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Guideline to EnergyPLAN Exercise 1: Define and calculate a simple national energy system.

Exercise 1.1: Define an electricity demand

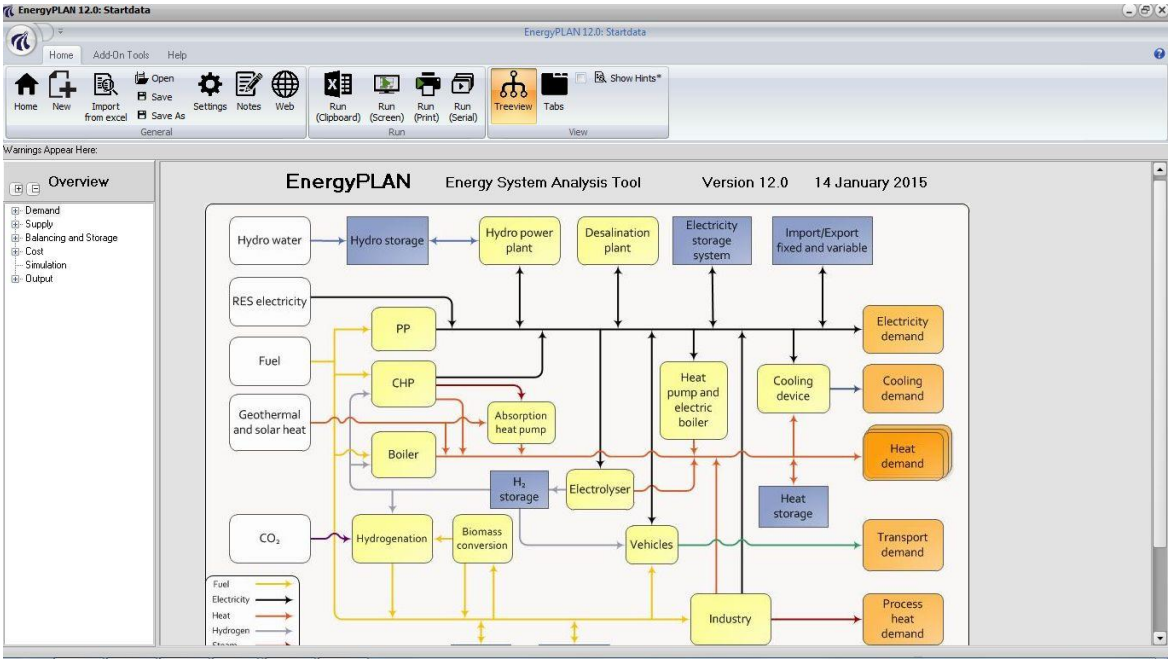
Open the EnergyPLAN model. Initialise data and define a simple national/regional energy system with an electricity demand of 49 TWh/year. Use the hour-distribution file of "hour-eldemand-eltra-2001" (The distribution of the western Danish region in 2001).

Question 1.1.1: What is the peak hour electricity demand?

Question 1.1.2: What is the peak hour electricity demand for 40 TWh/year and distribution data file "Hour_electricity.txt"?

How to do exercise 1.1:

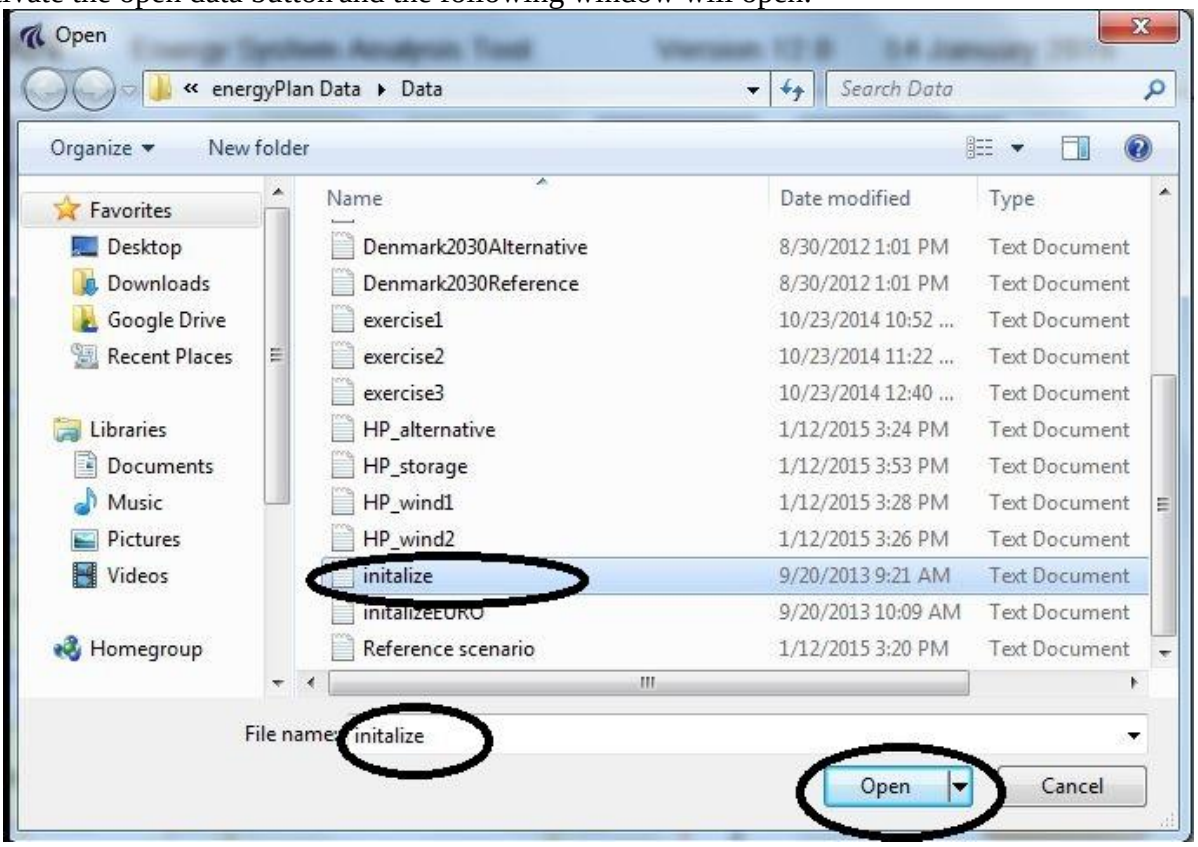
Step 1: Open the EnergyPLAN model. You will see the following front page (version 12):



Look at the top left-hand corner: The EnergyPLAN model is loaded with "Startdata"

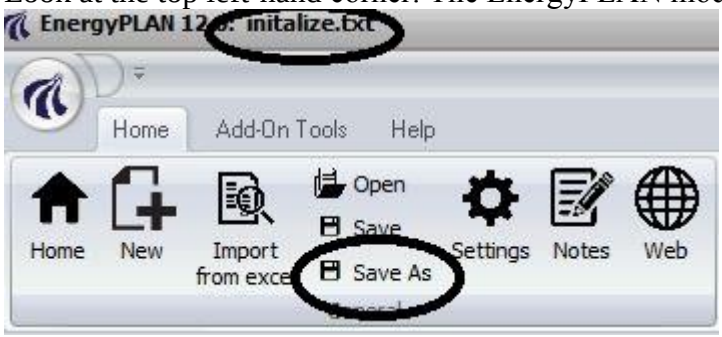
Step 2: Initialise the model by loaded "Initialize" data.

Activate the open data button and the following window will open:



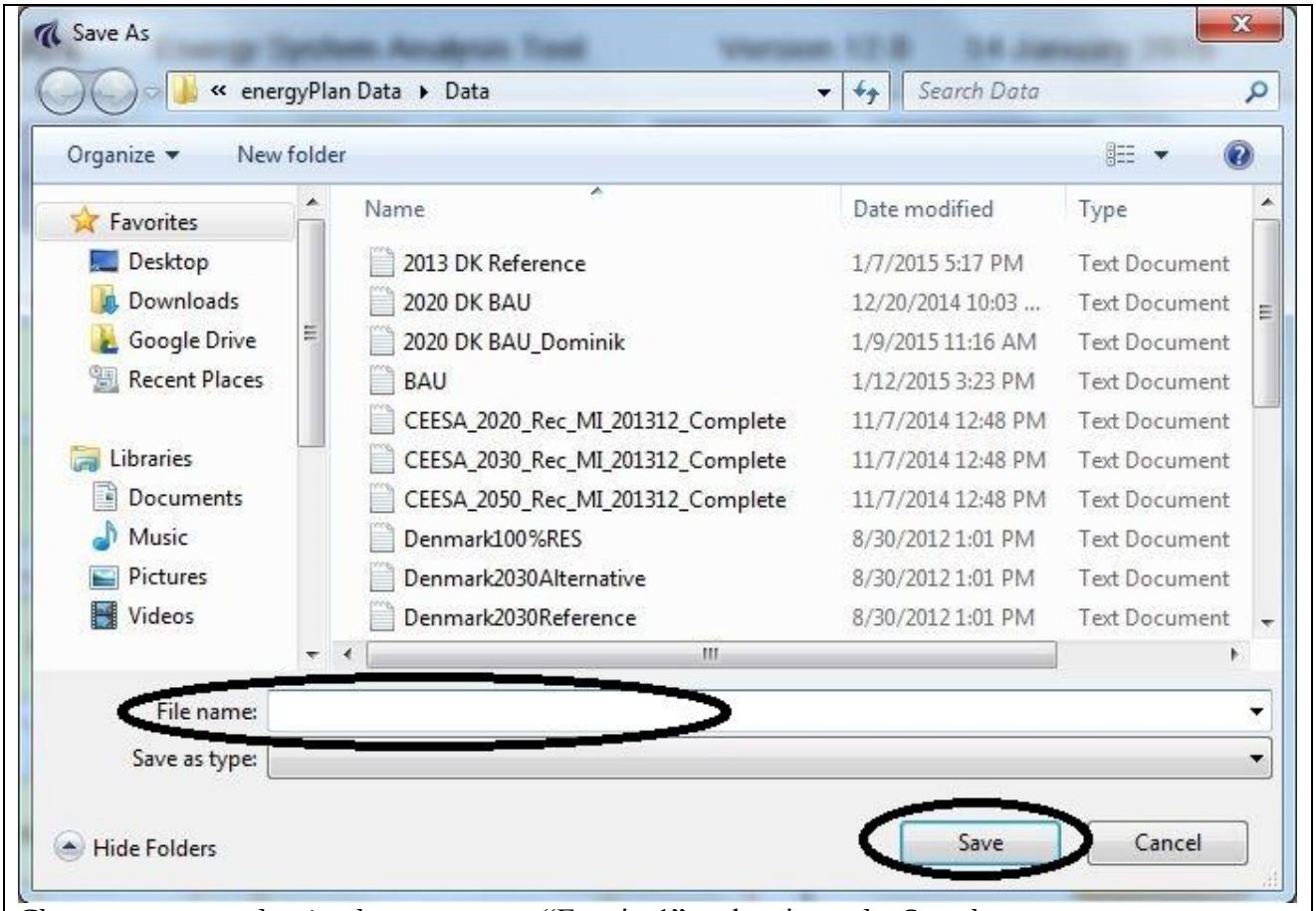
Choose "initialize.txt" and activate the Open button.

Look at the top left-hand corner: The EnergyPLAN model is loaded with "Initialize" data.



Step 3: Save Data

Press the "Save as" button at the top left-hand corner and the following window will open:

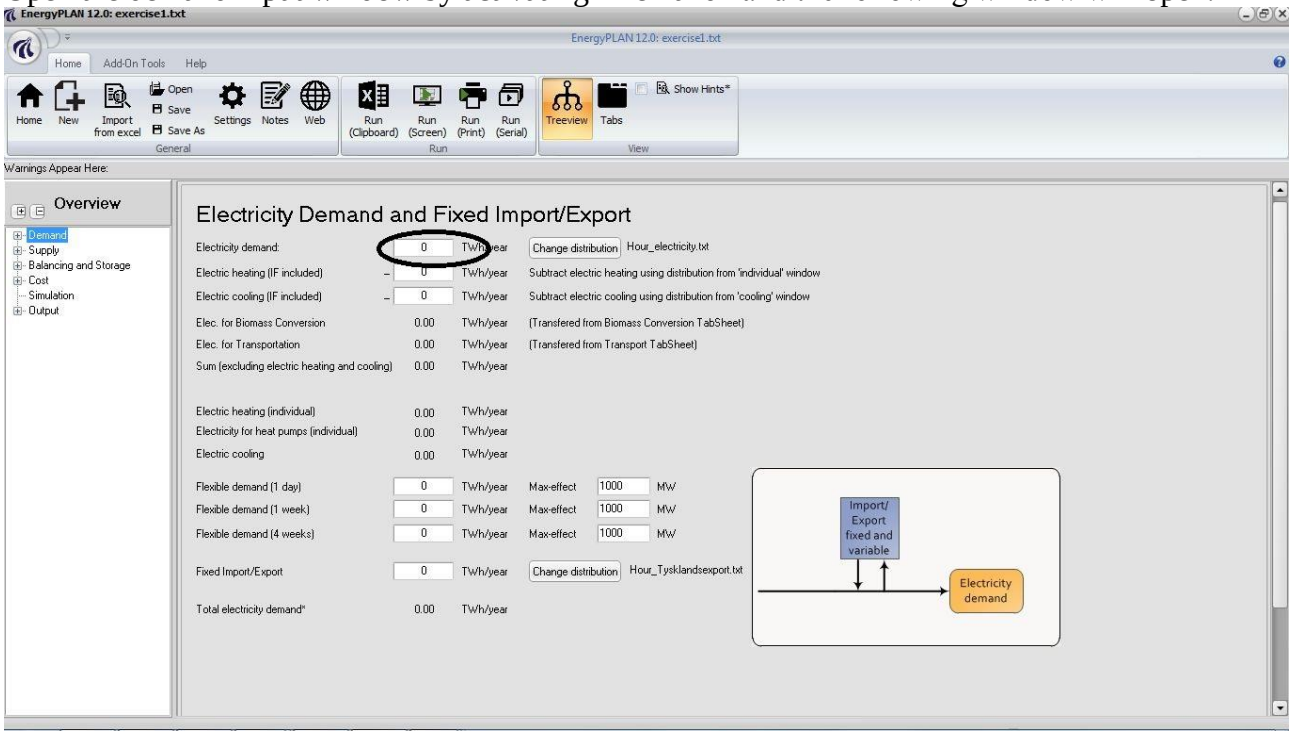


Choose a name and write the name, e.g.: "Execise1" and activate the Save button.

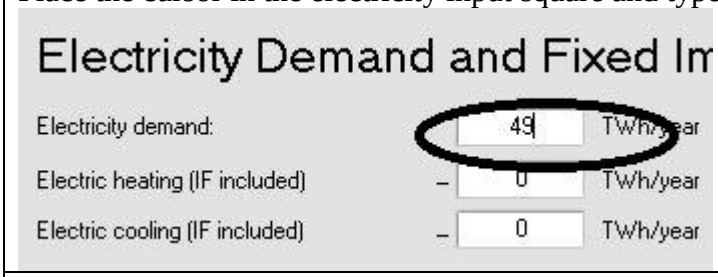
Look at the top left-hand corner: The EnergyPLAN model is loaded with "Exercise 1" data.

Step 4: Write input-data electricity demand 49 TWh/year.

Open the demand input window by activating ”Demand” and the following window will open:



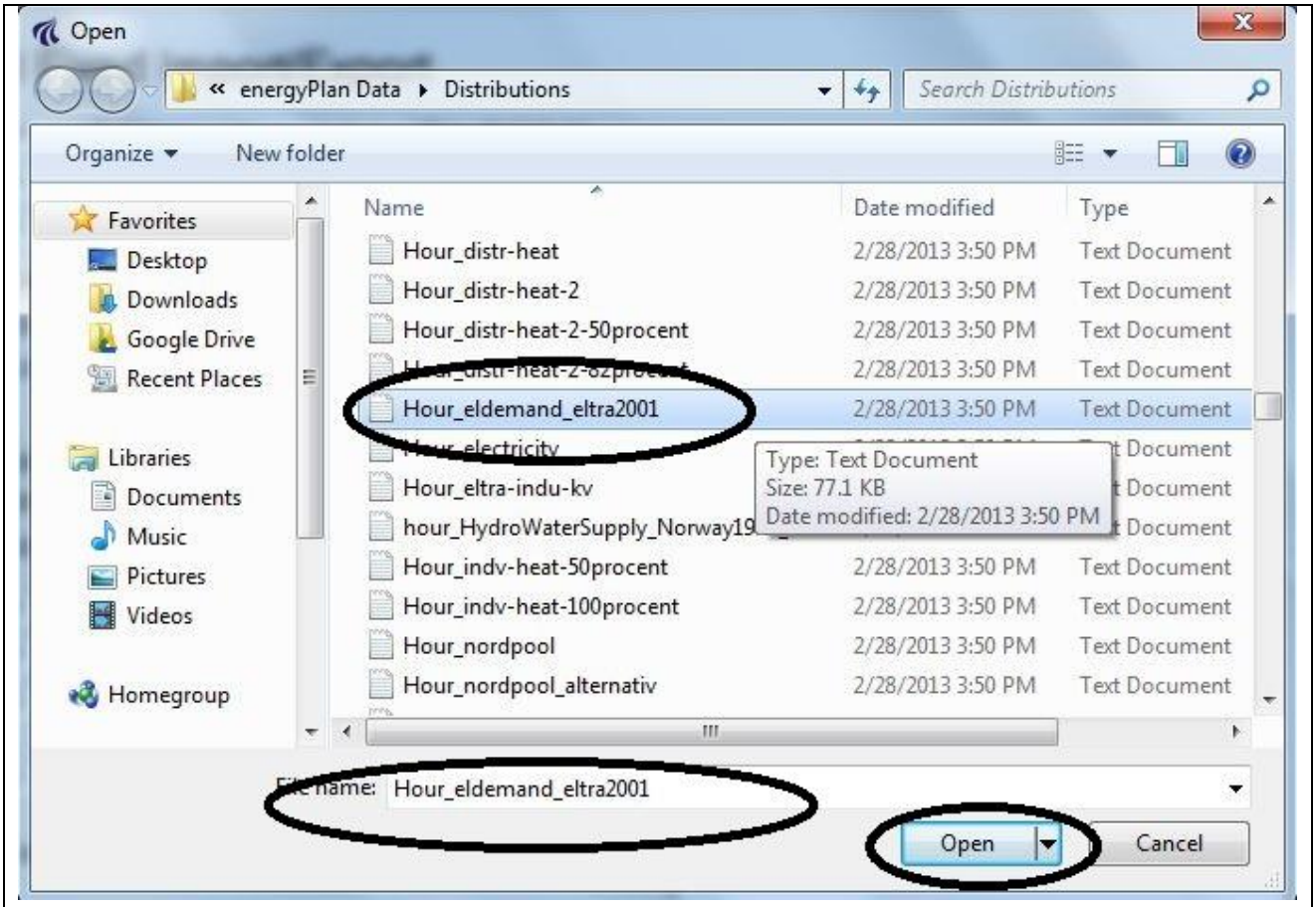
Place the cursor in the electricity input square and type in 49.



Step 5: Change hour-distribution to “hour-eldemand-eltra-2001”

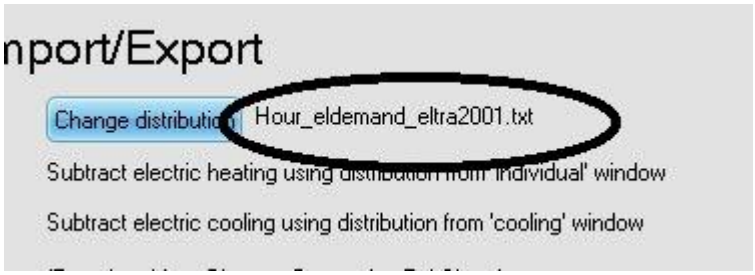
Look at the Electricity Demand input window:
The model is loaded with “Hour-electricity” distribution data.

Activate the Change distribution button and the following window will open:

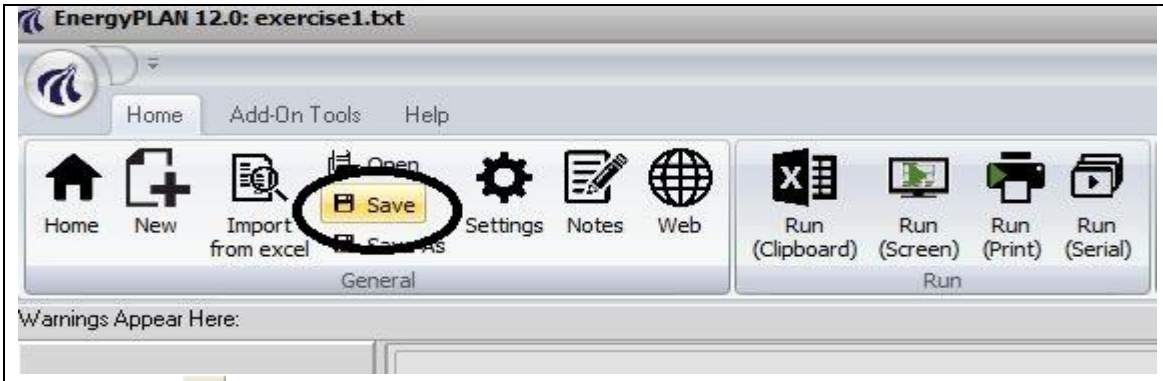


Choose “Hour_eldemand_eltra2001.txt” and activate the Open button.

Look at the Electricity Demand input window:
The model is now loaded with “Hour_eldemand_eltra2001.txt” distribution data:



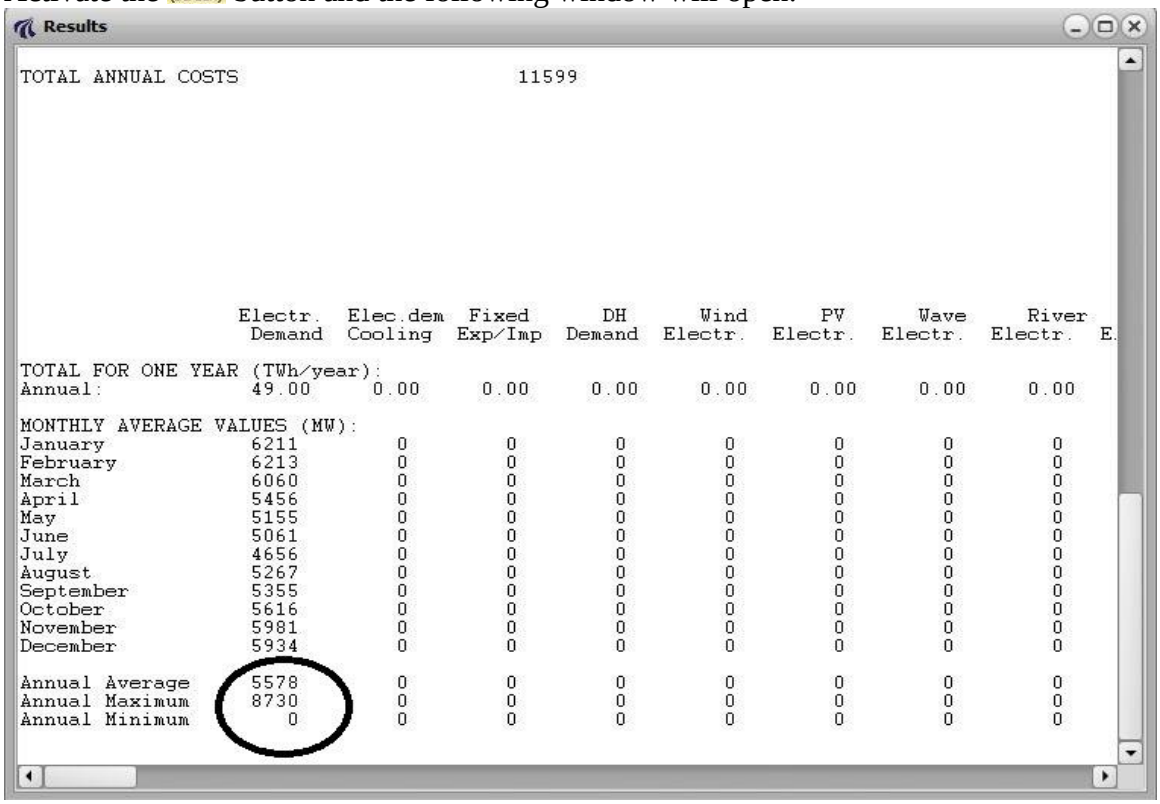
Step 6: Save data:



Activate the Save button.

EITHER Step 7A: Calculate and see result in clipboard

Activate the  button and the following window will open:

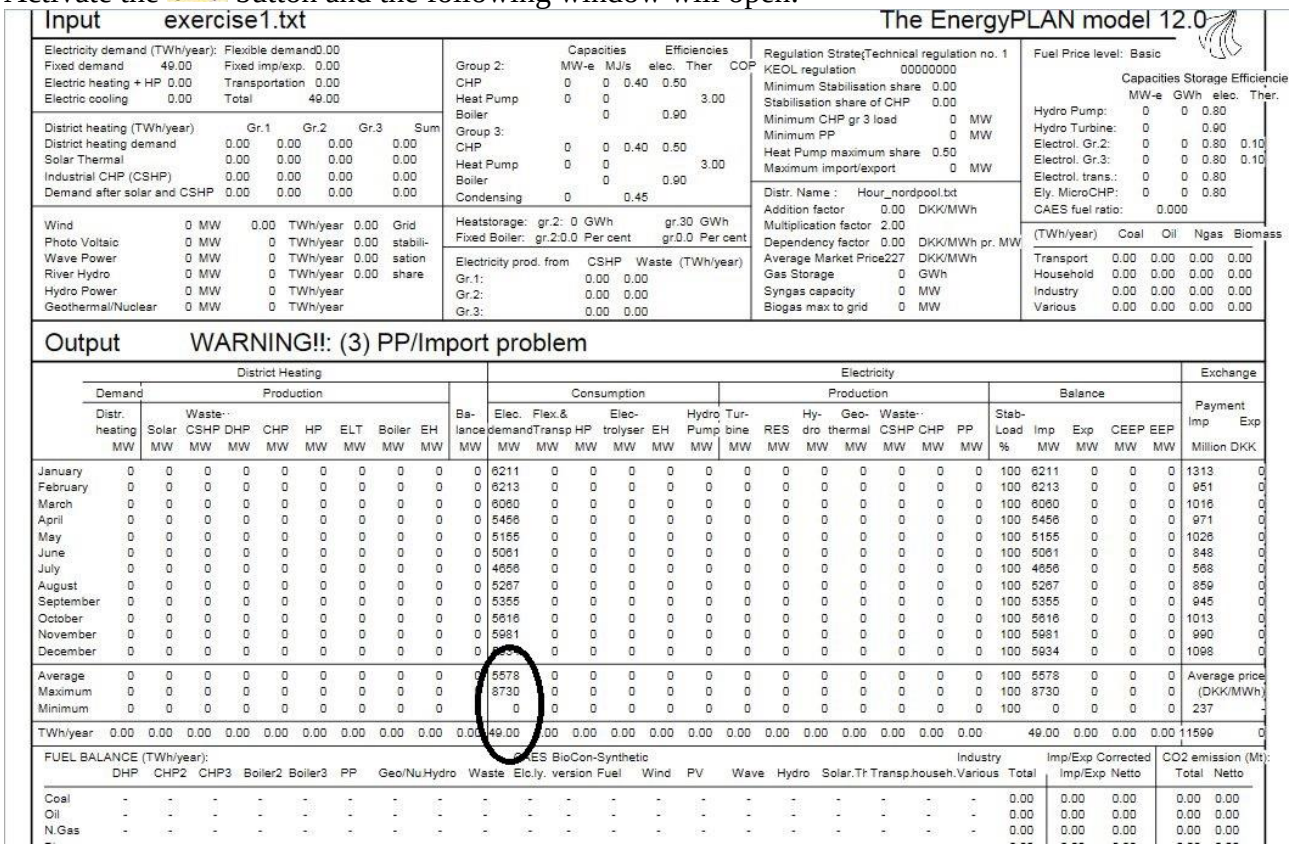


Read the result : 8730 MW

OR Step 7B: Calculate and see result in print output

Activate the 

button and the following window will open:



Read the result : 8730 MW

Step 8: Repeat steps 4 to 7 using 40 TWh/year and "Hour_electricity.txt".
The result is 7023 MW

Exercise 1.2: Define wind power and a power plant

Use the same electricity data as in exercise 1.1: Electricity demand of 49 TWh/year and "hour-eldemand-eltra-2001". Define a wind power input of 2000 MW using "Hour_wind_eltra2001" and a condensing power plant of 9000 MW burning coal.

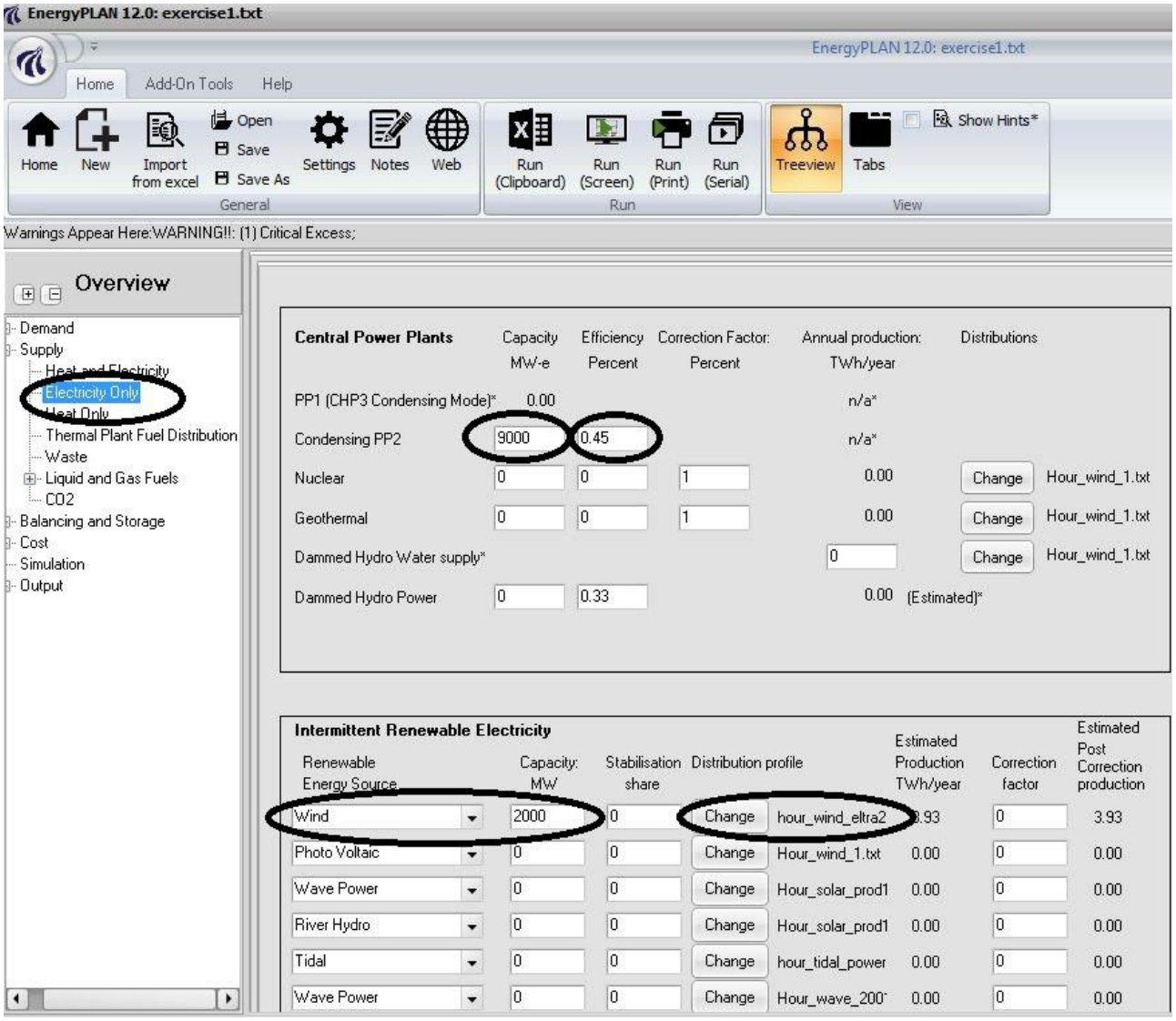
Question 1.2.1: What are the annual wind power and condensing power plant productions? What is the annual coal consumption? What is the annual CO2 emission?

Question 1.2.2: What are the annual wind power and condensing power plant productions, if the installed wind power capacity is raised to 6000 MW? What are the annual coal consumption and the CO2 emission?

How to do exercise 1.2: Use input data file from exercise1.1.

Step 1: Define wind power

Choose "Electricity only" in the tree view under the "Supply" tab and the following window will open:



Place cursor at the first RES Capacity input square and write 2000.

Step 2: Change hour distribution file

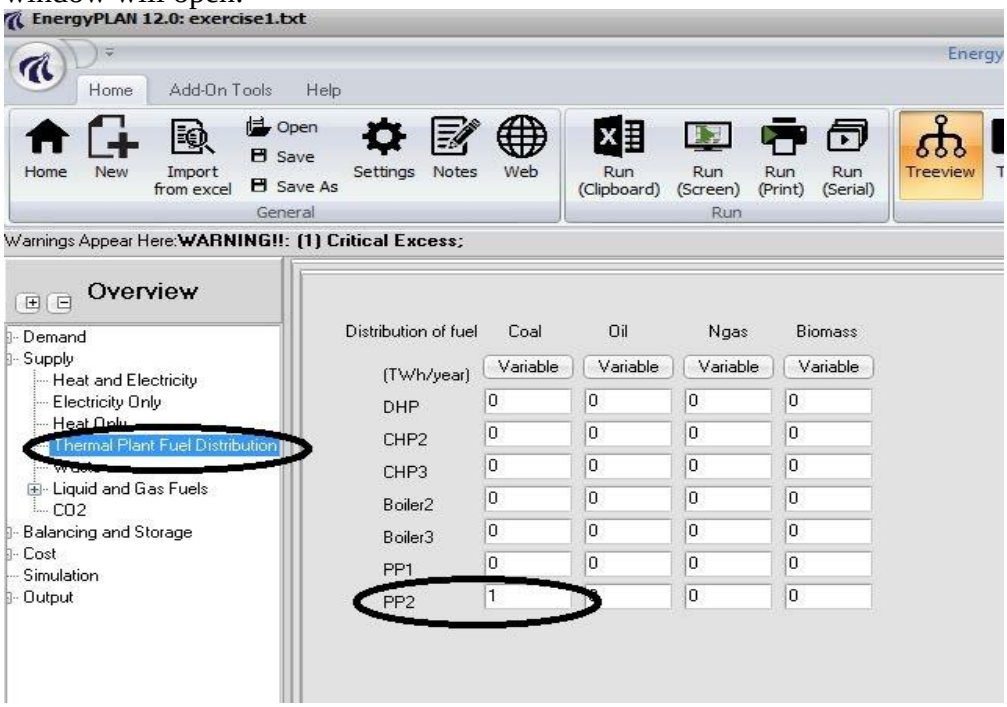
Look at the "Intermittent Renewable Energy" window. The hour-distribution-file next to the "Wind" renewable energy source is "Hour_wind1".

Activate the Change button and change to "hour-wind_eltra2001" as shown in exercise 1.1, step 5.

Step 3: Define condensing Power plant

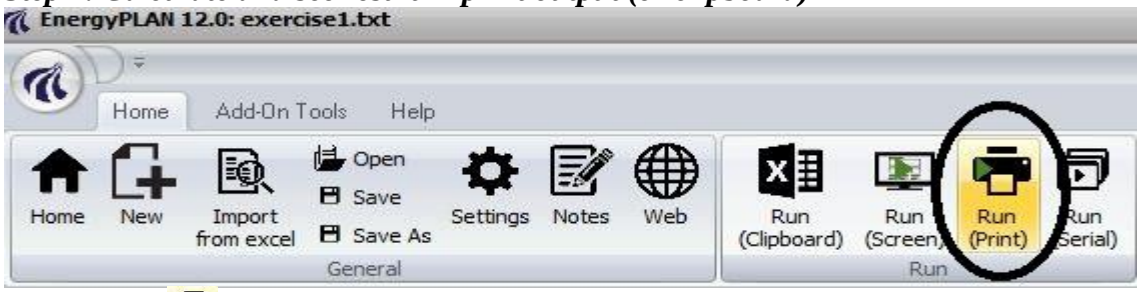
Look at the "Central Power Plants" part under the "Electricity Only" tab. Under the "Condensing PP2" capacity input square type in 9000.
Place the cursor at the condensing Efficiency input square and type in 0.45.

Choose "Thermal Plant Fuel Distribution" in the tree view under the "Supply" tab and the following window will open:

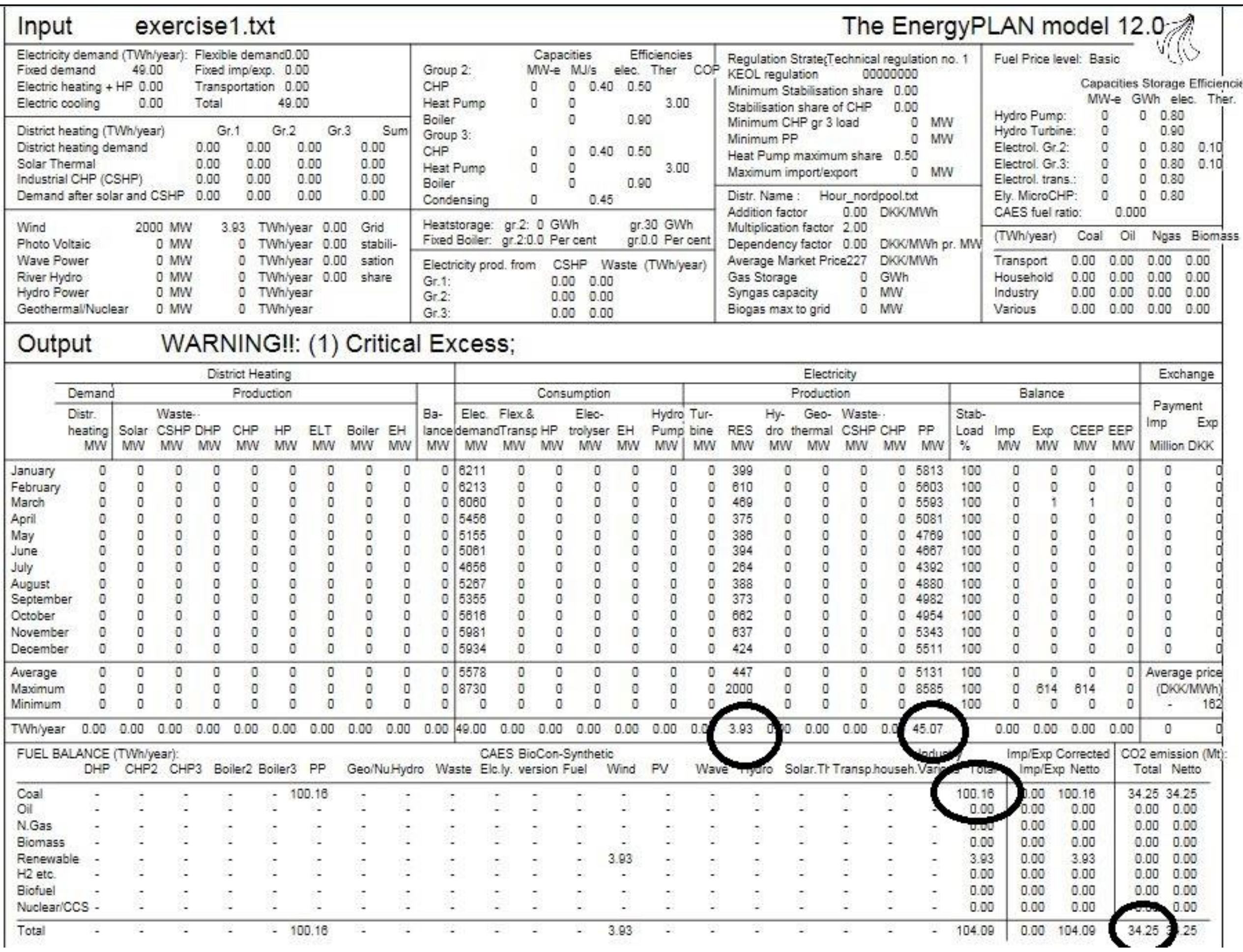


Place the cursor at the PP2 coal input square and type in 1 (Any number will do, they are all relative to the other fuel input squares)

Step 4: Calculate and see result in print output (or clipboard)



Activate the Run (Print) button and look at the following print output:



Input exercise1.txt — The EnergyPLAN model 12.0

Electricity demand (TWh/year): Flexible demand 0.00
Fixed demand 49.00 Fixed imp/exp. 0.00
Electric heating + HP 0.00 Transportation 0.00
Electric cooling 0.00 Total 49.00

District heating (TWh/year)	Gr.1	Gr.2	Gr.3	Sum
District heating demand	0.00	0.00	0.00	0.00
Solar Thermal	0.00	0.00	0.00	0.00
Industrial CHP (CSHP)	0.00	0.00	0.00	0.00
Demand after solar and CSHP	0.00	0.00	0.00	0.00

Wind 2000 MW 3.93 TWh/year 0.00 Grid
Photo Voltaic 0 MW 0 TWh/year 0.00 stabili-
Wave Power 0 MW 0 TWh/year 0.00 sation
River Hydro 0 MW 0 TWh/year 0.00 share
Hydro Power 0 MW 0 TWh/year
Geothermal/Nuclear 0 MW 0 TWh/year

	Capacities MW-e	MJ/s	Efficiencies elec.	Ther	COP
Group 2:					
CHP	0	0	0.40	0.50	
Heat Pump	0	0			3.00
Boiler		0		0.90	
Group 3:					
CHP	0	0	0.40	0.50	
Heat Pump	0	0			3.00
Boiler		0		0.90	
Condensing	0		0.45		

Heatstorage: gr.2: 0 GWh gr.30 GWh
Fixed Boiler: gr.2:0.0 Per cent gr.0.0 Per cent

Electricity prod. from CSHP Waste (TWh/year)
Gr.1: 0.00 0.00
Gr.2: 0.00 0.00
Gr.3: 0.00 0.00

Regulation Strategy: Technical regulation no. 1
KEOL regulation 00000000
Minimum Stabilisation share 0.00
Stabilisation share of CHP 0.00
Minimum CHP gr 3 load 0 MW
Minimum PP 0 MW
Heat Pump maximum share 0.50
Maximum import/export 0 MW

Distr. Name : Hour_nordpool.txt
Addition factor 0.00 DKK/MWh
Multiplication factor 2.00
Dependency factor 0.00 DKK/MWh pr. MW
Average Market Price 227 DKK/MWh
Gas Storage 0 GWh
Syngas capacity 0 MW
Biogas max to grid 0 MW

Fuel Price level: Basic

	Capacities MW-e	Storage GWh	Efficiencies elec.	Ther.
Hydro Pump:	0	0	0.80	
Hydro Turbine:	0		0.90	
Electrol. Gr.2:	0	0	0.80	0.10
Electrol. Gr.3:	0	0	0.80	0.10
Electrol. trans.:	0	0	0.80	
Ely. MicroCHP:	0	0	0.80	

CAES fuel ratio: 0.000

(TWh/year)	Coal	Oil	Ngas	Biomass
Transport	0.00	0.00	0.00	0.00
Household	0.00	0.00	0.00	0.00
Industry	0.00	0.00	0.00	0.00
Various	0.00	0.00	0.00	0.00

Output WARNING!!: (1) Critical Excess;

	DH Demand Distr. heating MW	Solar MW	CSHP MW	DHP MW	CHP MW	HP MW	ELT MW	Boiler MW	EH MW	Balance MW	Elec. demand MW	Flex.& Transp MW	HP MW	Electrolyser MW	EH MW	Hydro Pump MW	Turbine MW	RES MW	Hydro MW	Geothermal MW	Waste CSHP MW	CHP MW	PP MW	Stab-Load %	Imp MW	Exp MW	CEEP MW	EEP MW	Payment Imp Million DKK	Payment Exp Million DKK
January	0	0	0	0	0	0	0	0	0	0	6211	0	0	0	0	0	0	399	0	0	0	0	5813	100	0	0	0	0	0	0
February	0	0	0	0	0	0	0	0	0	0	6213	0	0	0	0	0	0	610	0	0	0	0	5603	100	0	0	0	0	0	0
March	0	0	0	0	0	0	0	0	0	0	6060	0	0	0	0	0	0	469	0	0	0	0	5593	100	0	1	1	0	0	0
April	0	0	0	0	0	0	0	0	0	0	5456	0	0	0	0	0	0	375	0	0	0	0	5081	100	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	0	0	5155	0	0	0	0	0	0	386	0	0	0	0	4769	100	0	0	0	0	0	0
June	0	0	0	0	0	0	0	0	0	0	5061	0	0	0	0	0	0	394	0	0	0	0	4667	100	0	0	0	0	0	0
July	0	0	0	0	0	0	0	0	0	0	4656	0	0	0	0	0	0	264	0	0	0	0	4392	100	0	0	0	0	0	0
August	0	0	0	0	0	0	0	0	0	0	5267	0	0	0	0	0	0	388	0	0	0	0	4880	100	0	0	0	0	0	0
September	0	0	0	0	0	0	0	0	0	0	5355	0	0	0	0	0	0	373	0	0	0	0	4982	100	0	0	0	0	0	0
October	0	0	0	0	0	0	0	0	0	0	5616	0	0	0	0	0	0	662	0	0	0	0	4954	100	0	0	0	0	0	0
November	0	0	0	0	0	0	0	0	0	0	5981	0	0	0	0	0	0	637	0	0	0	0	5343	100	0	0	0	0	0	0
December	0	0	0	0	0	0	0	0	0	0	5934	0	0	0	0	0	0	424	0	0	0	0	5511	100	0	0	0	0	0	0
Average	0	0	0	0	0	0	0	0	0	0	5578	0	0	0	0	0	0	447	0	0	0	0	5131	100	0	0	0	0	Average price (DKK/MWh)	
Maximum	0	0	0	0	0	0	0	0	0	0	8730	0	0	0	0	0	0	2000	0	0	0	0	8585	100	0	614	614	0		
Minimum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	-	162
TWh/year	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.00	0.00	0.00	0.00	0.00	0.00	0.00	3.93	0.00	0.00	0.00	0.00	45.07		0.00	0.00	0.00	0.00	0	0

FUEL BALANCE (TWh/year):

	DHP	CHP2	CHP3	Boiler2	Boiler3	PP	Geo/Nu	Hydro	Waste	Elc.ly	CAES	BioCon-version	Synthetic Fuel	Wind	PV	Wave	Hydro	Solar.Th	Transp.	househ.	Industry	Various	Total	Imp/Exp Corrected Imp/Exp	Netto	CO2 emission (Mt) Total	Netto
Coal	-	-	-	-	-	100.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100.16	0.00	100.16	34.25	34.25
Oil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00
N.Gas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00
Biomass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00
Renewable	-	-	-	-	-	-	-	-	-	-	-	-	-	3.93	-	-	-	-	-	-	-	-	3.93	0.00	3.93	0.00	0.00
H2 etc.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00
Biofuel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00
Nuclear/CCS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00
Total	-	-	-	-	-	100.16	-	-	-	-	-	-	-	3.93	-	-	-	-	-	-	-	-	104.09	0.00	104.09	34.25	34.25

Read results:
Wind power production = 3.93 TWh/year.
Condensing Power production = 45.07 TWh/year.
Coal consumption = 100.16 TWh/year.
CO2 emissions = 34.25 Mt.

Step 5: Change installed wind power capacity

Repeat step 1 for 6000 MW wind power.

The results are now:
Wind power production = 11.79 TWh/year.
Excess production (export) = 0.06 TWh/year.
Condensing Power production = 37.28 TWh/year.
Coal consumption = 82.83 TWh/year.
CO2 emission = 28.33 Mt

Exercise 1.3: Define district heating and individual house heating

Use the data from exercise 1.2:

- Electricity demand of 49 TWh/year and "hour-eldemand-eltra-2001"
- Condensing power plant: 9000 MW coal –fired
- 2000 MW wind power using "Hour_wind_eltra2001"

Define 1) an annual district heating demand of 39.18 TWh (distribution "hour_distr_heat") of oil boilers and 2) a fuel demand for individual house heating of 23.07 TWh divided into 0.01 coal, 6.72 oil, 9.05 natural gas and 7.29 biomass. Use the efficiencies already used in the model (part of the initialize data set).

Question 1.3.1: What is the net annual heat demand for individual houses?

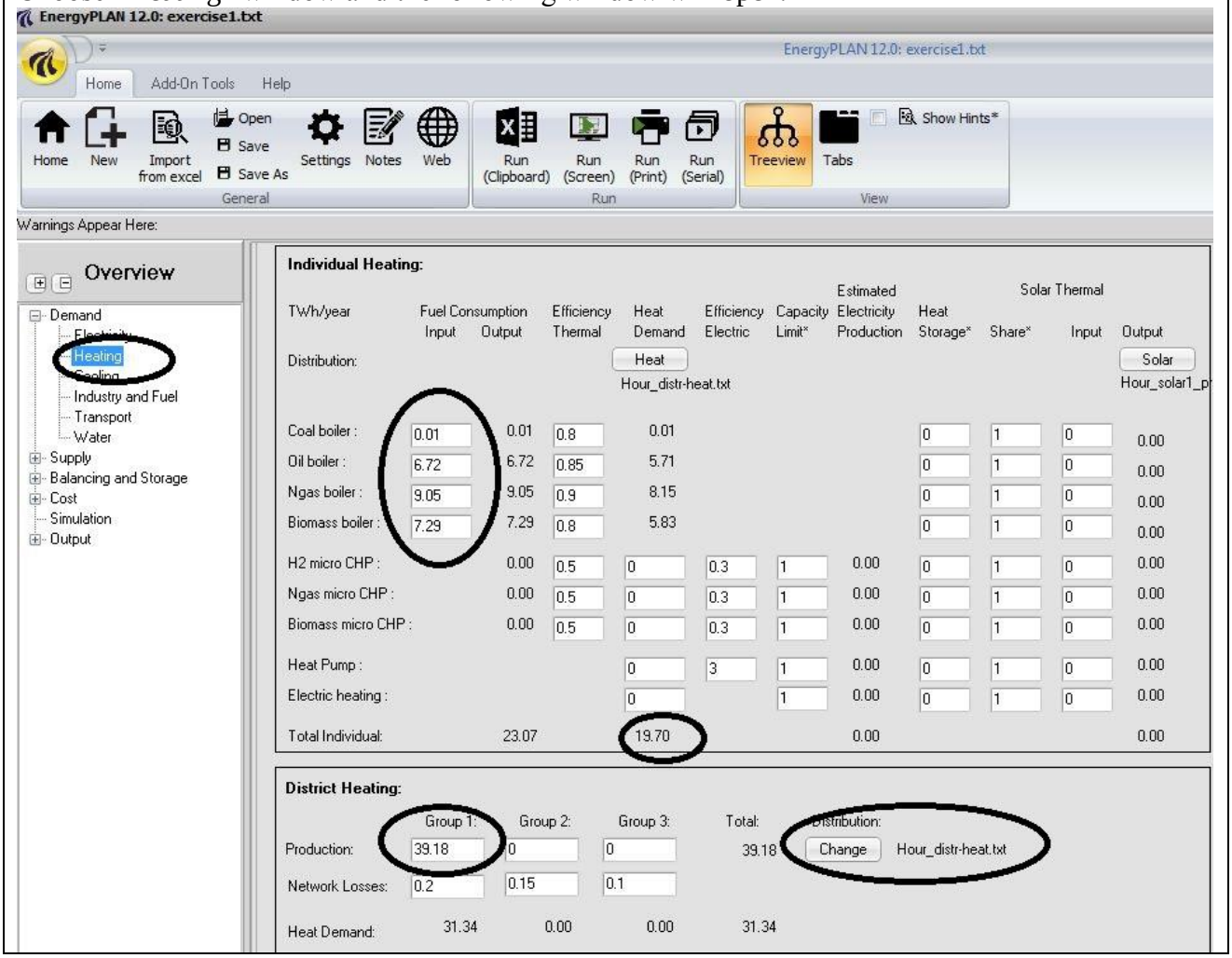
Question 1.3.2: What is the peak hour district heating demand?

Question 1.3.3: What is the annual primary energy supply of the system? And what is the annual CO2 emission?

How to do exercise 1.3: Use input data file from exercise1.2.

Step 1: Define individual house heating

Choose "Heating" window and the following window will open:



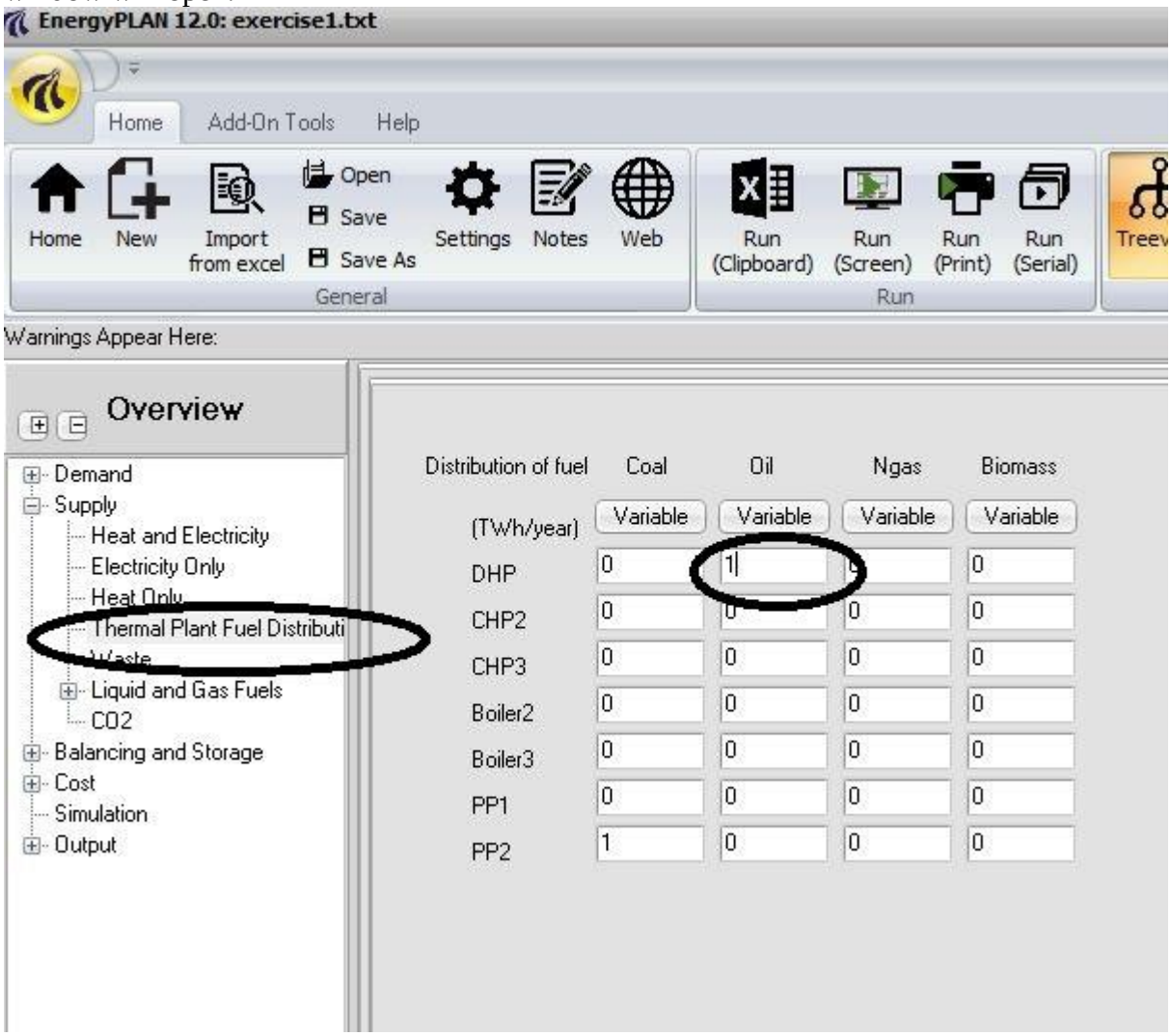
Place the cursor in the input squares of Coal boiler, Oil boiler, Ngas boiler and Biomass boiler and type in the fuel demands.

Read the answer of question 1.3.1: The annual house heat demand is 19.7 TWh.

Step 2: Define district heating

In the same window, in the District Heating part, place the cursor in the Production group 1 input square and type in 39.18.
Make sure that the distribution is already "hour-distr-heat"

Choose "Thermal Plant Fuel Distribution" in the tree view under the "Supply" tab and the following window will open:

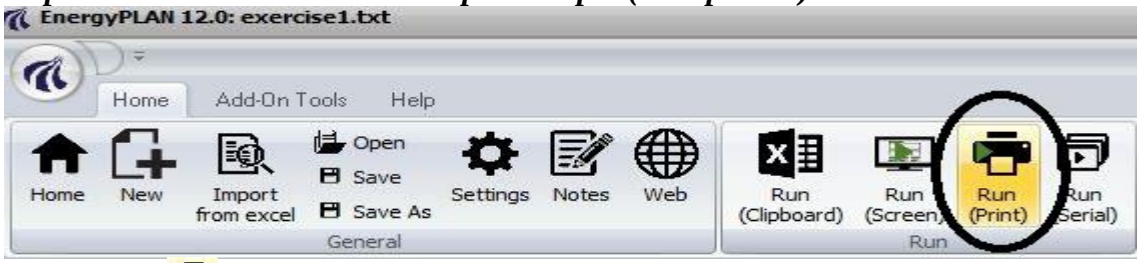


Place the cursor in the DHP oil input square and type in 1 (Any number will do, they are all relative to the other fuel input squares)

Step 3: Calculate and see result in clipboard

The district heating peak hour load demand is 7932 MW (Question 1.3.2)

Step 4: Calculate and see result in print output (or clipboard)



Activate the 

button and look at the following print output:

Input exercise1.txt — The EnergyPLAN model 12.0

Electricity demand (TWh/year):		Flexible demand	0.00		
Fixed demand	49.00	Fixed imp/exp.	0.00		
Electric heating + HP	0.00	Transportation	0.00		
Electric cooling	0.00	Total	49.00		

District heating (TWh/year)	Gr.1	Gr.2	Gr.3	Sum
District heating demand	39.18	0.00	0.00	39.18
Solar Thermal	0.00	0.00	0.00	0.00
Industrial CHP (CSHP)	0.00	0.00	0.00	0.00
Demand after solar and CSHP	39.18	0.00	0.00	39.18

Wind	2000 MW	3.93	TWh/year	0.00	Grid
Photo Voltaic	0 MW	0	TWh/year	0.00	stabili-
Wave Power	0 MW	0	TWh/year	0.00	sation
River Hydro	0 MW	0	TWh/year	0.00	share
Hydro Power	0 MW	0	TWh/year		
Geothermal/Nuclear	0 MW	0	TWh/year		

	Capacities MW-e	MJ/s	Efficiencies elec.	Ther	COP
Group 2:					
CHP	0	0	0.40	0.50	
Heat Pump	0	0			3.00
Boiler		0		0.90	
Group 3:					
CHP	0	0	0.40	0.50	
Heat Pump	0	0			3.00
Boiler		0		0.90	
Condensing	0		0.45		

Heatstorage:	gr.2: 0	GWh	gr.3 0	GWh
Fixed Boiler:	gr.2:0.0	Per cent	gr.3 0.0	Per cent

Electricity prod. from	CSHP	Waste	(TWh/year)
Gr.1:	0.00	0.00	
Gr.2:	0.00	0.00	
Gr.3:	0.00	0.00	

Regulation Strate	Technical regulation no. 1		
KEOL regulation	00000000		
Minimum Stabilisation share	0.00		
Stabilisation share of CHP	0.00		
Minimum CHP gr 3 load	0	MW	
Minimum PP	0	MW	
Heat Pump maximum share	0.50		
Maximum import/export	0	MW	

Distr. Name :	Hour_nordpool.txt		
Addition factor	0.00	DKK/MWh	
Multiplication factor	2.00		
Dependency factor	0.00	DKK/MWh pr. MW	
Average Market Price	227	DKK/MWh	
Gas Storage	0	GWh	
Syngas capacity	0	MW	
Biogas max to grid	0	MW	

Fuel Price level: Basic

Capacities Storage	MW-e	GWh	Efficiencie elec.	Ther.
Hydro Pump:	0	0	0.80	
Hydro Turbine:	0		0.90	
Electrol. Gr.2:	0	0	0.80	0.10
Electrol. Gr.3:	0	0	0.80	0.10
Electrol. trans.:	0	0	0.80	
Ely. MicroCHP:	0	0	0.80	
CAES fuel ratio:	0.000			

(TWh/year)	Coal	Oil	Ngas	Biomass
Transport	0.00	0.00	0.00	0.00
Household	0.01	6.72	9.05	7.29
Industry	0.00	0.00	0.00	0.00
Various	0.00	0.00	0.00	0.00

Output WARNING!!: (1) Critical Excess;

	District Heating										Electricity														Exchange
	Demand	Production									Consumption						Production						Balance							Payment
	Distr. heating MW	Solar MW	Waste CSHP MW	DHP MW	CHP MW	HP MW	ELT MW	Boiler MW	EH MW	Balance MW	Elec. demand MW	Flex.& Transp MW	HP MW	Elec-trolyser MW	EH MW	Hydro Pump MW	Tur-bine MW	RES MW	Hy-dro MW	Geo-thermal MW	Waste CSHP MW	CHP MW	PP MW	Stab-Load %	Imp MW	Exp MW	CEEP MW	EEP MW	Imp Million DKK	Exp
January	7553	0	0	7553	0	0	0	0	0	0	6211	0	0	0	0	0	0	399	0	0	0	0	5813	100	0	0	0	0	0	0
February	7139	0	0	7139	0	0	0	0	0	0	6213	0	0	0	0	0	0	610	0	0	0	0	5803	100	0	0	0	0	0	0
March	6151	0	0	6151	0	0	0	0	0	0	6060	0	0	0	0	0	0	469	0	0	0	0	5593	100	0	1	1	0	0	0
April	4595	0	0	4595	0	0	0	0	0	0	5456	0	0	0	0	0	0	375	0	0	0	0	5081	100	0	0	0	0	0	0
May	3012	0	0	3012	0	0	0	0	0	0	5155	0	0	0	0	0	0	386	0	0	0	0	4769	100	0	0	0	0	0	0
June	2202	0	0	2202	0	0	0	0	0	0	5061	0	0	0	0	0	0	394	0	0	0	0	4667	100	0	0	0	0	0	0
July	1788	0	0	1788	0	0	0	0	0	0	4656	0	0	0	0	0	0	264	0	0	0	0	4392	100	0	0	0	0	0	0
August	1853	0	0	1853	0	0	0	0	0	0	5267	0	0	0	0	0	0	388	0	0	0	0	4880	100	0	0	0	0	0	0
September	2611	0	0	2611	0	0	0	0	0	0	5355	0	0	0	0	0	0	373	0	0	0	0	4982	100	0	0	0	0	0	0
October	4058	0	0	4058	0	0	0	0	0	0	5816	0	0	0	0	0	0	662	0	0	0	0	4954	100	0	0	0	0	0	0
November	5727	0	0	5727	0	0	0	0	0	0	5981	0	0	0	0	0	0	637	0	0	0	0	5343	100	0	0	0	0	0	0
December	6921	0	0	6921	0	0	0	0	0	0	5934	0	0	0	0	0	0	424	0	0	0	0	5511	100	0	0	0	0	0	0
Average	4460	0	0	4460	0	0	0	0	0	0	5578	0	0	0	0	0	0	447	0	0	0	0	5131	100	0	0	0	0	Average price	
Maximum	7932	0	0	7932	0	0	0	0	0	0	8730	0	0	0	0	0	0	2000	0	0	0	0	8585	100	0	614	614	0	(DKK/MWh)	
Minimum	1607	0	0	1607	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	-	162
TWh/year	39.18	0.00	0.00	39.18	0.00	0.00	0.00	0.00	0.00	0.00	49.00	0.00	0.00	0.00	0.00	0.00	0.00	3.93	0.00	0.00	0.00	0.00	45.07		0.00	0.00	0.00	0.00	0	0

FUEL BALANCE (TWh/year):	DHP	CHP2	CHP3	Boiler2	Boiler3	PP	Geo/Nu	Hydro	Waste	CAES Elc.ly.	BioCon-version	Synthetic Fuel	Wind	PV	Wave	Hydro	Solar.Th	Transp	Industry household	Various	Total	Imp/Exp	Corrected Netto	CO2 emission (Mt): Total	Netto
Coal	-	-	-	-	-	100.16	-	-	-	-	-	-	-	-	-	-	-	-	0.01	-	100.17	0.00	100.17	34.26	34.26
Oil	43.53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.72	-	50.25	0.00	50.25	13.39	13.39
N.Gas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.05	-	9.05	0.00	9.05	1.85	1.85
Biomass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.29	-	7.29	0.00	7.29	0.00	0.00
Renewable	-	-	-	-	-	-	-	-	-	-	-	-	3.93	-	-	-	-	-	-	-	3.93	0.00	3.93	0.00	0.00
H2 etc.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00
Biofuel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00
Nuclear/CCS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00
Total	43.53	-	-	-	-	100.16	-	-	-	-	-	-	3.93	-	-	-	-	-	23.07	-	170.69	0.00	170.69	49.49	49.49

Read the results of question 1.3.3:
Primary energy supply = 170.69 TWh/year.
CO2 emissions = 49.49 Mt.

Exercise 1.4: Define industrial fuel demand and heat and electricity productions.

Use the data from exercise 1.3:

- Electricity demand of 49 TWh/year and "hour-eldemand-eltra-2001"
- Condensing power plant: 9000 MW coal –fired
- 2000 MW wind power using "Hour_wind_eltra2001"
- Annual district heating demand of 39.18 TWh (distribution "hour_distr_heat")
- Fuel demand for individual house heating of 23.07 TWh divided into 0.01 coal, 6.72 oil, 9.05 natural gas and 7.29 biomass.

Define an industrial fuel demand of 53.66 TWh divided into 3.37 coal, 26.92 oil, 18.19 natural gas and 5.18 biomass (including fuel for district heating and electricity production). Define an industrial district heating production of 1.73 TWh and an electricity production of 2.41 TWh. Use the hour distribution file "const".

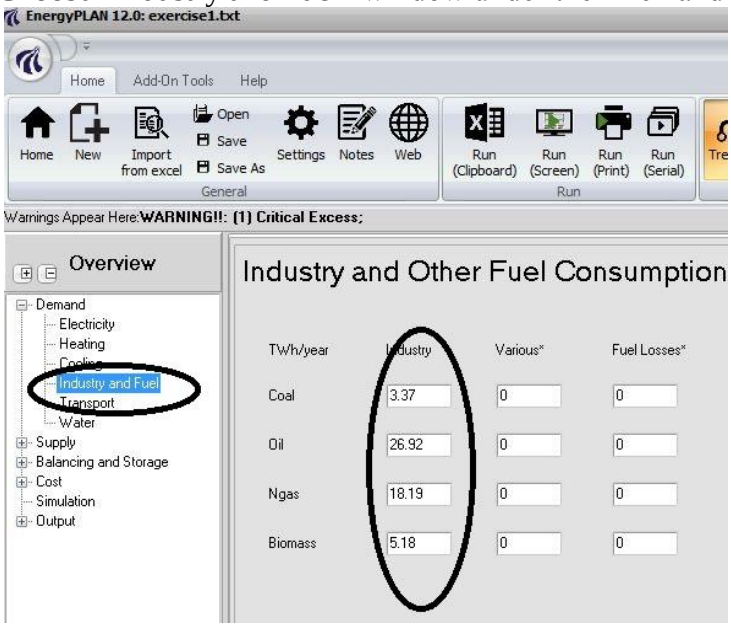
Question 1.4.1: What is the annual primary energy supply of the system? And what is the annual CO2 emission?

Question 1.4.2: What are the annual primary energy supply of the system and the CO2 emission when there is no district heating or electricity production from the industry?

How to do exercise 1.4: Use input data file from exercise1.3.

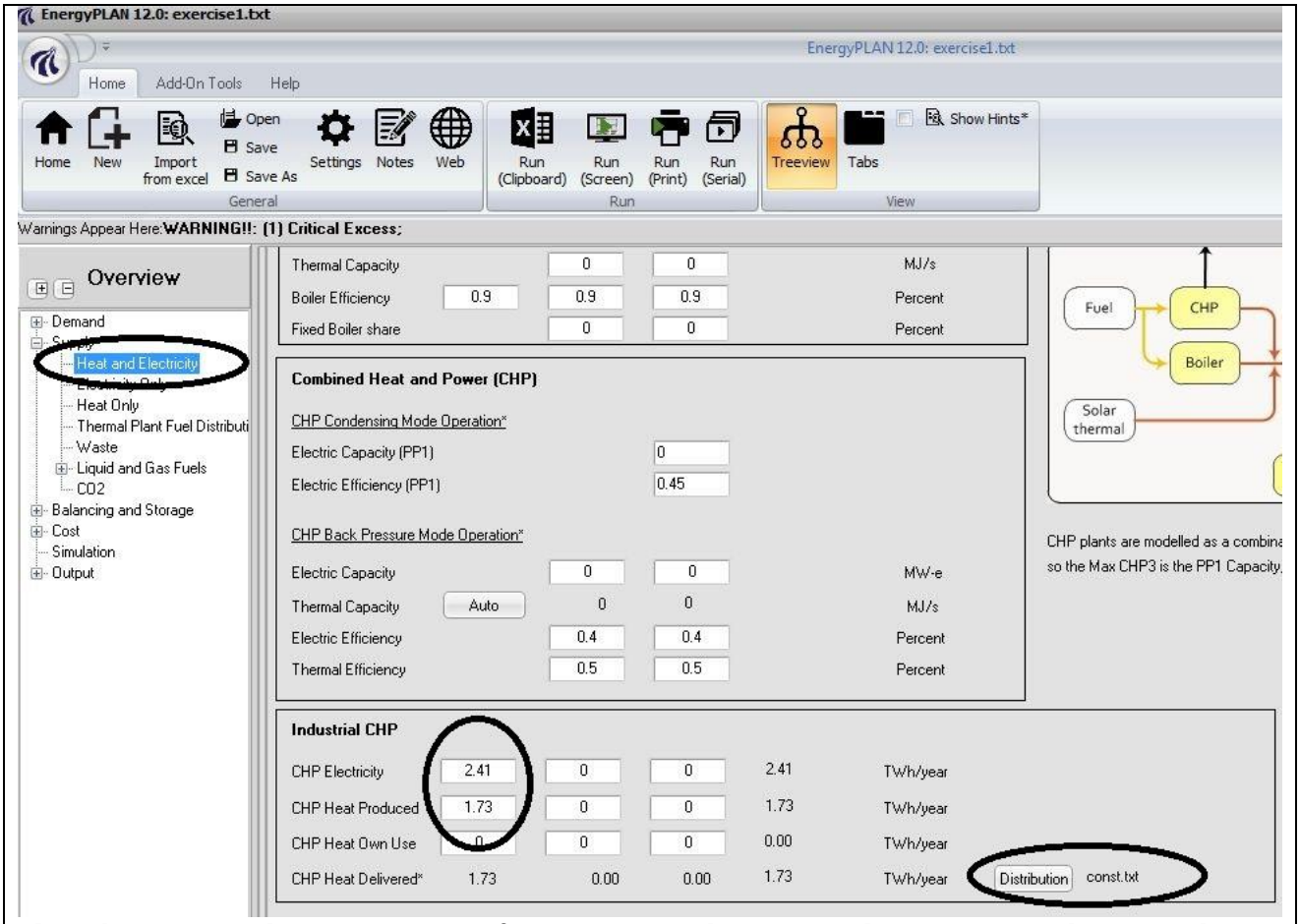
Step 1: Define industrial fuel demand and district heating and electricity productions.

Choose "Industry and Fuel" window under the "Demand" tab and the following window will open:



Place the cursor in the input squares of Coal, Oil, Ngas and Biomass and type in the fuel demands.

Choose "Heat and Electricity" window under the "Supply" tab and the following window will open:

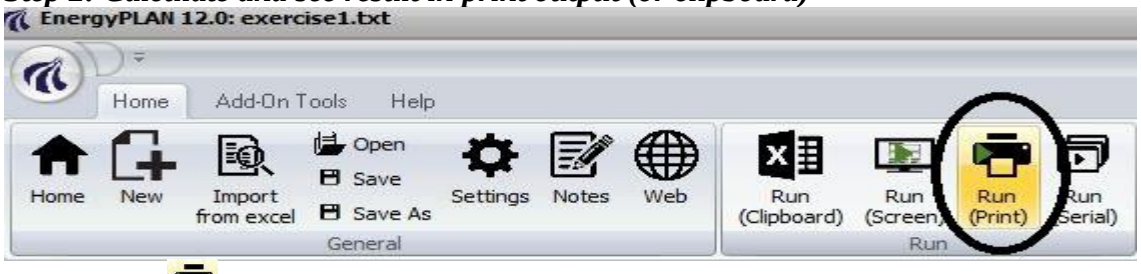


Place the cursor in the input squares of group 1 CHP Electricity and CHP Heat Production and type in 2.41 and 1.73.

The hour-distribution-file is "Hour_cshpel".

Activate the Change distribution button and change to "const" as shown in exercise 1.1, step 5.

Step 2: Calculate and see result in print output (or clipboard)

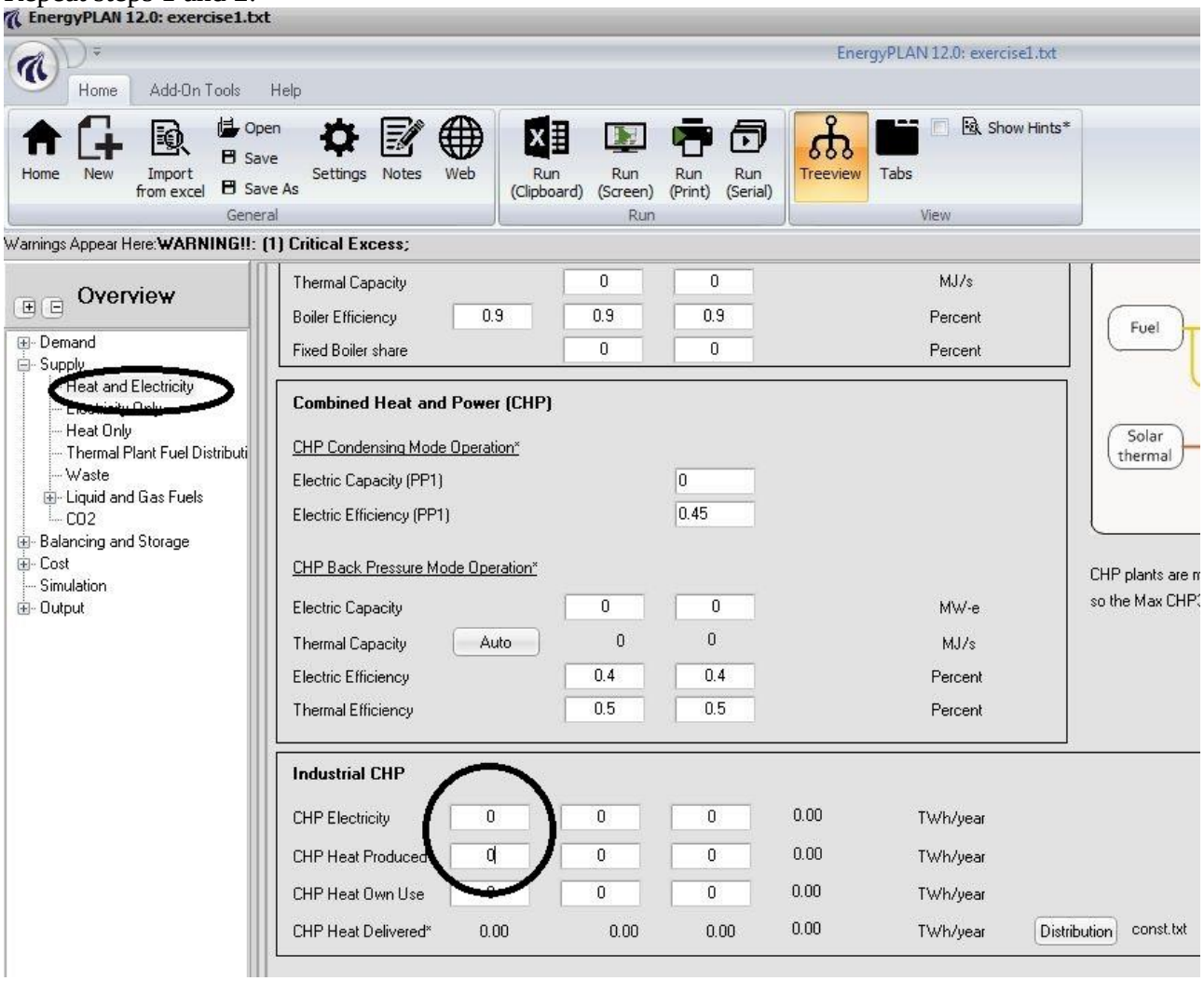


Activate the Run (Print) button and look at the following print output:

Read the results of question 1.4.1:
Primary energy supply = 217.07 TWh/year.
CO2 emissions = 59.19 Mt.

Step 3: Change district heating and electricity production

Repeat steps 1 and 2:



Place the cursor in the input squares of group 1 CHP Electricity and CHP Heat Production and type in 0.

Read the results of question 1.4.2:
Primary energy supply = 224.35 TWh/year.
CO2 emissions = 61.53 Mt.

Exercise 1.5: Define fuel demand for transportation.

Use the data from exercise 1.4:

- Electricity demand of 49 TWh/year and "hour-eldemand-eltra-2001"
- Condensing power plant: 9000 MW coal –fired
- 2000 MW wind power using "Hour_wind_eltra2001"
- Annual district heating demand of 39.18 TWh (distribution "hour_distr_heat")
- Fuel demand for individual house heating of 23.07 TWh divided into 0.01 coal, 6.72 oil, 9.05 natural gas and 7.29 biomass.
- Industrial fuel demand of 53.66 TWh divided into 3.37 coal, 26.92 oil, 18.19 natural gas and 5.18 biomass (including fuel for district heating and electricity production).
- Industrial district heating production of 1.73 TWh and an electricity production of 2.41 TWh. Use the hour distribution file "const".

Add fuel demand for transportation: 13.25 TWh Jet Petrol, 27.50 TWh Diesel and 28.45 TWh Petrol.

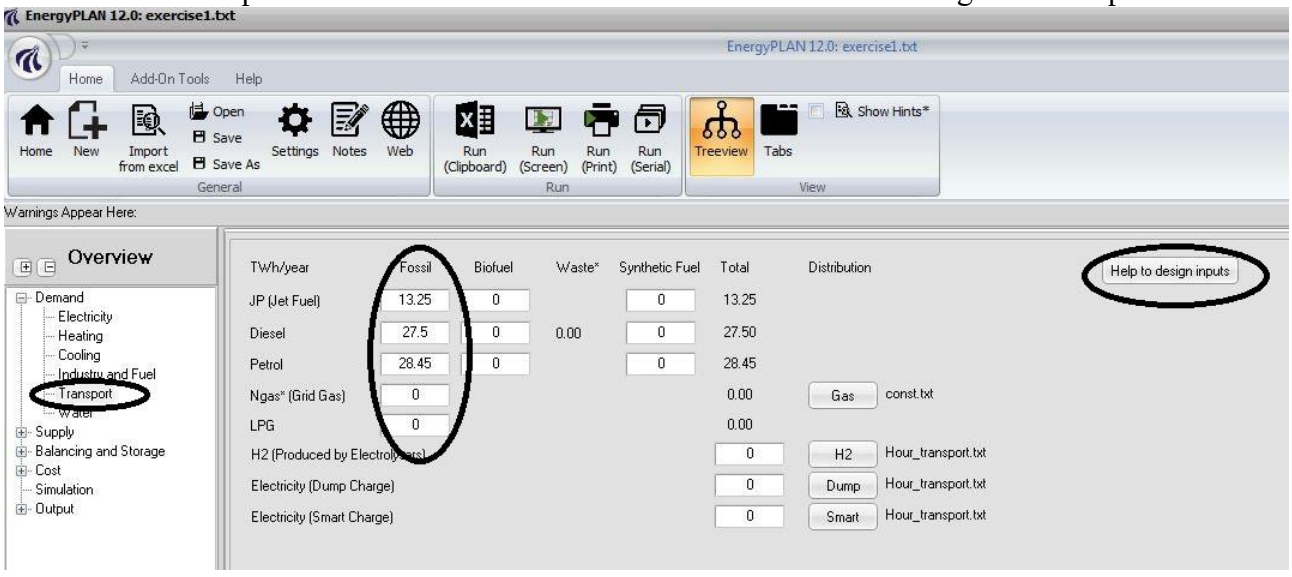
Question 1.5.1: Assuming an average car efficiency of 1.5 km/kWh what is the transportation demand in km/year of the diesel and petrol supply?

Question 1.5.2: What are the annual primary energy supply and the CO2 emission of the system?

How to do exercise 1.5: Use input data file from exercise1.4.

Step 1: Define fuel demand for transportation.

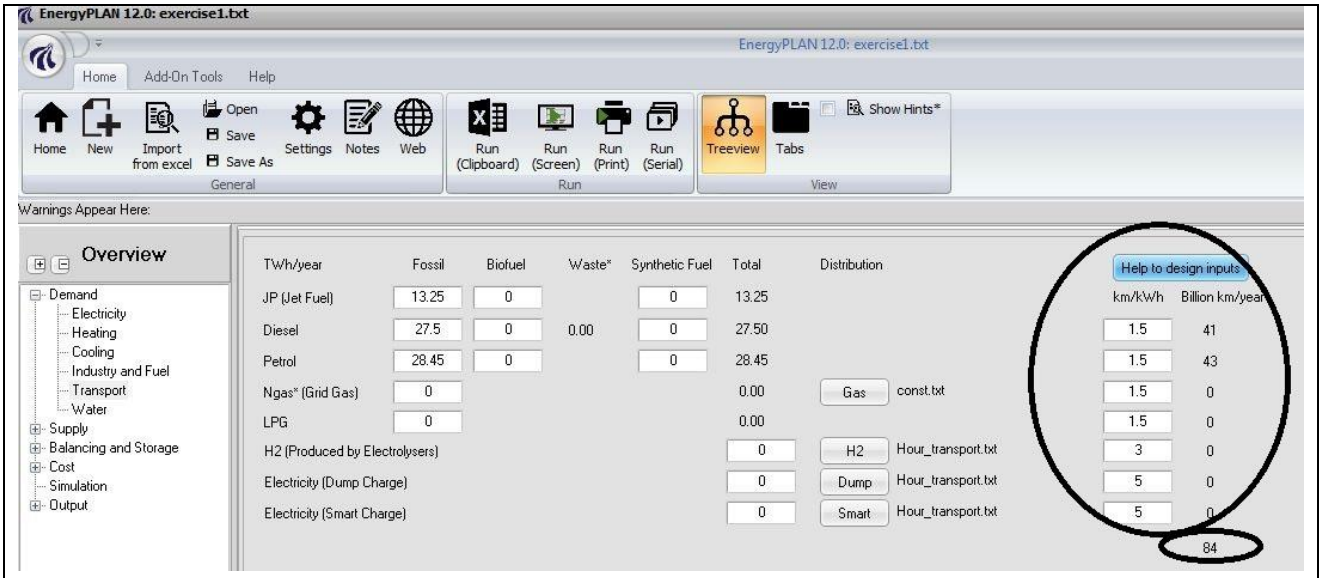
Choose the "Transport" window under the "Demand" tab and the following window open:



Place the cursor in the input squares of JP, Diesel and Petrol and type in the fuel demands.

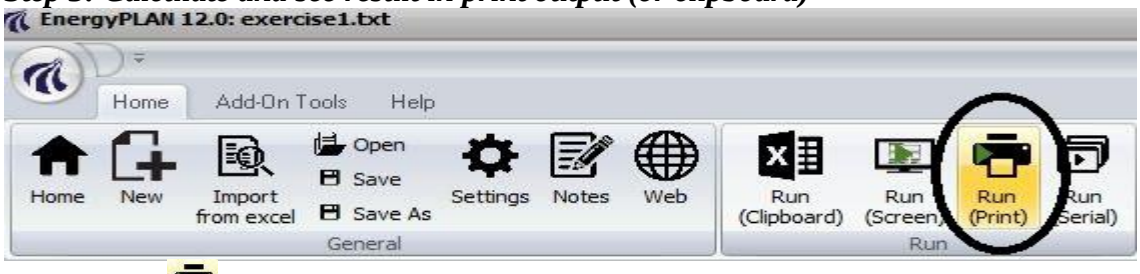
Step 2: Calculate annual transportation demand in km

Activate the Help to design inputs button and the following window will open:



The average efficiencies are already 1.5 km/kWh and the result of question 1.5.1 is 84 billion km/year.

Step 3: Calculate and see result in print output (or clipboard)



Activate the 

button and look at the following print output:

Read the results of question 1.5.2:
Primary energy supply = 286.27 TWh/year.
CO2 emissions = 77.62 Mt.

REMEMBER to save exercise 1. You will need it when doing exercise 2.