CCSP – Subtask 2.1.3 (case 3)

Deliverable 242. Cost and CO2 evaluation toolkit for PCC in multi-fuel CHP plant

Scope

The goal was to investigate the effects of different post combustion capture ratios in different CHP-plant operation (condensing-, mixed- and CHP-modes) and energy market situations on techno-economic feasibility for a 315 MW_{fuel} CFB-boiler using peat and biomass in retrofitted for PCC.

Approach for economic and environmental analyses

The economics of CCS are evaluated from investor's (local energy company) point of view including the effects on the existing energy system. Effect of CCS on operation economics of the CCS cases are compared to the reference system with varying parameters of operation. Regarding the GHG emissions, besides the site emissions, the main effects on global GHG emissions are also taken into account by using streamlined LCA and impacts on overall electricity production system.

In the study the whole CCS chain, including CO_2 capture, processing, transport and storage, was included by utilising CCS plant economics toolkit (system model *CC-Skynet*™ developed by VTT). In the toolkit, the profitability of each case can be analysed according to different market situations by adjusting plants operation and the most significant input values. In addition to plant and case specific technical inputs, the economic parameters can be varied, including interest rates, studied time frames, fuel taxes, subsidies and market prices for different fuels, electricity and CO_2 emission allowances (in the EU ETS) as well as CCS related costs, for example required investment, transportation costs etc.

As there is no storage capacity in Finland the captured CO_2 has to be transported and stored abroad. The storage phase in this study is evaluated according to Teir et al. (2011) [1]and the CO_2 transportation including costs related are assumed according to Kujanpää et al. (2010)[2].

Main results

The main output is a Flash-based toolkit to visualise the costs and CO_2 impacts with different inputs by selecting key variables using interactive menus. The toolkit was provided to Oulun Energia by VTT and it is not public.

From the study it was concluded that the required CO_2 allowance price would need to be in range of 60-100 €/tn to make the studied CCS solutions more economical than operation without CCS.

Example screens of the toolkit are shown in figures 1-4.

[1] Teir, S; Arasto, A; Tsupari, E; Koljonen, T; Kärki, J; Kujanpää, L; Lehtilä, A; Nieminen, M; Aatos, S. Hiilidioksidin talteenoton ja varastoinnin (CCS:n) soveltaminen Suomen olosuhteissa. 2011. VTT, Espoo. VTT Tiedotteita - Research Notes : 2576

[2] Kujanpää, L; Rauramo, J; Arasto, A. Cross-border CO2 infrastructure options for a CCS demonstration in Finland Proceedings of the International Conference on Greenhouse Gas Technologies (GHGT-10), 19-23 September 2010, Amsterdam, The Netherlands. Energy Procedia. Elsevier. Vol. 4 (2011), 2425-2431

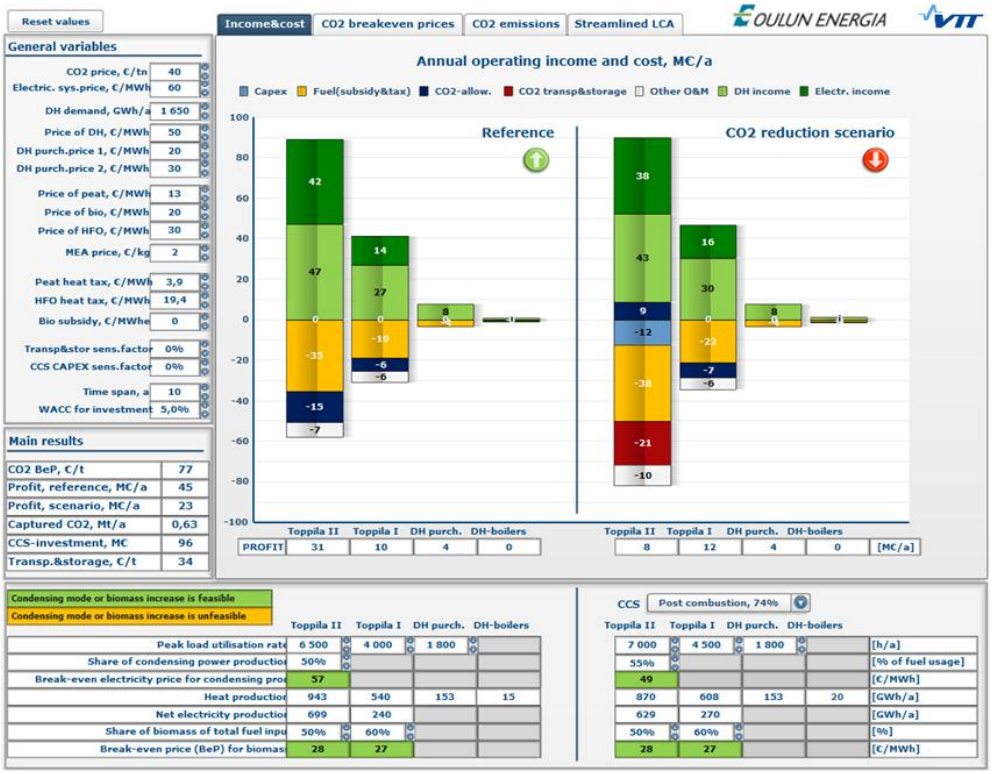

Figure 1. Annual operating costs and overall profit of the case plants.

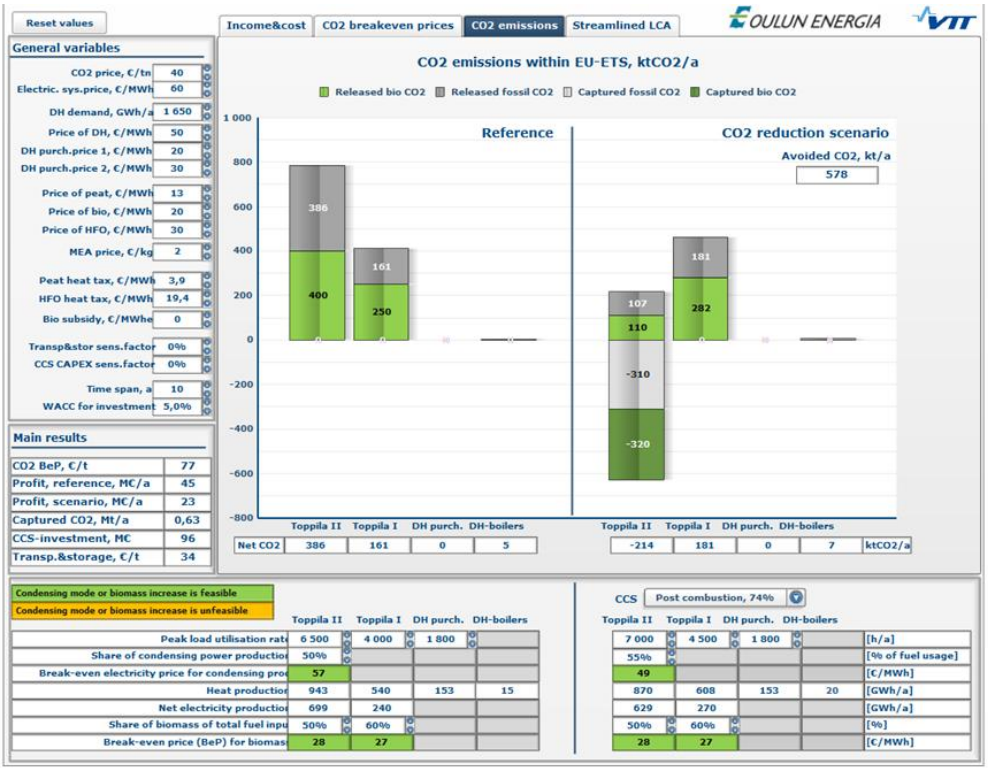

Figure 2. CO2 emissions of the case plants.

Figure 3. Breakeven prices for CO2.

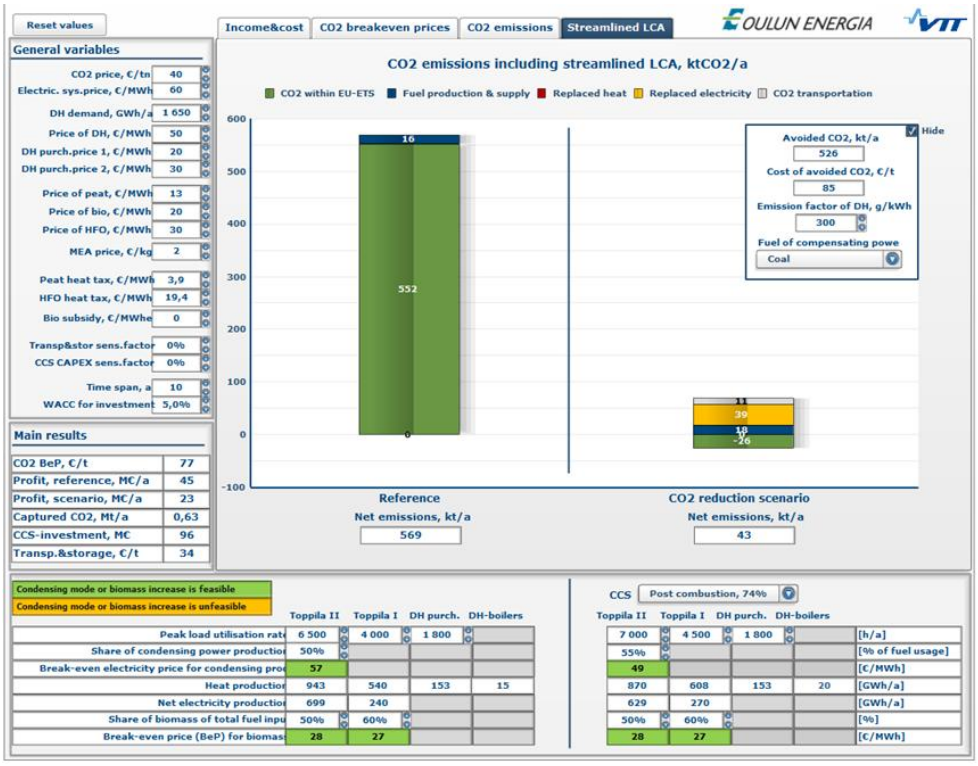

Figure 4. CO2 emissions including streamlined LCA.