ILEX: a Mass Flow Model for the forestry sector in Italy

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Background

- Although Italy has substantial forest cover (about one-third of its territory– almost 12 M ha), **limited domestic wood mobilization makes the Italian forestry sector heavily trade-dependent**.
- The rate of **wood recycling** is in Italy among the highest in the world, so waste paper and paperboard, recycled final wood products and by-products from wood processing have a **fundamental role in the domestic wood industry**
- EU climate instruments, including the Carbon Removals and Carbon Farming Regulations (CRCF), **require transparent, robust, and verifiable accounting of carbon stored in long-lived wood products.**
- **Credible monitoring of wood and carbon flows** across the value chain is essential **for our forest, climate, energy policies.**
- The **Italian Lumber Exchange (ILEX) model** (Figure 1), a detailed Material Flow Analysis (MFA) of Italian forest-wood value chain including the cascade wood flows has been developed [1].

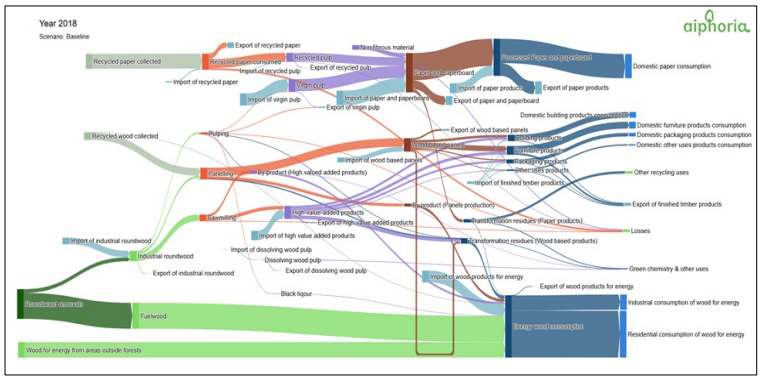

Figure 1: *Overview of the Material Flow Analysis of wood use along the value chain in Italy (m^3 wood fiber eq. - 2018)*

Objectives of the research

- Develop a dynamic MFA-based framework to quantify wood biomass (in m^3 wood fiber equilavent) and carbon inflows and in-use stocks of HWPs in Italy (2000-23).
  - Assess and compare the role in carbon storage of different HWPs of the wood value chain
  - Compare carbon accounting approaches to identify methodological differences in HWP carbon reporting.

Material & Methods

System boundary

- National-scale analysis of Italy's **forest-wood value chain (2000-2023)** using the (Italian Lumber Exchange (ILEX) model.
- Focus on **HWP carbon pool of final products**; **bioenergy** is treated separately.
- Carbon tracked from **trade-adjusted inflows** to **in-use stocks** and **end-of-life pathways**.

Data collection

- Production and trade data (2000-2023) from **national statistics**, **FAOSTAT** and **other sources**
- Product-level material flows converted to carbon using **product-specific wood density** and **carbon content factors** (IPCC guidelines) [2,3].

Data analysis

- **Dynamic MFA to estimate carbon flows** and resulting in-use carbon stocks in HWPs over time.
- **Product-specific lifetime** applied to simulate stock accumulation.
- Comparison of **two approaches for carbon stock estimate:**
  - **Production plus Net Import (PNIA) =** accounts all products consumed in Italy, regardless of the origin of the wood.
  - **Production (PA)** [2,3]= accounts only wood products from roundwood harvested in Italy

Results and Discussion

- Over 2000-2023, cumulative HWP carbon inflows reached 228.8 Mt C (PNIA) and 100.0 Mt C (PA) (Figure 2), **highlighting Italy's reliance on imported wood**.
- In 2023, in-use HWP carbon stocks amounted to 94.4 Mt C under the PNIA approach, compared to 21.6 Mt C under the PA approach (Figure 3). **This 4.4-fold difference reflects**, also in this case, the strong role of imports.
- Short-lived products, such as packaging and paper, **have a predominant role in carbon inflows** under both approaches (PNIA and PA).
- Carbon stock accumulation is mainly driven by long-lived products (e.g., construction and furniture), which also **include components such as panels made from recycled wood** and are therefore not entirely derived from forest-sector supply chains.
- At the Italian level, in the production approach **exported material plays an important and growing role** in the carbon stock accumulated in HWPs
- These findings highlight that **is essential to evaluate and monitor the role of imported and exported HWP, as well as recycled material flows**, in order to ensure transparent HWP carbon accounting under the CRCF Regulation and national carbon registries.

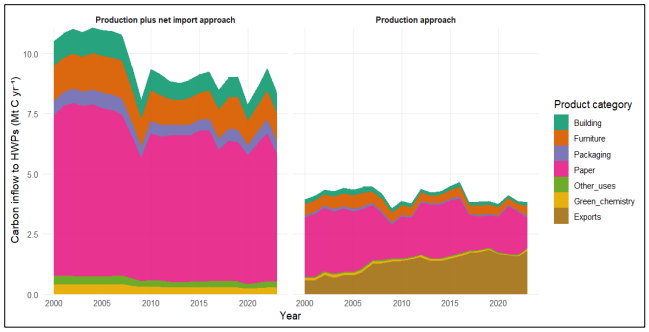

Figure 2: Annual carbon inflows to HWPs in Italy under the production plus net import approach and the production approach

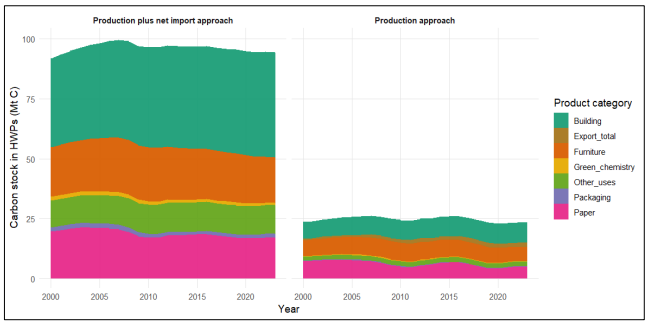

Figure 3: Carbon stock by product type under the production plus net import approach and the production approach

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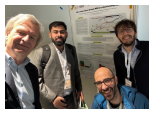
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