

## **A Simulation-Based Method for Evaluation of Energy System Cooperation between Pulp and Paper Mills and a District Heating System: A Case Study**

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**Abstract :** A step towards reducing greenhouse gases and energy consumption is to collaborate with the energy system between several industries. This work is based on a case study on integration of pulp and paper mills with a district heating system in Sundsvall, Sweden. Present research shows that it is possible to make a significant reduction in the electricity demand in the mechanical pulping process. However, the profitability of the efficiency measures could be an issue, as the excess steam recovered from the refiners decreases with the electricity consumption. A consequence will be that the fuel demand for steam production will increase. If the fuel price is similar to the electricity price it would reduce the profit of such a project. If the paper mill can be integrated with a district heating system, it is possible to upgrade excess heat from a nearby kraft pulp mill to process steam via the district heating system in order to avoid the additional fuel need. The concept is investigated by using a simulation model describing both the mass and energy balance as well as the operating margin. Three scenarios were analyzed: reference, electricity reduction and energy substitution. The simulation show that the total input to the system is lowest in the Energy substitution scenario. Additionally, in the Energy substitution scenario the steam from the incineration boiler covers not only the steam shortage but also a part of the steam produced using the biofuel boiler, the cooling tower connected to the incineration boiler is no longer needed and the excess heat can cover the whole district heating load during the whole year. The study shows a substantial economic advantage if all stakeholders act together as one system. However, costs and benefits are unequally shared between the actors. This means that there is a need for new business models in order to share the system costs and benefits.

**Keywords :** energy system, cooperation, simulation method, excess heat, district heating

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