

## **Biodiesel from Bark and Black Liquor—A Techno-Economic, Social, and Environmental Assessment**

### **Supplementary material**

#### **Text S1. System description of a kraft mill**

In a modern Kraft pulp mill (for which the main processes and flows are shown in Figure 1), wood is debarked, chipped, and then screened to remove non-wood materials. The wood chips are sent to the cooking process, where they are boiled under high pressure and high temperature in the presence of sodium sulfide and sodium hydroxide to separate the cellulosic fibres (pulp). After the cooking process, the pulp is washed to remove the spent liquor. It is then screened, bleached, and dried. The spent liquor is evaporated and incinerated in the recovery boiler. During the incineration process, the energy content of the organic material is recovered and transferred to the steam network to produce the heat and electricity required for the process. Inorganic cooking chemicals (sodium carbonate and sodium sulfide) are recovered during incineration. Sodium sulfide can directly be returned to the cooking process, while the recovered sodium carbonate is mixed in the recaustification unit with lime ( $\text{CaO}$ ) to regenerate sodium hydroxide ( $\text{NaOH}$ ). A by-product of the recausticising process is calcium carbonate ( $\text{CaCO}_3$ ), which is sent to a lime kiln, where it is returned to regenerate the  $\text{CaO}$ , releasing  $\text{CO}_2$  [33].



[illegible]

Mixed producer gas	0.169					
Hydrolised biomass	0.317					
Salt rem.biomass		0.252				
Cooled salt		0.002				
Syngas 1			0.256			
Syngas 2				0.031		
Residual gas				0.002		
Syngas 3					0.031	
Purified hydhydrogen						0.00063
Syngas 4						0.011
CO2						0.017
Syn FT fuels						0.169
Upgraded FT fuel						0.0627
Diesel						0.023

**Table S2.** Total social impacts in medium-risk-hour equivalents for implementation of the PulpAndFuel concept in different countries.

	France	Sweden	Finland	Germany	Portugal	Unit
<b>Labor Rights and Decent Work</b>	2.97E-03	1.55E-03	3.06E-03	1.78E-03	5.31E-03	mrheq
<b>Health and Safety</b>	1.58E-02	4.57E-03	1.40E-02	1.54E-02	3.35E-02	mrheq
<b>Human Rights</b>	1.44E-03	2.53E-03	9.04E-03	3.66E-03	2.72E-03	mrheq
<b>Governance</b>	2.72E-03	2.15E-04	2.42E-03	3.48E-04	1.34E-03	mrheq
<b>Community</b>	3.96E-04	2.08E-03	1.14E-03	2.81E-04	3.27E-03	mrheq