Exercise 1 EnergyPLAN workshop

The goal of these exercises is to familiarize yourself with EnergyPLAN. You will learn to navigate some of the basic modelling features in EnergyPLAN, as well as looking into how your inputs affects the results.

The exercises are split into four main sectors. Electricity, heating, industry and transport.

For each of the main sectors start with opening a new file. This is done in the top left corner.

Make sure that the program is set to MW and EUR in units. This is done in Settings.

To view result, we recommend opening a spreadsheet tool (like Excel), and calculate by run (Clipboard). After pressing the button, paste the result into your spreadsheet.

# Electricity

To model electricity demand, EnergyPLAN requires two inputs. 1) an annual demand and 2) a time series that distributes this demand over each hour (distribution file). For this exercise, we will try to change both values. For

1. *Input an electricity demand of 20 TWh. Use the distribution file already defined (hour\_electricity.txt) Note down the maximum and minimum demand, as well as the annual hourly average.*
2. *Change the electricity demand to 30 TWh. Use the distribution file already defined (hour\_electricity.txt) Note down the same values*

|  |  |  |  |
| --- | --- | --- | --- |
|  | Minimum | Maximum | Annual average |
| 1 |  |  |  |
| 2 |  |  |  |

We now need to supply this electricity demand of 30 TWh.

To do this we will input a power plant. The power plant needs to be able to fulfill the electricity in all hours. Thus, we need to use the maximum electricity demand as capacity.

*Define in EnergyPLAN a power plant with the capacity of the maximum electricity demand + 20%. This has an efficiency of 0.45*:

*Note down the fuel consumption and CO2 emissions from result sheet.*

Now model the PP with an efficiency of 0.47

*Note down the fuel consumption and CO2 emissions from result sheet*.

|  |  |  |
| --- | --- | --- |
|  | Fuel consumption | CO2 emission |
| 0.45 |  |  |
| 0.47 |  |  |

Right now, our power plant is operating on a mix of fuels. You can define the fuel type in the Fuel Distribution tab.

This tab works in rows, so you can define the share between each type of fuel for each technology. EnergyPLAN calculates the ratio itself, so you can put in any type of number to indicate this share.

*For this exercise, we need to see the fuel consumption CO2 emissions depending on whether it is running only on coal or only on biomass. The efficiency is still 0.47.*

|  |  |  |
| --- | --- | --- |
|  | Fuel consumption | CO2 emission |
| Coal |  |  |
| Biomass |  |  |

At the end of this exercise, you will now need to add the costs for the power plant. The investment cost is 1.5 M€/MW with a lifetime of 40 years and operation and maintenance (O&M) costs of 1,6% of the investment.

*What are the total annual costs?*

Now change the investment cost to 1.9 M€/MW:

*What are the total annual costs?*

Now add a fuel cost of biomass of 6 EUR/GJ (world market prices).

*What are the total fuel costs:*

# Heating

Start by creating a new file.

Here we focus on modelling individual heating solutions.

First step is to model 10 TWh of heat demand for each of the technologies one by one. The total heat demand should therefore always be 10 TWh. Please note that in EnergyPLAN the user defines fuel as input. So you need to identify the given fuel input based on the predefined efficiencies in the program.

*Note down fuel consumption and CO2 emissions.*

|  |  |  |
| --- | --- | --- |
|  | Fuel consumption | CO2 emission |
| Coal |  |  |
| Oil |  |  |
| Ngas |  |  |
| Biomass |  |  |

Now try adjusting the biomass efficiency to 0.95.

*How much fuel is needed now?*

Now let’s suppose that in this exercise all houses have the same heat demand, 15000 kWh/year. So, the total heat demand of 10 TWh is supplied in 667.000 households using biomass boilers.

*The cost of a biomass boiler is 2.7 M€ / 1000 unit a lifetime of 20 years and O&M of 7%. What is the annualized investment cost and fixed O&M?*

|  |  |  |
| --- | --- | --- |
|  | Annualized investment | Annualized O&M |
|  |  |  |

Now add a fuel cost of biomass of 6 EUR/GJ.

*What are the total fuel costs?*

# Industry

Start by creating a new file

Here we need to input the fuel demand for industry. Basically we want to input 10 TWh of fuel one at a time, for respectively coal, oil, gas and biomass.

*Fill out the table below.*

|  |  |  |
| --- | --- | --- |
|  | Fuel consumption | CO2 emission |
| Coal |  |  |
| Oil |  |  |
| Ngas |  |  |
| Biomass |  |  |

Now, in the Fuel tab add a cost of 6 €/GJ of biomass (world market prices).

*What are the annual costs with biomass?*

# Transport

Start by creating a new file

The overall idea behind the transport sector is to define an energy demand. However, different transport forms can have different efficiencies. Here you can use the “help to design inputs” button.

*Based on an efficiency of 1.5 km/kWh, define the needed petrol to cover a transport demand 10 billion km/year. What is the fuel consumption and CO2 emission*

|  |  |  |
| --- | --- | --- |
|  | Fuel consumption | CO2 emission |
| Petrol |  |  |

*What overall fuel type is Petrol categorized as in EnergyPLAN?*

*What is the total fuel cost if 1 GJ petrol costs 12€?*