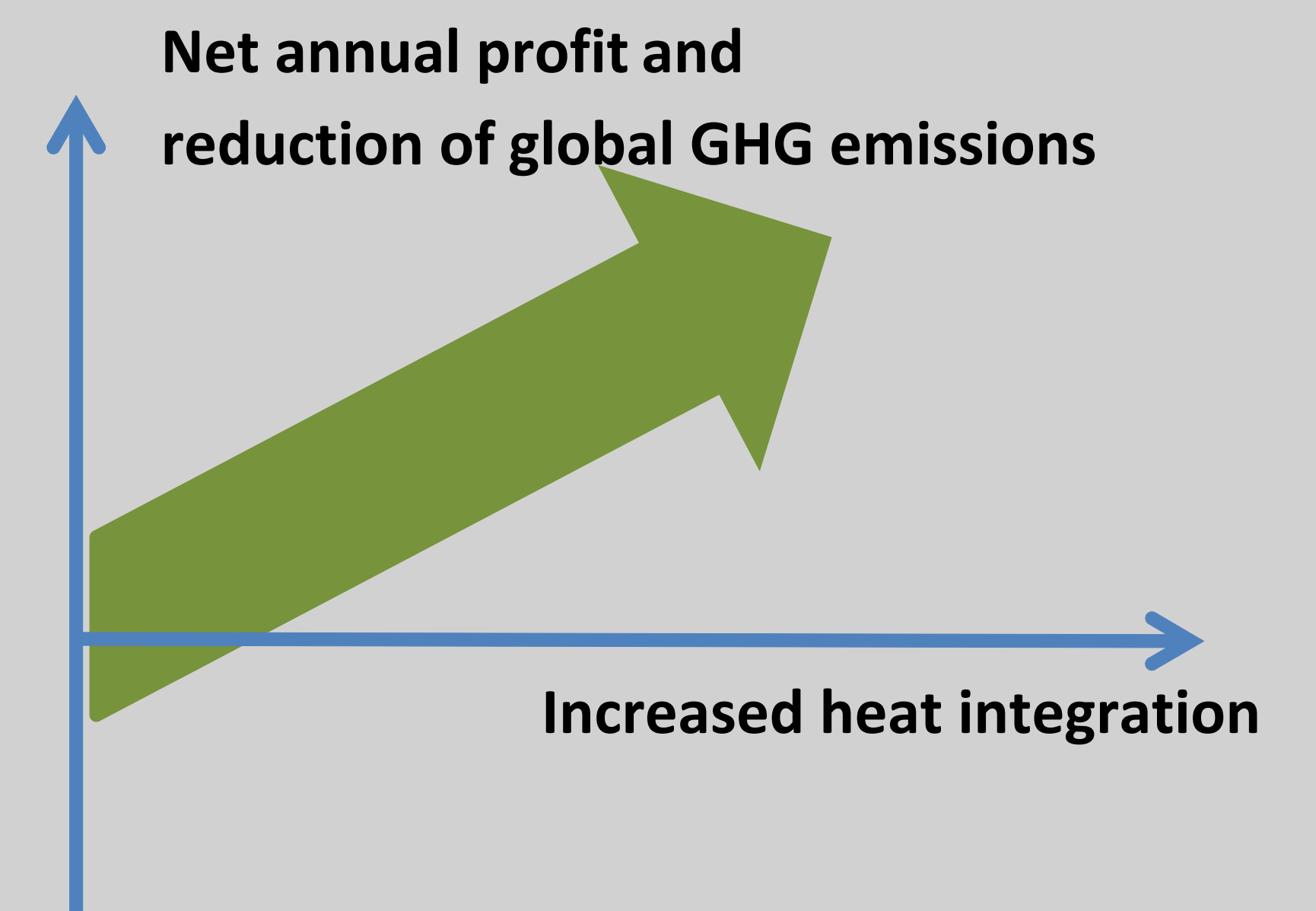


Pulp mill biorefineries

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Biorefineries constitute an attractive future development option for the pulp and paper industry, allowing mills to produce not only pulp or paper but also other value-added products such as biofuels, chemicals or materials. Examples of pulp mill biorefinery technologies are extraction of **hemicelluloses** from wood, extraction of **lignin from black liquor** and **gasification of black liquor**. It is also possible to co-locate other biorefinery technologies such as **gasification of solid biomass** with a mill.

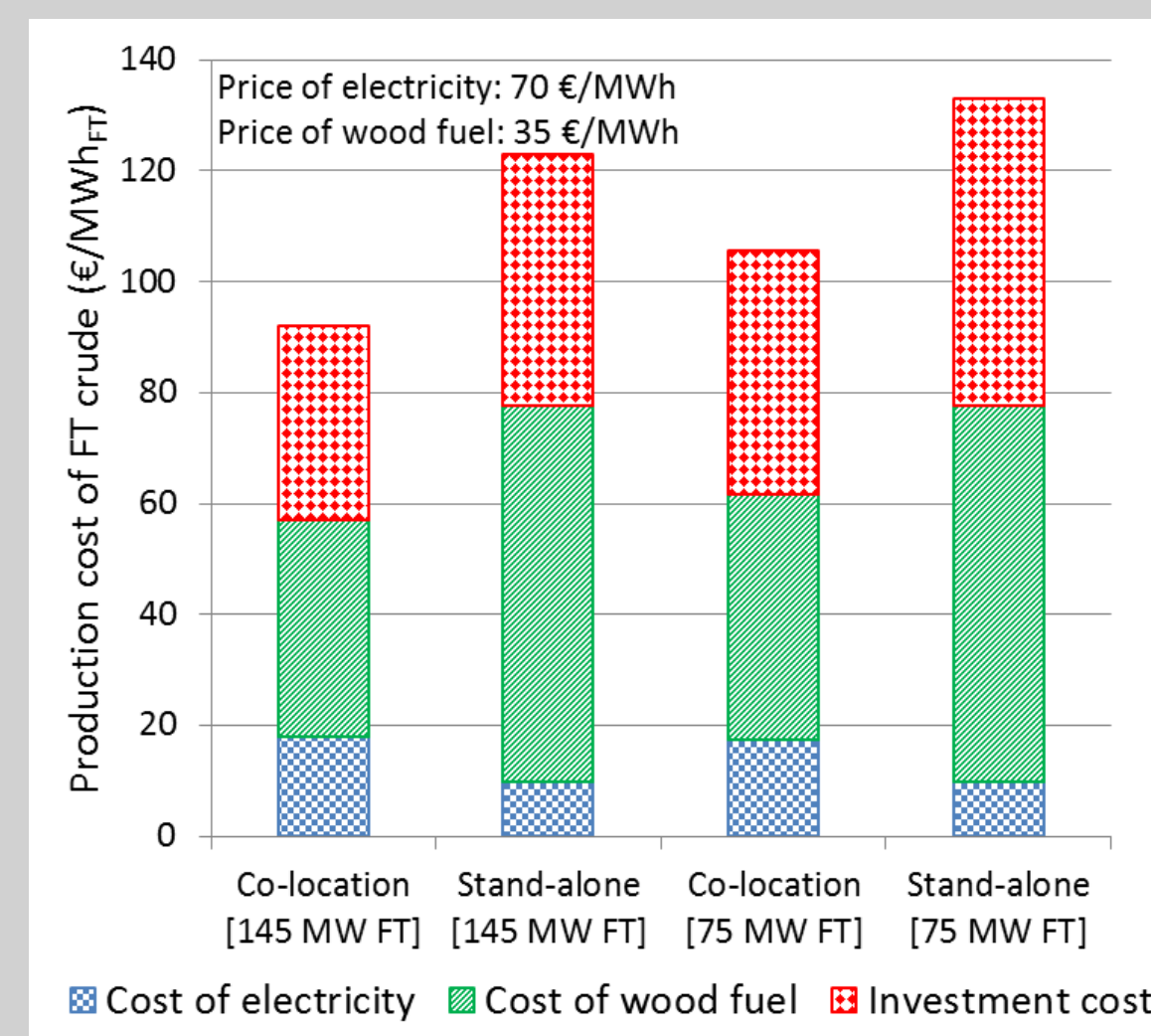
Process integration plays an important role both for identifying steam saving measures and estimating the potential for, and consequences of, integration of new technologies to the pulp and paper industry. The Heat and Power Technology group has been working with process integration in industry for several decades with focus on the pulp and paper industry. The research is conducted at different system levels dealing with everything from the technical conditions for Increased heat integration within the mill and between the mill and new biorefinery technologies makes it possible to produce more valuable products using the same amount of wood fuel or to produce the same amounts of products with less wood fuel. This leads greater reductions of global GHG emissions and to increased net annual profit.



Integration of gasification-based biofuel production

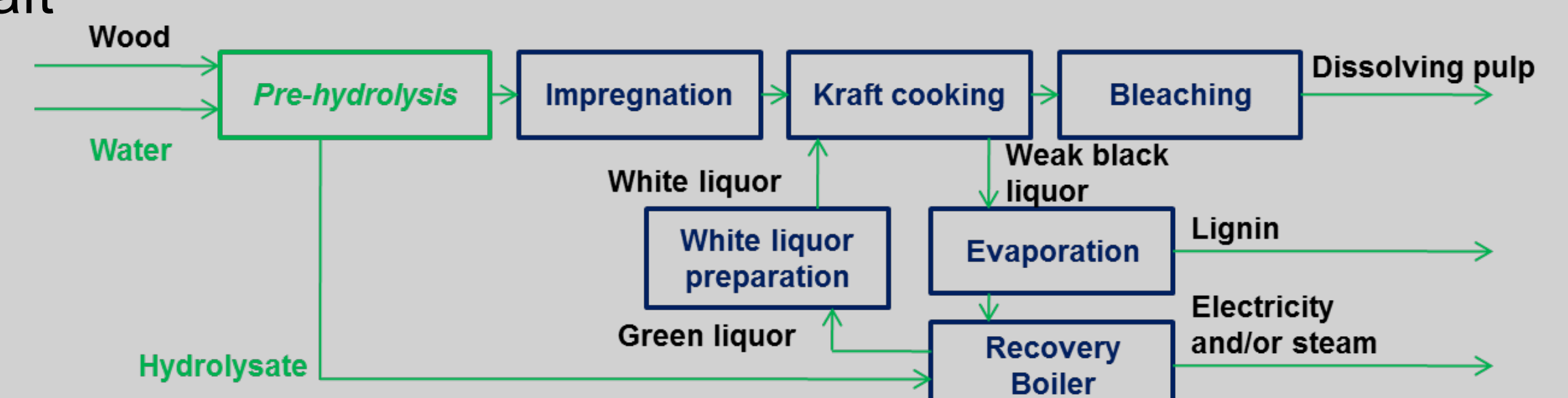
Stand-alone FT crude production with integration of a steam cycle to generate electricity is compared with heat integrated FT crude production, where excess heat from the FT crude plant is delivered to a steam cycle for production of electricity and process heat for a pulp and paper mill. The results show that the demand for wood fuel is lower, but the net electricity demand is larger in heat integrated operation. Heat integrated production of FT-crude has....:

- ...a **higher wood fuel-to-FT crude efficiency** in the wood fuel-to-electricity efficiency interval, relevant for future electricity generation,
- ...a **larger potential to contribute to GHG emission mitigation**, assuming a future generation of electricity emitting equal to or less than an NGCC power plant,
- ...a **lower production cost** for reasonable prices of wood fuel and electricity on a future energy market, compared to stand-alone production.

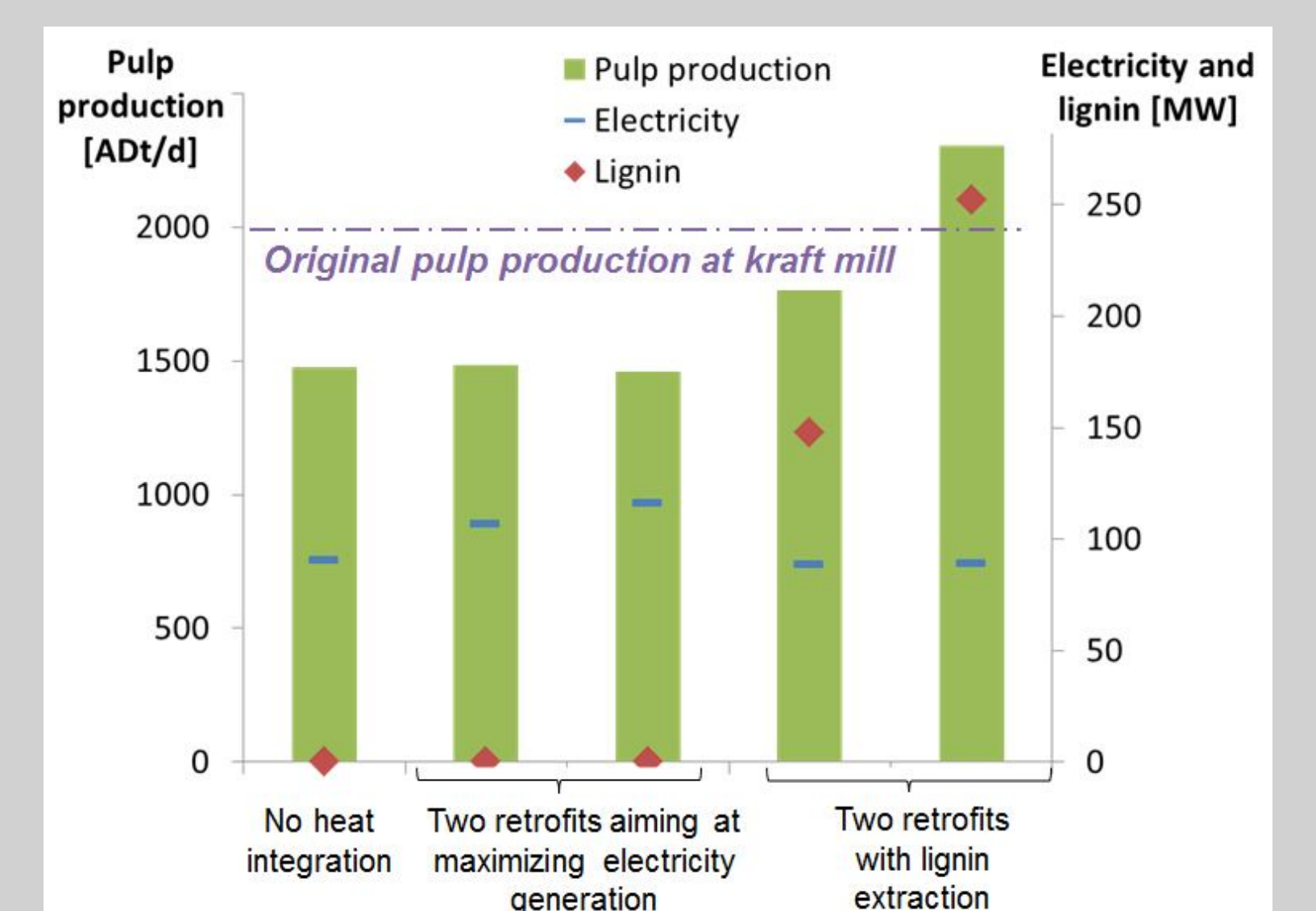


Multi-product biorefinery producing dissolving pulp for textiles, electricity and lignin

A conventional kraft pulp mill may be converted into **dissolving pulp** production by **extracting hemicellulose** prior to cooking via pre-hydrolysis. Dissolving pulp can be used for textile applications, whereas by-products can be upgraded to high-value products.

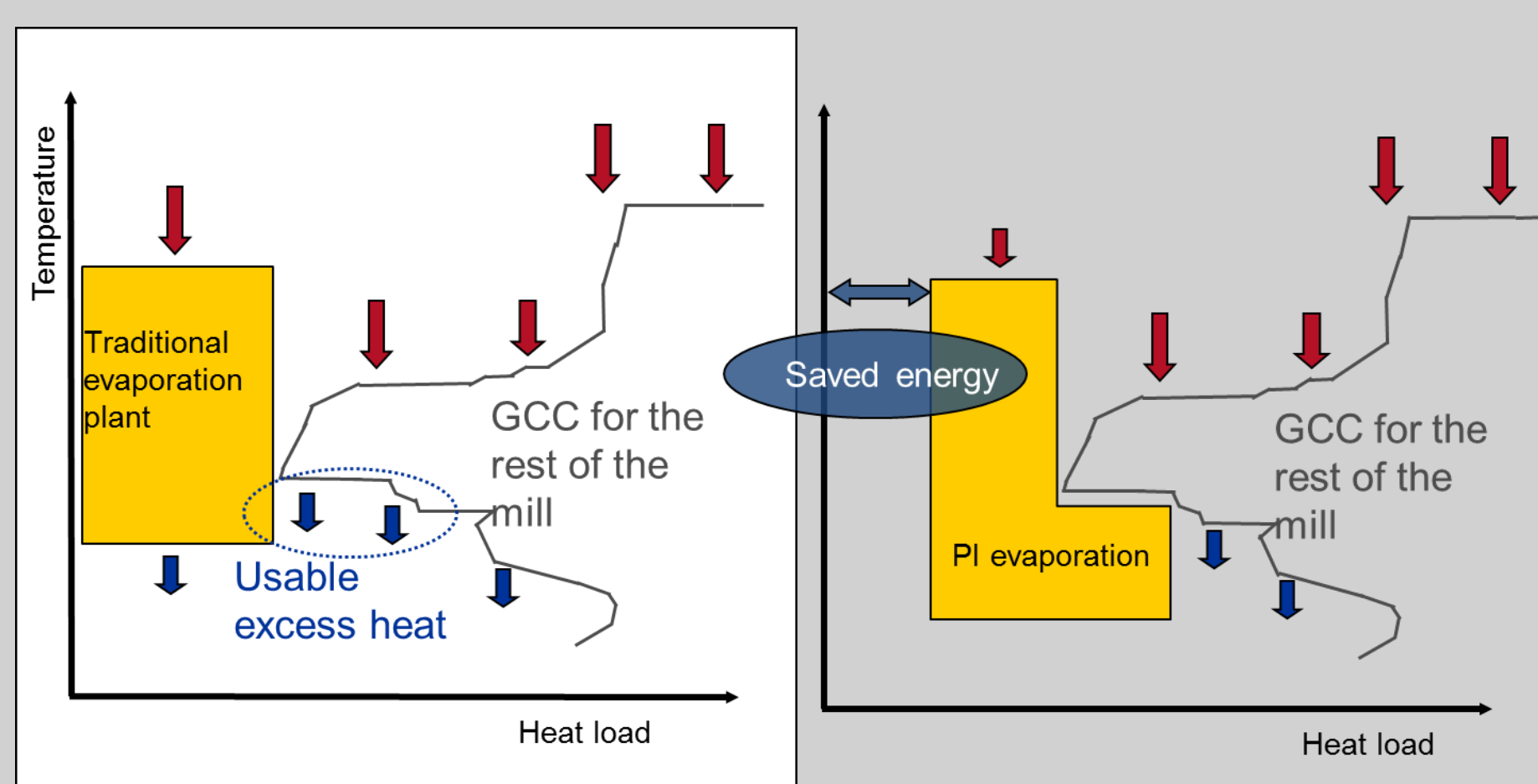


When producing dissolving pulp, a larger wood input is needed to produce the same amount of pulp and the existing equipment e.g. recovery boiler, may become bottle-necks. We have investigated which level of heat integration and combination of by-products that leads to a minimum decrease in pulp production. Our results show that **lignin extraction from black liquor** seems to be an attractive option to debottleneck the recovery boiler and maximize the pulp production.



Energy efficiency measures in the evaporation plant

The evaporation plant is usually the process unit with the greatest steam demand in a kraft pulp mill. We have showed that heat-integrating the evaporation plant with other parts of the mill can give energy savings of up to 40% in comparison with well-performing evaporation plants of today.



Vision of evaporator technology development

- 9 effects or more
- Much lower condensation temperature
- High-high dry solids concentration "85%+"
- 100% process water recovery
- Ready for heat integration with the rest of the mill

