How can we measure environmental impacts?

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European standards

- EN 15643-1 – Sustainability assessment of buildings – Part 1: general framework
- EN 15643-2 – Sustainability assessment of buildings – Part 2: framework for the assessment of environmental performance
- EN 15804 – Environmental product declarations – core rules for the product category of construction products
- EN 15942 – Environmental product declarations – communication format – business to business
- EN 15978: - Assessment of environmental performance of buildings – calculation method

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Rating systems

Rating system	Country
Green Star	Australia
LEED Canada	Canada
DGNB Certification System	Germany
IGBC Rating System	India
LEED India	India
Comprehensive Assessment System for Building Environmental Efficiency	Japan
Green Star NZ	New Zealand
Green Star SA	South Africa
BREEAM	UK
LEED Building Environmental Assessment Method Plus (BEAM Plus) Evaluation Standard for Green Building (ESGB)	USA Hong Kong China

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LEED

The Leadership in Energy and Environmental design (LEED) system was developed by the US Green Building Council (USGBC) in 1998 and is currently the most commonly used method to measure the environmental performance of a building. In order to obtain LEED certification, a building must obtain a certain number of points. Depending upon the type of construction or renovation being undertaken, one of arrange of LEED rating systems will apply. Each of which has a slightly different weighting of points. LEED (version 4) credits are divided into eight categories

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LEED

- Location and transportation
- Sustainable sites
- Water efficiency
- Energy and atmosphere
- Materials and resources
- Indoor environmental quality
- Innovation in design
- Regional priority

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LEED

Within the section entitled Materials and Resources there are 13 points available, with two points assigned for the provision of EPDs and two points allocated to material ingredients. In each section of the LEED system there are certain prerequisites that must be met, even though they do not count towards a building's total points. The building is then awarded LEED certification according to the following scores:

Category	Points
Certified	40-49
Silver	50-59
Gold	60-79
Platinum	80-110

The LCA aspects of the material composition of a building only contribute, at most, 4 out of 110 points, in terms of considering GWP and EE footprints. By comparison, 'access to quality transport' (for example) contributes 5 points.

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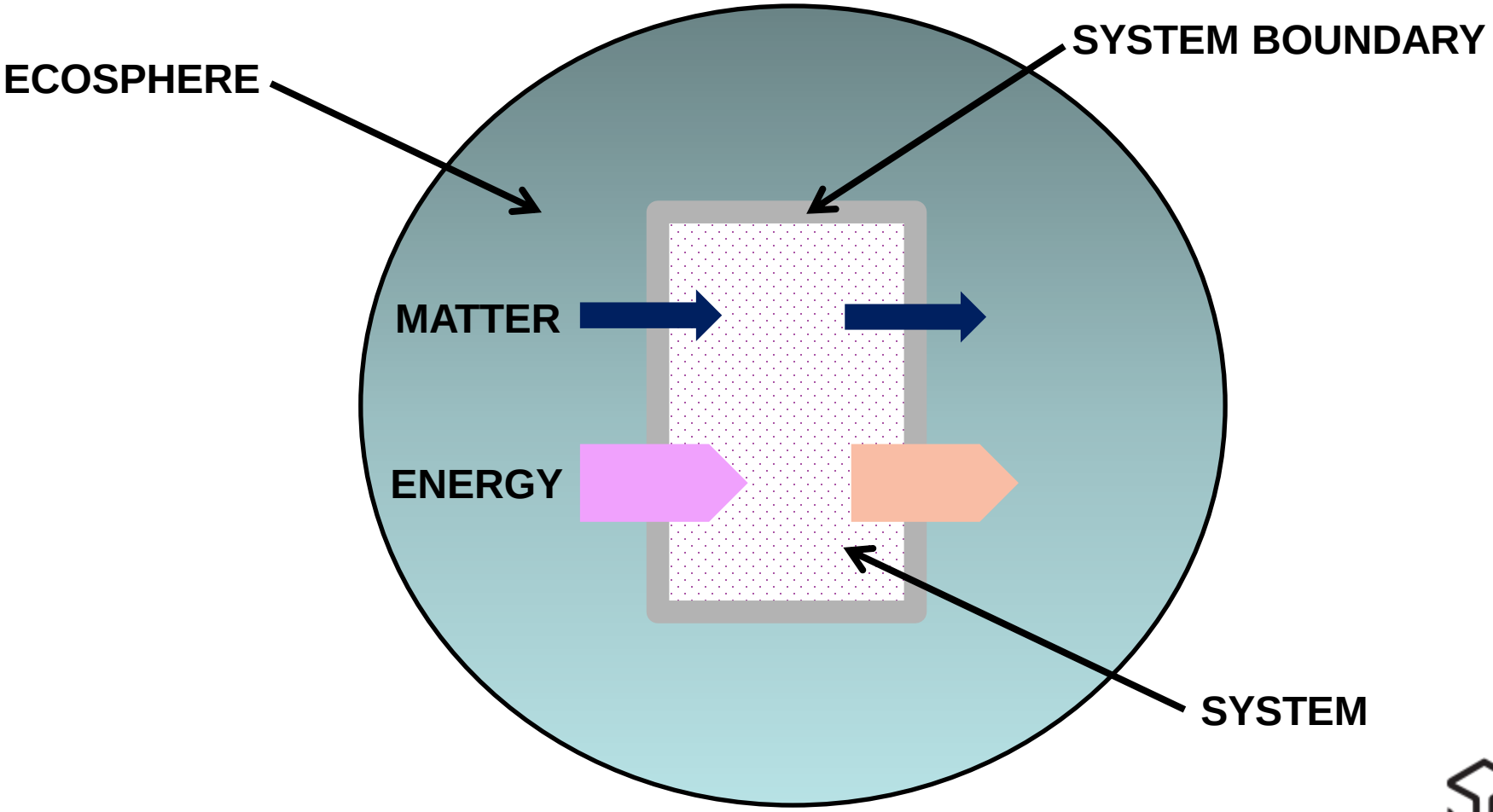
Principle of an LCA



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LCIA

- Not the same as a traditional risk assessment (narrow focus)
- LCIA involves determining the impact of hundreds, if not thousands, of stressors on the environment (broad range)
- Impact categories need to be defined and agreed upon
- There is uncertainty associated with them

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Impact categories

- Midpoint versus Endpoint modelling
- Midpoint models reflect the potency of stressors at a common midpoint within a cause-effect chain
- Endpoint reports on the consequences of the release of stressors into the environment

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Impact categories

- Selection and definition (e.g., global warming)
- Classification (e.g., carbon dioxide to global warming)
- Characterisation (e.g., impact of carbon dioxide and methane)
- Normalisation (e.g., comparing CO_2 and CH_4)
- Grouping (e.g., sorting indicators by local, regional global)
- Weighting (emphasising the most important impacts)
- Evaluating and reporting (understanding reliability)

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Midpoint categories

- Global warming
- Stratospheric ozone layer depletion
- Acidification of soil and water
- Eutrophication
- Tropospheric photochemical ozone creation
- Abiotic resource depletion – elements
- Abiotic resource depletion – fossil fuels

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Endpoint categories

- Skin cancer
- Species loss
- Flooding
- Drought
- Reduced life expectancy

(Much higher uncertainty)

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Midpoint impacts

global warming potential (GWP)

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- CFC-11, CFC-12, HCFC-22, HCFC-141b, HCFC-142b, HFC-125, HFC-134a, HFC-152a, HFC-23, PFC-14, PFC-116, etc., CCl_4, CH_3CCl_3
- SF_6

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Radiative forcing (2005)

Gas	Concentration	Radiative forcing (W m^{-2})
Carbon dioxide	379 ppm	+1.66
Methane	1774 ppb	+0.48

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Methane

- But – methane slowly oxidises in the atmosphere to water and carbon dioxide

Gas	20-yr	100-yr	500-yr
CO_2	1	1	1
CH_4	72x	25x	7.6x

1 kg methane has a GWP_{100} value of 25 kg CO_2 equivalents (CO_{2e})

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Midpoint impact categories (EN15804)

Category	Abbreviation	Unit
Global warming potential	GWP	kg CO_2 equivalents
Ozone depletion potential	ODP	kg CFC-11 equiv.
Acidification potential of soil and water	AP	kg SO_2 equiv.
Eutrophication potential	EP	kg $(PO_4)^{3-}$ equiv.
Photochemical ozone creation potential	POCP	kg ethene equiv.
Abiotic depletion potential- elements	ADP-elements	kg Sb equiv.
Abiotic depletion potential – fossil fuels	ADP-fossil fuels	MJ, net calorific value

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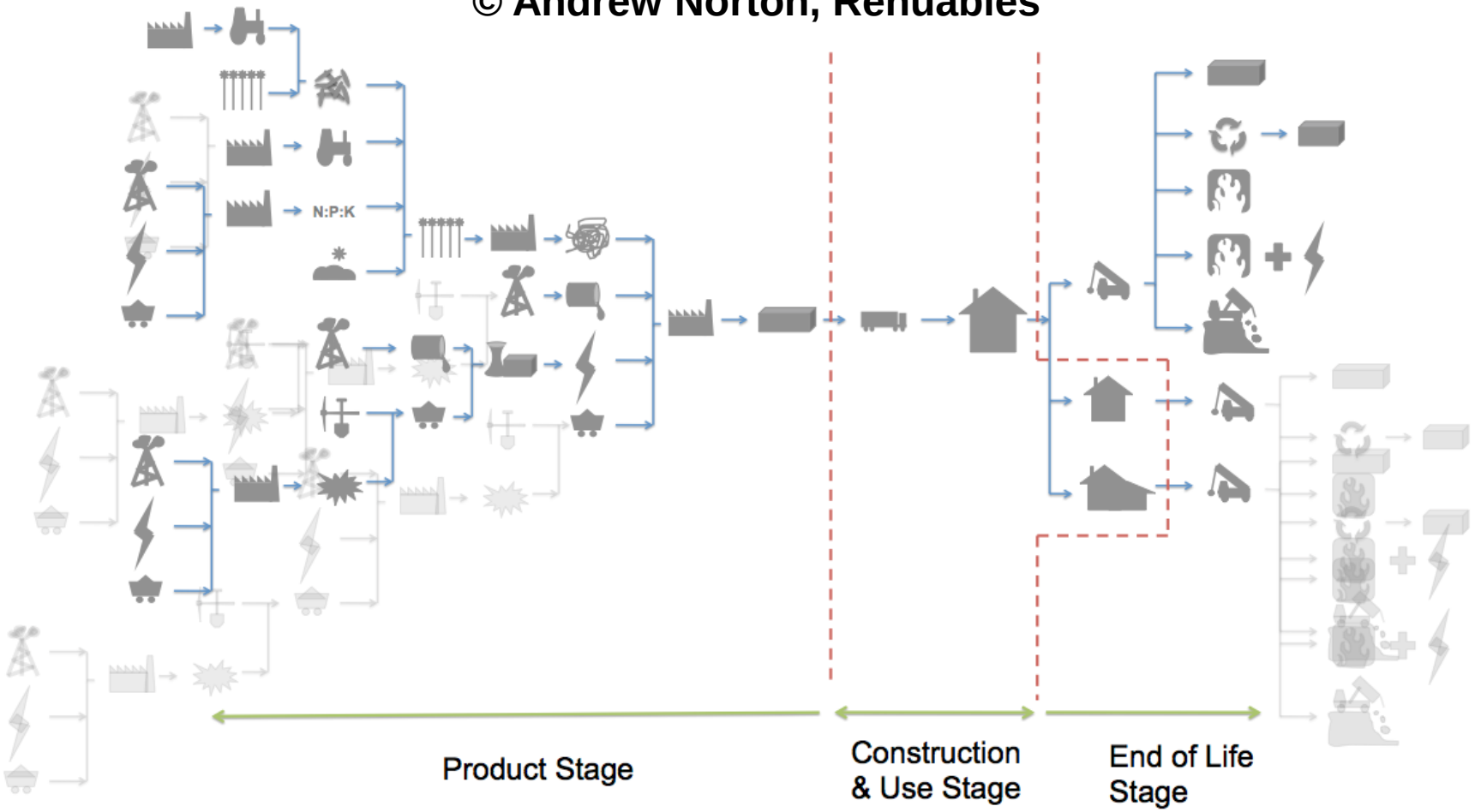
Product over time

© Andrew Norton, Renuables



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Reporting on life cycle stages according to EN15804

PRODUCT STAGE			CONSTRUCTION STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY
Raw material supply	Transport	Manufacturing	Transport	Construction-Installation process	Use	Maintenance	Repair	Replacement[1]	Refurbishment[1]	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-recovery Recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D

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EPD

Environmental Product Declaration

Type III environmental declaration

ISO 14025

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Product Category Rules (PCR)

Product Category Rules for preparing an environmental p
declaration (EPD) for Product Group:

Building Envelope Thermal Insulation
The product group includes all commercially available building envelope thermal insulatio
regardless of material type, including but not limited to: cellular glass, mineral fibre insulat
slag or glass), cellulose-based insulation, textile-based insulation, and polymer-based insu

VERSION 1.2 October 29, 2013
VALID THROUGH September 12, 2016

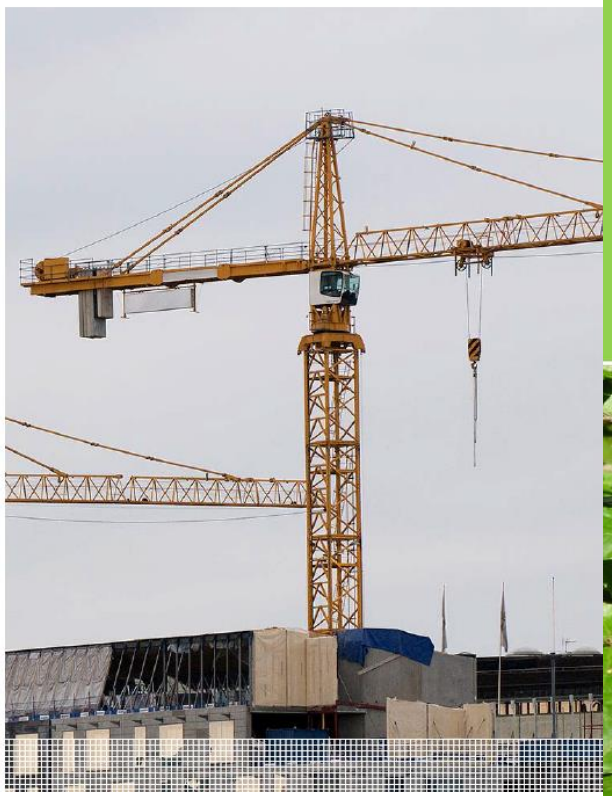
PRODUCT CATEGOR

PRODUCT CATEGORY RULES
DATE 2013-03-15

EPD®

CONSTRUCTION PRODUCTS AND
CPC 54 CONSTRUCTION SERVICES

2012:01
VERSION 1.2



PCR Guidance-Texts for Building-Related Products and Services

From the range of Environmental Product Declarations of Institute Construction and Environment e.V. (IBU)

Part B: Requirements on the EPD for Wood based panels

www.bau-umwelt.com

Institut Bauen und Umwelt e.V.

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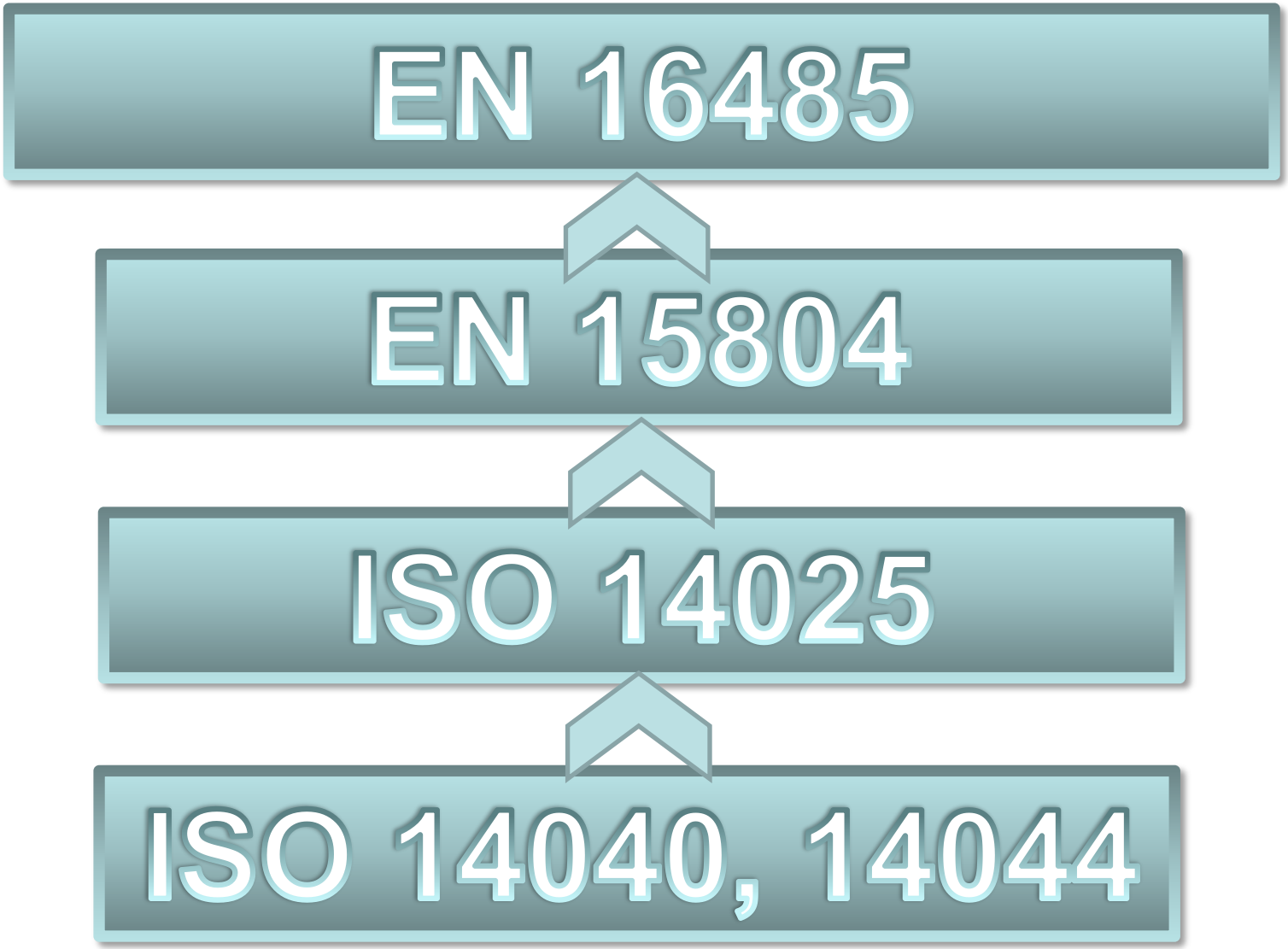

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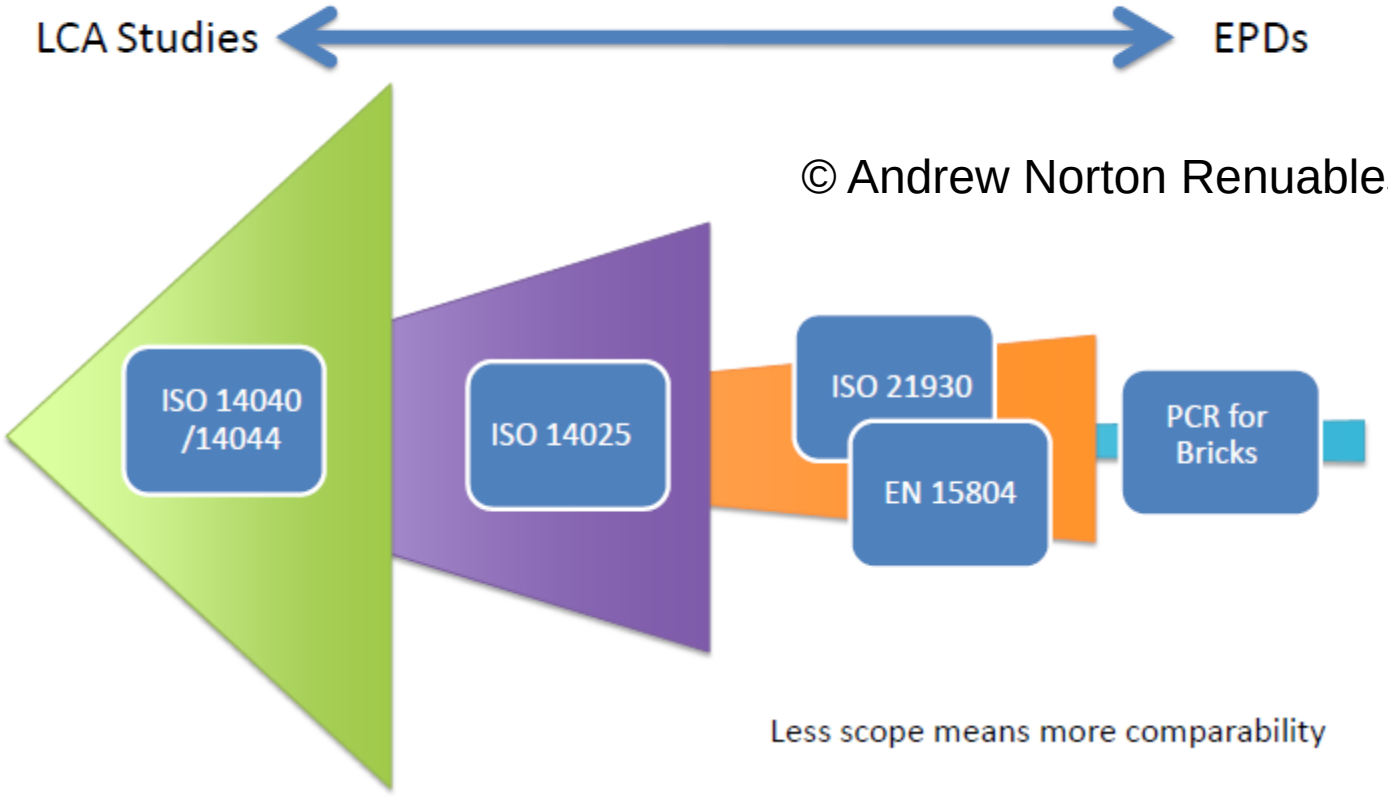
Scope of LCAs and EPDs



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ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Declaration holder	Kronoply GmbH / Kronopol Sp. z o.o.
Publisher	Institut Bauen und Umwelt (IBU)
Programme holder	Institut Bauen und Umwelt (IBU)
Declaration number	EPD-KRO-2012311-EN
ECO EPD Ref. No.	ECO-00000051
Issue date	28.07.2012
Validity	27.07.2017

KRONOTEC WP50 / DP50

Kronoply GmbH / Kronopol Sp. z o.o.

www.bau-umwelt.com

Institut Bauen und Umwelt e.V.

ECO PLATFORM EPD EN 15804 VERIFIED

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1 General information

Kronoply GmbH / Kronopol Sp. z o.o.

Programme holder

IBU - Institut Bauen und Umwelt e.V.
Panoramastr. 1
D-10178 Berlin

Declaration number

EPD-KRO-2012311-EN

This Declaration is based on the Product Category Rules:

Wood Materials, 06-2011
(PCR tested and approved by the independent Committee of Experts (SVA))

Issue date

28.07.2012

Valid until

27.07.2017

Prof. Dr.-Ing. Horst J. Bossenmayer
(President of Institut Bauen und Umwelt e.V.)

Prof. Dr.-Ing. Hans-Wolf Reinhardt
(Chairman of the Committee of Experts (SVA))

KRONOTEC WP50 / DP50

Declaration holder

Kronoply GmbH
Wittstocker Chaussee 1
D-16909 Heilgengrabe

Kronopol Sp z o.o.
ul.Serbska 56
PL-68200 Zary

Declared product/unit

1 cubic metre of KRONOTEC WP50 / DP50

Validity

This document refers to the KRONOTEC WP50 / DP50 boards manufactured by Kronopol in PL-68-200 Zary (Poland). The Life Cycle Assessment data was recorded in 2008 by the company in Zary. The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

Verification

The CEN EN 15804 standard serves as the core PCR.

Verification of the EPD by an independent third party in accordance with ISO 14025

☐ internal ☒ external

Dr. Frank Werner
(Independent auditor appointed by the SVA)

RESULTS OF THE LIFE CYCLE ASSESSMENT - ENVIRONMENTAL IMPACTS: 1m^3 KRONOTEC WP50 / DP50			
		Production	Credits
Parameter	**Unit**	**A1-A3**	**D**
Global Warming Potential (GWP)	[kg CO_2 equiv.]	-444	181
Ozone Depletion Potential (ODP)	[kg CFC11 equiv.]	8.93E-06	-3.94E-07
Soil and water Acidification Potential (AP)	[kg SO_2 equiv.]	5.48	-3.38
Eutrification Potential (EP)	[kg PO_4^{3-} equiv.]	0.255	-0.071
Photochemical Ozone Creation Potential (POCP)	[kg ethene equiv.]	0.321	-0.186
Abiotic Depletion Potential of elementary resources (ADPE)	[kg Sb equiv.]	7.26E-04	-3.09E-05
Abiotic Depletion Potential of fossil resources (ADPF)	[MJ]	7197	-10482

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RESULTS OF THE LIFE CYCLE ASSESSMENT - USE OF RESOURCES: 1m^3 KRONOTEC WP50 / DP50			
		Production stage	Credits
Parameter	**Unit**	**A1-A3**	**D**
Regenerative primary energy as an energy carrier (PERE)	[MJ]	3355	-43
Regenerative primary energy for material use (PERM)	[MJ]	9429	0
Total regenerative primary energy (PERT)	[MJ]	12784	-43
Non-regenerative primary energy as an energy carrier (PENRE)	[MJ]	3248	-10519
Non-regenerative primary energy for material use (PENRM)	[MJ]	4264	0
Total non-regenerative primary energy (PENRT)	[MJ]	7512	-10519
Use of secondary materials (SM)	[kg]	0	0
Regenerative secondary fuels (RSF)	[MJ]	0	0
Non-regenerative secondary fuels (NRSF)	[MJ]	0	0
Use of fresh water resources (FW)	[m³]	7.7	-0.17

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EXAMPLE – TIMBER PRODUCTS

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GWP (kg CO_2 eq)
1 m^3 of product

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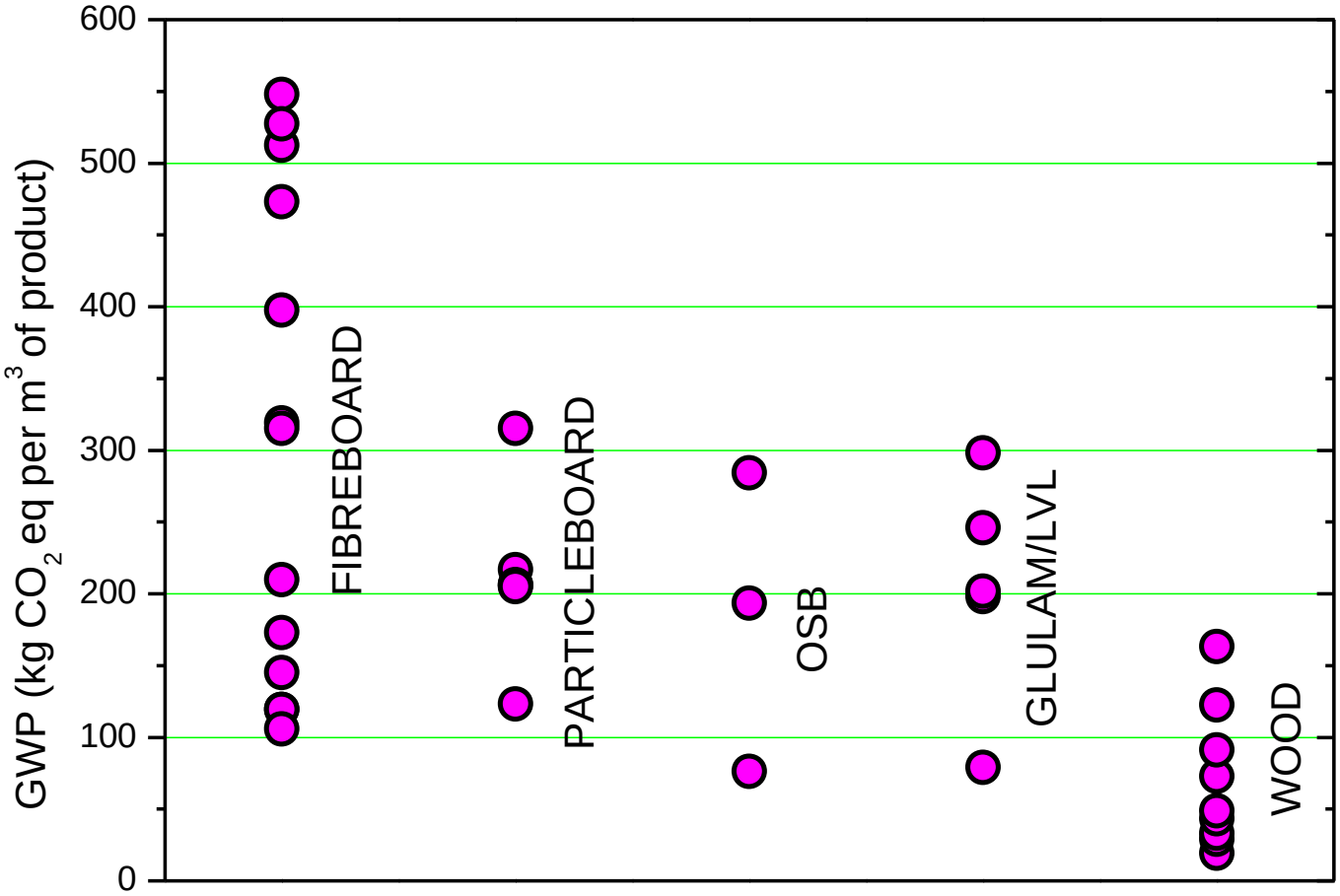

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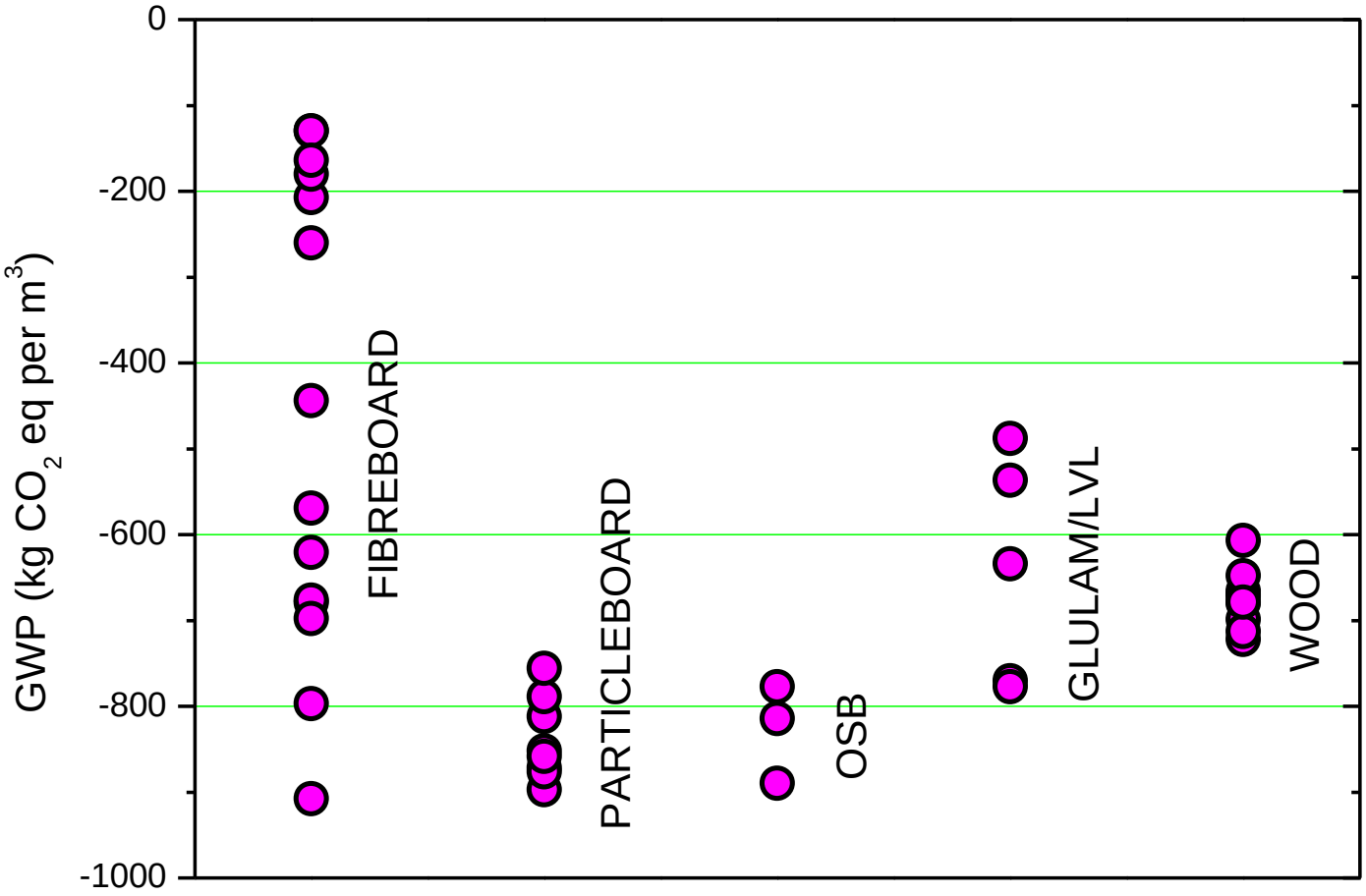

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GWP (kg CO_2 eq)
1 kg of product

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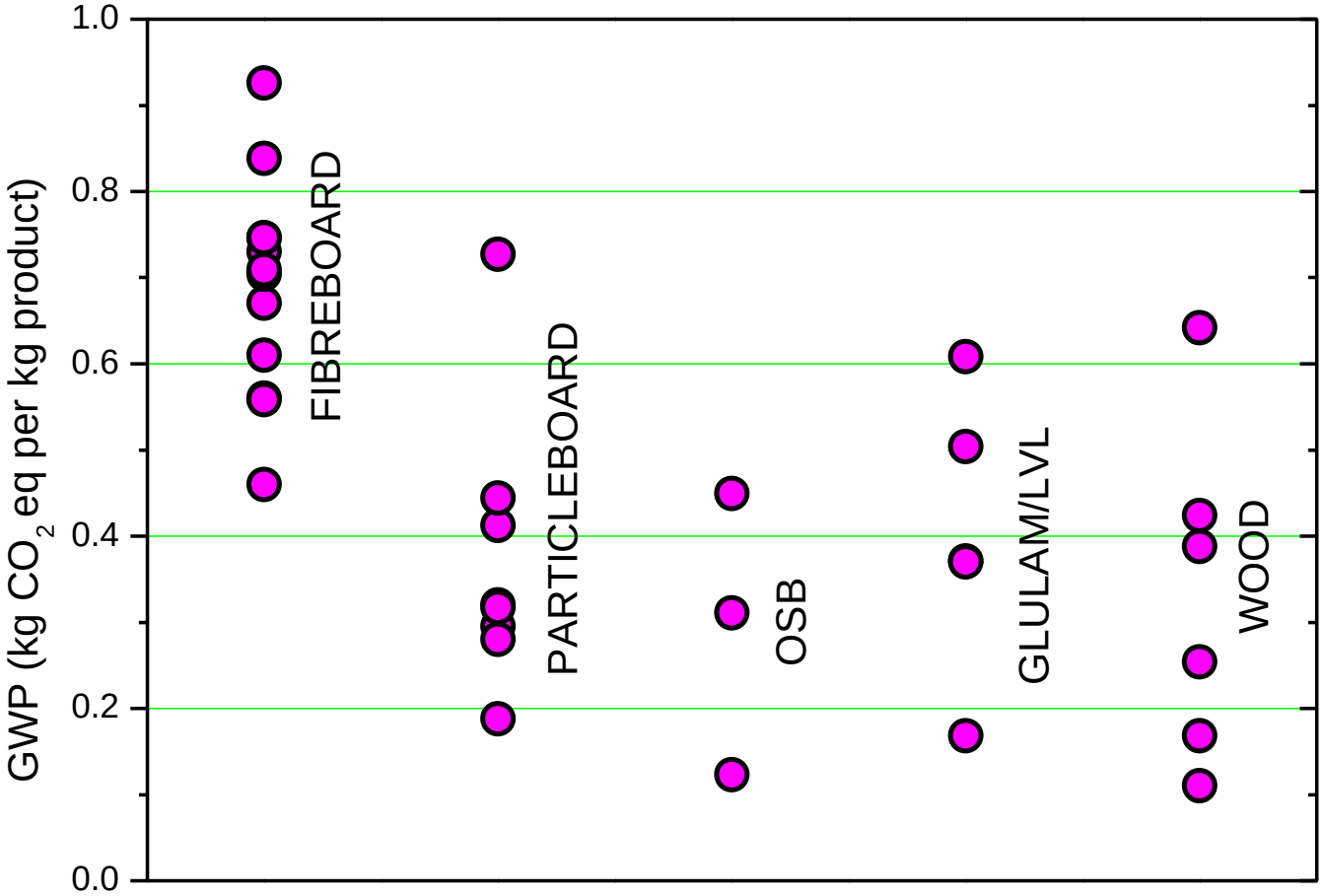

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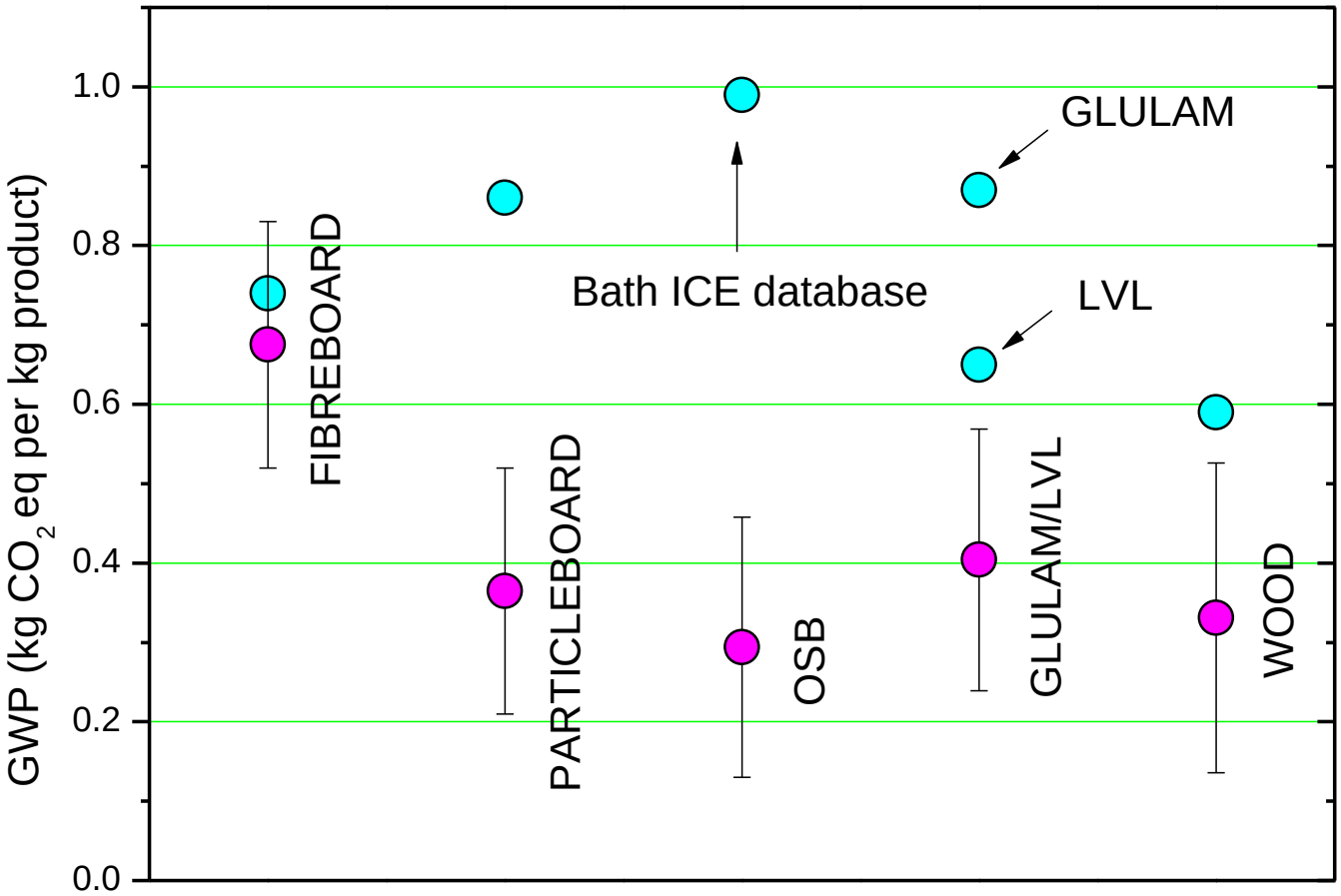

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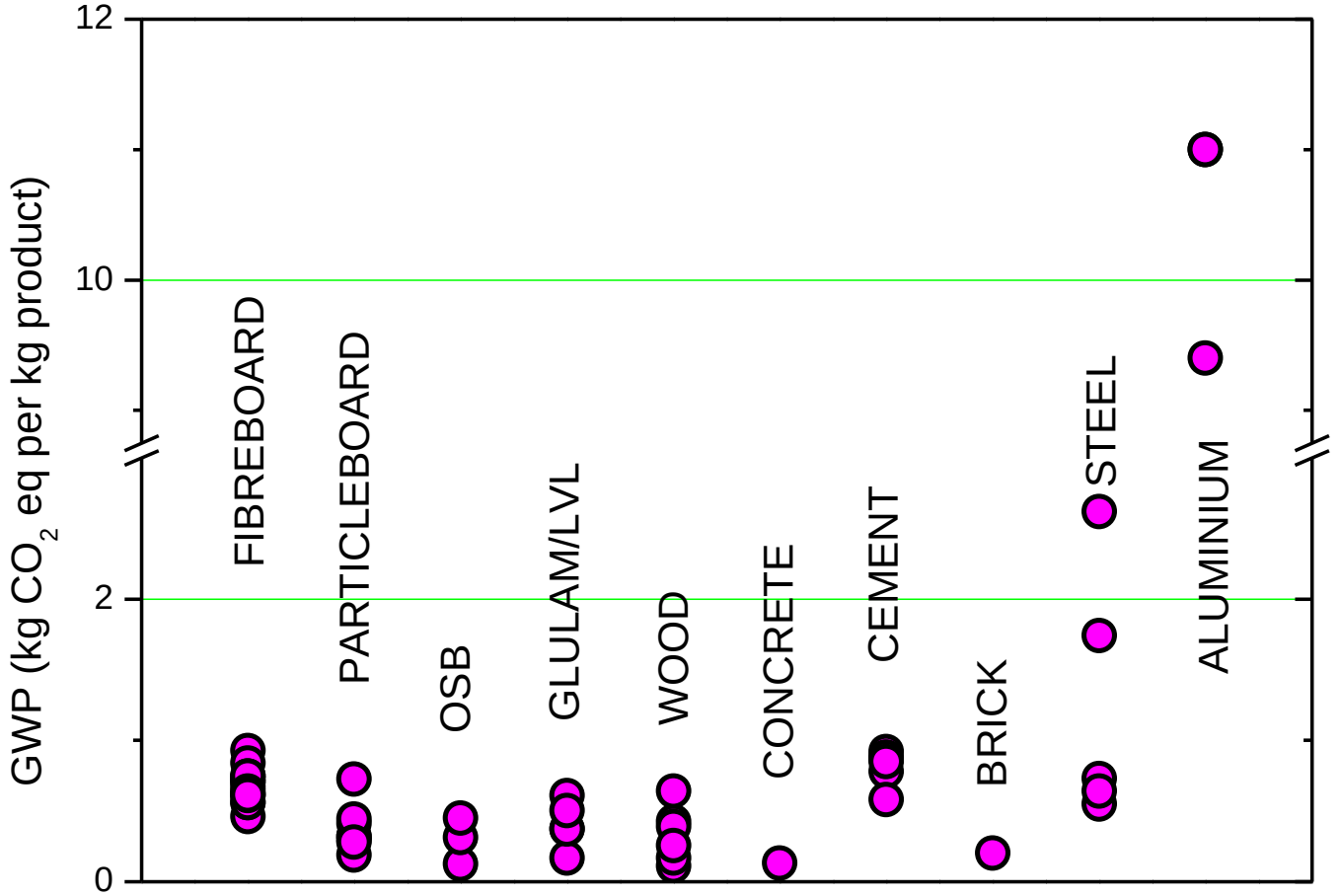

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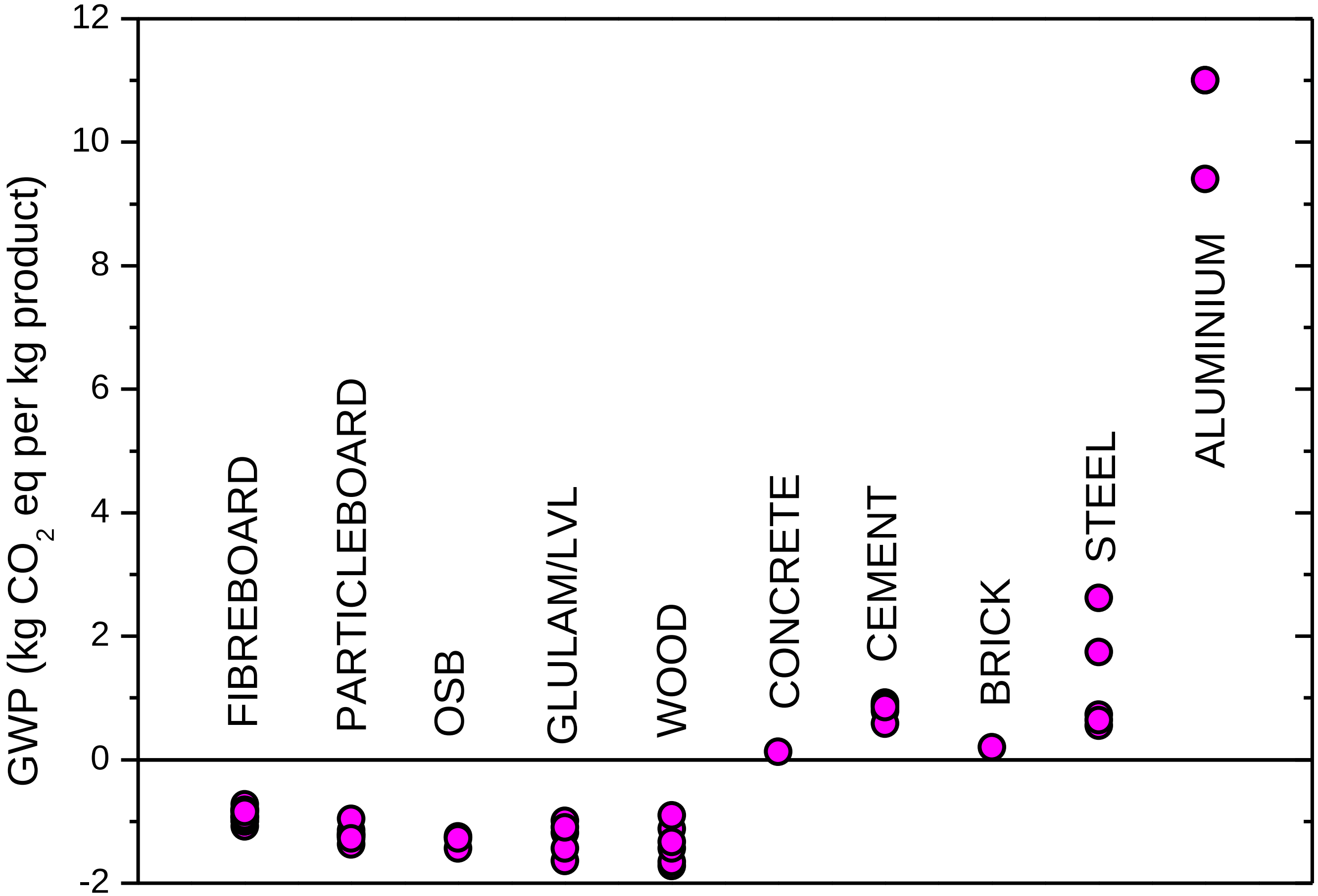

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Embodied energy
(MJ per kg of product)

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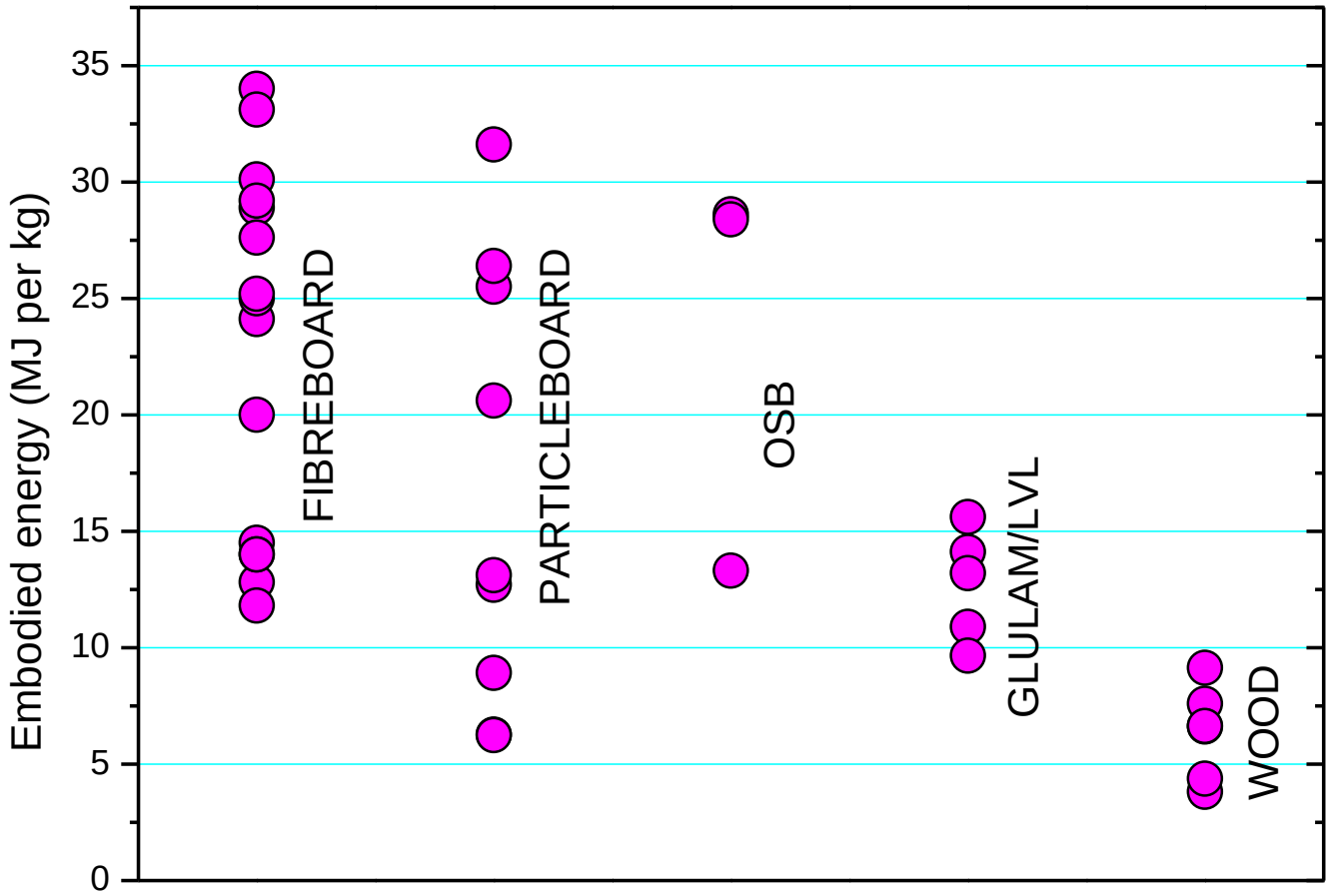

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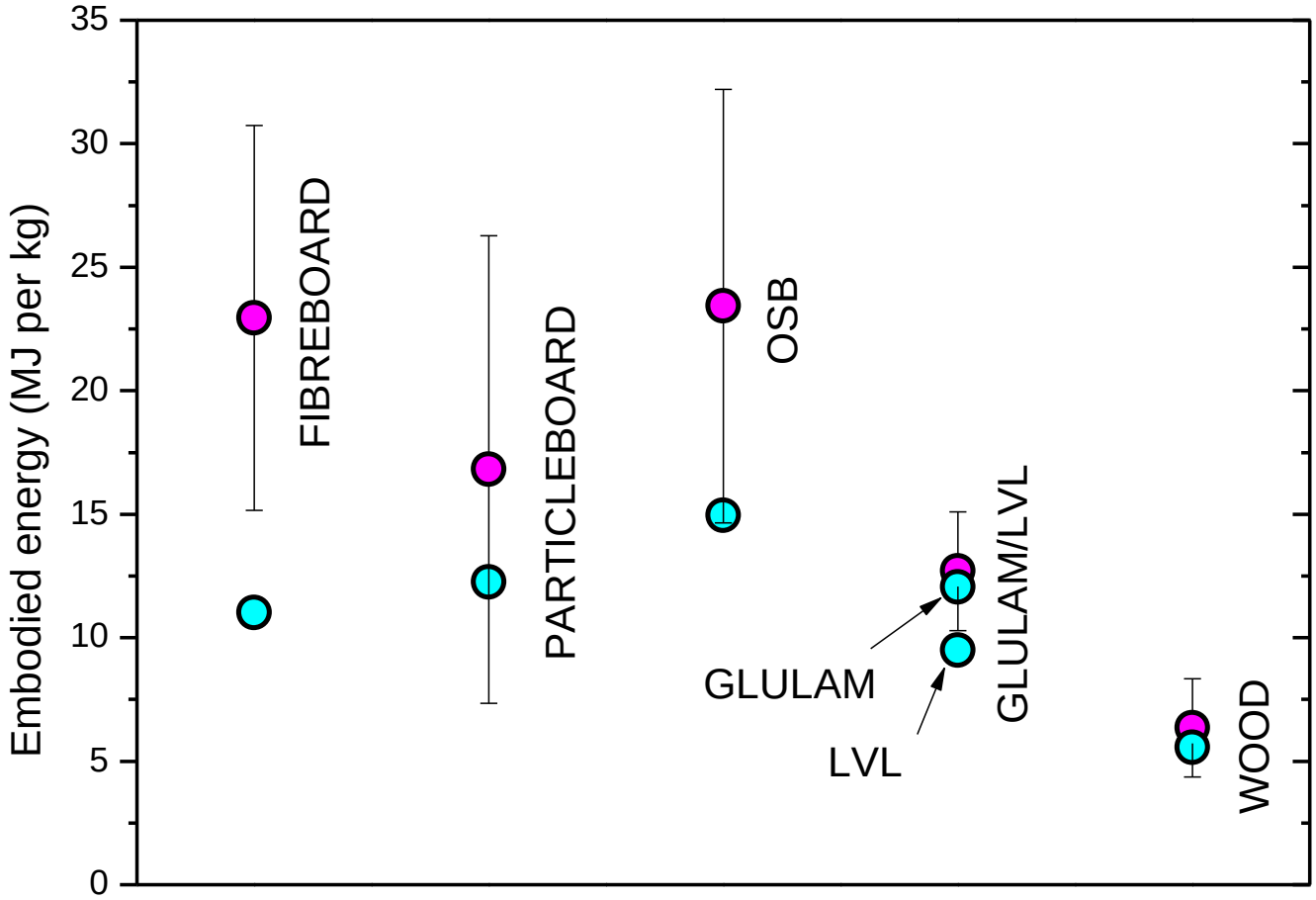

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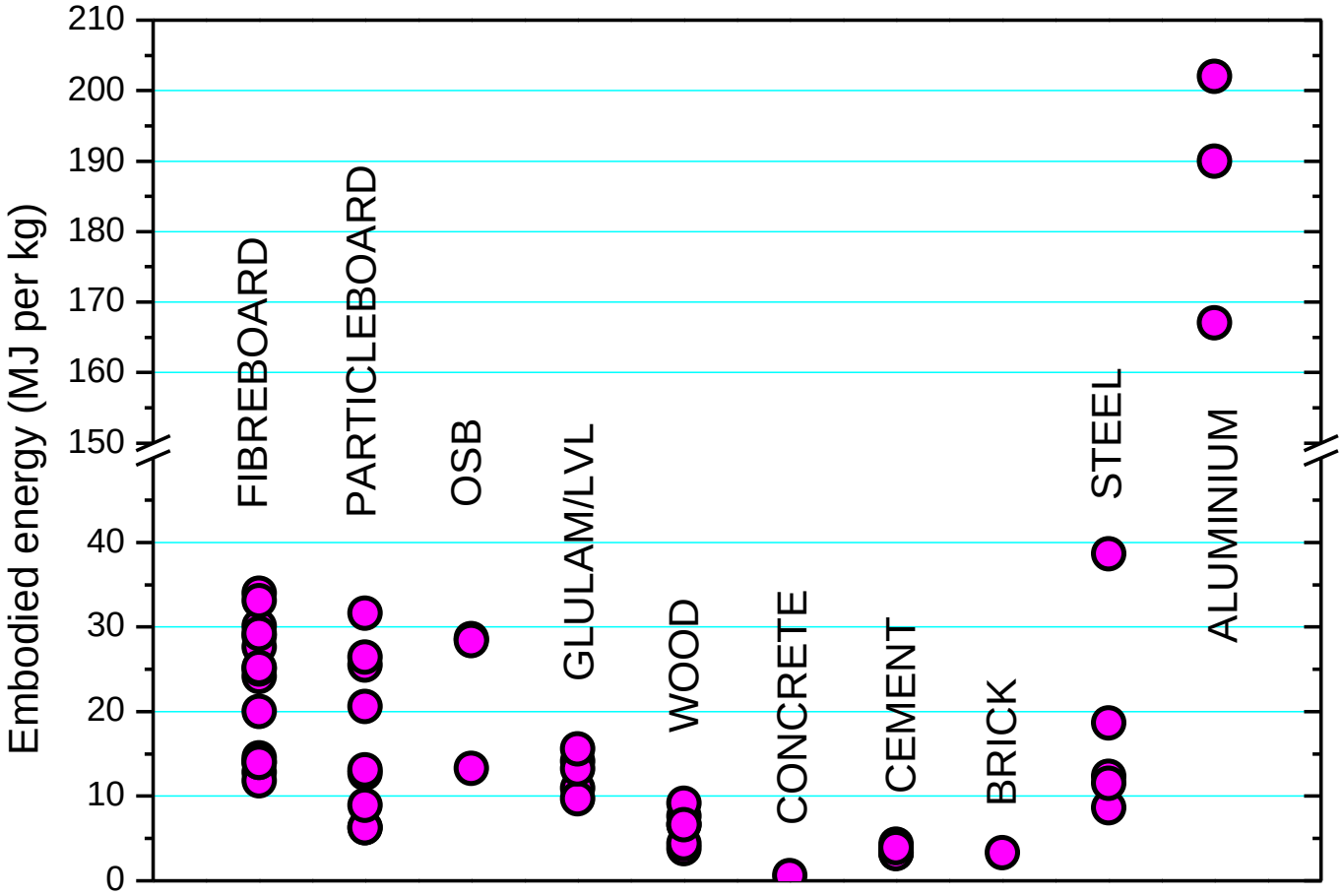

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Unit of comparison

- 1 kg is a declared unit
- This is used as an input into other calculations for a more realistic comparison

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Unit of comparison

- But here we are comparing weight
- To make a sensible comparison we need to use a functional unit
- A wall element of a given area (e.g. 1m^2)
- A window element of a given area
- A door element of a given area
- A beam with given properties
- Etc.

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EXAMPLE – INSULATION MATERIALS
UNIT OF COMPARISON 1KG
ISOBIO PROJECT

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NATURALLY HIGH PERFORMANCE INSULATION

isobio

Development and demonstration of highly insulating, construction materials from bio-derived aggregates

ISOBIO

Development of new approach to insulating materials through the novel combination of existing bio-derived aggregates with low embodied carbon with innovative binders to produce durable composite construction materials.

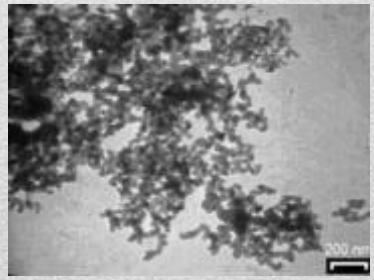
ISOBIO Project targets

- **50%** reduction in embodied energy and CO_2 emissions
- **15%** reduction in total costs
- **20%** better insulation properties than conventional materials
- **5%** total energy reduction over the lifetime of a building

Challenges

Condensation prevention within the panels
Maintain moisture buffering
Fire retardancy

Preserving the structure integrity of the building



Solutions

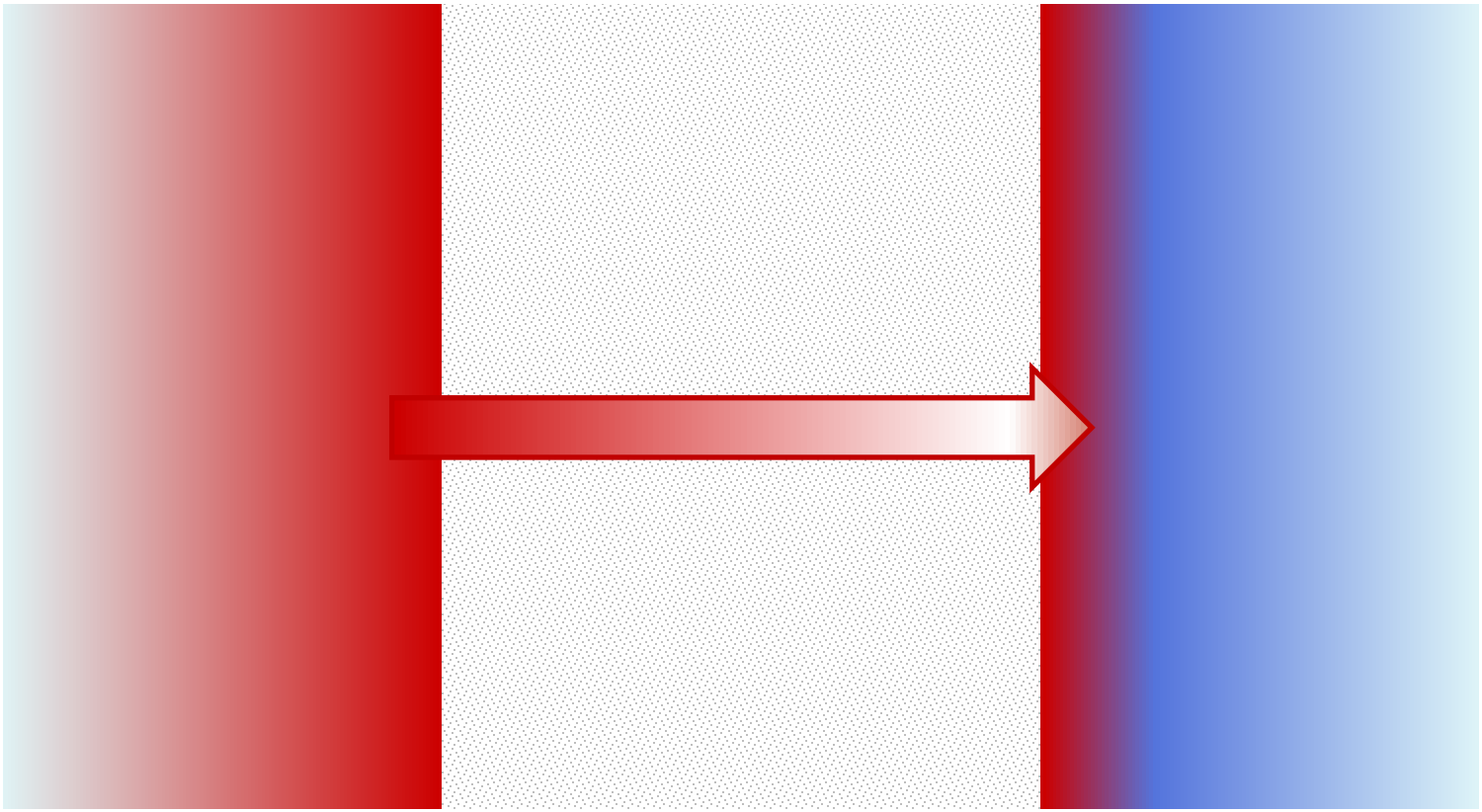
New protective treatments
- Water repellence
- Fire performance

Improvement of existing products
- Fibre insulation
- Hemp Lime
- Clay Board

Development of new products
- Use of natural lignin to bind bio-aggregate

isobio

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°636835.



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Functional unit

- Thermal conductivity of a material is usually reported as a lambda (λ) value (units: W/m.K) which is the quantity of heat in Watts conducted through a 1 m^2 wall of thickness 1 m when the temperature difference is 1 K.
- Insulation in a building is reported as a R (m^2.K/W) or as a U value (W/m^2.K) – depends on thickness
- R is thermal resistance and U is thermal transfer coefficient
- R = t/λ; U = λ/t ……where t = thickness

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Functional unit

Functional unit (1 m^2 with an R value of 1)

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Conclusions

- Have to be cautious when making comparisons between different materials
- Only fair comparison is with a functional unit
- Timber products are always superior when the sequestered atmospheric carbon is taken into account (GWP)

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