Energy balance and flue gas emissions of various plants

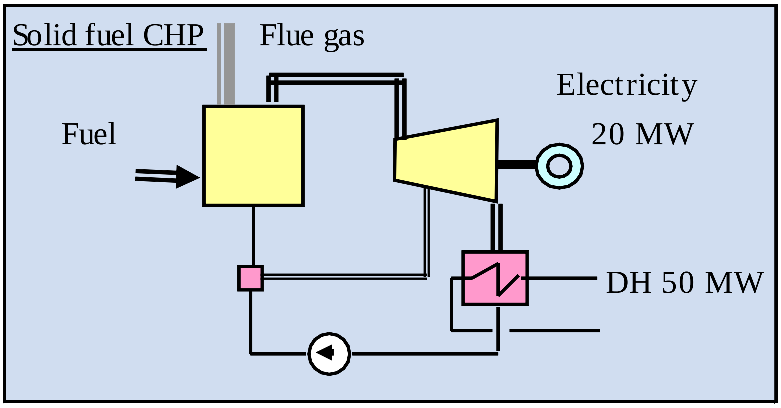
Description: Creates the power, heat and fuel balance as well as emissions of various power and heat plants
Type Excel
Version 5
Last changed 2013-02-08
Download M_02_Fuels and emissions_ENG.

This tool supports learning of Module 2 (see Modules M01..M10 above).

The spreadsheet calculates the fuel consumption and emissions of various types of heat and power plants. The steam and gas turbines, piston engines and their combinations, with or without heat recovery for district heating or industry are included in the tool. As fuels, both coal of different quality, natural gas, oil, biomass and peat can be used.

The peak load duration time is expressed as annual energy (MWh) divided by the total capacity (MW).

In the picture, a simple steam and water flow has been presented with DH (district heating), electricity generation as well as fuel input and flue gas heat losses and emissions.



Other power and/or heat plants are shown in similar drawings.

The world statistics of natural gas, liquid and shale oils per coninets is presented to give an idea of the resources.

Economy of individual heat pumps in a potential DH/CHP supply area

Description: Creates the power, heat and fuel balance as well as emissions of various power and heat plants
Type Excel
Version 5
Last changed 2013-02-08
Download :M_06_Heat_pumps_and_CHP_ENG

This tool supports learning of Module 6(see Modules M01..M10 above).

In general, heat pumps are energy efficient and save energy. Nevertheless, if individual heat pumps will be installed in an area which potentially is a district heating and CHP supply area, the overall economy of the individual heat pumps becomes questionable.

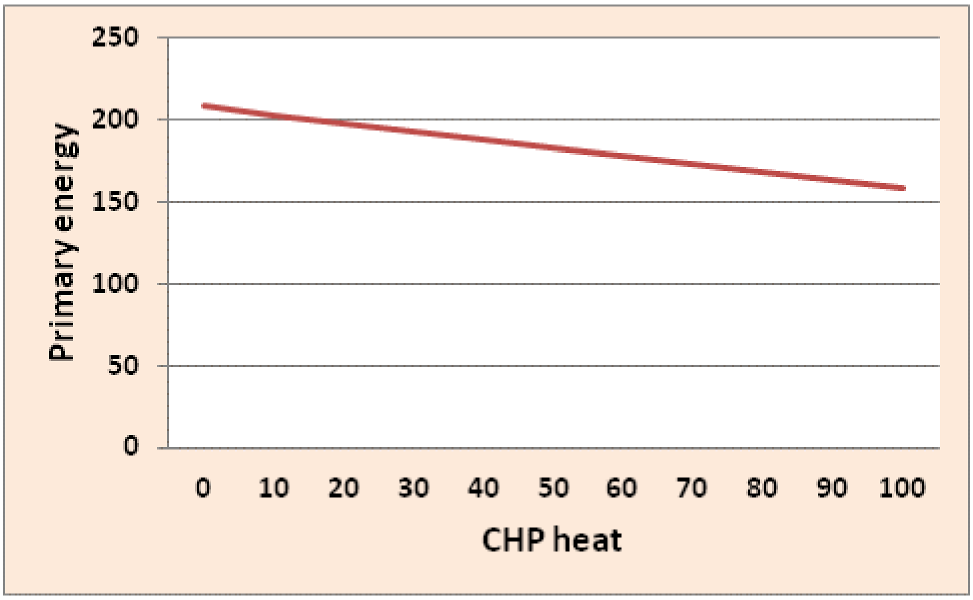
The heat pump needs electric energy to produce heat from the groundwater or ambient air, for instance. Such heat will reduce the potential of district heating and CHP as there cannot be CHP without district heating (or industrial heat demand).

During the heating season, when the heat of the district heating system will be converted to heat pump supplied heat in 10% point steps, simultaneously the CHP electricity will be converted to condensing power that has a efficiency much lower than that of CHP. Also the electricity needed by the heat pump should be produced by condensing power during the heating season.

Therefore, the conversion from district heating to individual heat pumps may increase, and not decrease as initially assumed, primary energy consumption.

As conclusion, individual heat pumps should not be supported in an area potentially or really being a district heating and CHP supply area.

In the picture, the primary energy consumption of the energy system including heating and electric power supplies, decreases while the heat pumps can be replaced by district heating and CHP.



Primary energy
250
200
150
100
50
0
0
10
20
30
40
50
60
70
80
90
100
CHP heat

Economy of district heating

Description: Analysys the economy of district heating to individual heating solutions as well as RES fuelled boiler compared to a fossil fuel fired boiler in life-cycle costs
Type Excel
Version 5
Last changed 2013-02-08
Download M_06_District_Heating_Economy_ENG

This tool supports learning of Module 6 as well (see Modules M01..M10 above). It provides simplified examples of economy of RES fuel compared to a fossil fuel boiler as well as district heating compared to individual gas boilers. Additional, there is the conversion of annual costs and benefits to the first base year.

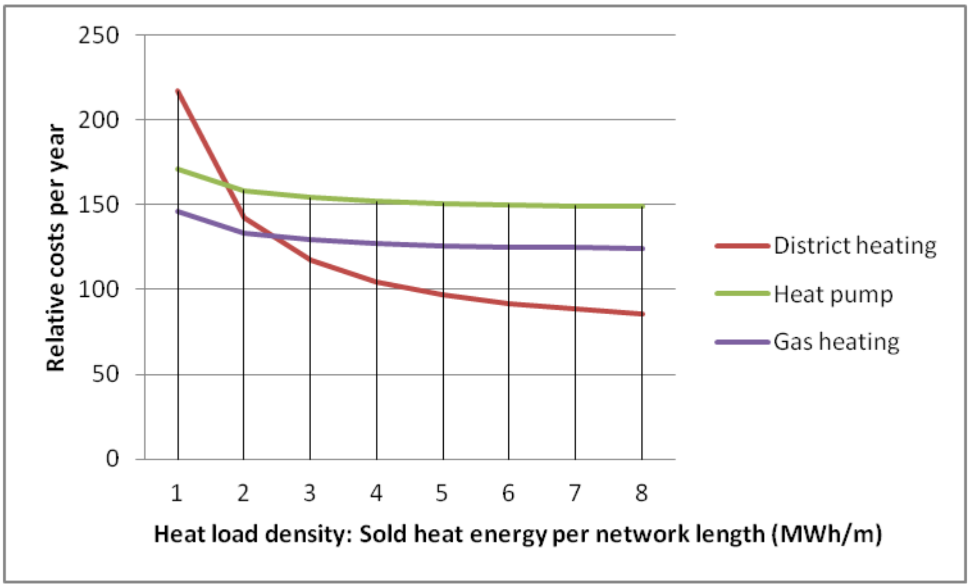
The data here are considered typical, but the real cost depend on the particular case, and may lead to different conclusions.

Inserting the investment cost and physical parameters of the heat sources, district heating network, consumer substations and fuel prices into the *Investment Cost* sheet, one can see how the total economy of district heating depends on the length of the network, the linear heat load density in other words. The heat load density is calculated as heat sales per network length in terms of MWh/m, for instance, as done here. As a rule of thumb the heat load density values of 2 MWh/m and higher indicates that the heating system is obviously economic for district heating, whereas the densities lower than 1 MWh/m may not be commercially (without subsidies) economic. The values between 1 and 2 require a more thorough analysis. Of course, the economy, depends on what alternatives are locally possible: is there natural gas piping or not, for instance.

Moreover, comparison of district heating to heat pumps and individual gas boilers can be estimated in the *Economic Analysis* sheet.

In the *Cash Flow* sheet, the economy of a biomass boiler compared to the existing oil boilers can be calculated in a life cycle analysis.

In the picture, the economy of district heating compared to individual gas heating and individual heat pumps is presented as an example. High heat load densities support the choice of district heating.



250
200
150
100
50
0
Relative costs per year
1
2
3
4
5
6
7
8
Heat load density: Sold heat energy per network length (MWh/m)
District heating
Heat pump
Gas heating