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Wood Supply Chains for a Sustainable and Carbon-smart Bioeconomy in Italy: Between Challenges and Opportunities

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Background: forest resources and wood sector in Italy

Forest coverage: **40%** of national land area
Forest area **tripled** in the **last 70 years**
INFC, 2015

Net removals of about **14%** of national **CO_2 emissions** (+ other benefits)
National Inventory Document, Ispra (2025)

Italy: **leading European producer of furniture and wood-furnishing products** Federlegno-Arredo, 2023

Long-lived wood products (furniture, construction, etc.) and the **substitution of fossil raw materials = removal/avoided CO_2 emissions**
(UE CRCF, 2024)

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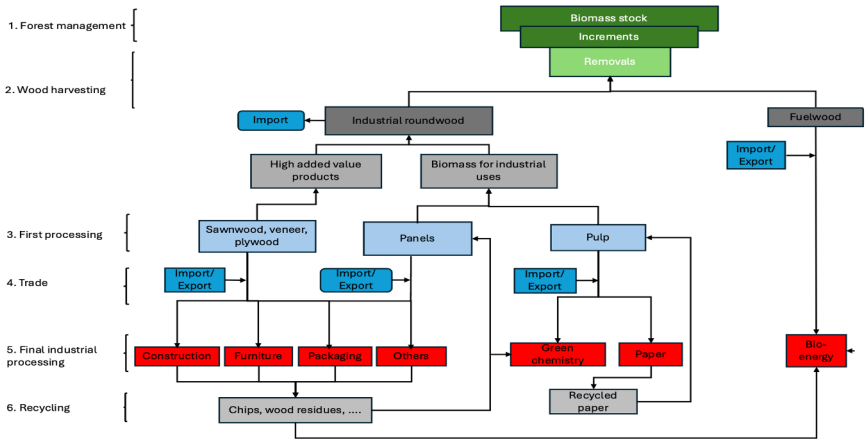
A complex set of value chains without data that allows the different flows to be described.

→ no data on the final consumption of wood, net trade or carbon sinks → no forecasting or simulation is possible.



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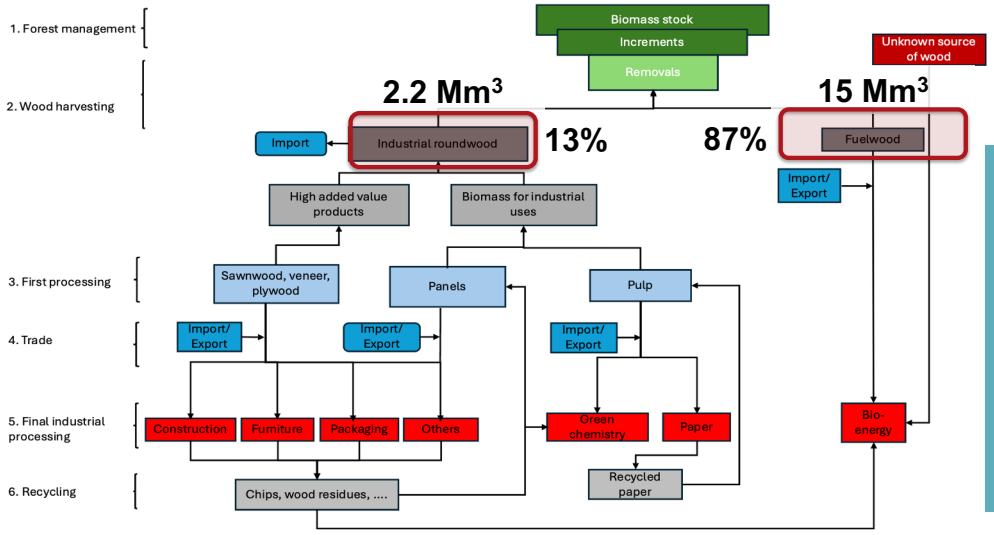
Domestic forest removals and roundwood imports



Italy among the **main European importers of industrial-use wood** and the **world's leading importer of firewood**

FAOSTAT, 2025

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The research consist of two main blocks:

1. Literature review on *Material Flow Analysis* (MFA)

Open Access Review

Material Flow Analysis of the Wood-Based Value Chains in a Rapidly Changing Bioeconomy: A Literature Review

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2. Modelling of the forest-wood supply chain in Italy

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Research objectives

- Analysing the state-of-the-art of the **wood value chains in Italy**
- Developing a comprehensive **forestry sector model** accounting for material flows for Italy
- Modeling forest and timber supply chain dynamics under **current and future scenarios** analyzing changes in **material flows and C-stock**

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Modelling of the forest-wood supply chain in Italy

- Material flows modelled via ***System Dynamic modeling*** (Vensim)
- **Conversion coefficients** from literature:
  - **Semi-finished** and **finished** products → ***Wood Fiber Equivalent*** (m^3) (Weimar, 2009)
  - ***Wood Fiber Equivalent*** → **Wood in the rough** (*Roundwood Equivalent*, RWE, m^3) (FAO, 2020)

THÜNEN

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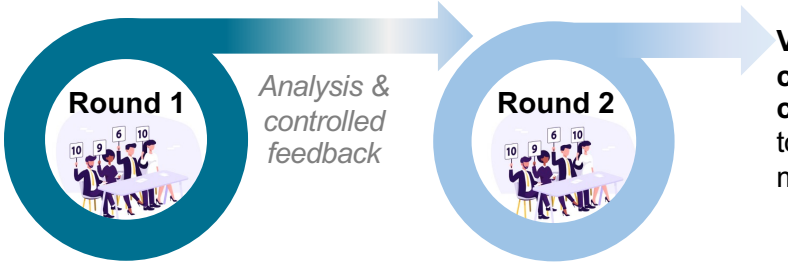
Modelling of the forest-wood supply chain in Italy

- **Expert-based** review and validation: **Delphi Method** (Niederberger & Renn, 2023)

Expert panel
N= 13
Research/academia + private sector: spanning different wood-based products



Validated & calibrated coefficients to feed the model

- **Dynamic MFA** and **scenario assesment** (Aiphoria, Open-source Python)

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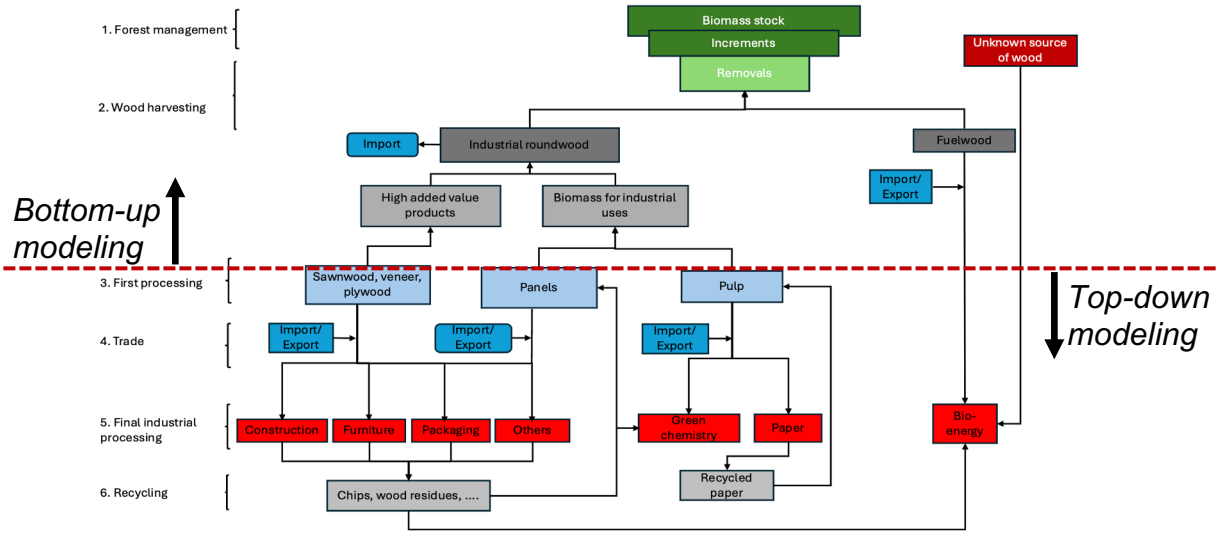
Wood material flow model for Italy (Structure)



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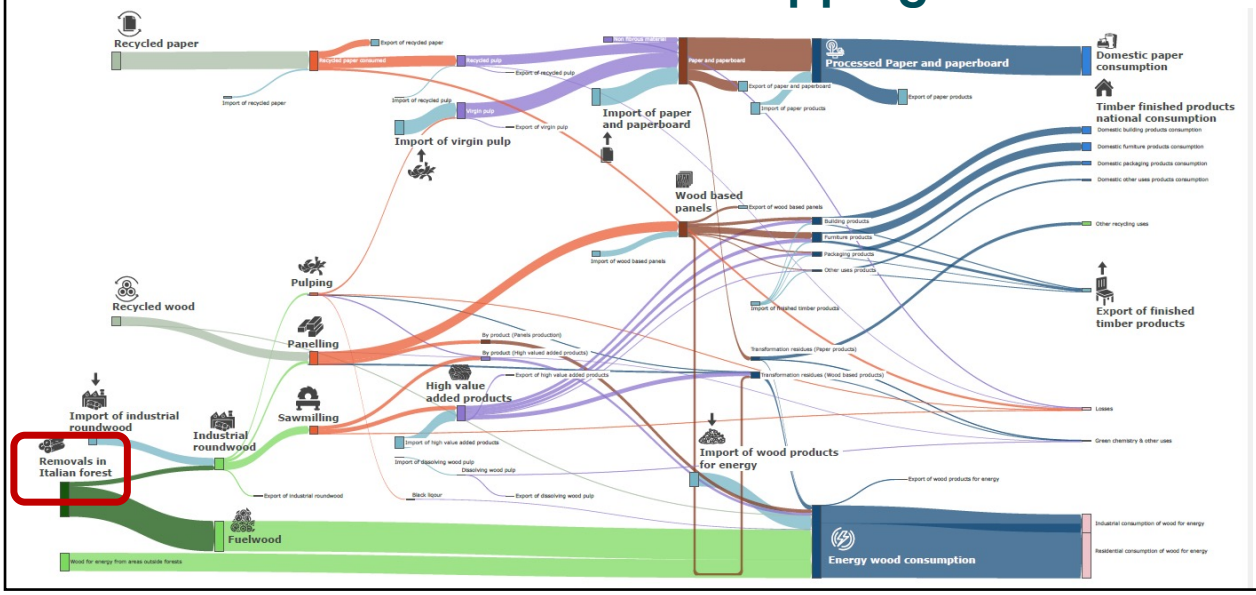
Detailed flows mapping



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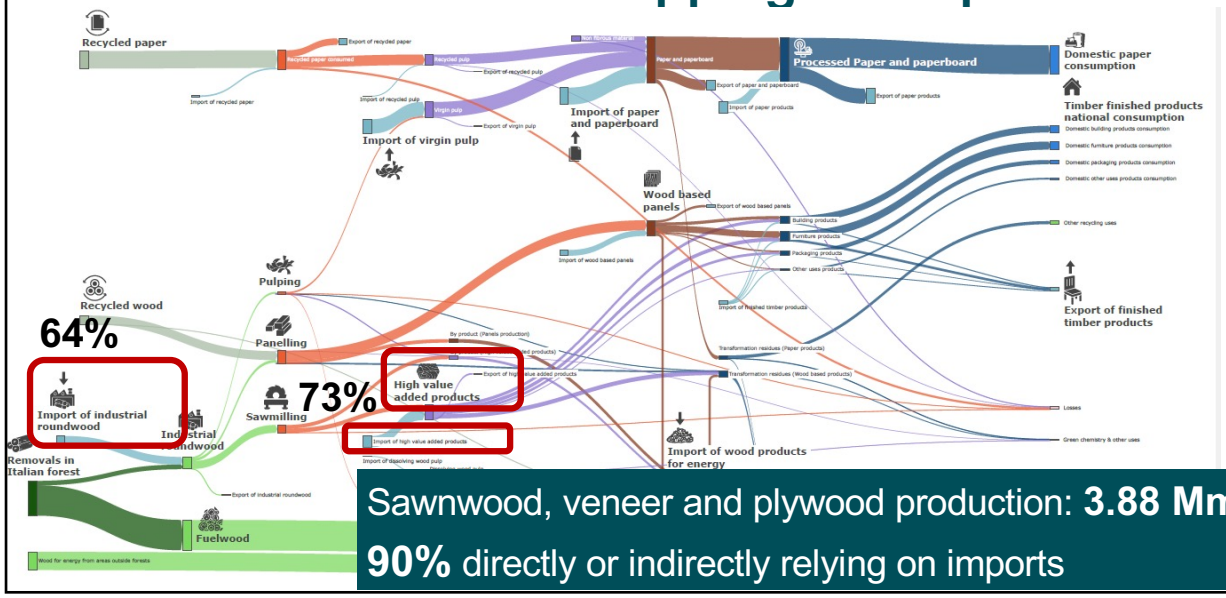
Detailed flows mapping: example 1



Sawnwood, veneer and plywood production: **3.88 Mm³**

90% directly or indirectly relying on imports

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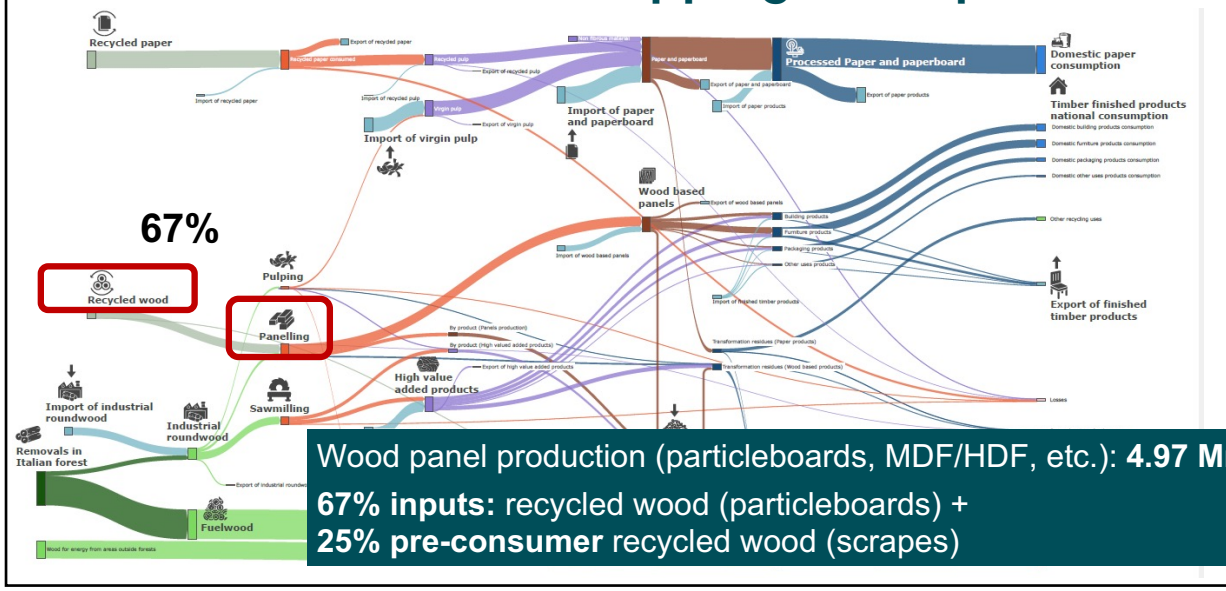
Detailed flows mapping: example 2



Wood panel production (particleboards, MDF/HDF, etc.): **4.97 Mm³**

67% inputs: recycled wood (particleboards) +
25% pre-consumer recycled wood (scrapes)

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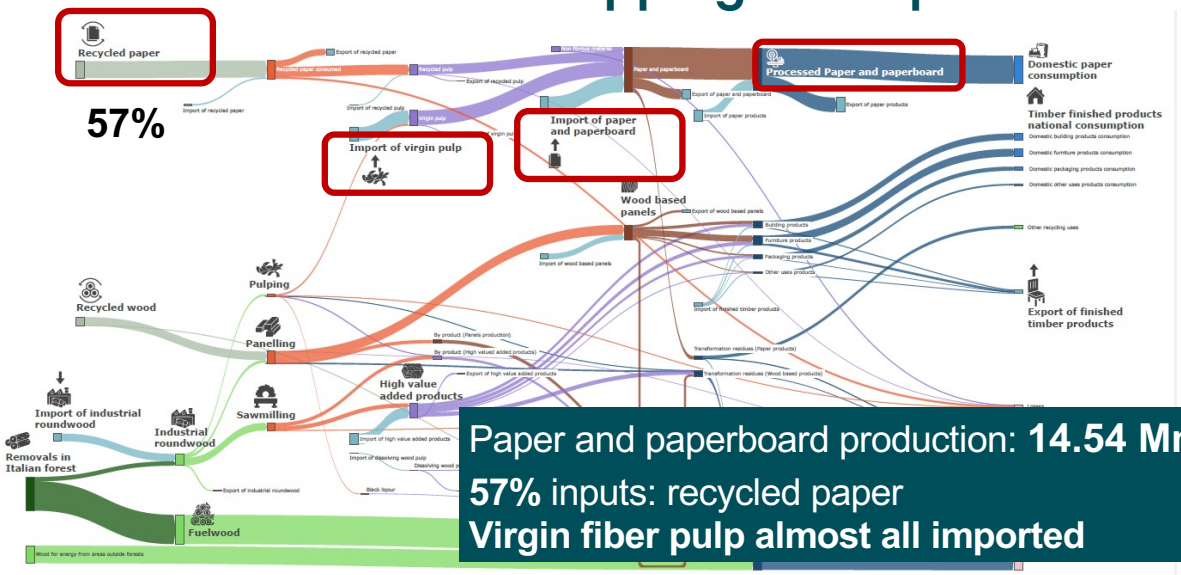
Detailed flows mapping: example 3



Paper and paperboard production: **14.54 Mm³**

57% inputs: recycled paper

Virgin fiber pulp almost all imported

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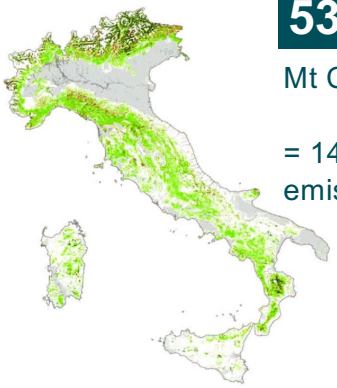
Carbon stock potential under current management (year 2023)



53.6

Mt CO_2eq

= 14% of national CO_2 emissions

Net CO_2eq removals by Italian forests

National Inventory Document, Ispra (2025)

Building 2.9

Furniture 4.3

Packaging 2.0

Other 0.9

Paper 20.9

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Mt CO_2eq

~60% of total forest removals

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Some final considerations

- Domestic harvesting and wood industrial use **strongly decoupled**
- **Limited** domestic wood **mobilization**
- Dependence on **imports** for **sawn timber, veneers and plywood** (and for **wood pulp)**
  → **Primary processing** largely **phased out/downsized**
  → Lack of **valorization/competitiveness** of local supply chains
  → **Negative impacts** in the **countries of origin** (deforestation/degradation)
- Central role of **recycled/recovered material** for panels (particleboard) and paper
  → **Circular bioeconomy** (EU and national Bioeconomy Strategies)
- Key role in **C-stock**: room to improve removals keeping stocking capacity

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Thanks for your attention

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