Assessing Finnish forest sector bioCCS/U value-added potential

Preliminary scenarios and results

Lintunen, J., Kohl, J., Lehto, J.
Natural Resources Institute Finland (Luke)

Kujanpää, L., Mäkikouri, S., Lehtonen, J., Arasto, A.
VTT Technical Research Centre of Finland

Bio-CO2 Use and Removal 2024

April 16th, 2024, Kulttuurikasarmi, Helsinki, Finland

Agenda

- Introduction
- Value added
- Scenarios
- Modelling
- Results
- Conclusions

Background

Policy processes as drivers

- EU Hydrogen Strategy & REPowerEU plan
- ReFuelEU Aviation and FuelEU Maritime regulations
- The Delegated Act on a methodology for renewable fuels of non-biological origin (RFNBO)
- Renewable Energy Directive (III) and RFNBOs
- Carbon capture in the Communication “Europe's 2040 climate target and path to climate neutrality by 2050”
- Finnish Government Resolution on Hydrogen
- Finnish Bioeconomy Strategy
- Etc.

The Aim

We examine the potential, costs, and scale of carbon capture, utilization, and storage in Finland.

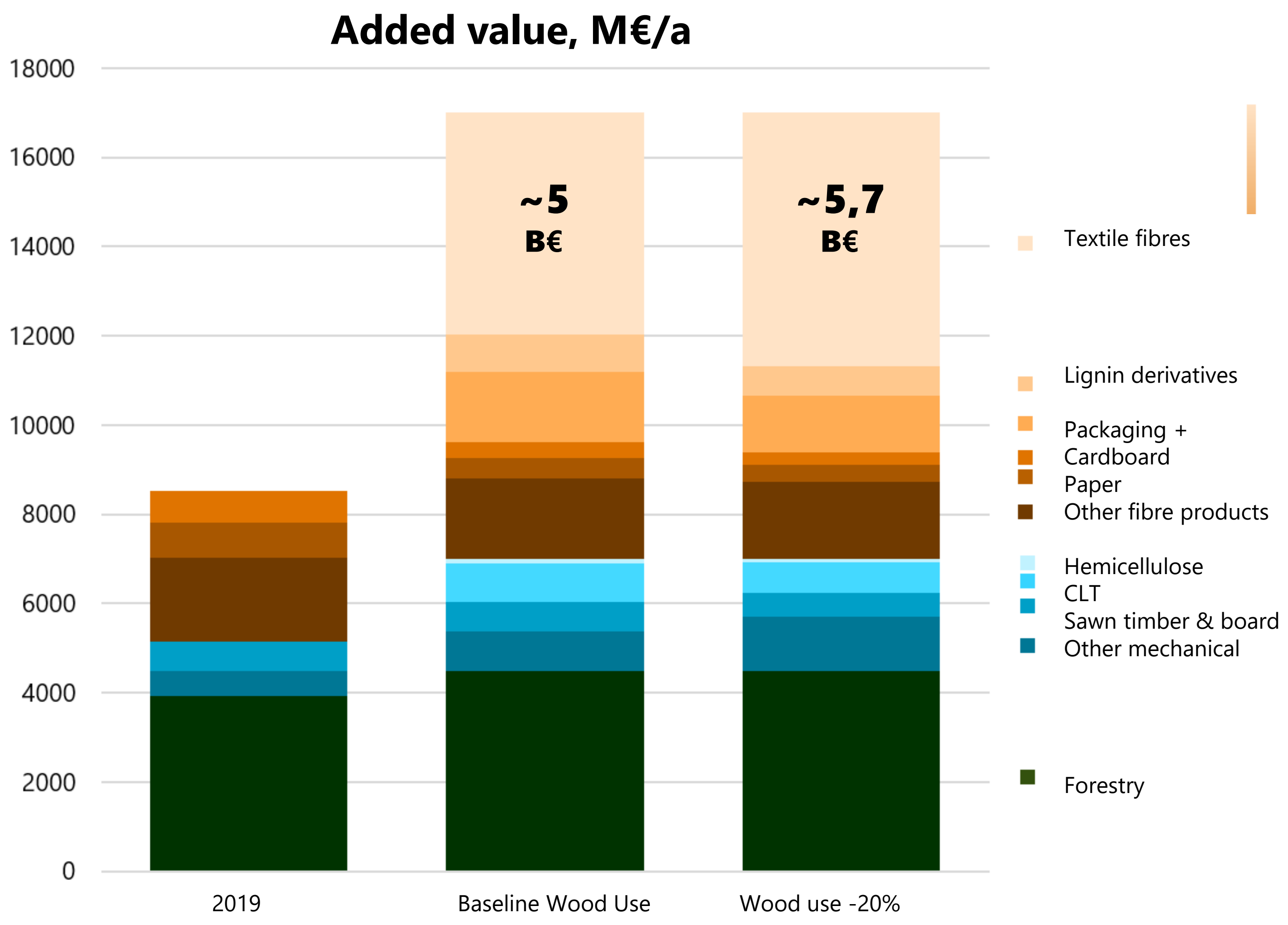
The interest is on the economic implications of the deployment, i.e., **the (gross) value added**

We focus on the biogenic CCS and CCU from the most significant industrial facilities, i.e., from **the forest sector**, in Finland through three development scenarios.

We:

- Assess the bio-CO_2 as a source of the value added in the forest sector
- Contrast the potential to the targets of the Bioeconomy Strategy of Finland

Bioeconomy strategy: doubling the value added by 2035



Assumptions:

- Product portfolio that doubles the value added of the Finnish forest sector
- Value added increases in both pulp and mechanical wood product sectors

The (gross) value added

The definition used here is based on the System of National Accounts:

- gross value added is the **value of output less the value of intermediate consumption**;
- it is a measure of the contribution to GDP made by an individual producer, industry or sector;
- gross value added is the source from which the primary incomes of the SNA are generated

In short, value added

- is the **value created** by the processing and
- is the **income for the factors of production** (capital and labor)

The value chains

A. Carbon capture
B. Electrolysis

CCU:

- A + B + Production of RFNBO-kerosene
- A + B + Production of polycarbonate polyols

CCS:

- A + Geological storage (coastal and inland)
- A + Storage by mineralization (long-distance transportation of CO2, rock, or neither)

Scenario setup

Three scenarios:

- CCSMAX
- VALUEMAX
- OPPORTUNITY

Three time periods:
2030, 2035, and 2040

Amount of captured carbon:
5, 10, and 20 mill. t_{CO2} yr^{-1}, respectively.

	2030		2035		2040	
	CCU	CCS	CCU	CCS	CCU	CCS
CCSMAX		5		10		20
VALUEMAX	5		10		20	
OPPORTUNITY	2.5	2.5	5	5	15	5

CCS:

- Coastal, inland, and mineralization (on-site and CO2 transport)

CCU:

- Aviation e-fuel and polycarbonate polyols

Varying production shares on each scenario and period

Modelling: data & assumptions

Data from the literature:

- Investment costs
- Yield (main product and by-products)
- Intermediate inputs
- Other costs

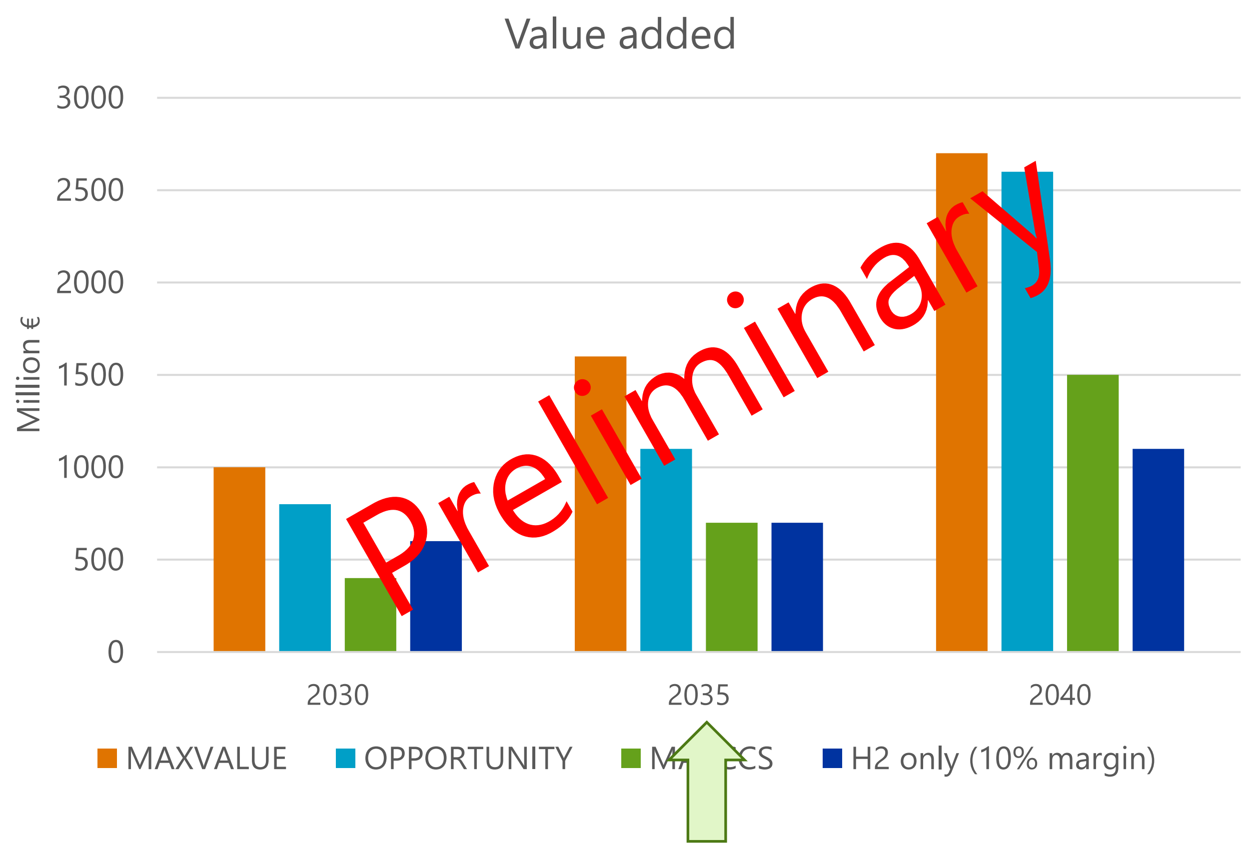
Assumptions

- WACC
- Prices
- Profit margin
- Technical potential
- Full load hours
- Lifetime of installations

Preliminary results

CCU has higher value added than CCS, (but the value added of CCS is notable too)

Production of H_2 only has relatively high value added, in 2030 when the H_2 price is high



About 5-10% of the Bioeconomy strategy target

Discussion I

In the scenarios, the value added is calculated using

- **resource-potential-based production levels** and
- **cost-based pricing (plus markup)**.

Hence, the scenarios depend on sufficient demand and willingness to pay:

- **Regulation has a central role**

To make CCS profitable for firms:

- Depending on the technology and time period the **CO_2 price** of 110-210 €/tCO_2 is needed

Demand for e-fuels and polyols:

- Until they become competitive, **regulation such as one for RFNBOs** is needed

Discussion II

The **electricity demand is high** (up to 100+ TWh), especially, in CCU scenarios

- Central role of electricity **price**
- Possibilities to increase **efficiency** of electrolysis?
- **Competitive uses** for the electricity?

A side note: The investments are assessed in a later stage of the project

Conclusions

- Finnish forest sector is a big source of biogenic CO2, which can be an asset in hydrogen economy as well as in creating technological carbon sinks
- Both utilization and even storage concepts could produce significant value added, if markets for both storage and utilization concepts emerge
- It seems likely that a lot of renewable electricity capacity will be built in Finland during the next decade, especially, if there is a clear prospect for demand.
- From the value-added point of view, it would be important to reap the benefits of this synergy and seek hydrogen production and processing capacity to be built in Finland.
- Finland could be more than a source of renewable electricity for EU.

Thank you!

Jussi.Lintunen@luke.fi