Techno-economic analysis of polygeneration systems based on catalytic hydropyrolysis for the production of bio-oil and fuels - DTU Orbit (01/08/2019)

The present paper presents an assessment of the techno-economic performance of novel polygeneration concepts for bio-oil production. They are based on catalytic hydropyrolysis and hydrodeoxygenation, and can be integrated with other processes for co-production of synthetic natural gas, molecular hydrogen and methanol. Thirteen system layouts were evaluated considering different technological alternatives and process pathways. Firstly, detailed thermodynamic and economic models were developed to calculate and compare the energy demands, capital and production costs of all plants, given a biomass input of 2000 dry metric tonnes per day. Sensitivity analyses using local approaches, Morris screening and multi-variable linear regression tools were then conducted to identify the essential parameters. Finally, uncertainty analyses were performed to estimate the minimum selling price of bio-oil for each case. The results show that the total capital costs range between $180 and $620 million, for a production cost between $17 and $24 per GJ of fuel. The feedstock and electricity costs represent the greatest share (up to 60% together) followed by the annualised investment costs (up to 18%). The sensitivity analyses suggest that the plant profitability is mostly impacted by the bio-oil yield, by-product characteristics, electrolysis costs, wood and power prices. The uncertainty analysis, through Monte-Carlo simulations, demonstrates that the minimum fuel selling prices may vary from $-3 to $240 per GJ. The most promising layouts are those with SNG and H₂ production, whilst the riskiest ones are those with electrolysis.

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