

## EnergyPLAN Exercise 1:

### Define and calculate a simple national energy system.

Exercise one makes an introduction to the EnergyPLAN model. Together with “How to solve exercise one” you are told step by step how to define a simple energy system and make a few calculations.

#### Exercise 1.1: Define an electricity demand

Open the EnergyPLAN model. Reset data by pressing “New” in the top bar and define a simple national/regional energy system with an electricity demand of 49 TWh/year. Use the hour-distribution file of “DK 2013 electricity demand” (The distribution of the Danish electricity demand in 2013).

*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”?*

#### 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 “DK 2013 electricity demand”. Define a wind power input of 2000 MW using “DK 2013 Wind onshore” 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 CO<sub>2</sub> 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 CO<sub>2</sub> emission?*

#### Exercise 1.3: Define district heating and individual house heating

Use the data from exercise 1.2:

- Electricity demand of 49 TWh/year and “DK 2013 electricity demand”
- Condensing power plant: 9000 MW coal –fired
- 2000 MW wind power using “DK 2013 Wind onshore”

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.

*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 CO<sub>2</sub> emission?*

### **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 “DK 2013 electricity demand”
- Condensing power plant: 9000 MW coal –fired
- 2000 MW wind power using “DK 2013 Wind onshore”
- 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?*

### **Exercise 1.5: Define fuel demand for transportation.**

Use the data from exercise 1.4:

- Electricity demand of 49 TWh/year and “DK 2013 electricity demand”
- Condensing power plant: 9000 MW coal –fired
- 2000 MW wind power using “DK 2013 Wind onshore”
- 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?*

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