SUSTAINABLE PLACES 2024

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R2M RESEARCH TO MARKET SOLUTION

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY | LIST

Paper Session #5

Session Chair

Thomas Messervey
R2M Solution
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Supported by

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Opening | Paper Session #5 AGENDA

14:00 - 14:05 | **Thomas Messervey**, Welcome, Session Chair, CEO, R2M Solution

14:05 - 14:25 | **Mia Ala-Juusela**, Senior Scientist, VTT Technical Research Centre of Finland
Funding instruments that would support roll-out of Positive Energy Buildings

14:25 - 14:45 | **Thomas Messervey**, Project Coordinator Scaling Super Heero / Super Heero CEO R2M Solution
Super-Heero: Results of three crowdlending campaigns

14:45 - 15:05 | **Nitesh Karmacharya**, Researcher, ArcelorMittal Belval & Differdange S.A
Integration of Building Information Modeling in the Life Cycle Assessment of an office building, considering various structural materials

15:05 - 15:25 | **Danielle Abbey**, PhD Student, University of Sheffield
Whole life carbon impacts of non-residential retrofit at scale

15:25 - 15:30 | **Thomas Messervey**, Closing, Session Chair, CEO, R2M Solution

Funding instruments that would support roll-out of Positive Energy Buildings

Mia Ala-Juusela, VTT
Clemens Mayer, Joanneum Research
Andreas Türk, Joanneum Research

Sustainable Places 2024, 24th Sep 2024

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 870157. This document reflects only the author's view and the Commission is not responsible for any use that may be made of the information it contains.

Contents of the presentation

- EXCESS project & Positive Energy Buildings
- Benefits of energy efficiency and renewable energy sources
- European level legal framework
- Financing schemes available for PEBs and their suitability for EXCESS demos
- Recommendations to better support the roll-out of PEBs

EXCESS-project

- EXCESS is about FleXible user-CEntric Energy poSitive houseS
- How nearly-zero energy buildings can be transformed into positive energy buildings (PEBs)?
- Five years, starting in 2019
- 21 partners from 8 countries
- 4 demos in 4 climate zones

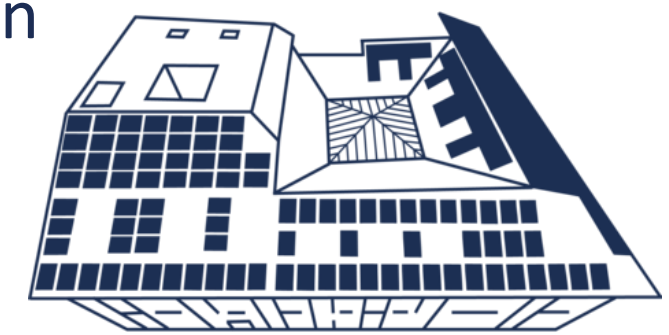
EXCESS Demos

- Former industrial complex in Graz, Austria

- Apartment building in Helsinki, Finland

- Social housing complex in Hasselt, Belgium

- Historical residential building in Valladolid, Spain



PEB definition for EXCESS

Positive Energy Building:

- **an energy efficient building**
- **produces more energy than it uses via renewable sources,** over a time span of one year.
- high self-consumption rate
- high energy flexibility
- high quality indoor environment **maintaining the comfort and well being** of the building occupants.

- able to **integrate the future technologies** like electric vehicles to maximize the onsite consumption and share the surplus renewable energy.

Components of PEB solution

PEB consists of the following technological components:

- Energy efficient building
- Renewable energy source
- Control system
- Storage

Benefits of PEB

- Those related to energy efficiency, e.g.
  - Reduced costs, emissions and risks
  - Improved flexibility and indoor conditions
- Those related to the use of renewable energy sources (+ storage + control), in addition to above:
  - Reduced dependency on external grids and their price variety
  - Improved self-sufficiency and resilience
  - Support to local economy and employment

\+ Many more

Legal framework in Europe

- Connection: The funding instruments are usually structured for supporting the legal framework
- Elements for both energy efficiency improvements and increase of the capacity of renewable energy in the European Union
- The realisation and detailed planning of EU-level targets, strategies and directives are left for the individual Member States > practices and emphases vary

Elements of the legal framework

- EPBD, several editions
- Green Deal
- Renovation Wave
- Fit-for-55
- Energy Efficiency Directive
- Renewable Energy Directive
- RePowerEU

Image source: Euopean Union 2023. FF55_DeliveringOnTheProposals_Factsheet.pdf

Existing financing frameworks

Plethora of opportunities for financing a PEB:

- EU-level
- National Level
- Regional Level
- City Level
- By technology

EU financing to kick-off the Renovation Wave

for Direct Investments

- Recovery and Resilient Facility
- Cohesion Policy Funds (ERDF, ESF, EU-REACT)
- Just Transition Mechanism - JTF

To leverage private investments

- InvestEU
- Private Financing 4 Energy Efficiency
- European Energy Efficiency Fund

for Research & Innovation

Horizon Europe
- Built 4 people
- EGD Calls
- Smart Cities

To address Market Barriers

- LIFE – Clean Energy Transition
- LIFE – Circular Economy & Quality of Life

For Technical Assistance and Advisory

- ELENA Facility
- Technical Support Instrument
- Technical Support – Cohesion Policy

European Commission

Image source: Stefan Moser, Head of Unit, European Commission, DG Energy, unit B.3: Buildings and Products. Renovation Wave The European Green Deal

Suitable funding schemes for Austrian demo

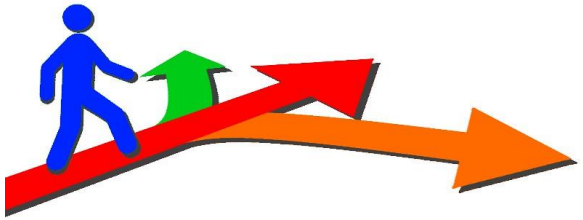
- Investment subsidy Photovoltaic
- Renovation bonus („Sanierungsbonus“) for multi-storey residential buildings
- Thermal component activation
- Heating system replacement
- Some funding schemes suitable for the technologies could not be applied as the building was not used as residential building before the renovation started (former fodder silo)

Suitable funding schemes for Belgian demo

- Premium from the network operator for the installation of a heat pump boiler in existing homes and recent new-build homes (DSO)
- Premium for photovoltaic solar panels (commissioning in 2021) (DSO)
- Interest free loan for energy efficiency measures which score better than the minimum EPB requirements

Conclusions on funding schemes

- Many funding opportunities and schemes available for energy efficiency and renewable integration
- Wide variety of schemes create challenges for the investors and house owners: hard to find the right channel
- Applying for funding from different sources create challenges in the timing - decision making has different lengths in different institutions providing the funding
- Most funding schemes are tied to a certain technology and not the holistic solution > too limited for PEBs
- Funding should rather take into account the final result
- Requires a common PEB definition & new ways of formulating the requirements for the funding + co-operation between the funding agencies



Recommendations

Facilitate the process, save time for the different actors, and thus speed up the green transition.

Helpdesk for applicants

Alignment of funding schemes

Reach the goals of the funding providers while clarifying the situation for the applicants.

Additional criteria

Targeted funding for e.g. low-income citizens to acquire PEB level for their buildings.

Desired results vs. technologies

Reaching PEB level usually requires use of several technical solutions together.

Suitability to target groups

Different actors have different possibilities to affect the level of energy positivity in different life-cycle stages.

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SUPER HEERO

Human Energy Efficiency Retrofitting Optimisation

Thomas Messervey
thomas.messervey@r2msolution.com
R2M Solution, CEO
Project Coordinator & Enthusiast

Paper: Results from 3 pilot campaigns and transition to Scaling Super Heero

Our Numbers

2012 founded

40% women

137+ R&D Projects

53 First Time EU Organizations

136 people

24% Ph.D.

619M Funds raised

9.3M turnover 2023

RESEARCH TO MARKET SOLUTION

Our Mission

To **facilitate and accelerate the development of technologies and services** to bring European scientific and technological research results to the market.

Our Values

COMMITMENT

We are committed to providing **innovative and high-quality solutions** to our customers, constantly striving for **excellence**.

DEDICATION

We pursue the success of our projects and our clients, always with our **maximum effort and care** into everything we do

NETWORKING

We believe in the **importance of collaboration** and building strong bonds with our clients, partners, and other organizations to **promote innovation and mutual success**

Our Journey

Innovation

Innovative Products

Sustainability Consulting & Energy Services

RESEARCH TO MARKET

Our Branches

10 Offices **in** **4** Countries

United Kingdom
London

Spain
Madrid
Barcelona
Bilbao

France
Roquefort-les-Pins
Paris

Italy
Pavia, HQ
Milan
Padua
Catania

What value do we unlock if we can bring community engagement to Supermarket EE interventions?


naturasi
bio per vocazione


SUPER HERO


SUPER
MEER

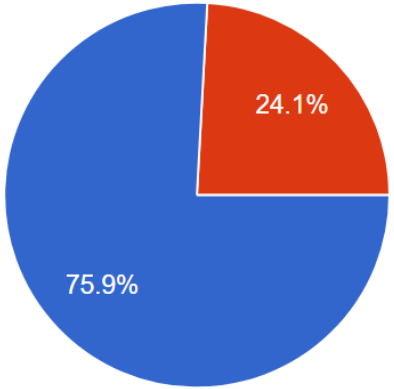

naturasì
bio per vocazione


naturasì
naturasì
naturasì
POSTEGGIO RISERVATO AI CLIENTI

What is the value unlocked of press & publicity?

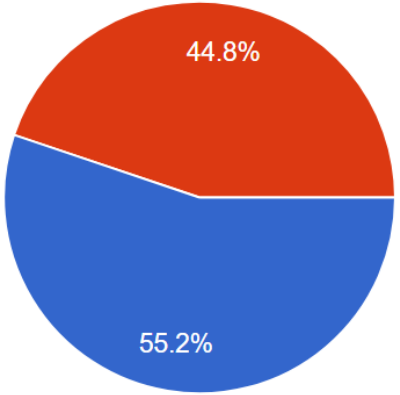
SUPER HEERO
Human Energy Efficiency Retrofitting Optimisation

How much value do we unlock if we can attain these types of results at scale?



This project gives me a more positive impression of NaturaSì

My impression of NaturaSì is not influenced by this project



I am more likely to shop at NaturaSì resultant of this campaign

My shopping habits will stay the same

SUPER HEERO

Human Energy Efficiency Retrofitting Optimisation

Please stop with all these questions and just tell me what this thing is and where I can buy it.

Super-Heero: Big Idea & Door Opener

A new way to connect to shoppers and build brand loyalty while saving energy and participating in the community

Super-Heero: How we do that

By making Energy Efficiency upgrades

Super-Heero: How we do that

And sharing the benefits with the shoppers and community via innovative financing schemes (Crowdlending + Rewards).

#HappyShoppers **#EnergySavings**

#Climate **#RenovtionWave**

#GreenDeal **#ESG/#SDG**

How it works!

The process adapts to:

- Supermarket Type
- Stakeholder Engaged
- Ownership structure

Supermarket Typologies

Urban Boutiques

Periphery medium size stores

Outer ring large stores

Old – Middle Age - New

Franchise Owned / Brand Owned / Co-Owned

Do not worry – there will be an EE intervention. If you want to be a Super-Heero, we will get it done.

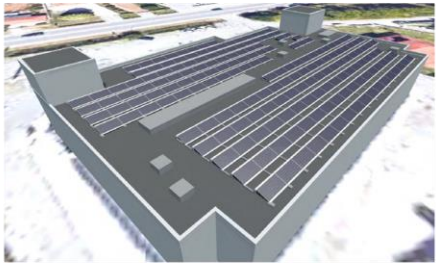
SUPER HEERO
Human Energy Efficiency Retrofitting Optimisation

Results of 3 Pilot Campaigns

Padova


naturasì | VIEMME | SUPER HEERO | R2M SOLUTION

Pordenone



naturasì | SUPER HEERO | R2M SOLUTION | GREEN TIME

Verona

naturasì | SUPER HEERO | R2M SOLUTION | GREEN TIME

Padova

naturasì · VIEMME · SUPER HEERO · R2M SOLUTION

Pordenone

naturasì · SUPER HEERO · R2M SOLUTION · GREEN TIME

Verona

naturasì · SUPER HEERO · R2M SOLUTION · GREEN TIME

SUPER HEERO
Human Energy Efficiency Retrofitting Optimisation

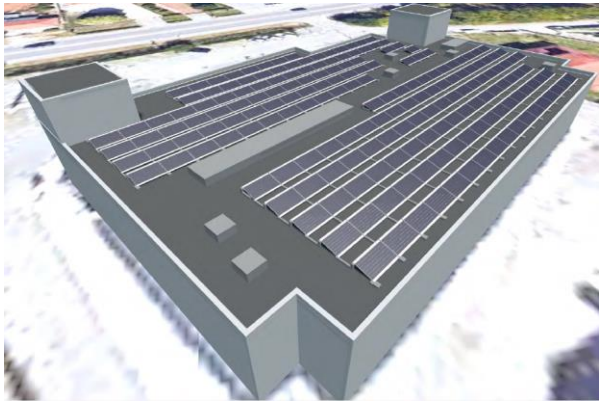
PV
tickets to community event

PV
Coupon
EV Charge

www.super-heero.com

PV
Heat Pump
Refrigeration
LED
Coupon
EV Charge
Staff Incentive

Business Plan Design



	10 anni	20 anni	30 anni
Energia Prodotta (MWh)	903	1805	2708
Beneficio CO_2 (Tons)	266	533	799
Valore €255/MWh	230,166 €	460,331 €	690,497 €
Valore €290/MWh	261,757 €	523,514 €	785,271 €

Rewards Program Design
Partner Side

SUPER HEERO

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naturasi
Pordenone

Rewards Program Design
Platform Side

Campaign Availability

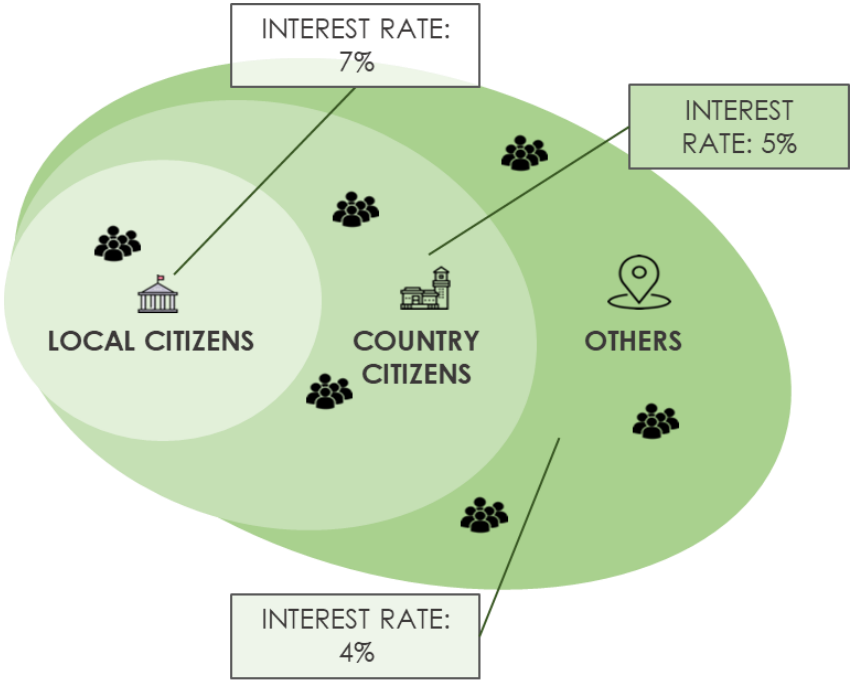
- 2 Weeks Local
- 1 Week Regional
- Opening National

Interest Rate

- 7% Local with loyalty card
- 6% Non-local with loyalty card
- 5% General Public (send link to get card)

Bonus Program

- 0.5% first time investors
- 0.5% refer a friend



naturasi

partecipa al webinar

Investi nel nostro impianto fotovoltaico e diventa protagonista della sostenibilità ambientale

rendimento garantito fino al 7%

Mercoledi 13 Aprile

ore 21.00

SUPER HEERO

Human Energy Efficiency Retrofitting Optimisation

Vuoi investire in un impianto fotovoltaico?

Vogliamo fare la nostra parte per la salvaguardia dell'ambiente in cui viviamo. A Maggio installeremo un impianto fotovoltaico da 25 kWp proprio qui, sul tetto del supermercato Naturasì. **Unisciti a noi!**

Il primo in Europa

In collaborazione con il progetto europeo Super-Heero, siamo i primi in Europa a invitare la comunità locale a investire con noi in un progetto di sostenibilità tramite il crowdlending e a condividerne i guadagni!

Rendimento fino al 7%

Hai letto bene!
È proprio così!

Investitori Via Parini Naturasi Aprile 2023				
Numero Investitore	Importo Investito	Tasso d'Interesse	Provenienza	
1	150.00 €	5.00	Campania / Casapulla	
2	150.00 €	6.00	Campania / Santa Maria la Fossa	
3	3,000.00 €	5.00	Emilia-Romagna / Castelfranco Emilia	NUOVO INVESTITORE
4	1,000.00 €	5.00	Emilia-Romagna / Ostellato	
5	100.00 €	6.00	Friuli-Venezia Giulia / Moimacco	
6	100.00 €	6.00	Lazio / Frosinone	
7	500.00 €	5.00	Lazio / Sacrofano	
8	2,500.00 €	6.00	Liguria / Pietra Ligure	
9	450.00 €	5.00	Lombardia / Castano Primo	
10	500.00 €	5.00	Lombardia / Gussago	
11	100.00 €	5.00	Lombardia / Mantova	
12	200.00 €	5.00	Lombardia / Milano	
13	100.00 €	6.00	Lombardia / Paderno Dugnano	
14	1,042.60 €	6.00	Lombardia / Pavia	
15	100.00 €	6.00	Piemonte / Ovada	
16	1,500.00 €	5.00	Piemonte / Settimo Torinese	
17	1,349.52 €	5.00	Piemonte / Settimo Torinese	
18	1,500.00 €	6.00	Piemonte / Torino	NUOVO INVESTITORE
19	100.00 €	5.00	Puglia / Massafra	
20	200.00 €	5.00	Sicilia / Caltanissetta	
21	5,000.00 €	6.00	Toscana / Cascina	
22	100.00 €	5.00	Toscana / Montopoli in Val d'Arno	
23	499.00 €	6.00	Veneto / Mestrino	NUOVO INVESTITORE
24	4,500.00 €	7.00	Veneto / Noventa Padovana	NUOVO INVESTITORE
25	1,533.57 €	6.00	Veneto / Noventa Padovana	
26	4,000.00 €	6.00	Veneto / Padova	NUOVO INVESTITORE
27	250.00 €	6.00	Veneto / Pieve di Soligo	
28	1,000.00 €	5.00	Veneto / Riese Pio X	
29	400.00 €	5.00	Veneto / San Dona' di Piave	
30	5,000.00 €	5.00	Veneto / Treviso	
31	1,100.00 €	6.00	Veneto / Trichiana	
32	1,231.00 €	5.00	Veneto / Venezia	
33	200.00 €	6.00	Veneto / Verona	
34	100.00 €	5.00	Veneto / Verona	
35	500.00 €	5.00	Veneto / Volpago del Montello	

TOTALE	**40,055.69 €**	
Mean interest rate		5.49
Weighted interest rate		5.68

Results

35 Investors
€40.055

One shopvestor specific to via Parini (€4,500 euros)
13 investors from the region for a total of €20,313
22 investors nationwide for a total of €19,742
5 new investors (not already part of Ener2crowd)
2 investors have opened the Naturasi card
16 investors are holders of the Naturasi card
19 investors are not holders of the Naturasi card

"Good morning, I already answered the survey last Friday, I take this opportunity to thank you for the opportunity offered to me to visit, with Green Souls, gardens in my city, some of which have never been seen.
Very interesting visit!
Cordially"

	Padova (PV)	Pordenone (PV)	Verona (PV + EE)
Fund raised	40,055.69 €	60,383.8 €	85,096.00 €
Number of Investors	35	64	99
Average investment per person	1,144.4 €	943.5 €	860 €
Mean interest rate	5.49	5.4	6.93
Regional Investors	13 (35%) Tot. 20,313 € **Ave. 1,562.5 €**	8 (13 %) Tot. 7,100 € **Ave. 887.5 €**	9 (9 %) Tot. 8,542.8 € **Ave. 949.2 €**
New Investors	5 (14%) Tot. 13,499 € **Ave. 2,700 €**	4 (6%) Tot. 11499 € **Ave. 2,874.8 €**	6 (6%) Tot. 2100 € **Ave. 350 €**
New Regional Investors	3 (Ave. inv. 3000 €)	0	1 (Ave. inv. 1000 €)
Cardholders Naturasi	16 (45%) 2 New Cardholders	22 (34.3%) Tot. 34,237 € Ave. 1556.2 €	44 (44 %) Tot. 67,263.2 € **(78%)** Ave. 1528.7€
Average age		45	45
Number of Women (%)		11 (17%)	14 (14%)

Key Lessons Learned

Crowd:

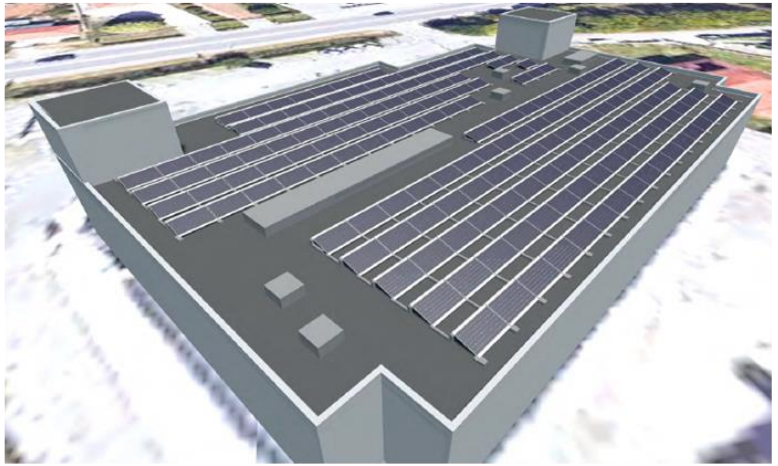
- Getting new people into the ecosystem takes a lot of work
- Once a community is built – there is the opportunity to curate it
- Ambushing people in the store isn't effective. In our second campaign we are making better use of associations or hubs that are promoters of sustainability
- People waited and then missed it!

Renovation Project:

- A process and email list to coordinate all actors involved at key identifiable steps is a must
- The supermarket loved the result – but wasn't initially confident in the process. Having first examples is precious.
- We made great connections to the local municipality for the franchise owner – we look to do the same in the second pilot
- The bonus programs are low-cost great marketing

Second Pilot

Pordenone



Second Pilot

Thomas Messervey • You
CEO & Co-Founder R2M Group
1d •

Over the weekend, Simone Buffa and Massimo Fuccaro were at our SUPER-HEERO pilot with EcorNaturaSì Spa in the Municipality of Pordenone discussing how it all works in an in-shop aperitivo. Project page a ...see more

SUPER HEERO
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Post Informazioni Video Altro

NaturaSì Pordenone
2 h ·

Diventa protagonista della sostenibilità. Investi nel nostro impianto fotovoltaico 💡

Sostieni l'installazione, nel negozio di via Ungaresca 26/28,di un impianto fotovoltaico da 83kWp sul tetto del punto vendita.

Grazie al progetto EU Super-Heero, anche tu puoi entrare a far parte di una comunità che vuole avere un ruolo di primo piano per migliorare l'ambiente in cui vive. Se vuoi saperne di più partecipa online ai webinar di martedì 13 o 20 giugno alle ore 20.30💚

L'iscrizione al link bit.ly/3oZpgMl
Non mancare🥰

Home Amici Watch Marketplace Notifiche Menu


rasi
scelte di vitalità
un sì per la terra e per l'uomo
scelte di vitalità


SUPER HEERO


SUPER HEERO


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R2M


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R2M
SOLUTION


TERRE
DI ECOR
Il marchio biodinamico di alta qualità di naturasì
per la terra e per l'uomo
SUPER HEROES
naturasì


naturasì
naturasì
naturasì


SUPER HEROES

Welcome to Scaling Super Heero Project Concept & Main Ideas

Coordinator: R2M Solution

Thomas Messervey

Scaling SUPER HEERO

Human Energy Efficiency Retrofitting Optimisation

R2M RESEARCH TO MARKET SOLUTION

This project has received funding from the European Union's LIFE Programme for research and Innovation under Grant Agreement no. 101167752

Project Concept & Main Ideas

What are we doing in this project?

It is right in the name. We are Scaling Super-Heero.

New building types
New partners
More pilots / data
Improved everything

Background

Super Heero
OwnYourSecap
ESMES

Validated Crowd Platform

Business Driven Consortium Partners (Scalers)

Sharpening
the 5-step Process and Widening the Approach

Technology Packages

Voltage Regulation Audits

Sector Adaptations

Tree Planting Teambuilding

Growing
and Strengthening the Multi-Sided Ecosystem

Platform Redesign

Boosting SECAP

Signup Campaigns

Incentive Monitoring Program

Round 1 — **10 Pilot Implementations** — Round 2

Supermarkets

Retailers / Shopping Centers

Schools

Energy Communities

Assessments and Ecosystem Analytics

Structuring for Scaling

Cookbooks and Capacity Building

Structuring Financial and Structural Instruments

Agreements and Business Plan Forward

Results

Sharpened and Widened Method

Improved Platform v2

10 Pilots to 100 Projects Pipeline

Ignited Ecosystem

SECAPs

Energy Communities

Investment Product

Sign-Up Campaigns

Potentially raising capital

Sharpeners

Voltage Regulation in Auditing

Bundling and making accessible incentives

Sharpeners

Scaling SUPER HEERO

EDUCATION: TERRA MISSION

Life Terra

6 MILLION TREES PLANTED!

In February 2024, we achieved a remarkable milestone: we reached 6 million trees planted!

With the help of dedicated volunteers, like Tristan, we put in the ground our tree number 6 million in the Green Rebel farm, in Miravet, Catalonia (Spain).

We were extremely proud of this achievement and to be able to share this beautiful moment with Tristan, his family and the people of the Green Rebel farm.

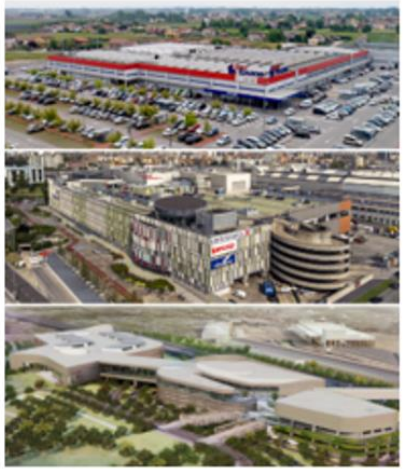
25
European **countries**

56,392
citizens involved

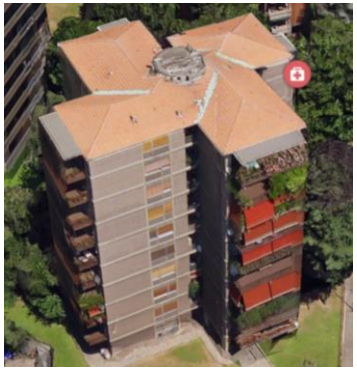
Hunting Pilots

Schools

Commercial Shopping Centers



Condominium Pavia



Small Airport

Sport Association

Technology Park

Scaling SUPER HEERO
Human Energy Efficiency Retrofitting Optimisation

Unique Value Proposition

- Engage people
- Deliver social impact
- Build brand loyalty
- Actions on the territory
- Make news

Stay tuned
We're going big

Make EE Renovation "Sexy" again

SUPER HEERO

Human Energy Efficiency Retrofitting Optimisation

SUPER-HEERO

SuperHeero_EU

@ thomas.messervey@r2msolution.com

www.super-heero.com

Horizon 2020
European Union Funding
for Research & Innovation

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 894404

Integration of Building Information Modeling in the Life Cycle Assessment of an office building

ArcelorMittal Global Research and Development
Date 24th September 2024

Nitesh KARMACHARYA
Jose Humberto Matias De Paula

Content

- Background
- BIM tool used
- Integration of Environmental data
- Definition of LCA boundaries
- Environmental Information in BIM objects
- EPDs adopted
- Case: Office Building
- Result and Discussion

Background

- The European Green Deal plans to transform its Economy to become climate-neutral continent by 2050.
- Achievement of net-zero greenhouse gas emission is an important goal. Reduce emissions by at least 55% by 2030 (compared to 1990 levels).
- The construction sector is responsible for 39% of global carbon emission.[1]
- While energy sector is undergoing decarbonization, the importance of embodied carbon in climate changes has become increasingly evident.
- The embodied carbon in construction materials (concrete, steel, glass) constitutes 11% of global energy-related CO_2 emissions.[2]
- A crucial method for achieving this goal involves the application of Life Cycle Assessment (LCA).
- LCA gives a systematic, scientific method to evaluate environmental impacts associated with all stages of products life cycle.

[1] Global Alliance for Buildings and Construction (GlobalABC). (2020). 2020 Global Status Report for Buildings and Construction. UNEP
[2] United Nations Environment Programme (UNEP). (2020). Global Status Report 2020: Towards a Zero-Emission, Efficient, and Resilient Buildings and Construction Sector.

Background- BIM

- In construction sector Building Information Modeling (BIM) is powerful tool for optimizing design, evaluation and construction phases. It has proven significance in cost reduction, efficiency, time-reduction and improved collaboration.
- The adoption of BIM is worldwide. It is even being used for build permit process.
- BIM can simplify and reduce data acquisition process during LCA application through automation(Bill of materials).
- LCA and BIM can be used together to automate procedures:
  - Data acquisition;
  - Results calculation.
- To do this, ArcelorMittal has integrated environmental properties in Building Information Modelling in the object level.
- Incorporating these properties during the modeling phase enables the rapid generation of LCA data, which can be utilized effectively in the design phase.
- Carbon emission being one of the key target, the LCA indicator selected to be integrated in BIM is Global Warming Potential (GWP) as $kgCO_2$-eq. /FU.

BIM tool

- There are several BIM tools available in the market.
- A survey conducted by ArcelorMittal with 11 different design offices showed that majority of them use Revit for BIM-modelling.
- Market research done by USP Marketing Consultancy (Q2 2021 European Architectural Barometer), asked Architects from eight European countries which BIM software they use the most. Together, Autodesk and Graphisoft are the two players dominating the European market, with between 80% of the architects using their software for BIM.[3]
- To reach higher compatibility, Autodesk Revit was used to develop the BIM object enriched with environmental data.

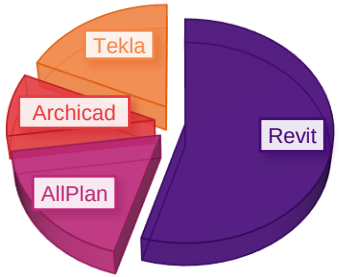


Figure – Share of BIM tool used by desinger From survey conducted by AM

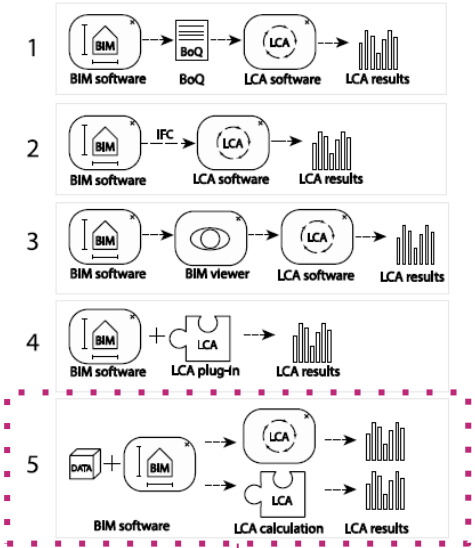
Figure – Share of BIM tool used by Architects from survey conducted by USP Marketing Consultancy.

[3] USP Marketing Consultancy (Q2 2021 European Architectural Barometer).

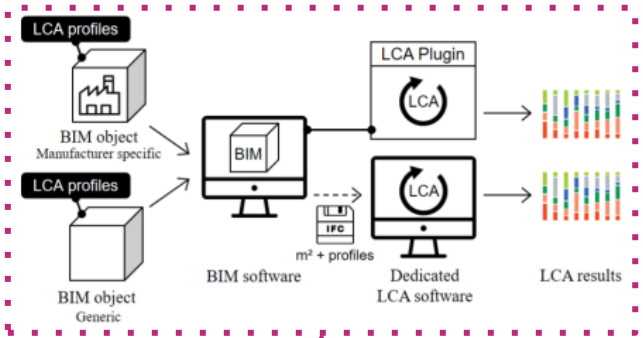
Integration of Environmental data in BIM – How?

Wastiels and Decuypere define how BIM and LCA can be integrated. These researchers divided BIM-LCA integration into five types:

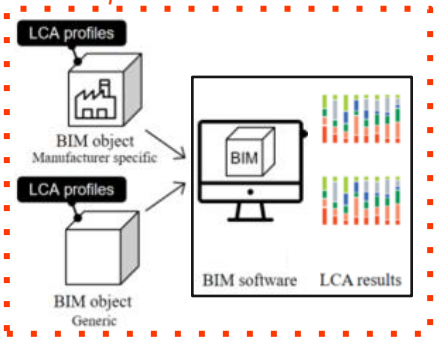
Source: Wastiels and Decuypere



Source: Wastiels and Decuypere



Link Adopted:



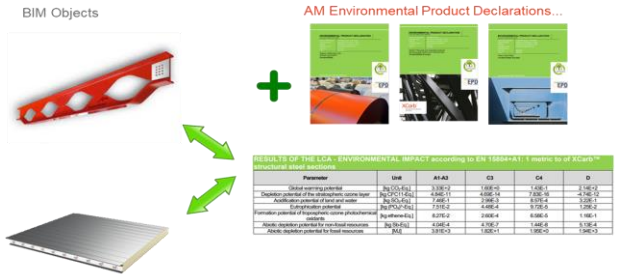


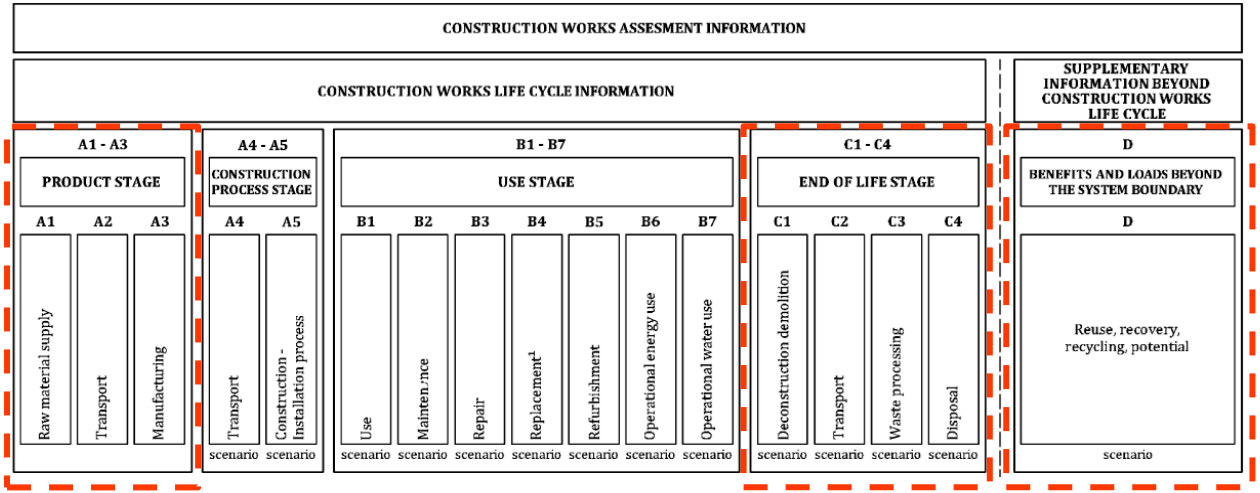
Figure – BIM objects enriched with environmental data.

[4] Identification and comparison of LCA-BIM integration strategies.(2019) Wastiels L, Decuypere R

Definition of LCA boundaries of assessment considering BIM/software constraints

The majority of EPDs, including ArcelorMittal's published EPDs, declare the following life cycle stages:

- Product stage A1-A3: This stage accounts for impacts related to material extraction A1, transport to a manufacturing center A2 and manufacturing of the raw materials into the final product.
- EOL C3 and C4: C3 accounts for the impacts related to the waste treatment and C4 account for impacts related to disposal.
- Potential benefits outside the system boundaries D: D accounts for benefits related to the EOL scenario (e.g.: recycling benefits avoiding extraction of raw materials for production)



Environmental Information in BIM objects

Based on ISO 22057:22 and considered LCA boundaries and environmental indicator, the following list of properties was considered to be highly important and to be added to BIM objects:

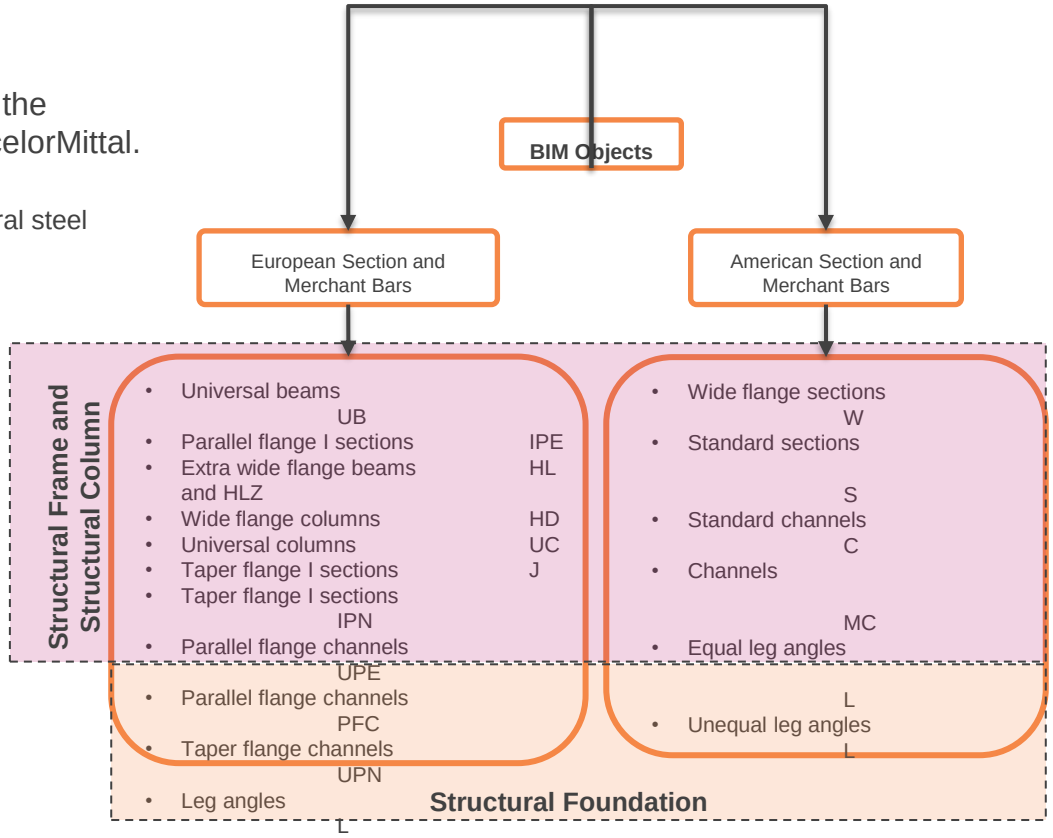
- EPD General Information:
  - Data set valid until;
  - EPD program operator;
  - Name of the owner;
  - Product name;
  - Production site(s) name;
  - Production technology;
  - Region(s) according to ISO 3166-2;
  - Web domain;
- EPD Methodological framework:
  - Generic LCA data;
  - information module;
  - LCA EOL scenario;
- Reference unit and RSL:
  - Application;
  - Mass conversion factor;
  - Reference unit type;
  - Time period;
- EN 15804:2012+A1:2013 LCIA Indicators
  - Global warming potential

Green Building Properties	
LCA_EoL_Scenario type (default)	88% recycling, 11% re-use, 1% landfill
LCA_GEN_Data set valid until (default)	06/02/2024
LCA_GEN_EPD programme operator (default)	Institut Bauen und Umwelt e.V. (IBU)
LCA_GEN_EPD registration number (default)	EOD-ARM20190015-CBD1-EN
LCA_GEN_Name of owner (default)	ArcelorMittal Europe-Long Products
LCA_GEN_Product name (default)	Structural seteel sections andmerchant bars
LCA_GEN_Production site(s) name (default)	LU: Differdange, Belval, Rodange/ RO: Huned
LCA_GEN_Production technology (default)	
LCA_GEN_Region(s) according to ISO 3166-2 (	LU
LCA_GEN_Web domain (default)	https://epdonline.com/PublishedEpd/Detail?i
LCA_MET_Generic LCA data (default)	NO
LCA_MET_Information module (default)	A1-A3; C3; C4; D
LCA_RSL_Application (default)	Buildings, bridges and composte steel and co
LCA_RSL_Mass conversion factor (default)	0.001000
LCA_RSL_Reference unit type (default)	t
LCA_RSL_Time Period (years) (default)	100.000000
LCIA_GWP_kgCO2eq_100years_A-C (default)	246.738816
LCIA_GWP_kgCO2eq_100years_A-D (default)	218.142096
LCIA_GWP_kgCO2eq_100years_A1-A3 (default	246.200800
LCIA_GWP_kgCO2eq_100years_C (default)	0.538016
LCIA_GWP_kgCO2eq_100years_D (default)	-28.596720
LCI_GWP_kgCO2eq_100years_A1-A3 (default)	842.000000
LCI_GWP_kgCO2eq_100years_C (default)	1.840000
LCI_GWP_kgCO2eq_100years_D (default)	-97.800000

These information were included in the BIM objects under the parameter “Green Building Properties”

EPDs and BIM objects

- BIM objects are prepared with Environmental data.
- The environmental data were included according to the Environmental Product declaration published by ArcelorMittal.
  - EPD- Structural steel sections and merchant bars
  - EPD- XCarb™ Recycled and renewably produced Structural steel sections and merchant bars



ArcelorMittal

Case: BIM modeling of Office building in Autodesk® REVIT

- Using this BIM object an office building was modelled.
- Beam Sections
  - IPE100, W250x100x22.3, W310x100x32.7, W360x170x44.6, W460x150x60, W460x150x68, W530x210x82, W610x230x101
- Column Sections
  - UC152x152x23, UC152x152x30, UC152x152x37, UC203x203x46, UC203x203x60, UC203x203x7, UC254x254x73

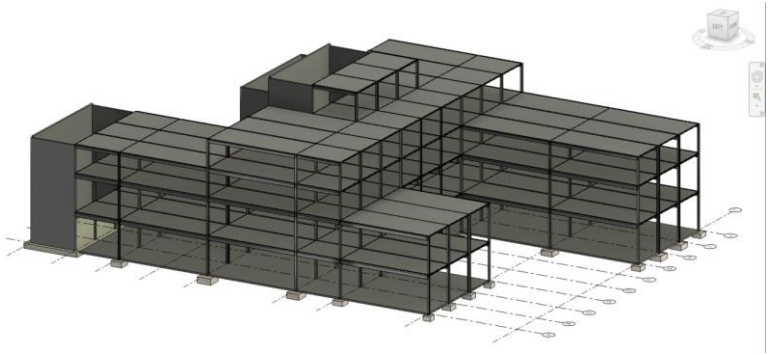


Figure – Revit Model of the result from VDP.

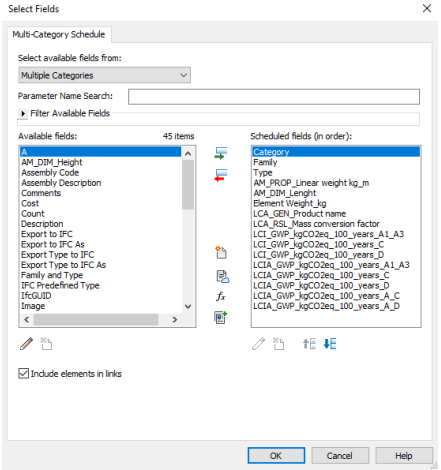


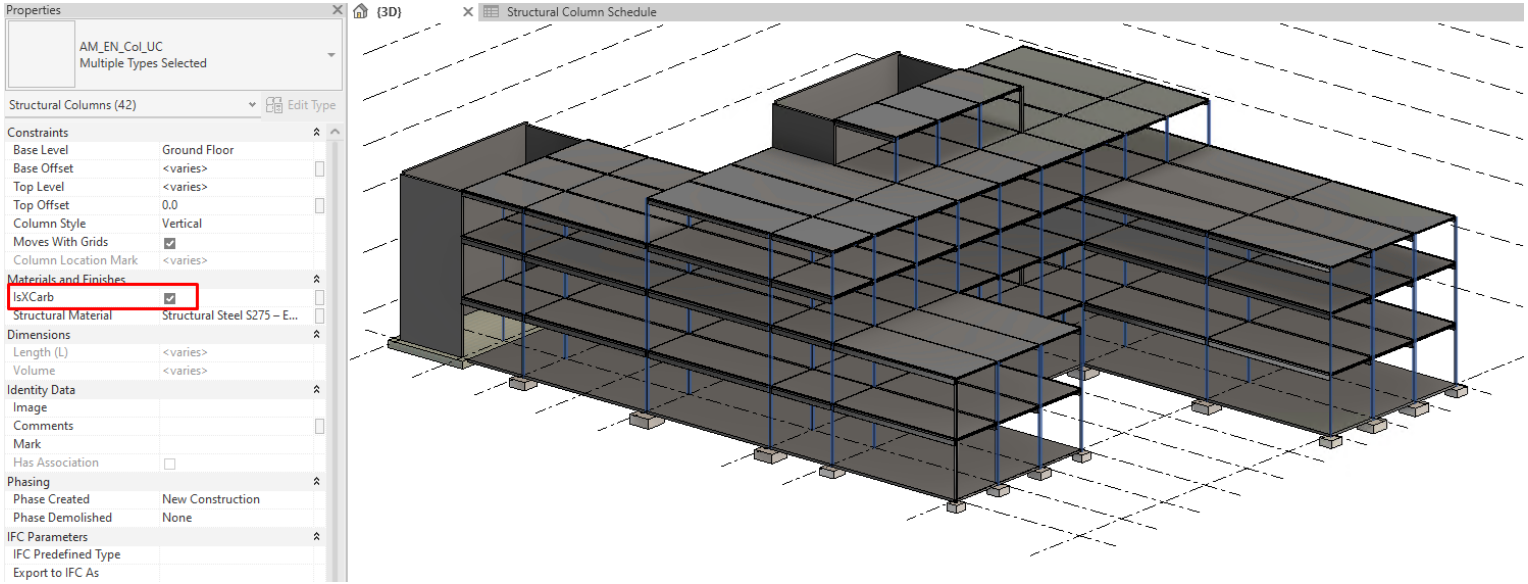
Figure – Schedule in Revit.

A	B	C	D	E	F
Family and Type	Structural Material	LCA_EoL_Scenario type	LCIA_GWP_kgCO2eq_100years_A1-A3	LCIA_GWP_kgCO2eq_100years_A-C	LCIA_GWP_kgCO2eq_100years_A-D
AM_US_FRA_W: W 460 x 150 x 60	Structural Steel	88% recycling, 11% re-use, 1	505.038336	506.141983	447.48076
AM_US_FRA_W: W 460 x 150 x 60	Structural Steel	88% recycling, 11% re-use, 1	505.043388	506.147046	447.485237
AM_US_FRA_W: W 460 x 150 x 60	Structural Steel	88% recycling, 11% re-use, 1	252.918276	253.470972	224.094003
AM_US_FRA_W: W 460 x 150 x 60	Structural Steel	88% recycling, 11% re-use, 1	504.881724	505.985028	447.341997
AM_US_FRA_W: W 460 x 150 x 60	Structural Steel	88% recycling, 11% re-use, 1	252.918276	253.470972	224.094003
AM_US_FRA_W: W 460 x 150 x 60	Structural Steel	88% recycling, 11% re-use, 1	504.881724	505.985028	447.341997
AM_US_FRA_W: W 460 x 150 x 60	Structural Steel	88% recycling, 11% re-use, 1	252.918276	253.470972	224.094003
AM_US_FRA_W: W 460 x 150 x 60	Structural Steel	88% recycling, 11% re-use, 1	505.2	506.304	447.624
AM_US_FRA_W: W 460 x 150 x 60	Structural Steel	88% recycling, 11% re-use, 1	505.2	506.304	447.624
AM_US_FRA_W: W 460 x 150 x 60	Structural Steel	88% recycling, 11% re-use, 1	252.933432	253.486161	224.107432
AM_US_FRA_W: W 460 x 150 x 60	Structural Steel	88% recycling, 11% re-use, 1	503.28024	504.380045	445.923029
AM_US_FRA_W: W 460 x 150 x 60	Structural Steel	88% recycling, 11% re-use, 1	505.038336	506.141983	447.48076
AM_US_FRA_W: W 460 x 150 x 60	Structural Steel	88% recycling, 11% re-use, 1	505.361664	506.466017	447.76724
AM_US_FRA_W: W 530 x 210 x 82	Structural Steel	88% recycling, 11% re-use, 1	690.44	691.9488	611.7528
AM_US_FRA_W: W 530 x 210 x 82	Structural Steel	88% recycling, 11% re-use, 1	690.44	691.9488	611.7528
AM_US_FRA_W: W 530 x 210 x 82	Structural Steel	88% recycling, 11% re-use, 1	690.219059	691.727376	611.557039
AM_US_FRA_W: W 530 x 210 x 82	Structural Steel	88% recycling, 11% re-use, 1	690.44	691.9488	611.7528
AM_US_FRA_W: W 530 x 210 x 82	Structural Steel	88% recycling, 11% re-use, 1	690.44	691.9488	611.7528
AM_US_FRA_W: W 530 x 210 x 82	Structural Steel	88% recycling, 11% re-use, 1	688.251305	689.755322	609.813544
AM_US_FRA_W: W 530 x 210 x 82	Structural Steel	88% recycling, 11% re-use, 1	690.219059	691.727376	611.557039

Figure – Example of LCA values obtained from BIM objects in Revit.

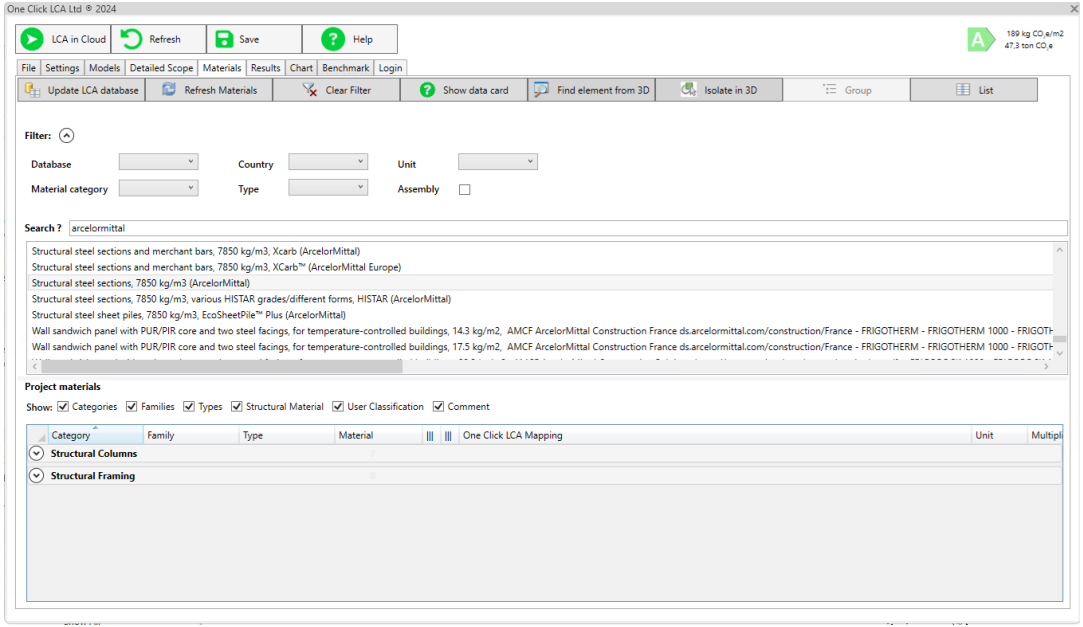
Low Carbon Switch

- The BIM objects include data from ArcelorMittal Standard Steel and XCarb™ Steels
- XCarb™ steel is an initiative focused on reducing carbon emissions throughout the steelmXCaking process, aiming to support the decarbonization of the steel industry.
- In the Revit Environment, user can simply toggle between Standard steel and XCarb™ Steels using a toogle and compare the values obtained for carbon emission.



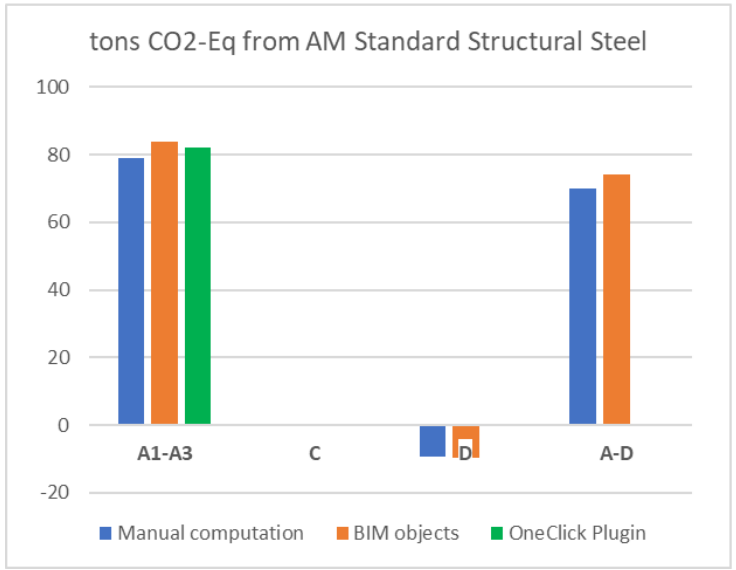
OneClick LCA Plugin in Revit

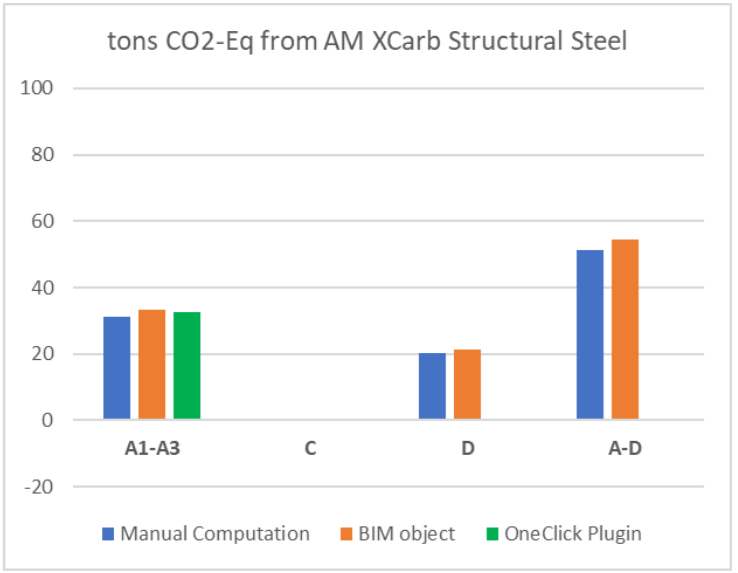
- OneClick LCA also provides plugin for Autodesk Revit for Computing LCA for A1-A3
- The plugin is able to adopt volume data from Revit and apply the unit weight according to material for computing carbon emission for A1-A3 Phase.
- The plugin provides wide range of data and user can choose the EPD to compute the environmental data.



Results

- The carbon emission values for the structural steel used in the whole building obtained from BIM objects, manual computation and Onclick LCA can be seen below





Discussion

- The result obtained from the three methods adopted are comparable.
- The difference is obtained due to the difference in quantity consideration in each method. The differences are consistent.
- If used properly the LCA enriched BIM objects can help compare among material options.
- It is important to enrich BIM in object level, this can introduce many potentials of BIM process.

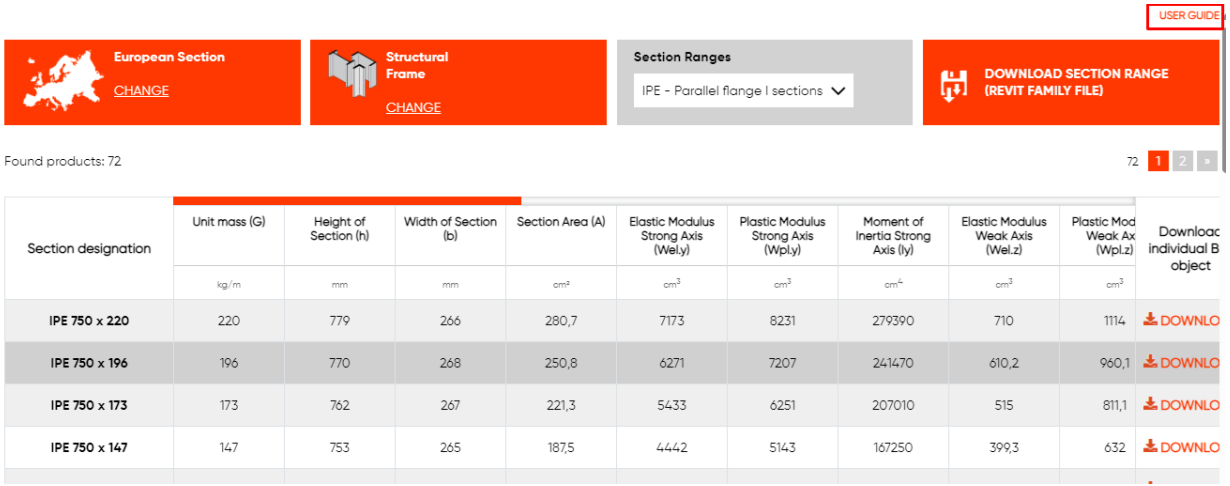
Limitation of the Environmentally enriched BIM data

- All the BIM objects for a category should be compatible to compute accurate LCA data. Ex. All the column members should have environmental data else; the computed values would be incomplete.
- The environmental data should be updated with update in EPDs and addition of material options.

BIM objects from ArcelorMittal

BIM objects enriched with Environmental data can be downloaded here :
https://sections.arcelormittal.com/design_aid/BIM/EN

Or Scan



Section designation	Unit mass (G)	Height of Section (h)	Width of Section (b)	Section Area (A)	Elastic Modulus Strong Axis (Wel.y)	Plastic Modulus Strong Axis (Wpl.y)	Moment of Inertia Strong Axis (Iy)	Elastic Modulus Weak Axis (Wel.z)	Plastic Mod Weak Ax (Wpl.z)	Downloac individual B object
	kg/m	mm	mm	cm²	cm³	cm³	cm⁴	cm³	cm³	
IPE 750 x 220	220	779	266	280,7	7173	8231	279390	710	1114	DOWNLO
IPE 750 x 196	196	770	268	250,8	6271	7207	241470	610,2	960,1	DOWNLO
IPE 750 x 173	173	762	267	221,3	5433	6251	207010	515	811,1	DOWNLO
IPE 750 x 147	147	753	265	187,5	4442	5143	167250	399,3	632	DOWNLO

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ArcelorMittal

Thank you

SUSTAINABLE PLACES 2024

ArcelorMittal

Whole life carbon impacts of educational retrofit at scale

Danielle Abbey

School of Mechanical, Aerospace and Civil Engineering

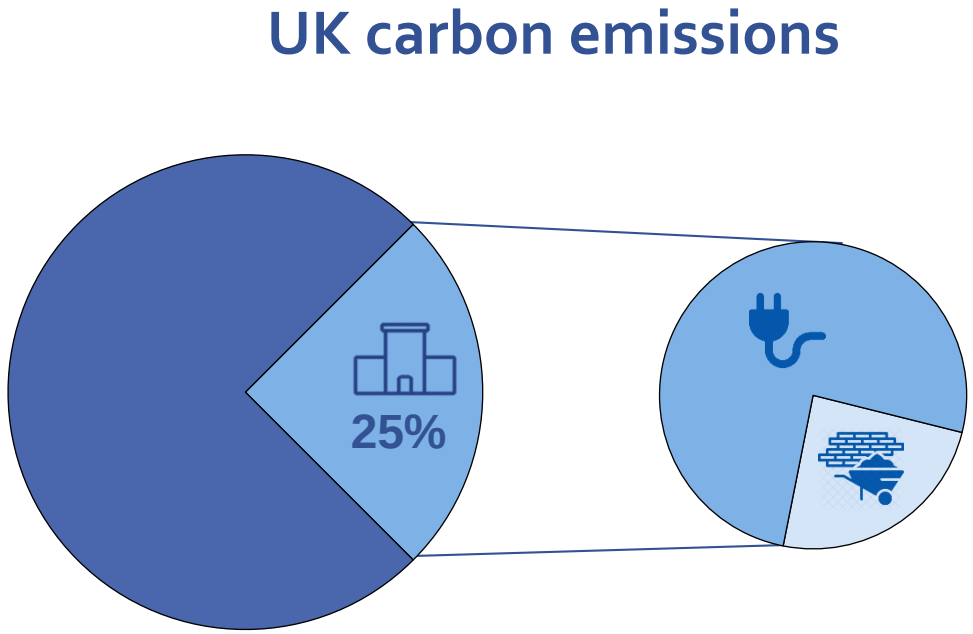
University of Sheffield

SUSTAINABLE PLACES 2024

Engineering and Physical Sciences Research Council

University of Sheffield

Why do we need retrofit at scale?



(UKGBC, 2021)

Research aims

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1. What is the impact of retrofit on total carbon emission for our **non-residential stock?**
    - Using English school buildings as a case study

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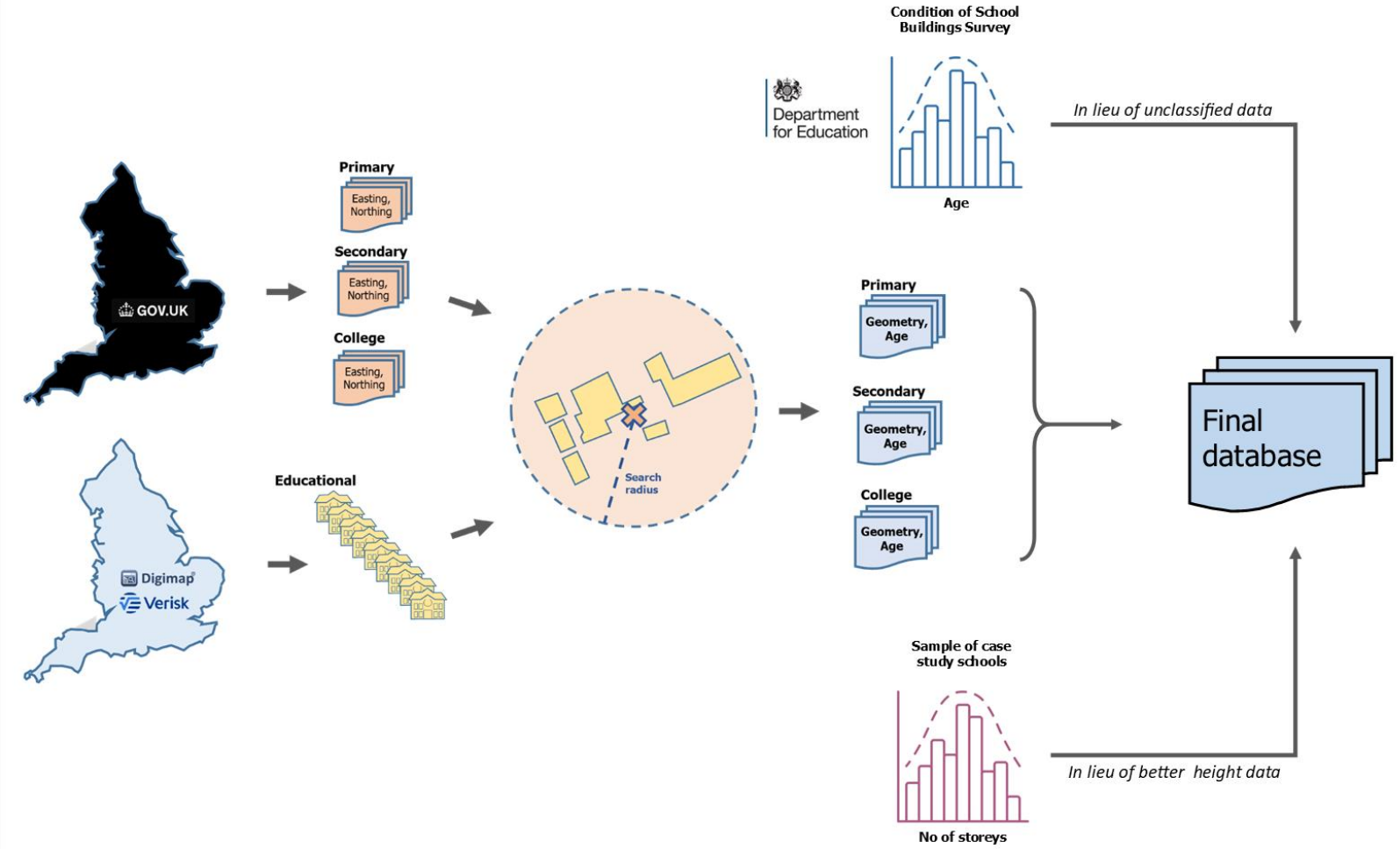
Research aims

1. What is the impact of retrofit on total carbon emission for our **non-residential stock?**
   - Using English educational buildings as a case study
2. What is the impact of material emissions **from a whole life perspective** on meeting carbon budgets and targets?
3. What is the best **pathway** we should be adopting to successfully retrofit our schools and how does this compare to current practice?
   - Comparing different sensitivities such as electricity and material decarbonisation.
   - Comparing retrofit to the option of demolition and new construction.

Methodology

Methodology – Data collection



*The whole life carbon impact of retrofit to our existing English school stock (Abbey, Arbabi and Densley Tingley) – **Paper in prep***

Methodology – Whole life carbon

Energy modelling:

$$\boldsymbol{F}_{total}(kWh) = \boldsymbol{F}_{heating} + \boldsymbol{F}_{DHW+Kitchen} + \boldsymbol{F}_{electricity}$$

- Input data and simple model tested on 235 case studies using metered energy data.

Whole life Carbon:

- **System boundaries:** A1 – C4
- **Data Sources:** Environmental Product Declarations, Manufacturers data and RICS Guide to whole life carbon.

*The whole life carbon impact of retrofit to our existing English school stock (Abbey, Arbabi and Densley Tingley) – **Paper in prep***

Methodology – Carbon budget

		England	Buildings – operational and embodied carbon	Public Sector	Educational stock	Primary, secondary schools and colleges
2025 – 2050	**CCC budget** Government has set its carbon budget in line with this. **($MtCO_2e$):**	3677	920	106	38	**20.8**
	Tyndall budget A more stringent budget **($MtCO_2$):**	917	229	26.4	9.5	**5.2**

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(HM Government, 2021)(CCC, 2020) (Tyndall Centre, 2024)

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Direct UK emissions only

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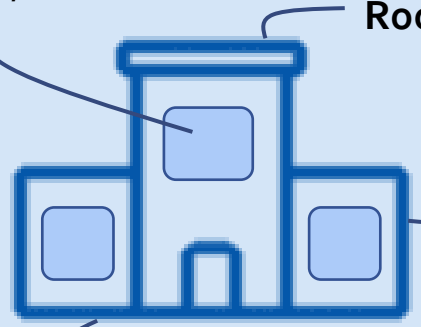
(CCC, 2020) (Tyndall Centre, 2024)

Retrofit scenario

Retrofit to a PartL2B (UK building regulation) standard:

Window U-Value = 1.6 W/m^2K

Roof U-value = 0.16 W/m^2K



Wall U-value = 0.3/0.35 W/m^2K

Floor U-Value = 0.25 W/m^2K

Heating = All existing heating and hot water systems replaced with **heat pumps**.

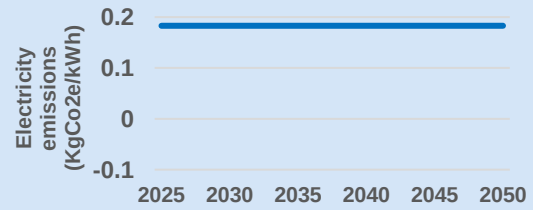
*The whole life carbon impact of retrofit to our existing English school stock (Abbey, Arbabi and Densley Tingley) – **Paper in prep***

(HM Government, 2023)

Decarbonisation scenarios

No decarbonisation

- Constant electricity carbon factor.

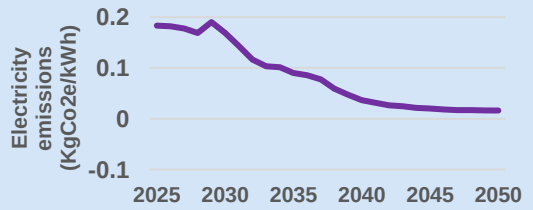


- No material decarbonisation.

- Heat pump refrigerant is **R513A**.

Falling short

- Electricity carbon factor follows *the UK national grid* ***Falling short*** *scenario:*

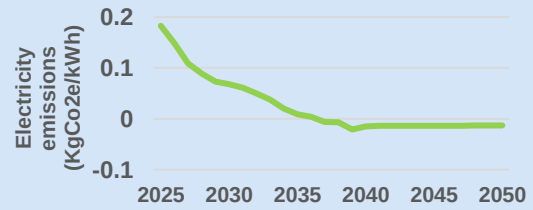


- Material decarbonisation: *Follows the Industrial pathways* ***Business as Usual model.***

- Heat pump refrigerant is **R513A**.

Leading the Way

- Electricity carbon factor follows *the UK national grid* ***Leading the way*** *scenario:*



- Material decarbonisation: *Follows the Industrial pathways* ***Max technical model.***

- Heat pump refrigerant is **R774.**

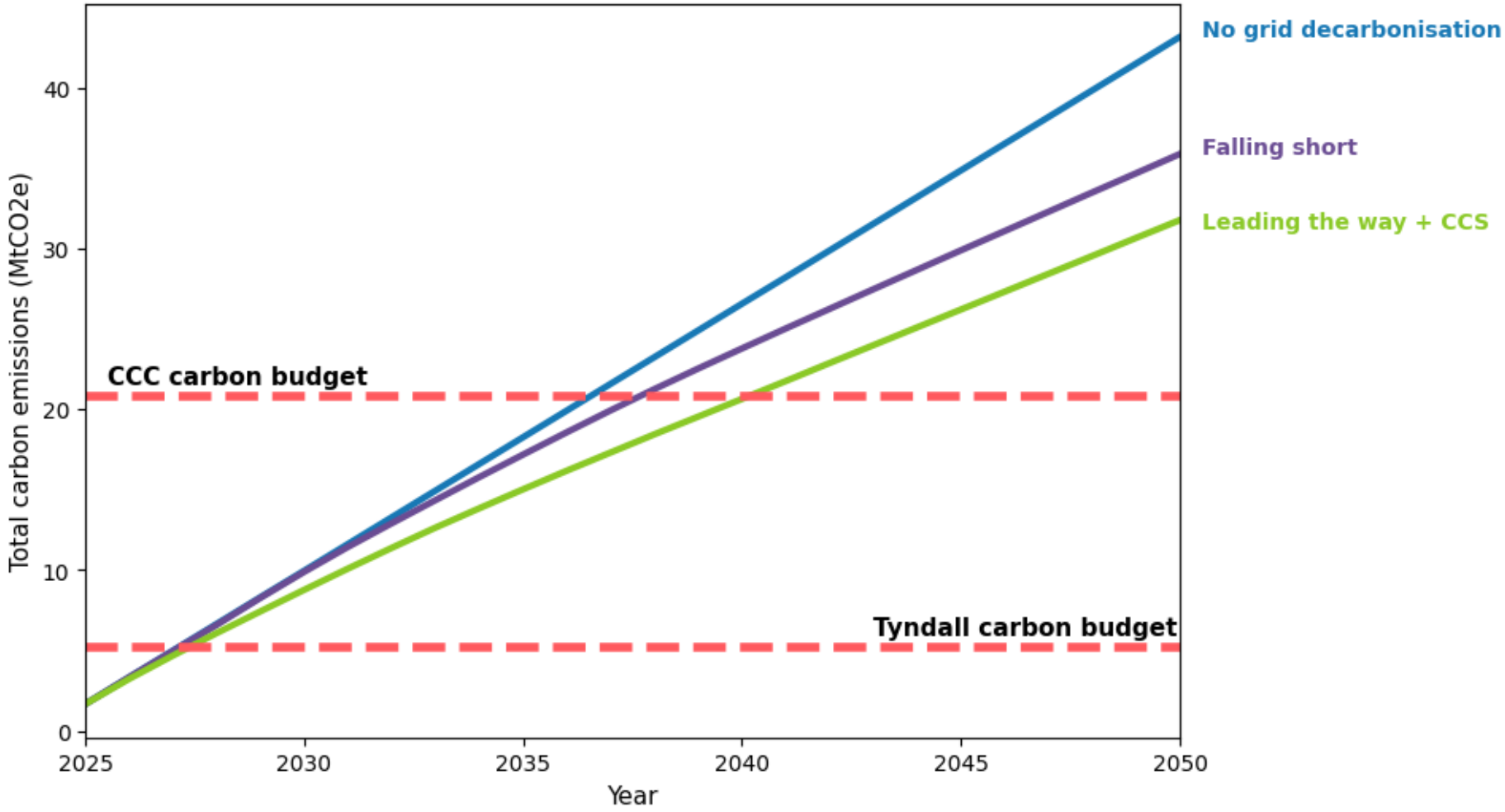
The whole life carbon impact of retrofit to our existing English school stock (Abbey, Arbabi and Densley Tingley) – ***Paper in prep***

(ESO, 2024) (DoECC & DBIS, 2015)

Results

The whole life carbon impact of retrofit to our existing English school stock (Abbey, Arbabi and Densley Tingley) – ***Paper in prep***

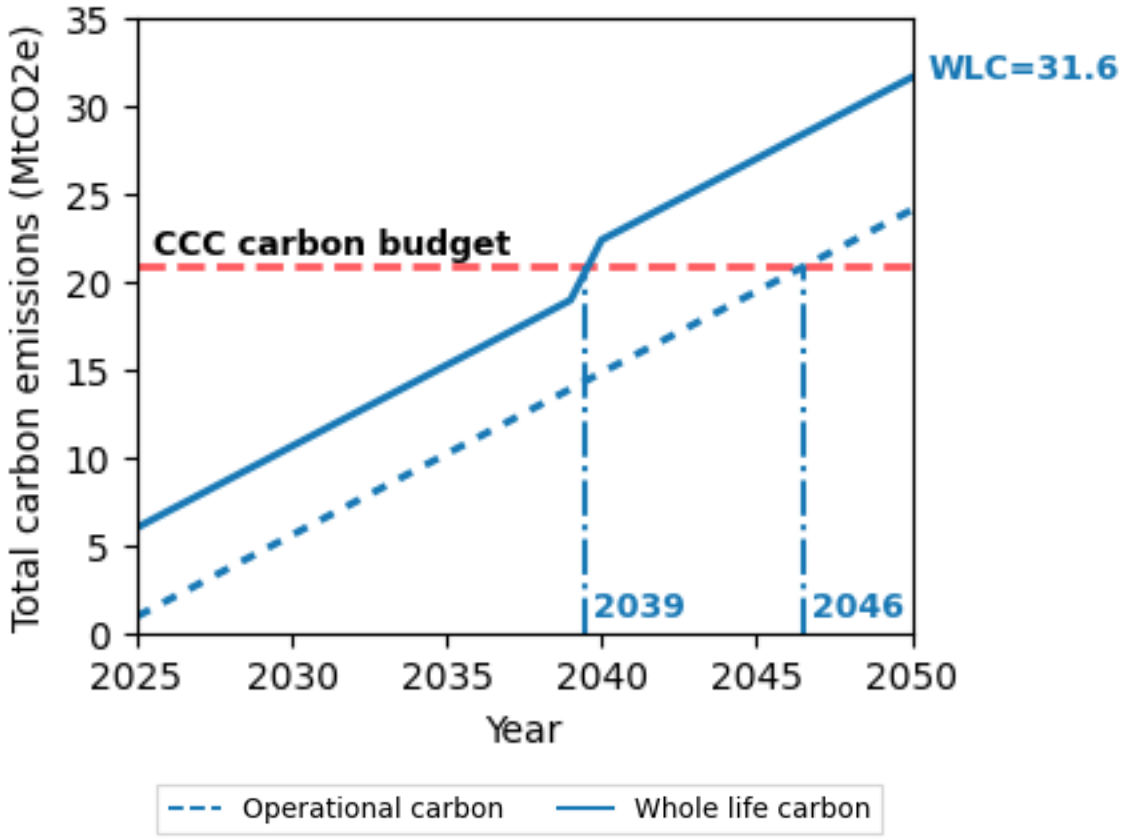
Results – *Baseline operational carbon*



The whole life carbon impact of retrofit to our existing English school stock (Abbey, Arbabi and Densley Tingley) – ***Paper in prep***

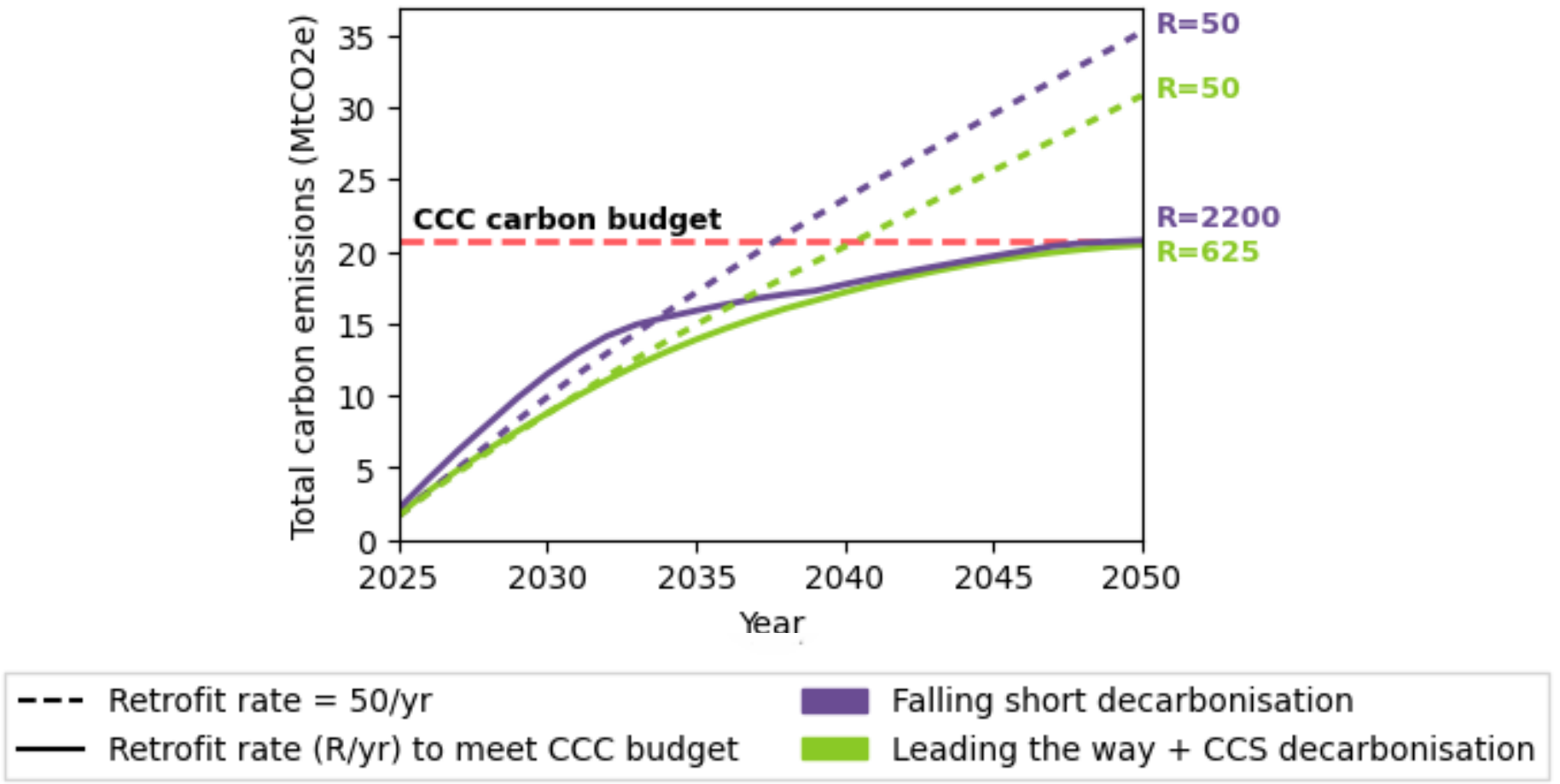
Results – *No decarbonisation*

Everything retrofit in 2025



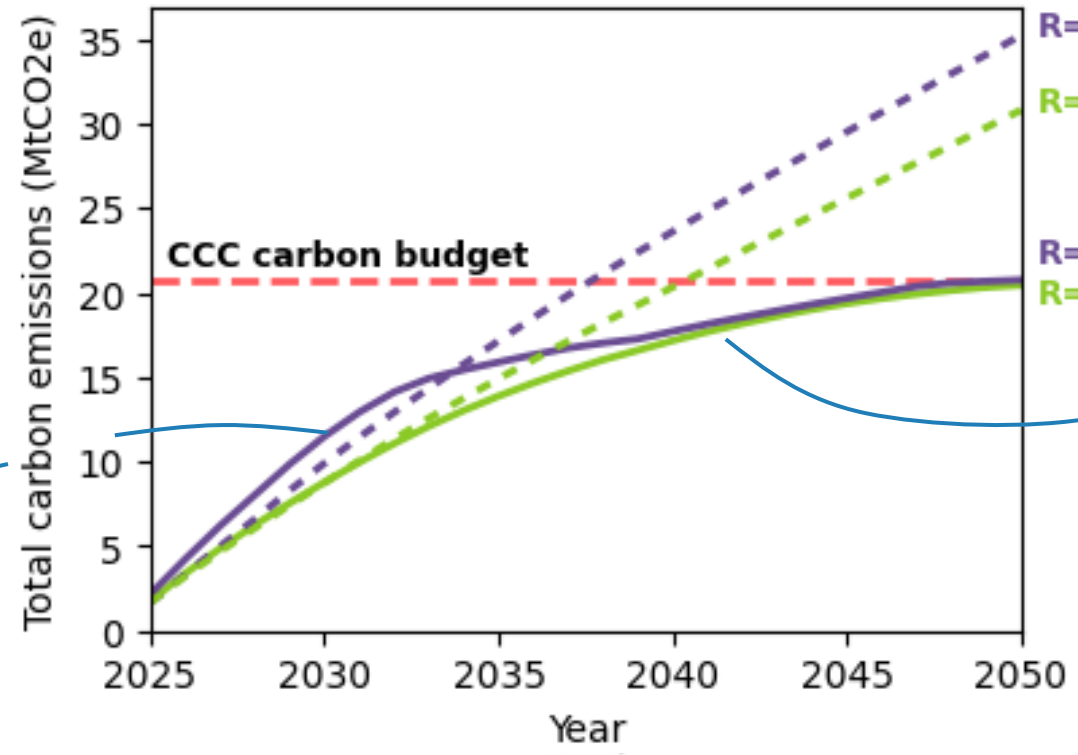
The whole life carbon impact of retrofit to our existing English school stock (Abbey, Arbabi and Densley Tingley) – ***Paper in prep***

Results – *Meeting the CCC Budget*



The whole life carbon impact of retrofit to our existing English school stock (Abbey, Arbabi and Densley Tingley) – ***Paper in prep***

Results – *Meeting the CCC Budget*



Steeper curve due to upfront carbon costs

Steeper curve due to the replacement of heat pumps

Retrofit rate = 50/yr

Retrofit rate (R/yr) to meet CCC budget

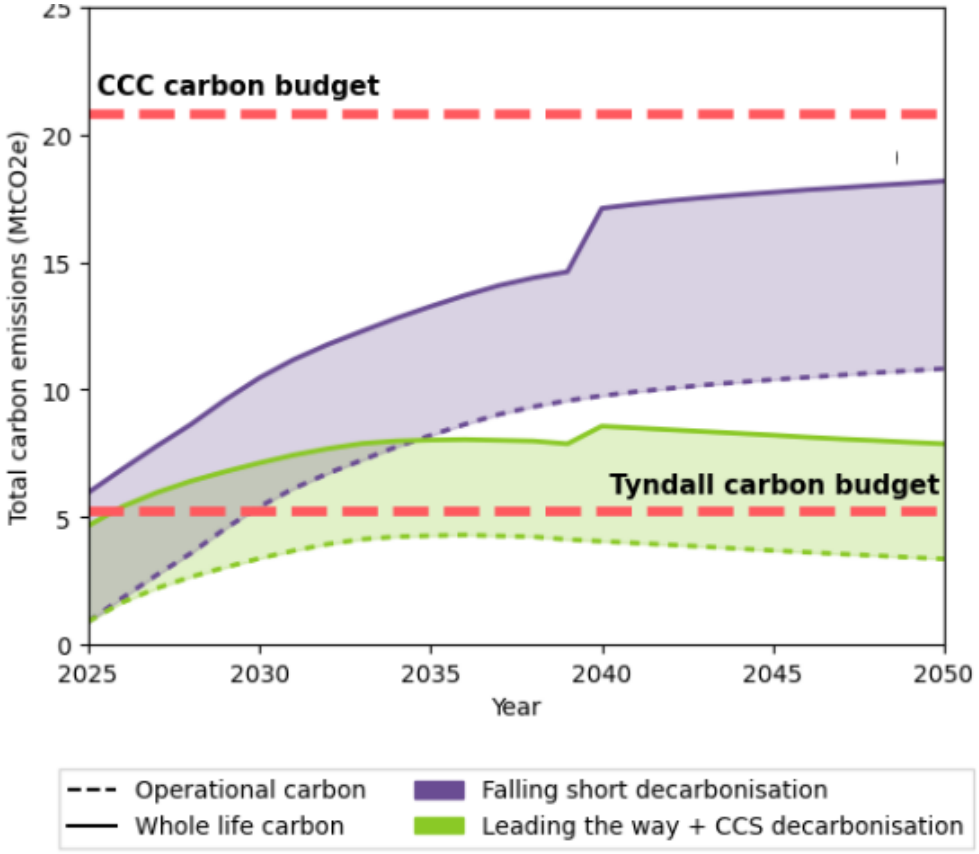
Falling short decarbonisation

Leading the way + CCS decarbonisation

*The whole life carbon impact of retrofit to our existing English school stock (Abbey, Arbabi and Densley Tingley) – **Paper in prep***

Results – *Meeting the Tyndall Budget*

Everything retrofit in 2025



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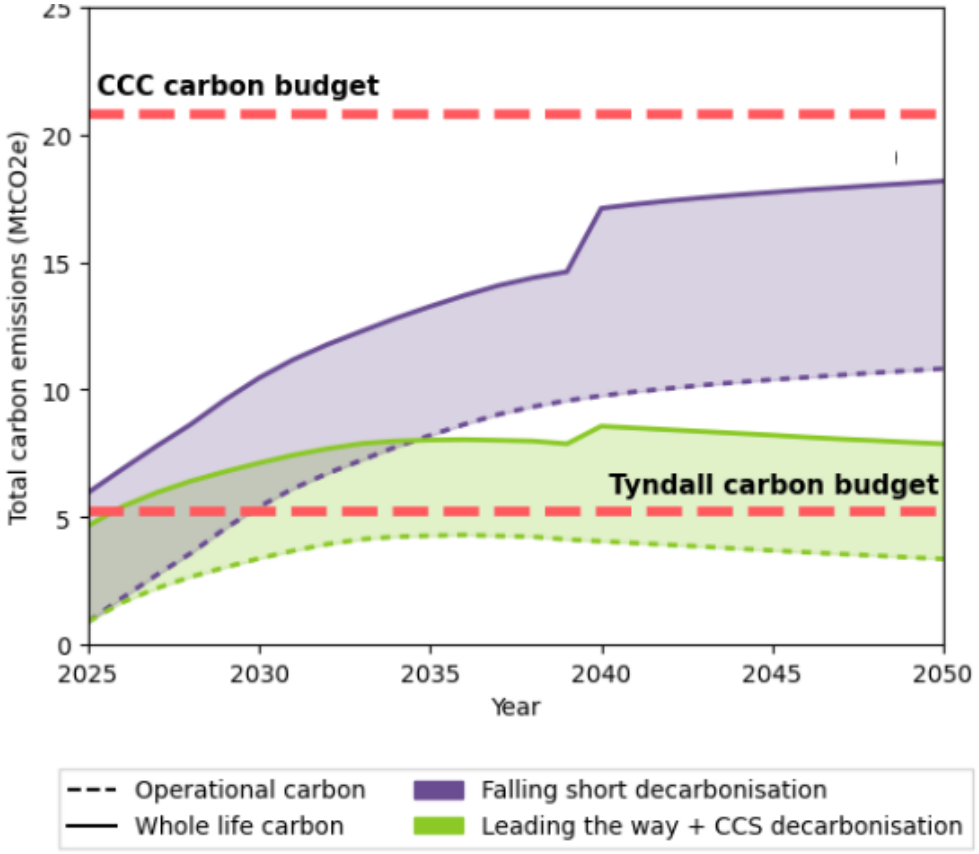
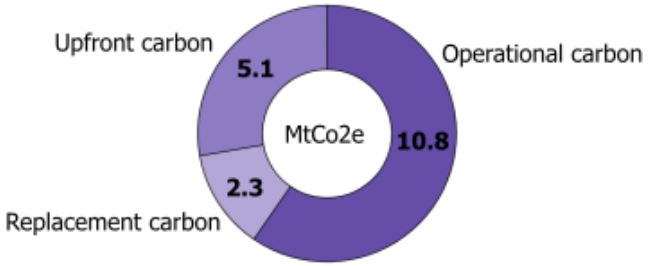
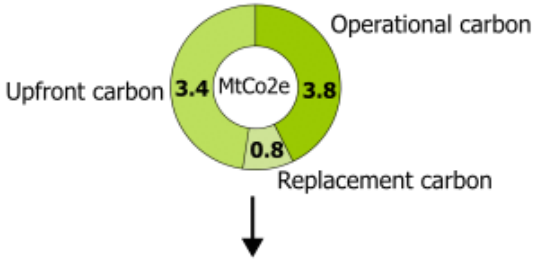
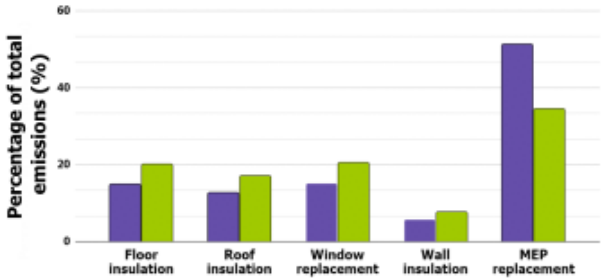


Carbon emissions breakdown





Upfront emissions



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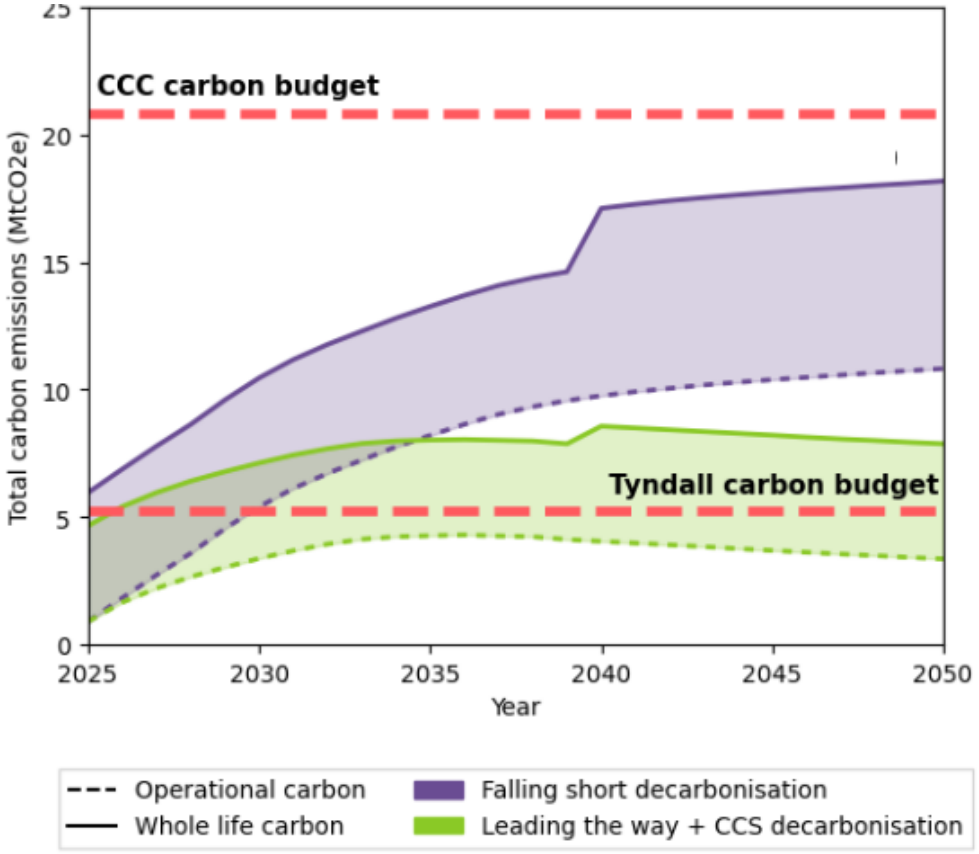

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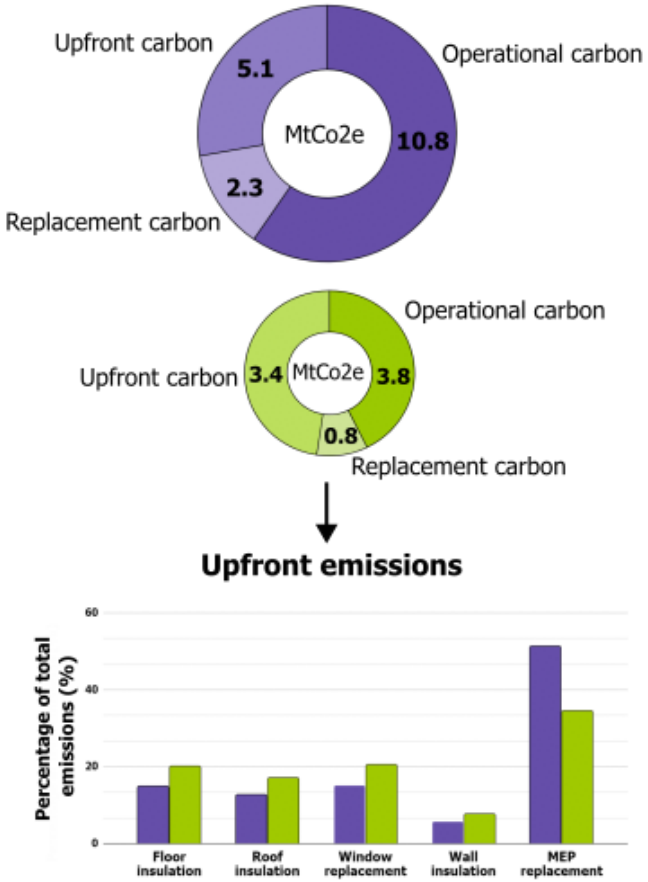


Installing **wood fibre** for the same volume of insulation material:

Upfront emissions including sequestration*: **-0.2** to **-2.0 MtCO2e**

Depending on whether flexible[1] or rigid insulation[2] is assumed.

***A1 – C4 would include the release of sequestered carbon and therefore be net positive emissions.**

*The whole life carbon impact of retrofit to our existing English school stock (Abbey, Arbabi and Densley Tingley) – **Paper in prep***

1.(STEICO SE, 2020) 2.(SCHNEIDER, 2023)

Results – *Comparison to new construction*

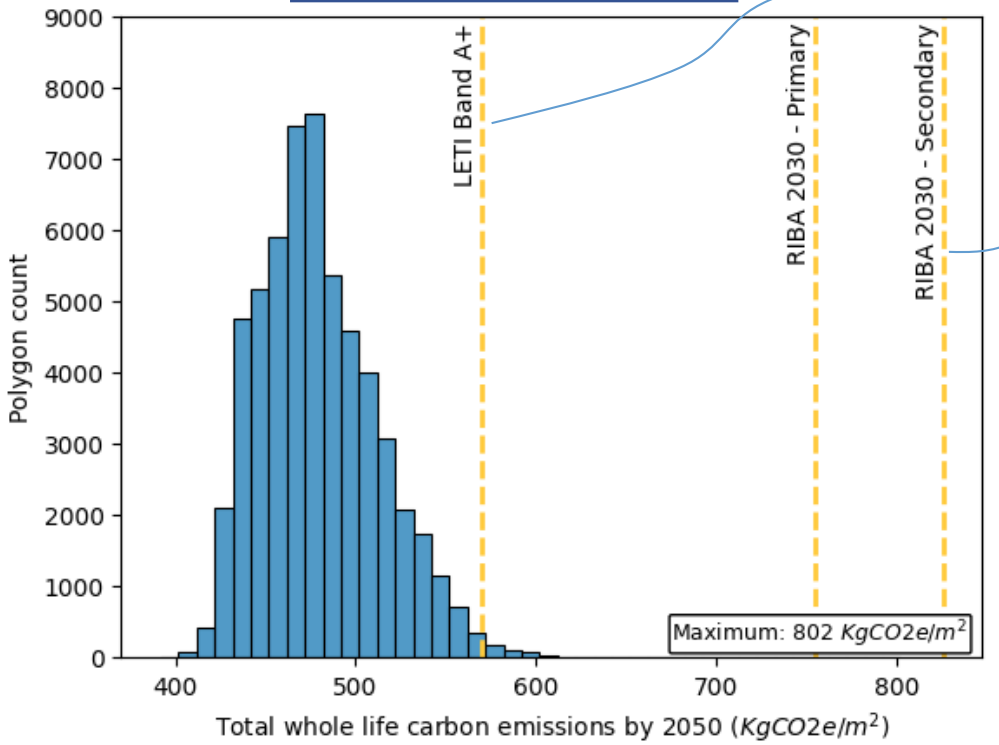
Total whole life carbon emissions of English Schools by 2050

Assuming everything retrofit in 2025

Results – *Comparison to new construction*

Total whole life carbon emissions of English Schools by 2050
Assuming everything retrofit in 2025

No decarbonisation



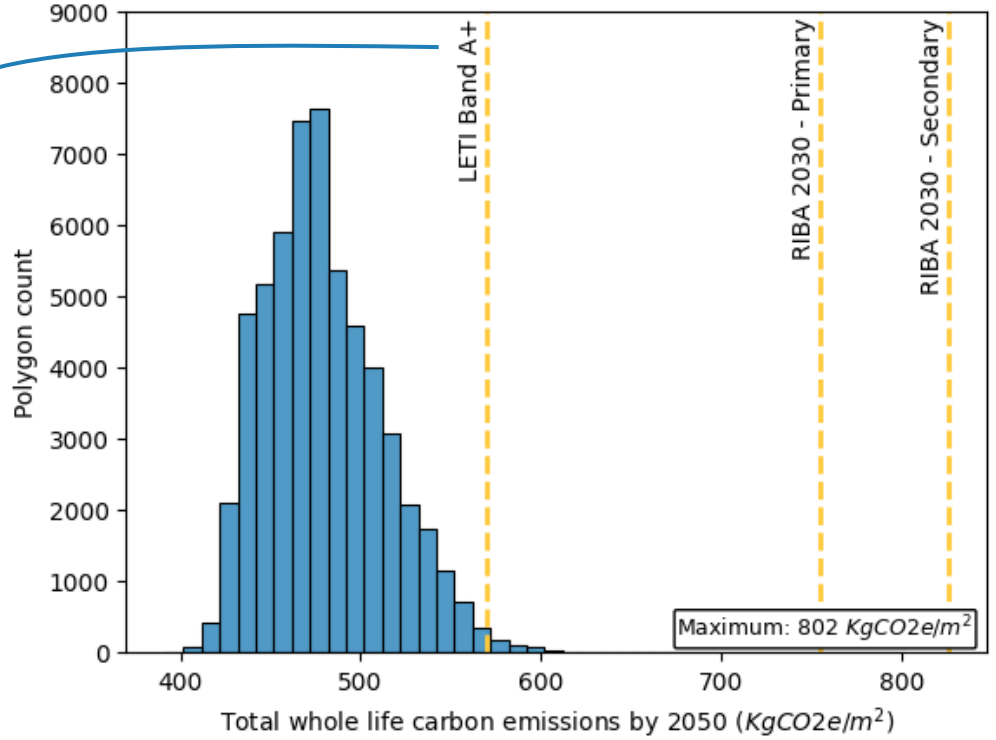
Different new construction targets

(RIBA, 2021) (LETI, 2020) (LETI, 2020)

Results – *Comparison to new construction*

Total whole life carbon emissions of English Schools by 2050
Assuming everything retrofit in 2025

No decarbonisation



Not currently strived for or achievable at scale within industry

No building with higher whole life emissions than RIBA 2030 standards despite a more operationally efficient new construction being modelled.

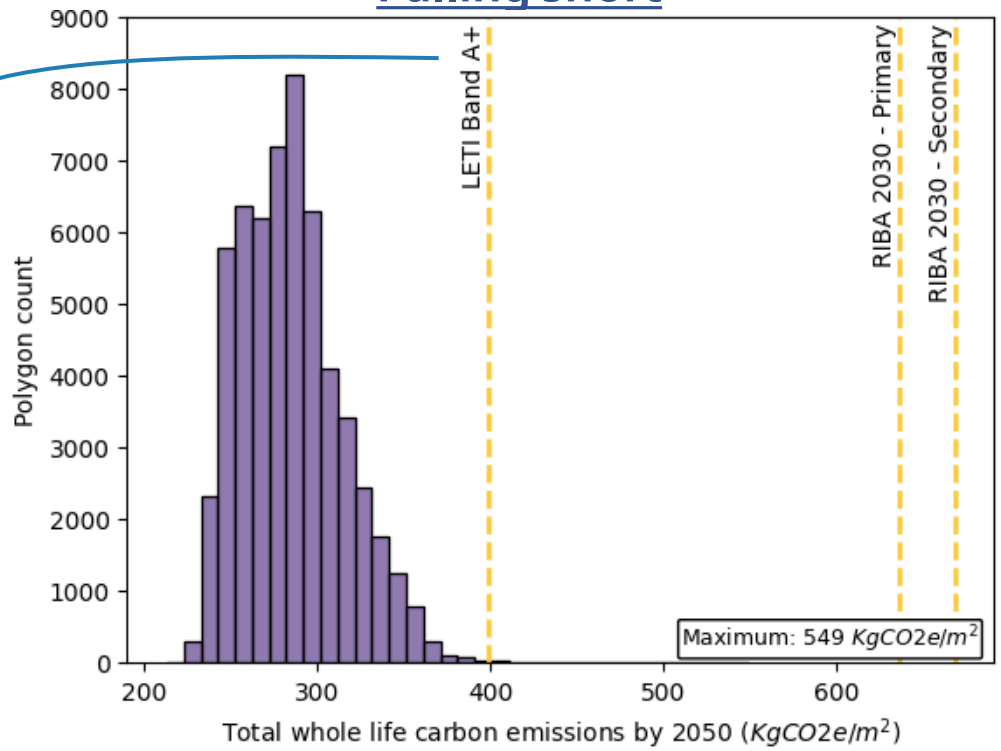
(RIBA, 2021) (LETI, 2020) (LETI, 2020)

Results – *Comparison to new construction*

Total whole life carbon emissions of English Schools by 2050
Assuming everything retrofit in 2025

Not currently strived for or achievable at scale within industry

Falling short



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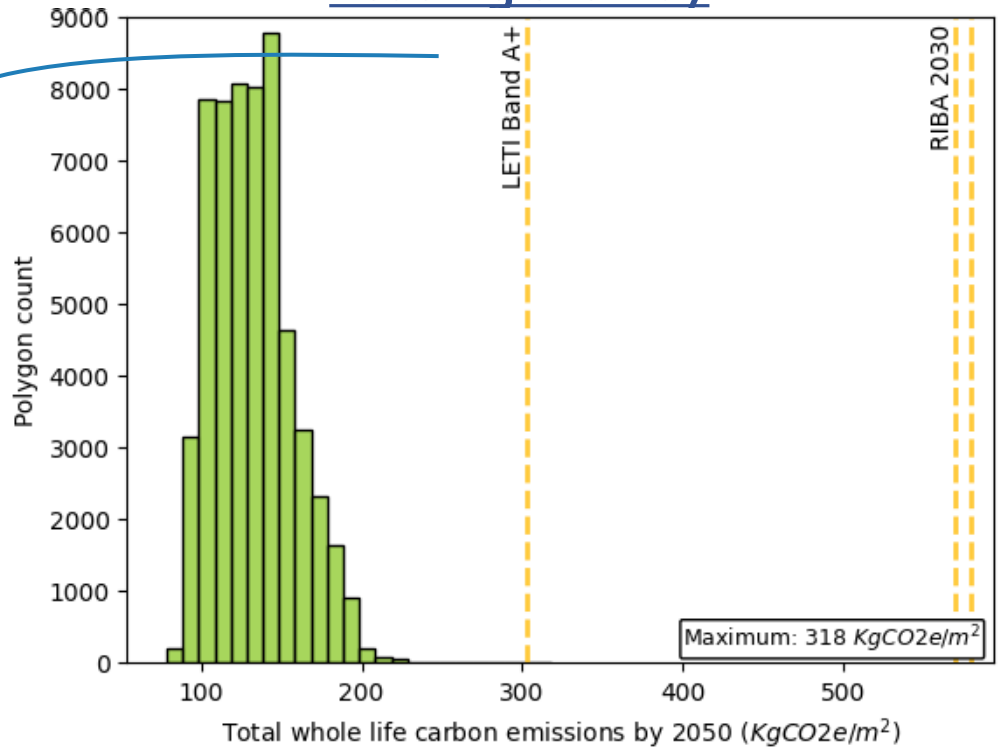
Assuming everything retrofit in 2025

Not currently strived for or achievable at scale within industry

Leading the way



No buildings with a whole life carbon > LETI Band A+

The more we can decarbonise our operational carbon the more important embodied emissions become.

(RIBA, 2021) (LETI, 2020) (LETI, 2020)

Conclusions and future work

Key findings –

- Retrofit at current rates is insufficient to meet carbon budgets for the English school stock.
- Retrofit alone is not enough – we need decarbonisation in other sectors such as electricity and material decarbonisation.
- Building systems poses a carbon hotspot which could be focused on the help speed up this decarbonisation.
- Current attainable new construction benchmarks are not sufficient to justify demolition of school stock despite operational savings.

Future work -

- Incorporation of cost calculations to understand the economic impact of retrofit at scale.
- Incorporation of a wider range of non-residential typologies.
- Inclusion of mechanical cooling to make it applicable to countries and climates all over the world.
- Understanding of the impact of changes to future temperatures – *Should we be adding in adaptability now?*

The whole life carbon impact of retrofit to our existing English school stock (Abbey, Arbabi and Densley Tingley) – ***Paper in prep***

Thank you

Any questions? ☺

SUSTAINABLE PLACES 2024

UKRI Engineering and Physical Sciences Research Council

University of Sheffield

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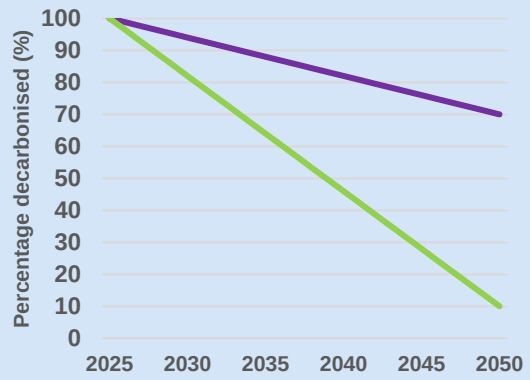
Material decarbonisation

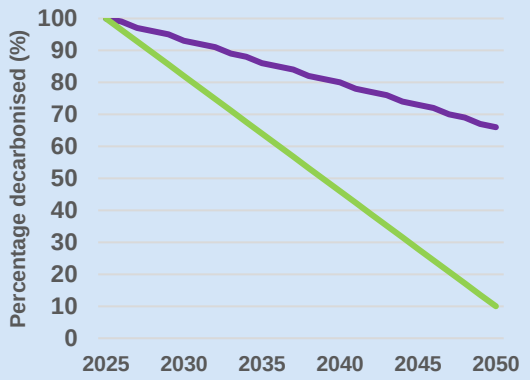
EPS Insulation

Source:
Industrial Decarbonisation and Energy Efficiency Roadmaps to 2050 ***- Plastic***



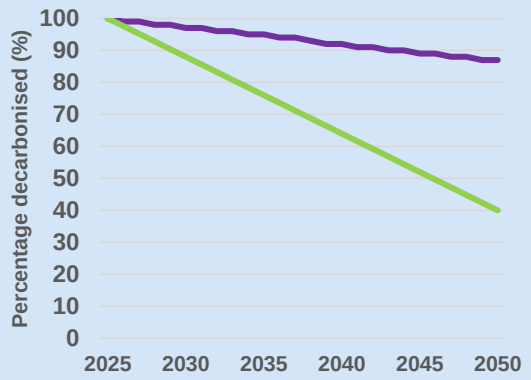
Glazing and glass wool insulation

Source:
Industrial Decarbonisation and Energy Efficiency Roadmaps to 2050 ***- Glass***



MEP

Source:
Industrial Decarbonisation and Energy Efficiency Roadmaps to 2050 ***– Iron and Steel***

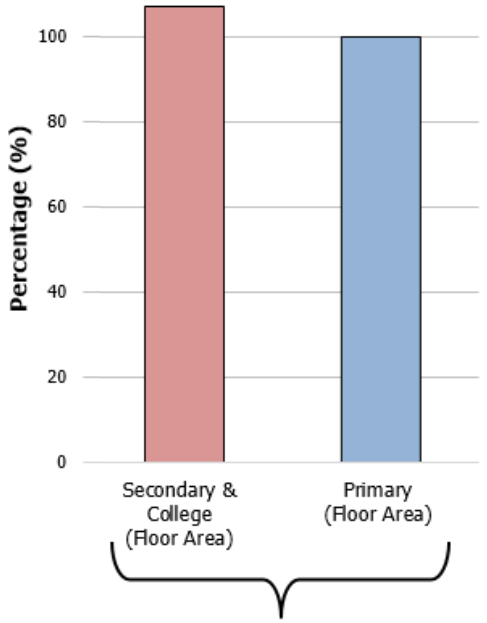


Business as Usual: Max Technical:

(DoECC & DBIS, 2015)

Total floor area assessed compared to actual floor area

Percentage of floor area accounted for compared to the English School Condition Survey



Applying a distribution of number of storeys

(DoE, 2021)