SETAC EUROPE 34TH ANNUAL MEETING

SCIENCE-BASED SOLUTIONS IN TIMES OF CRISIS:
INTEGRATING SCIENCE AND POLICY FOR ENVIRONMENTAL CHALLENGES.

LIÈGE université
Chemical Engineering

MaIsoVi Project: Vacuum Insulation Materials, Innovative Approach for Windows in Construction and Renovation

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Presentation

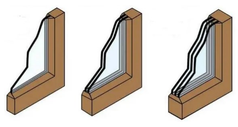
The building sector is responsible for almost 40% of greenhouse gases (GHG) emissions in Europe and 50% of energy consumption. This underlines the need to develop new solutions to support the strategy of reducing the energy needs of housing.

The objective of the **MaIsoVi project (GreenWin n°8653)** is to offer the construction and renovation market for the residential and commercial (tertiary) segment:

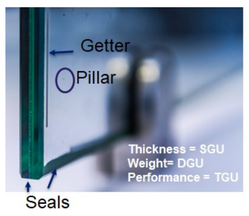
→ A **vacuum glazing** (tempered FINEO) demonstrating the same or better energy efficiency than triple glazing but with the same weight as double glazing and the thickness of single glazing.

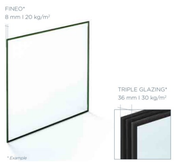
→ A **wooden window** equipped with this FINEO and using a minimum of materials while guaranteeing the best performance over a maximum extended life span.

State of the art – FINEO glazing (AGC)



- ✓ Vacuum insulating glazing
- ✓ Minimal glass **thickness** 7.7 mm → Single glazing (SGU)
- ✓ 0.1 mm of vacuum enclosed between **2 sheets of glass**, one of which is coated with a low-emissivity layer → Double glazing (DGU)
- ✓ **Thermal insulation** coefficient = 0.7 W/(m².K) → Triple glazing (TGU)
- ✓ 15% more natural light than triple glazing
- ✓ https://www.fineoglass.eu





Limitations

- ✓ **Warpage** phenomenon (bimetal effect) ⇒ **Limited size** (1.5 x 2.5 m)
  ⇒ Historical building market ≠ Sustainable renovation and new construction
- ✓ Long processing at **high t°** ⇒ 
- ✓ Production **cost €** >> TGU

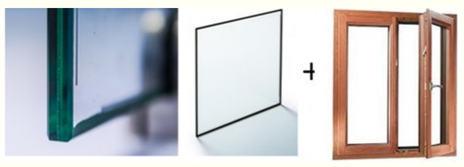
State of the art – Menuiserie Riche

- ✓ Woodworking expertise
- ✓ Long time involvement in terms of and sustainable development:
  - Choice of raw materials
  - Design and manufacture of the products
  - Integration of energy (wood waste to energy), acoustic and thermal performance
  - Economy of materials, recyclability of materials and reduced environmental impacts

- ✓ Edition of a Belgian EPD [B-EPD n° 21-0117-002.00.00]
- ✓ https://www.chassisriche.be

MaIsoVi response & Project objectives

- ✓ FINEO: tempered, without size limitation, lower production cost, lower CO_2 footprint, wider range of functionalities
- ✓ Wooden frame design suitable for FINEO
- ✓ Final product = Wood window 80 mm with FINEO glazing



Wood window

- ✓ Raw material for window = Glued laminated timber (Glulam)
- ✓ **Modular design** with removable parts for maintenance and extended service life (→ no need to replace the whole frame)
- ✓ Combination of ≠ wood species (hard ↔ soft) depending on the part (frame/casement)

- ✓ **Hard wood**
  Meranti – Malaysia (MY)
  Sipo – Cameroun (CM)
  Oak – Europe (EU)
  Accoya (NZ/EU): chemically modified pine (acetylation) → ≥ exotic hard wood
  Heat treated Ash (EU) → durability class 1

- ✓ **Soft wood**
  Larch – Russia (RU)
  Pine – Europe (EU)
  Spruce – Europe (EU)

Design tool: Window 1.23 x 1.48 m – Primary data: FINEO & Wood frame

Excel file with rapid evaluation of environmental impacts for 1 window
(in accordance with EULA for ecoinvent data/results – extra licence)

⇒ Technical constraints (hard wood/soft wood) + client's choice (species, finishing)
⇒ Test of different design → Climate Change & Single Score

- ✓ **A1:** Raw materials (glulam, FINEO or DGU/TGU glazing, finishing, other materials)
- ✓ **A2:** Transport of raw materials to Belgium
- ✓ **A3:** Transformation (wood processing, finishing, window assembling)
- ➡ **Selection** of wood type, finishing, glazing / combinations ⇒ Impact evaluation

Type of Wood	Meranti - MY	Sipo - CM	Oak - EU	Larch - RU	Pine - EU	Spruce - EU	Accoya	HT Ash	Total
Density kg/m³	550	650	750	600	500	450	515	680	
Frame gross part 1 - soft				1	0	0			1
Frame gross part 3 - hard - basic	1	0	0				0	0	1
Frame gross part 4 - hard (removable)	1	0	0				0	0	1
Frame gross part 5 - hard (removable)	1	0	0				0	0	1
Casement gross part 2 - soft				1	0	0			1

hard - average density kg/m³	629
soft - average density kg/m³	517
Weight of wood per window	
Wood - net	21.35
hard	*8.35*
soft	*13.00*

FInishing	
Wood stain - standard	0
Opaque paint	0
Wood stain - natural	1
Basic protection	1

always for part 3 (in the wall - basic finishing)

Glazing	FINEO 4/4	FINEO 4/5	FINEO 5/5	Double Glazing	Triple glazing
size (m²) - for 1 window 1.23 x 1.48 m	1	0	0	0	0

A1 Glazing - for 1 m² of glazing	CC kg CO2 eq/m²	Single score Pt/m²	Weight kg/m²
Glazing (FINEO classical) - for 1 m²			
A1 FINEO 8 (4/4 mm)	47.04	4.57E-03	20
A1 FINEO 9 (4/5 mm)	50.94	4.84E-03	22.5
A1 FINEO 10 (5/5 mm)	54.83	5.12E-03	25
A1 Double glazing (4/4) (EI 3.9.1)	34.02	3.247E-03	20
A1 Triple glazing (4/4/4) (EI 3.9.1)	54.87	4.923E-03	30

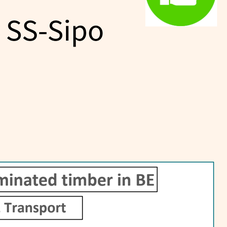
A3 Transformation - for 1 m²	Unit	Amount	CC kg CO2 eq	Single score Pt
A3 Transformation - for 1 m²	p	1	46.40	2.960E-03

	Unit	Amount	CC kg CO2 eq	Single score Pt
TOTAL A1 for 1 window of glulam	p	1	29.71	1.306E-02
TOTAL A2 for 1 window of glulam	p	1	14.04	1.429E-03
TOTAL A3 for 1 window of glulam	p	1	46.40	2.960E-03
TOTAL A1-A3 for 1 window of glulam with glazing	p	1	90.15	1.745E-02
TOTAL A1 for 1 frame of window of glulam	p	1	-3.231E+01	7.042E-03
TOTAL A2 for 1 frame of window of glulam	p	1	1.384E+01	1.413E-03
TOTAL A3 for 1 frame of window of glulam	p	1	46.40	2.960E-03
TOTAL A1-A3 for 1 frame of window of glulam without glazing	p	1	27.93	1.141E-02
Glazing	p	1	62.02	6.021E-03

Inventory

Wood (glulam) (A1)

SimaPro ecoinvent



- ✓ Creation of specific data for Glued laminated timber (glulam)
  ⇒ Adaptation of ecoinvent background data
- ✓ Accoya: data from EPD (type III)
- ✓ Heat treated ash: primary data (provider)
- ✓ **Transport (A2)**: primary data

Glazing (A1, A2)

- ✓ **FINEO**
  - Primary data for float glass 4 and 5 mm (AGC)
  - Primary data for "standard" FINEO processing (classical/not tempered) (AGC) (EPD type I)

EPD ENVIRONMENTAL PRODUCT DECLARATION — Currently, FINEO has EPD type 1, which was achieved through self-evaluation.

- ✓ **Double- and Triple-glazing**: ecoinvent 3.9.1 background data

Window: additional raw material for assembly **(A1, A2)** and processing **(A3)**

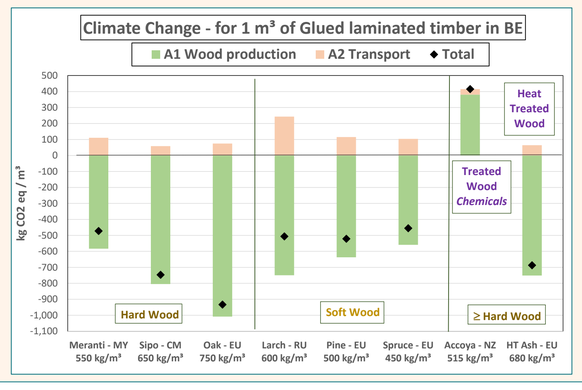
- ✓ Primary data (Menuiserie Riche)

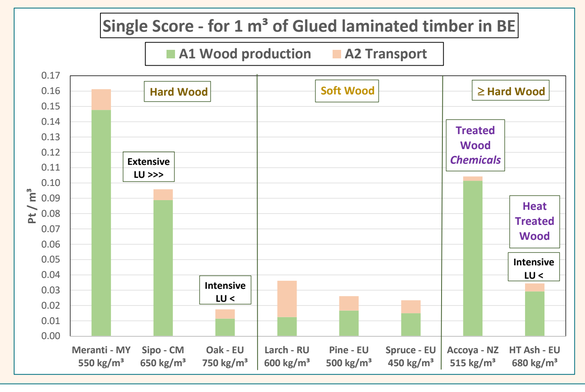
Preliminary LCA - Wood

- ✓ **Climate Change (CC)**: characterisation EN15804+A2:2019
  Biogenic carbon / CO_2: "manual" calculation → 0.5 kg C/kg wood (DM) ; Humidity = 13%
- ✓ **Single Score (SS)**: normalisation & weighting factors EF 3.1
  ⇒ Detection of transfer of impacts
- ✓ **FU = 1 m³ of Glued laminated timber**

Results: CO_2 sequestration by wood

- ☺ Hard wood : **Oak**: density, intensive forest, European
  Heat treated Ash (EU): CC-HT Ash ≅ CC-Sipo (Cameroun) & SS-HT ash < SS-Sipo
- ☺ Soft wood: **Pine/Spruce**: transport ; **Larch** ≡ for CC cf. density
- ☹ Accoya : chemicals





Hard wood	Meranti	Meranti	Oak	Sipo	Accoya	HT Ash	HT Ash
Soft wood	Larch	Larch	Larch	Spruce	Spruce	Pine	Pine
FInishing	Natural	Natural	Natural	Standard	Standard	Standard	Opaque
Glazing	**FINEO 4/4**	**Triple G**	FINEO 4/4	FINEO 4/4	FINEO 4/4	FINEO 4/4	FINEO 4/4
Climate change (kg CO2 eq/window)							
Window (all)	**90.15**	**100.6**	78.66	85.79	94.92	82.72	83.83
Windows (wood)	27.93	27.93	**16.44**	23.57	32.7	**20.5**	21.61
Glazing	**62.02**	**72.34**	62.02	62.02	62.02	62.02	62.02
Single Score (mPt/window)							
Window (all)	**17.45**	**17.93**	13.87	153	154.4	13.76	13.9
Windows (wood)	11.4	11.41	**7.827**	9.262	9.402	**7.718**	7.858
Glazing	6.021	6.490	6.021	6.021	6.021	6.021	6.021

Project and Partnership

- ✓ **2 years project** started on June 1st 2022
- ✓ **10 WP**
- ✓ **5 partners: AGC – Menuiserie Riche – MateriaNova – Cenaero - ULiège**

AGC · RICHE FENÊTRES | PORTES | VERANDAS · MATERIA NOVA Materials R&D Center · Cenaero · LIÈGE université

✓ **Funded by The Walloon Region and supported by GreenWin**

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