED-EL. This activity uses the Demo MAEDEL case study that we used in Hands-on session 8. After the last session, all the scenario data have been defined, so the next step is to check the base year results.

As we have seen in Hands-on 8, you can review the results after calculating them by clicking on the Results tab in the navigation menu on the left side of the page. Click on the Summary tab on the top of the page to view a table summarizing the demand for each year in the model.

To check the results of the base year, then compare the maximum load values with the statistical data. The maximum load in each season predicted in MAED-EL should match the statistical data within an acceptable margin. You should also check that the season in which the peak load occurs matches the base year data. Similarly, you should evaluate whether the load factors in each season are consistent with base year values.



If the base year results are satisfactory, you can analyze the results for the other years of the study to check their consistency with your expectations and other projections. Otherwise, you need to review the input data to find the differences and repeat this process until MAED-EL results match the base year data within an acceptable margin of error.

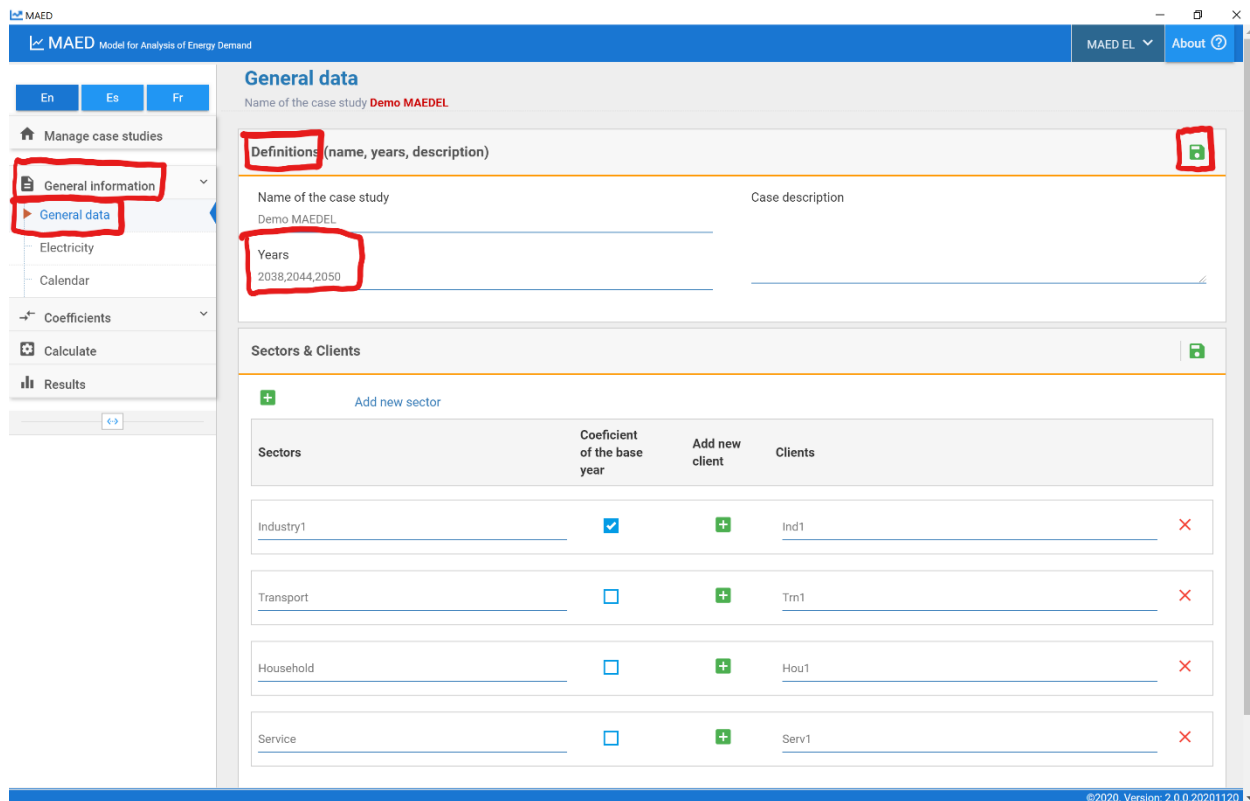
The scenario assumptions that most commonly lead to mismatch between the reference year data and the results are:

- annual demand
- percentage of electricity supplied by the grid
- clients
- transmission and distribution losses
- seasonal, daily, and hourly coefficients

Confirm these values and adjust them as needed so that the reference year data and results match. Review previous hands-on materials for how to set these values.

Activity 2: Adding years to case study

Now that you have reviewed the base year results provided with the Demo MAEDEL case study, we will add two projected years to the case study. Click on the General data tab under the General Information heading in the navigation menu on the left side of the page. In the Definitions box at the top of the page, add the years 2044 and 2050 to the study. Be sure to click the green Save data button on the top right of the box.

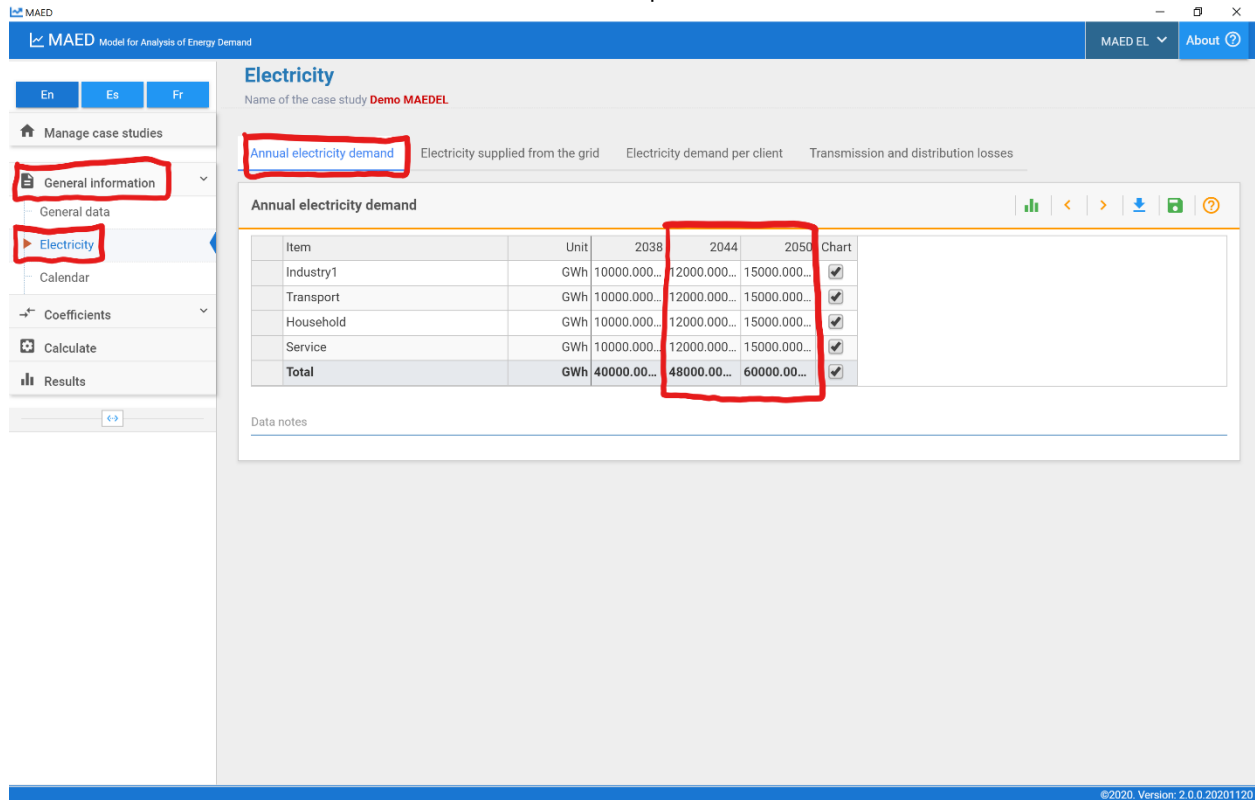


The screenshot shows the MAED Model for Analysis of Energy Demand interface. The left navigation menu has the 'General data' tab selected. The main content area is titled 'General data' and shows the 'Definitions (name, years, description)' section. The 'Name of the case study' is 'Demo MAEDEL'. The 'Years' field contains '2038,2044,2050'. The 'Sectors & Clients' section shows a table with four rows: Industry1, Transport, Household, and Service. Each row has a checkbox for 'Coefficient of the base year', a green '+' button for 'Add new client', and a red 'X' button for 'Clients'.

Sectors	Coefficient of the base year	Add new client	Clients
Industry1	<input checked="" type="checkbox"/>	<input data-bbox="889 1087 911 1115" type="button" value="+"/>	Ind1 <input data-bbox="1349 1087 1370 1115" type="button" value="X"/>
Transport	<input type="checkbox"/>	<input data-bbox="889 1157 911 1184" type="button" value="+"/>	Tm1 <input data-bbox="1349 1157 1370 1184" type="button" value="X"/>
Household	<input type="checkbox"/>	<input data-bbox="889 1226 911 1253" type="button" value="+"/>	Hou1 <input data-bbox="1349 1226 1370 1253" type="button" value="X"/>
Service	<input type="checkbox"/>	<input data-bbox="889 1295 911 1323" type="button" value="+"/>	Serv1 <input data-bbox="1349 1295 1370 1323" type="button" value="X"/>

Next, click on the Electricity tab under the General information heading on the navigation menu on the left side of the page. Click on the Annual electricity demand tab at the top of the page. We assume that each sector has equal annual electricity demand in each year: 10,000 GWh in 2038,

12,000 GWh in 2044, and 15,000 GWh in 2050. Input each of these values into the chart.



MAED Model for Analysis of Energy Demand

Electricity

Name of the case study **Demo MAEDEL**

Annual electricity demand

Item	Unit	2038	2044	2050	Chart
Industry1	GWh	10000.000...	12000.000...	15000.000...	<input checked="" type="checkbox"/>
Transport	GWh	10000.000...	12000.000...	15000.000...	<input checked="" type="checkbox"/>
Household	GWh	10000.000...	12000.000...	15000.000...	<input checked="" type="checkbox"/>
Service	GWh	10000.000...	12000.000...	15000.000...	<input checked="" type="checkbox"/>
Total	GWh	40000.00...	48000.00...	60000.00...	<input checked="" type="checkbox"/>

Data notes

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Click on the Electricity supplied from the grid tab at the top of the page. We assume that all sectors get 100% of their electricity from the grid in every year in the study, so input 100 in each cell of the table.

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Electricity

Name of the case study **Demo MAEDEL**

Annual electricity demand **Electricity supplied from the grid** Electricity demand per client Transmission and distribution losses

Electricity supplied from the grid

Item	Unit	2038	2044	2050	Chart
Industry1	%	100.00000	100.00000	100.00000	<input checked="" type="checkbox"/>
Transport	%	100.00000	100.00000	100.00000	<input checked="" type="checkbox"/>
Household	%	100.00000	100.00000	100.00000	<input checked="" type="checkbox"/>
Service	%	100.00000	100.00000	100.00000	<input checked="" type="checkbox"/>

Data notes

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Click on the Electricity demand per client tab at the top of the page. We assume that every sector is comprised of a single client, so input 100% for each client in the 2044 and 2050 column.

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Name of the case study **Demo MAEDEL**

Annual electricity demand Electricity supplied from the grid **Electricity demand per client** Transmission and distribution losses

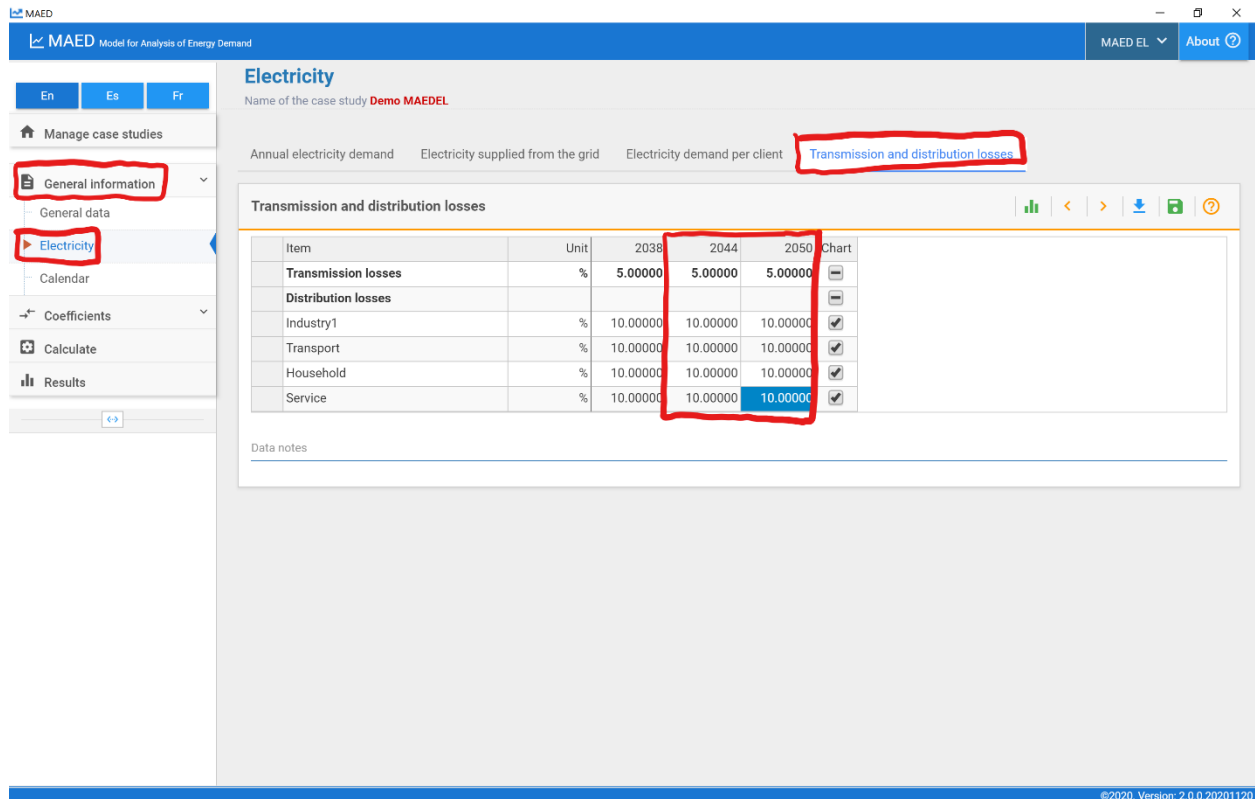
Electricity demand per client

Item	Unit	2038	2044	2050	Chart
Industry1	%	100.00000	100.00000	100.00000	<input type="checkbox"/>
Ind1	%	100.00000	100.00000	100.00000	<input checked="" type="checkbox"/>
Transport	%	100.00000	100.00000	100.00000	<input type="checkbox"/>
Trn1	%	100.00000	100.00000	100.00000	<input checked="" type="checkbox"/>
Household	%	100.00000	100.00000	100.00000	<input type="checkbox"/>
Hou1	%	100.00000	100.00000	100.00000	<input checked="" type="checkbox"/>
Service	%	100.00000	100.00000	100.00000	<input type="checkbox"/>
Serv1	%	100.00000	100.00000	100.00000	<input checked="" type="checkbox"/>

Data notes

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Click on the Transmission and distribution losses tab at the top of the page. We assume that the transmission and distribution losses will be kept constant throughout the study period, so you should input 5% for the transmission losses for each year and 10% for distribution losses in each sector in each year.



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Name of the case study **Demo MAEDEL**

Annual electricity demand Electricity supplied from the grid Electricity demand per client **Transmission and distribution losses**

Transmission and distribution losses

Item	Unit	2038	2044	2050	Chart
Transmission losses	%	5.00000	5.00000	5.00000	
Distribution losses					
Industry1	%	10.00000	10.00000	10.00000	<input checked="" type="checkbox"/>
Transport	%	10.00000	10.00000	10.00000	<input checked="" type="checkbox"/>
Household	%	10.00000	10.00000	10.00000	<input checked="" type="checkbox"/>
Service	%	10.00000	10.00000	10.00000	<input checked="" type="checkbox"/>

Data notes

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Next, click on the Industry tab under the Coefficients heading on the navigation menu on the left side of the screen. Select the Weekly coefficients tab at the top of the page. We assume that the base year modulating coefficients can be used to model hourly demand for the projected years, so should copy the weekly coefficients from the 2038 column and paste them in the 2044 and 2050 columns.

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Transport (1)

Household (1)

Service (1)

Calculate

Results

MAED EL About

Weekly coefficients Daily coefficients Hourly coefficients

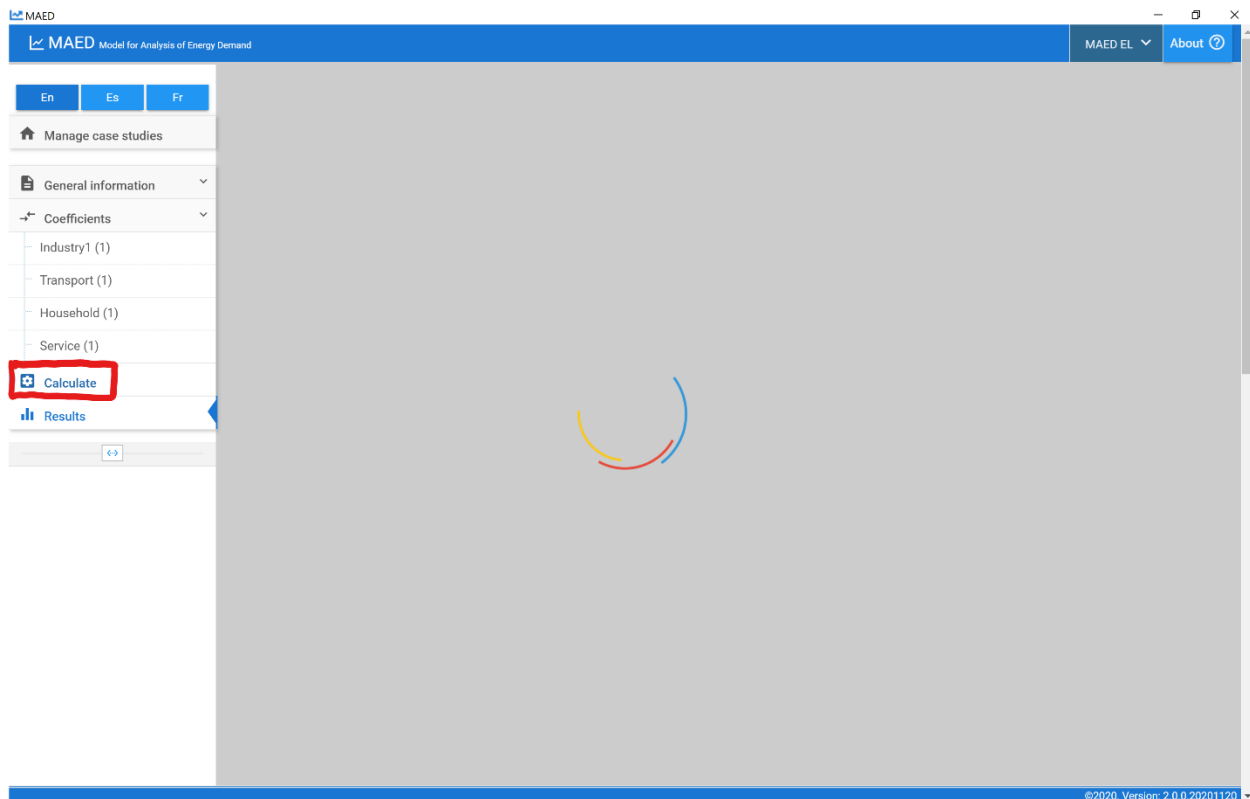
Weekly coefficients

Clients Ind1

Week	2038	2044	2050
1	1.02008	1.02008	1.02008
2	1.03358	1.03358	1.03358
3	1.05017	1.05017	1.05017
4	0.95966	0.95966	0.95966
5	1.01626	1.01626	1.01626
6	1.00275	1.00275	1.00275
7	1.00636	1.00636	1.00636
8	0.96744	0.96744	0.96744
9	1.00552	1.00552	1.00552
10	1.01530	1.01530	1.01530
11	0.98370	0.98370	0.98370
12	1.02983	1.02983	1.02983
13	1.02966	1.02966	1.02966
14	0.87465	0.87465	0.87465
15	0.94519	0.94519	0.94519
16	0.92481	0.92481	0.92481
17	0.93293	0.93293	0.93293
18	0.94999	0.94999	0.94999
19	0.97454	0.97454	0.97454
20	0.97499	0.97499	0.97499
21	0.98035	0.98035	0.98035

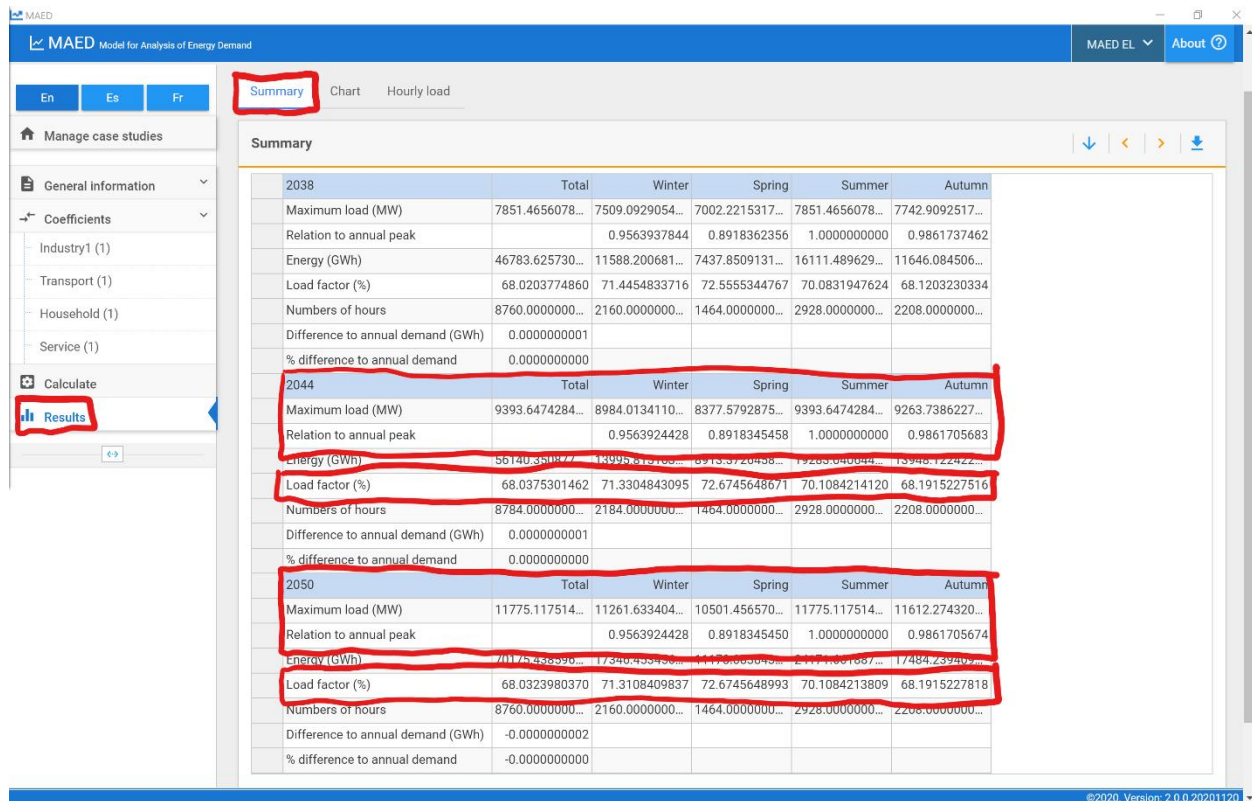
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Repeat this procedure for the daily and hourly coefficients in the industry sector and for all the other sectors. Then click the Calculate tab on the navigation menu on the left side of the screen.

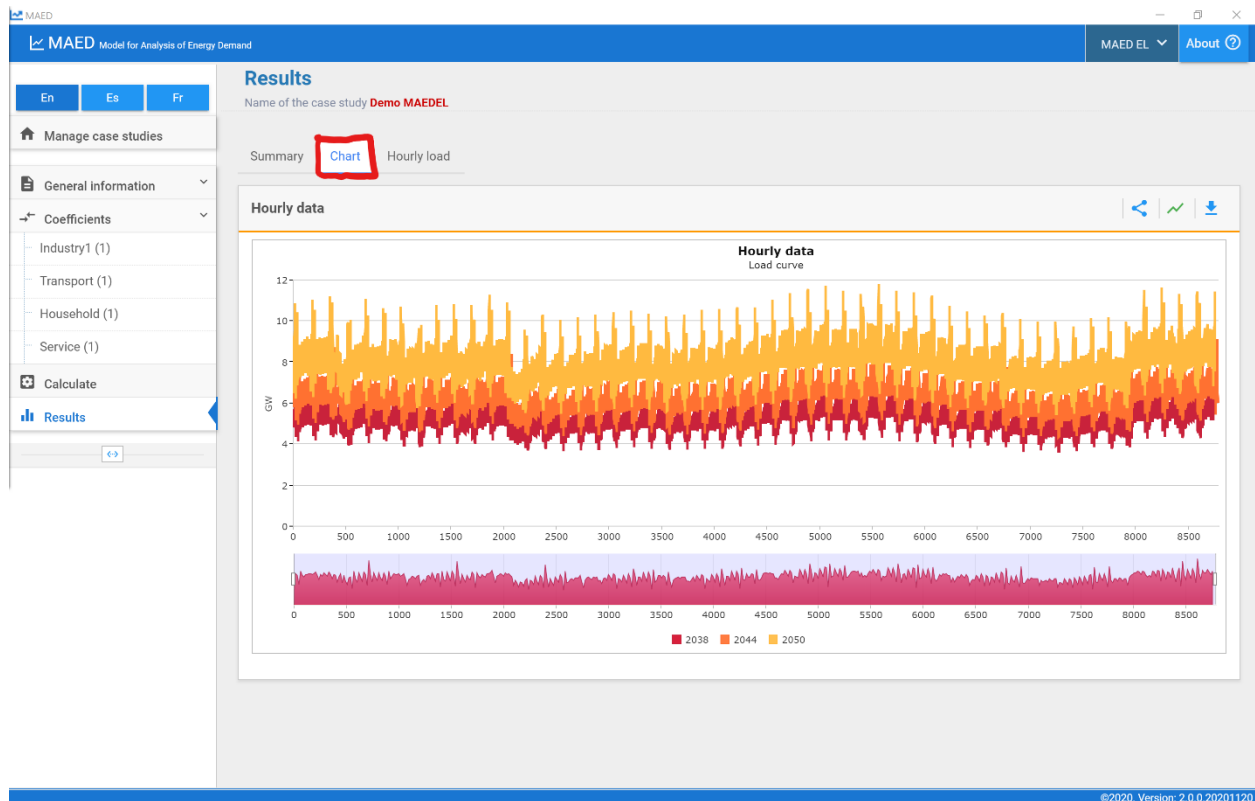


After the calculation is complete, the programme should automatically redirect you to the Results section. Click on the Summary tab at the top of the page and scroll down to view the summary tables for each year. As with the base year, you should check the maximum load in each season, the season in which the maximum load occurs, and the load factor in each season.

Because these results are for the future and there are no statistical data to compare with, you should rely on those with experience to assess the validity of the results. You can also compare the MAED-EL projections with the results from other models.



You can also quickly visualize how hourly demand changes by clicking on the Chart tab at the top of the page.

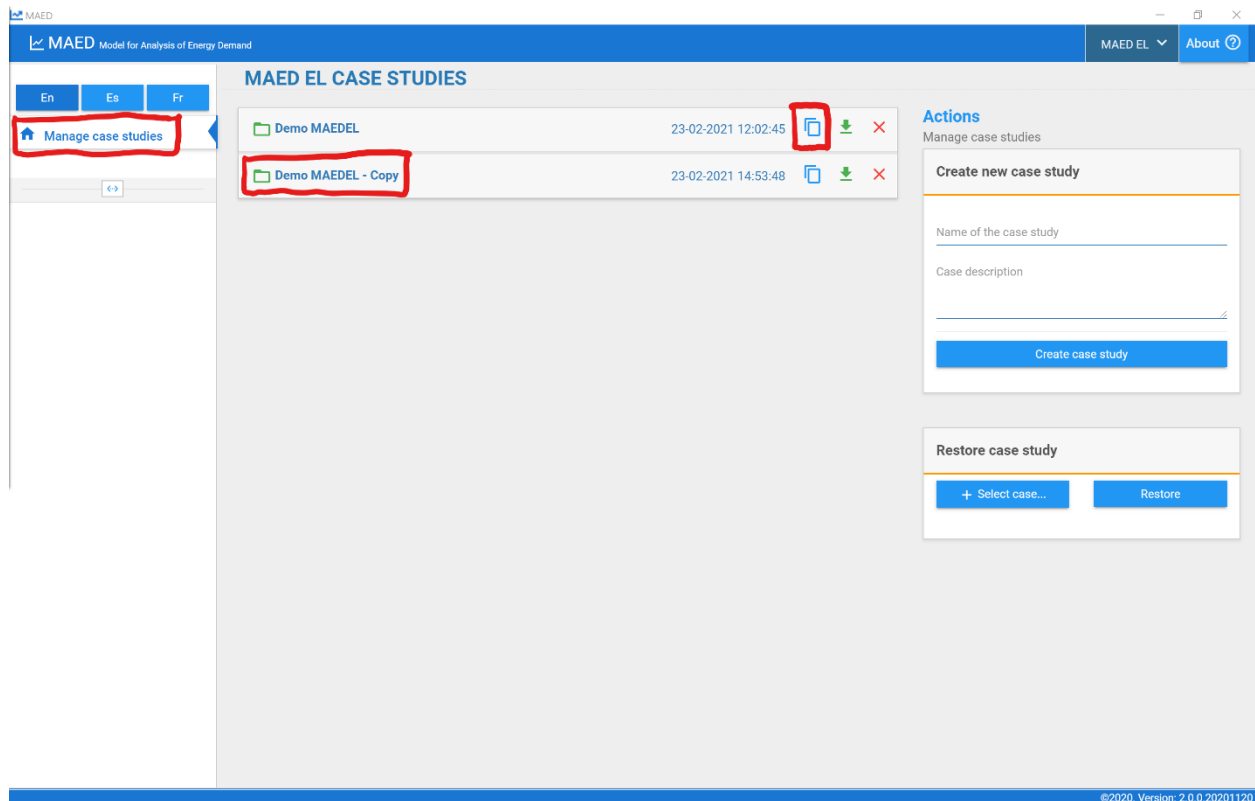


We can observe that hourly demand rises from 2038 and 2044 and again from 2044 to 2050, as we might expect because we increased the total annual electricity demand. Notice that the weekly and seasonal patterns of demand do not change because we kept the same modulating coefficients.

Activity 3: Developing an alternative scenario

Now we want to develop an alternative scenario to understand the impact of improvements in the transmission and distribution systems. New power lines will be built and the accuracy in metering and billing will be improved. These measures will reduce the transmission and distribution losses, respectively. The transmission losses at the end of the study period will be 3% while the distribution losses will be reduced to 5%. The improvements will occur gradually throughout the study period.

First, click on the Manage case studies tab at the top of the navigation menu on the left side of the screen. Find the case study named Demo MAEDEL that we have been using for the first part of this hands-on activity and click the icon with two overlapping blue rectangles that says Copy case to create a copy of this case. This copy will automatically be named Demo MAEDEL - Copy.



MAED EL CASE STUDIES

Name	Date	Actions
Demo MAEDEL	23-02-2021 12:02:45	[Copy] [Download] [Delete]
Demo MAEDEL - Copy	23-02-2021 14:53:48	[Copy] [Download] [Delete]

Actions
Manage case studies

Create new case study

Name of the case study
Case description

Create case study

Restore case study

+ Select case... Restore

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Click on the name of the new case study to open it. This action will open the General data tab. In the Definitions box at the top of the screen, in the field “Name of the case study”, rename this case study “Demo MAEDEL – TD Improvement.”

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Transport (1)

Household (1)

Service (1)

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General data

Name of the case study **Demo MAEDEL**

Definitions (name, years, description)

Name of the case study
Demo MAEDEL - TD Improvement

Case description

Years
2038,2044,2050

Sectors & Clients

Add new sector

Sectors	Coefficient of the base year	Add new client	Clients
Industry1	<input checked="" type="checkbox"/>	+	Ind1
Transport	<input type="checkbox"/>	+	Tm1
Household	<input type="checkbox"/>	+	Hou1
Service	<input type="checkbox"/>	+	Serv1

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Because all the data from the MAEDEL Demo case study are copied, we only need to change the transmission and distribution losses. Click on the Electricity tab under the General information heading in the navigation menu on the left side of the screen. Click on the Transmission and distribution losses tab at the top of the page. Change the input data as follows:

- Transmission losses: 5%, 4%, 3%
- Distribution losses: 10%, 8%, 5%

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Coefficients

Industry1 (1)

Transport (1)

Household (1)

Service (1)

Calculate

Results

Electricity

Name of the case study **Demo MAEDEL - TD Improvement**

Annual electricity demand Electricity supplied from the grid Electricity demand per client **Transmission and distribution losses**

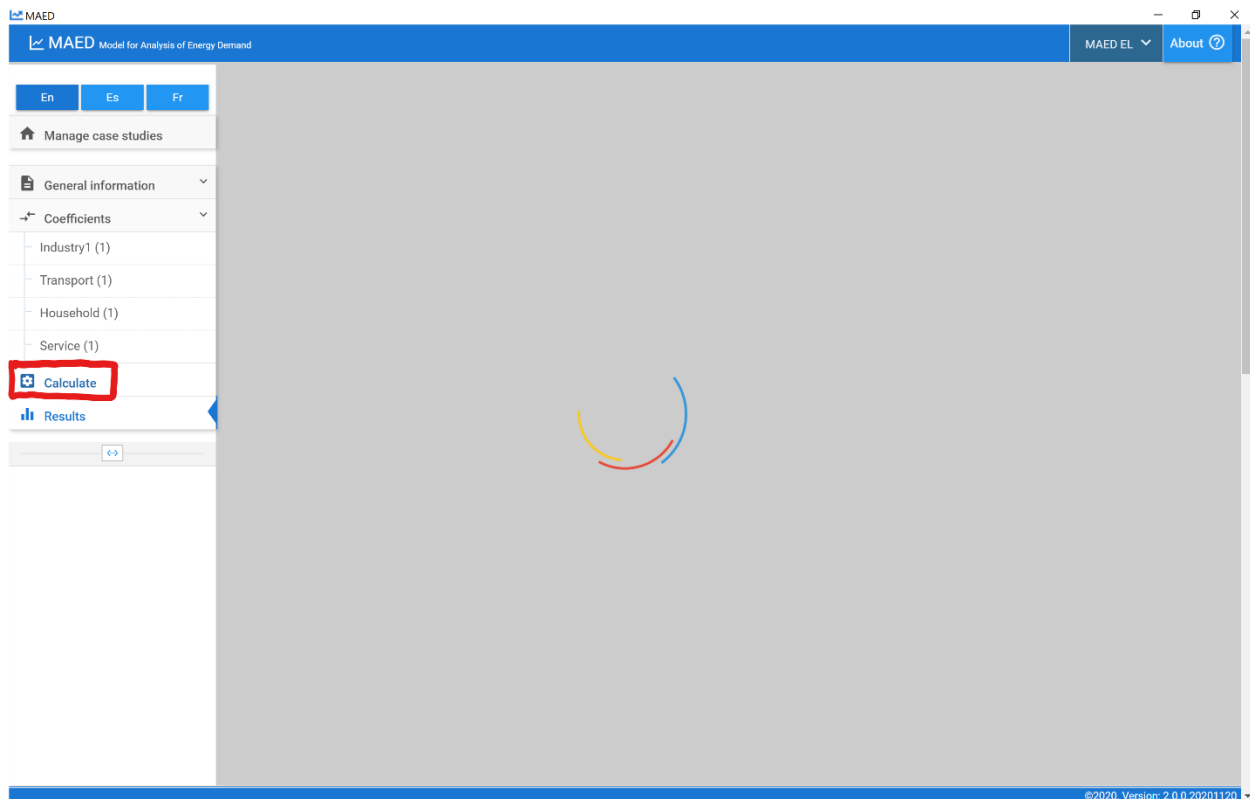
Transmission and distribution losses

Item	Unit	2038	2044	2050	Chart
Transmission losses	%	5.00000	4.00000	3.00000	
Distribution losses	%				
Industry1	%	10.00000	8.00000	5.00000	<input checked="" type="checkbox"/>
Transport	%	10.00000	8.00000	5.00000	<input checked="" type="checkbox"/>
Household	%	10.00000	8.00000	5.00000	<input checked="" type="checkbox"/>
Service	%	10.00000	8.00000	5.00000	<input checked="" type="checkbox"/>

Data notes

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Then click the Calculate tab on the navigation menu on the left side of the screen.



After the calculation is complete, the programme should automatically redirect you to the Results section. Click on the Summary tab at the top of the page and scroll down to view the summary tables for each year. You should check the maximum load in each season, the season in which the maximum load occurs, and the load factor in each season for 2044 and 2050. Compare these key summary statistics for the case with transmission and distribution improvements with the demo case.

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Industry1 (1)

Transport (1)

Household (1)

Service (1)

Calculate

Results

Summary

	Total	Winter	Spring	Summer	Autumn
2038					
Maximum load (MW)	7851.4656078...	7509.0929054...	7002.2215317...	7851.4656078...	7742.9092517...
Relation to annual peak		0.9563937844	0.8918362356	1.0000000000	0.9861737462
Energy (GWh)	46783.625730...	11588.200681...	7437.8509131...	16111.489629...	11646.084506...
Load factor (%)	68.0203774860	71.4454833716	72.5555344767	70.0831947624	68.1203230334
Numbers of hours	8760.0000000...	2160.0000000...	1464.0000000...	2928.0000000...	2208.0000000...
Difference to annual demand (GWh)	0.0000000001				
% difference to annual demand	0.0000000000				
2044					
Maximum load (MW)	9093.7143923...	8697.1597219...	8110.0886445...	9093.7143923...	8967.9534901...
Relation to annual peak		0.9563924428	0.8918345458	1.0000000000	0.9861705683
Energy (GWh)	54347.826086...	13548.937913...	8628.7744703...	18667.345732...	13502.767970...
Load factor (%)	68.0375301462	71.3304843095	72.6745648671	70.1084214120	68.1915227516
Numbers of hours	8760.0000000...	2160.0000000...	1464.0000000...	2928.0000000...	2208.0000000...
Difference to annual demand (GWh)	0.0000000003				
% difference to annual demand	0.0000000000				
2050					
Maximum load (MW)	10925.366766...	10448.938210...	9743.6194988...	10925.366766...	10774.275143...
Relation to annual peak		0.9563924428	0.8918345450	1.0000000000	0.9861705674
Energy (GWh)	65111.231687...	16094.647536...	10366.778823...	22497.611111...	10272.490173...
Load factor (%)	68.0323980370	71.3108409837	72.6745648993	70.1084213809	68.1915227818
Numbers of hours	8760.0000000...	2160.0000000...	1464.0000000...	2928.0000000...	2208.0000000...
Difference to annual demand (GWh)	0.0000000001				
% difference to annual demand	0.0000000000				

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