Operation economy of CHP plants using forest biomass and peat

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Introduction

The operation economics of a multifuel CHP plant are affected by various factors such as **investment costs, fuel and CO_2 (EUA) prices, operation and maintenance (O&M) costs, values of produced electricity & heat, subsidies and taxes**.

Due to more challenging properties of **biomass,** plant's operational costs can increase through **negative effects on efficiency and availability of the boiler and increased maintenance work** (Fig. 1).

Co-combustion of biomass and peat can help to mitigate the negative effects.

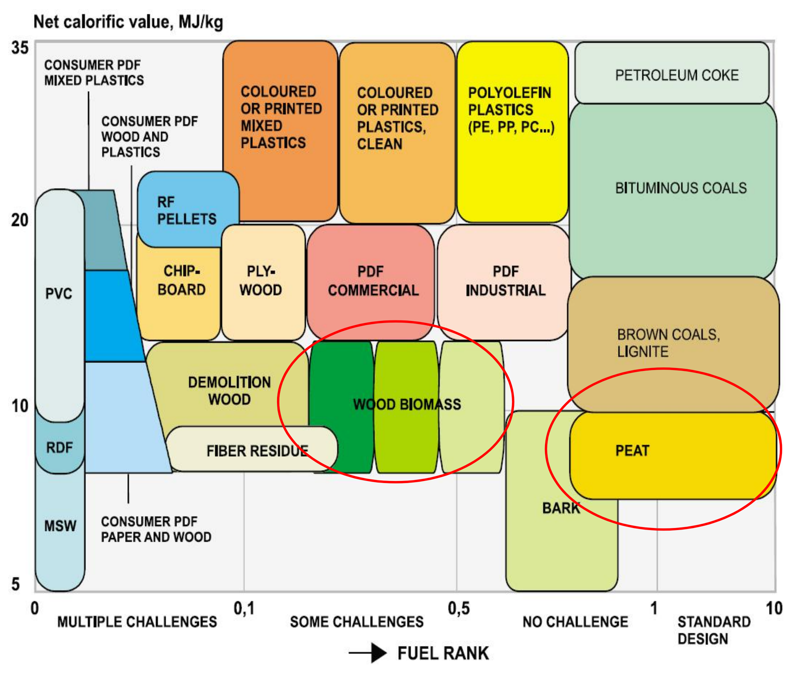

Figure 1. Solid fuel challenge ranking (Courtesy of Amec Foster Wheeler).

Interactive tool

An interactive tool (Fig. 2) was created for studying the operation economics of a CHP plant when **forest residues, stumps, small diameter wood and peat** are used in a bubbling fluidized bed (**BFB**) boiler.

The idea is to **let the user to change e.g. market values or plant or fuel specifications** and **see how the changes affect the operation economics** in an illustrative way.

The **main results** include:

- **Biomass price breakdowns** at the power plant gate
- **Fuel blend specific O&M cost estimations**
- Plant's **annual operation cost and income breakdowns**
- **CO_2 emissions**

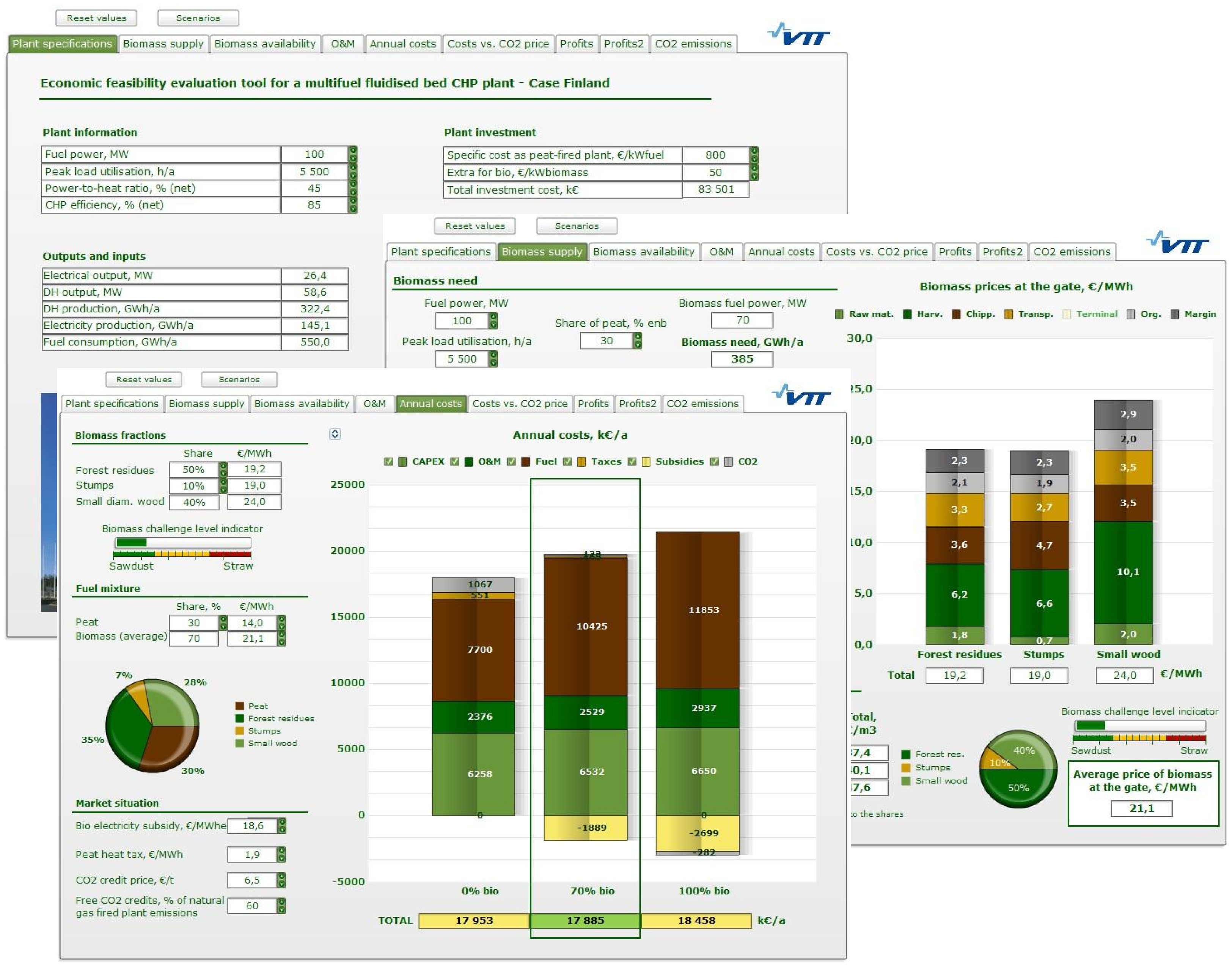
Figure 2. Screenshots from Plant specifications, Biomass supply and Annual costs tabs.

Case example

The respective competitiveness of three CHP plant (Table 1) options differing in their fuel mixtures (Fig. 3) was studied.

Market prices and policy framework used in the study represent current situation in Finland.

Table 1. CHP plant assumptions

Property	Value
Fuel power	100 MW
CHP efficiency (LHV, net)	85%
Power-to-heat ratio (net)	0.45
Peak load utilisation hours	5500 h/a
Specific investment cost (as peat fired unit)	800 €/kW$_{fuel}$
Extra investment for biomass	50 €/kW$_{fuel, biomass}$
Economic lifetime	25 years
Discount rate (real terms)	6%

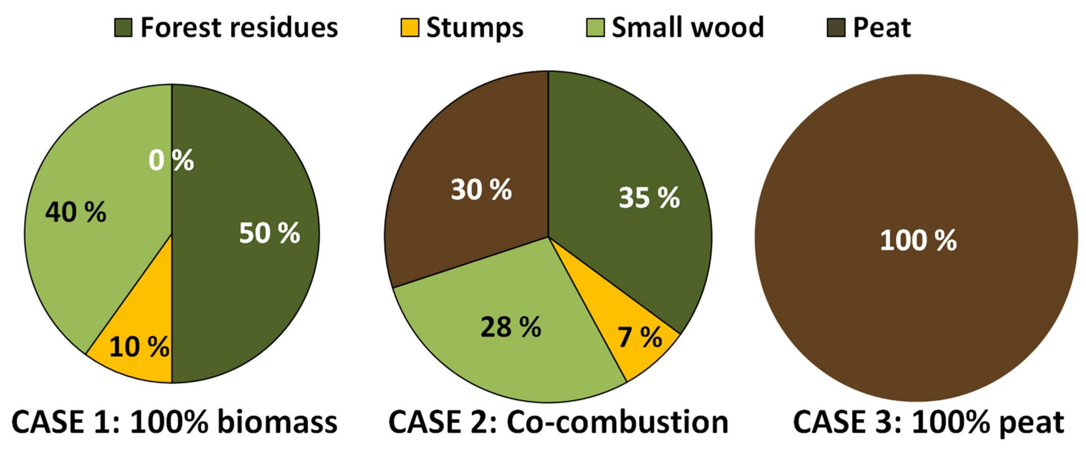

Figure 3. Considered fuel blend options.

Results

- The **co-combustion case was found the most feasible** by a small margin (Fig. 4) due to **synergy effects** which decrease O&M costs.
- Without subsidies, plant firing 100% peat would be the most competitive in the current market situation.

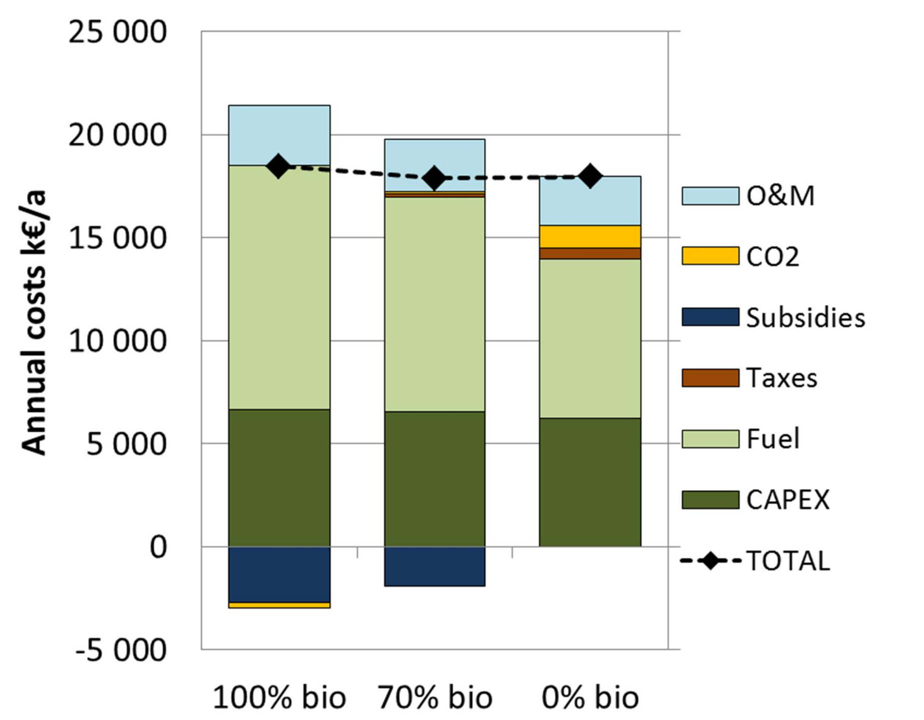

Figure 4. Annual costs.

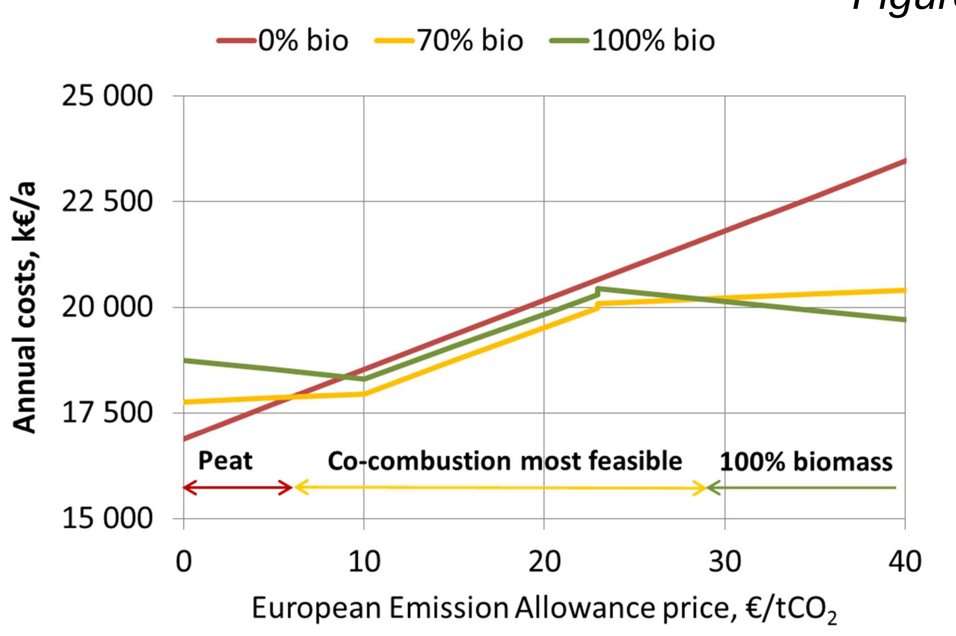

Figure 5. The effect of CO_2 price on the respective competitiveness of the studied cases.

In addition to fuel prices, the **most relevant market parameter** determining the respective competitiveness of biomass and peat is the **price of emissions allowances** (Fig. 5).

Conclusions

- The interactive tool approach helps to understand and study how fuel qualities, plant specifications or market and policy related aspects affect the operation economics of power and CHP plants.
- Power plant operators/investors, fuel suppliers, people responsible for energy policies, consultants, researchers, teachers etc. could benefit from these kinds of toolkits.
- For each purpose a tailor-made toolkit can be created.

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