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EBENTO

Digital Tools and Innovative Energy Performance Contracts for Building Renovation

Joanneum Research / Clemens Mayer

Funded by the European Union

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Energy efficiency Building Enhancement through performance guarantee Tools

Overview

- Objective and Introduction
- EBENTO project overview
- EBENTO one-stop shop
- Digital tools in EBENTO one-stop-shop
- Energy Performance Contracting in EBENTO
  - Basic Contract
  - **New EnPC enhanded with flexibility services**
  - **New EnPC enhanced with conformt guarantees**
- Summary and Outlook

Objective / Introduction

- European building stock is responsible for ~36% of CO2 emissions in EU
- Around 90% of the buildings that exist today will still be standing in 2050
- => Strong need for renovation to decarbonize building sector
- Renovation rates too low to achive climate neutrality 2050
- EBENTO aims to support building renovation through Energy Performance Contracting
- EBENTO creates a one-stop-shop with digital tools to support performance based building renovation

EBENTO at a glance

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Consortium

- ETRA: Coordinator
- 11 Partners (7 countries)
- 4 Pilots (Spain, Estonia, Greece and UK)
- Total Budget 5,6 M€ (Funding 4,8 M€)
- Duration 36 Months

Research entities
JR, UL, IECCP, IRI

Legal and EPC expert
JR, UL, IEECP

Technology providers
ETRA, HYPERTECH, CCOOP

End users
VCE, CEMOSA, TalTech, MYT, CCOOP

Project objectives

- **Development of a one-stop-shop** platform for all actors involved in the building and renovation sector
- **Development of Digital Tools** for EnPC management as components of the one-stop-shop platform
- **Focuses on citizen** as key players in the energy transition
- Increase the **involvement of public institutions and energy communities** by helping them to identify potential buildings for improvement
- Develop new Innovative Energy Performance Contracting Business Models that include flexibility elements and comfort guarantees

EBENTO One Stop Shop

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OSS Modules

One Stop Shop

One-stop shop tool for the **management of energy efficiency contracts, simulation and monitoring of buildings**, with the aim of improving the dialogue between the actors involved in the renovation of buildings and the citizen.

Building performance contract module

- Working as a logbook where energy efficiency certificates and financial information for the different contracts will be stored.
- **Decision support system**: generation of "standard" contracts.
- **Contract management** and control: EnPC life cycle and validating metrics.

Monitoring Module

- **Monitoring** the state of the houses (energy, comfort…)
- List of **KPIs** that allow the evaluation of energy performance contracts
- Metrics of housing **behaviour for consumers**.

Simulation Module

- **Physical simulation:** Calculations based on BIM and specific energy simulation programs.
- **Economic simulation:** Profitability calculation coming by the physical simulation and actuations and simulation of the best performance contract to increase the benefits for the end user.

Digital Tools in One Stop Shop

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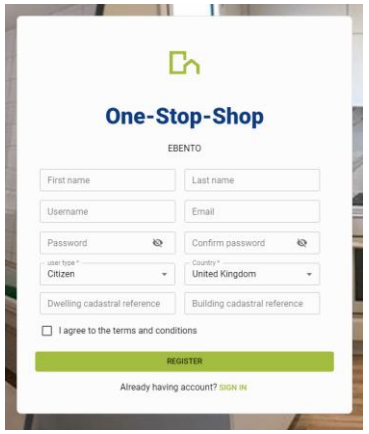
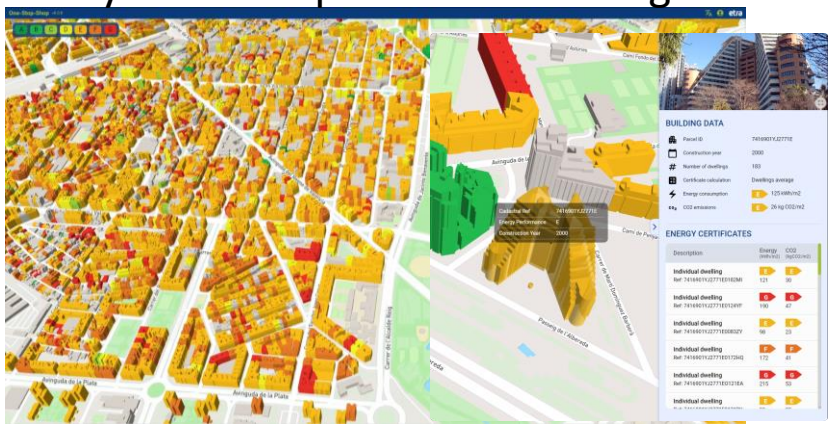
Unique platform with different roles



A unique platform for the **management of energy efficiency contracts, simulation and monitoring of buildings.**
Shows the information generated by EBENTO modules and allows users to interact with these modules and between them.

Main interface where the users of the platform (citizens, public administrations, constructors, ESCOs…) can review the current status of the Energy Performance Certificates of building in different cities, to be able to define new strategies for enhance building.

Dynamic Map: EPC for buildings in cities



Digital Tools in One Stop Shop

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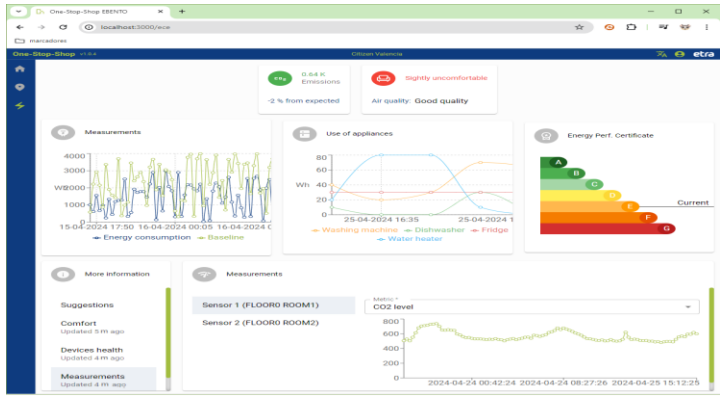
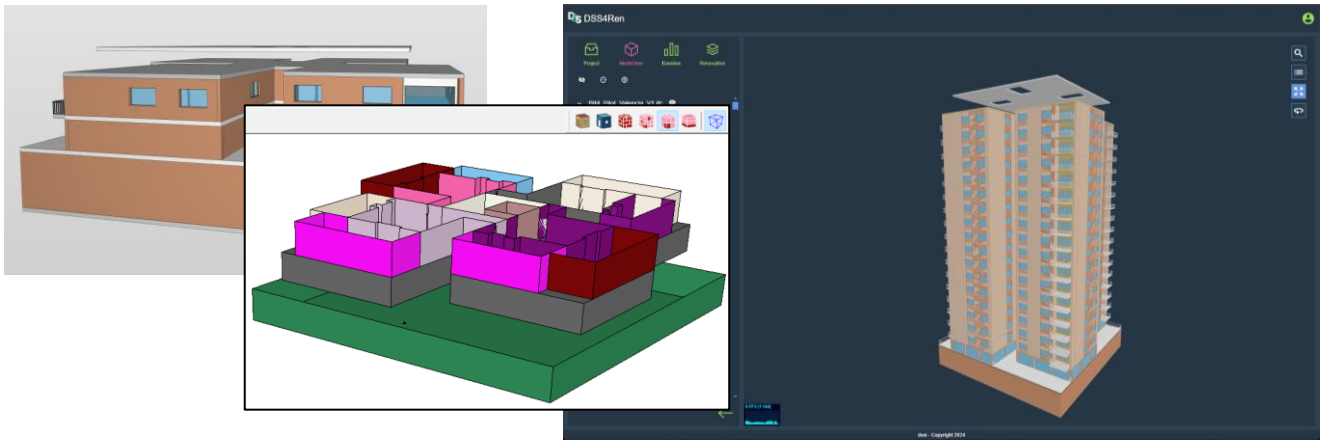
Monitoring (energy, comfort, CO2..) and user clustering



Energy and comfort simulation based on BIM in Energy+



Monitoring energy consumption and comfort from users and buildings is needed for the verification of the EnPC.
The Monitoring module provide all the OSS users with the needed data to understand and better manage the contracts

For the definition of a EnPC the simulation of the possible options to enhance the building energy consumption is crucial. The Simulation module provides realistic results based on BIM to allow the contractors and citizens to select the best option for the contracts.

Digital Tools in One Stop Shop

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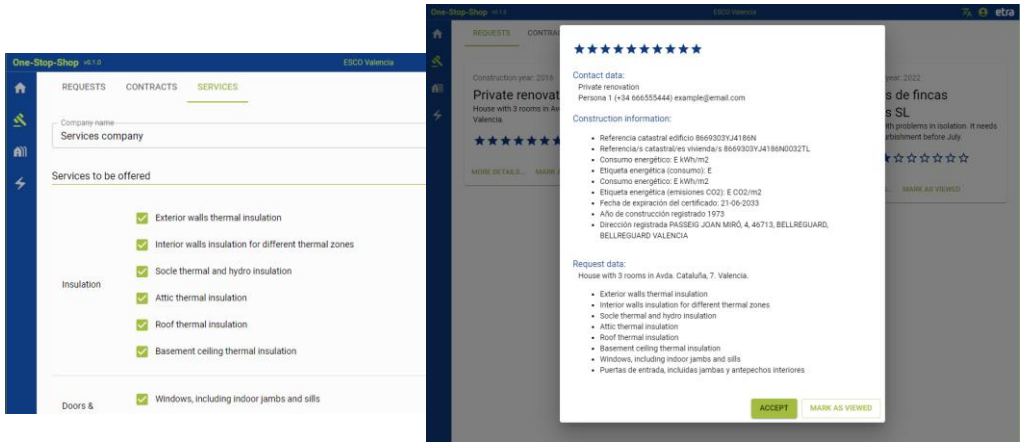
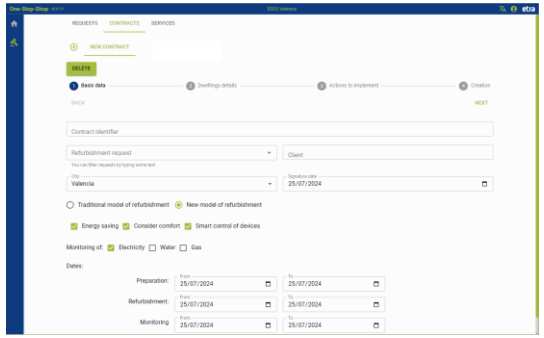
- Common space for citizens and companies



One of the main barriers for the citizens to start the process of renovation and energy building enhancement is the lack of information about professionals able to make it possible. The EBENTO OSS allows both citizens and companies to make contact and start a relation for the house/building renovation

- EnPC management, control and definition



EBENTO OSS offers the possibility to create standard and innovative Energy Performance Contracts directly though the EnPC decision support system. With this new models, integrated on the platform, the users involved on the renovation process will be able to check the information on the contract and validate the results during the whole contract duration

Energy Performance Contracting

Basic Elements of EnPC

- Contractual cooperation between building owner and ESCO
- ESCO and building owner define baseline energy consumption
- Type, volume, quality and timeline of the investment are defined in the EPC
- **Energy efficiency measures are financed by energy savings**
- ESCO guarantee the achievement of agreed energy savings

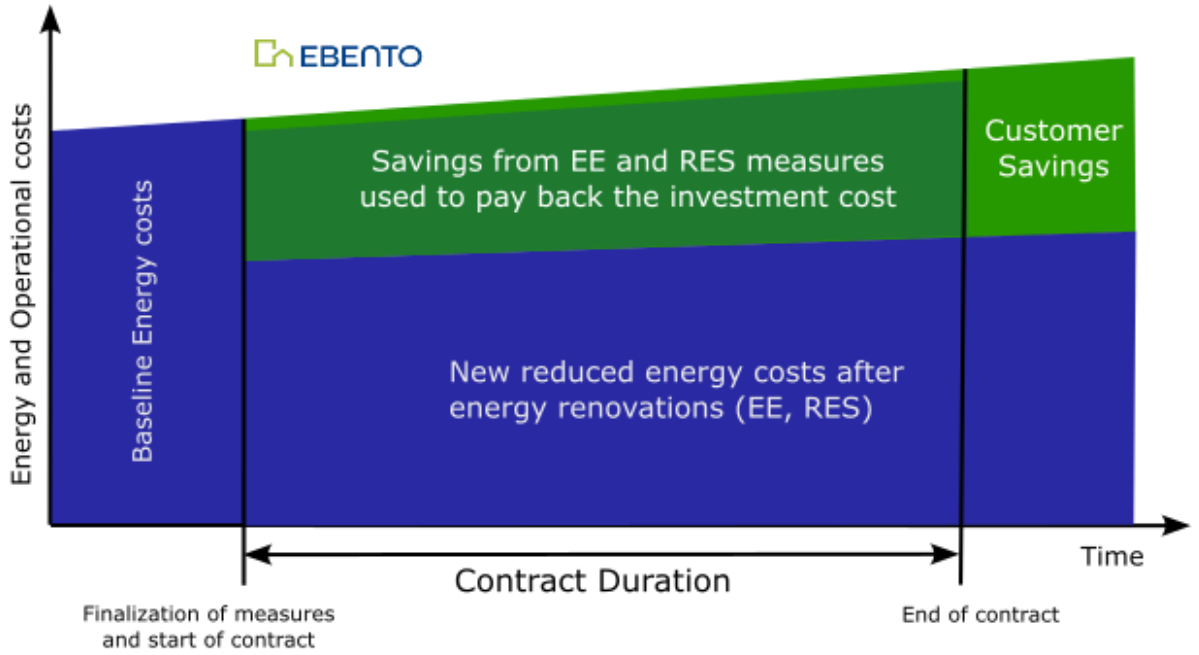
Market status of EnPCs in the EU

- Initial market development has taken place in most European countries
- Current market development static or slowly growing
- Energy supply contracting more established as payback time is much lower
- Long payback periods and therefore long contract durations as main barrier
- Availability of competent facilitators or support services as main driver

Energy Performance Contracting

EnPC business model

- ESCO and building owner define baseline energy consumption and energy efficiency / RES measures in EnPC
- ESCO guarantee the achievement of agreed energy savings
- Contract duration is defined in the EnPC
- ESCO delivers defined energy efficiency measures
- **Savings from EE and RES measures are used to pay back the investment costs**
- After contract duration customer benefits from lower energy costs



Source: own elaboration based on https://renovation-hub.eu/business-models/enhanced-energy-performance-contracting/

EBENTO Enhanced EnPCs

- Long payback times and contract durations as central problems of EnPCs

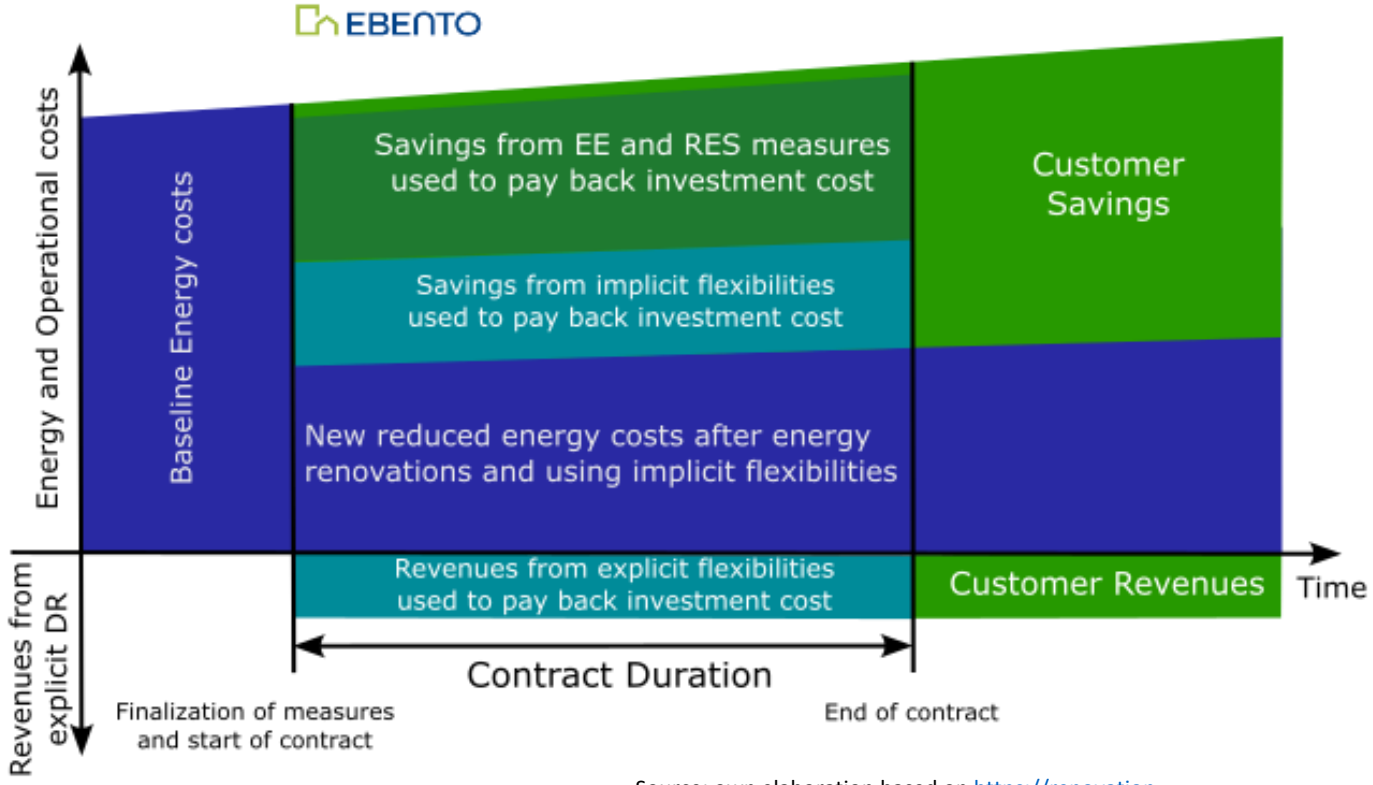
⇒ Additional revenues and savings have to be considered in EnPC to reduce contract duration

- **EnPC enhanced with flexibility savings/revenues**
- **EnPC enhanced with comfort guarantees**

EBENTO EnPCs with flexibilities

- Revenues from Implicit/Explicit Flexibilities in EnPC to improve profitability
- Implicit flexibilities
  - Shift of demand to times with lower electricity prices
  - Optimize self-consumption rate or adjust to flexible electricity tariffs
  - ESCO manages total BEMS to control implicit flexibility savings
- Explicit flexibilities
  - Shift of demand based on external signals from network operators or aggregators
  - ESCO could act as aggregator or as contractual partner of aggregator or grid operator

EnPC business model including implicit and explicit flexibility services



Source: own elaboration based on https://renovation-hub.eu/business-models/enhanced-energy-performance-contracting/

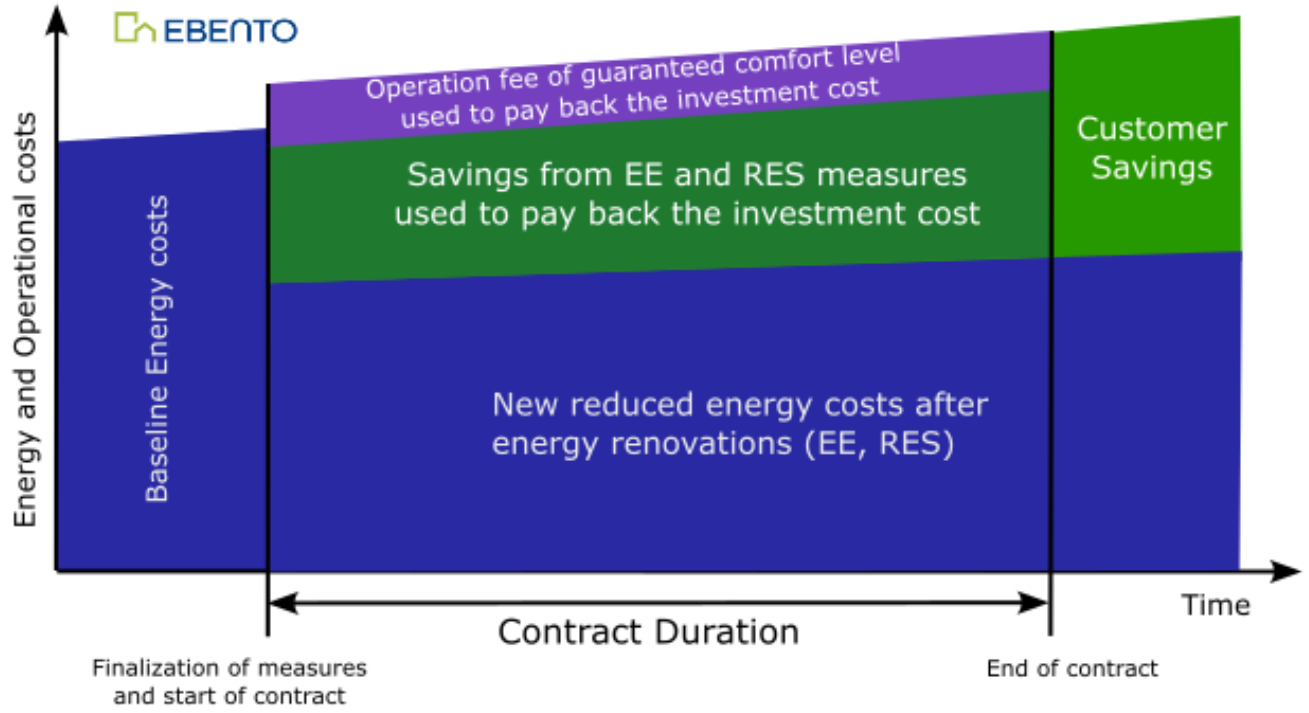
Savings from implicit flexibilities and revenues from explicit flexibilities are used to pay back investment costs

Contract duration gets reduced
After end of contract, customer receives all savings and revenues

EBENTO EnPCs with comfort guarantees

- Growing market demand for contracts that offer guaranteed comfort
- ESCO offer guaranteed comfort levels (temperature, humidity, air quality) to customers as part of EnPC
- ESCO responsible for continues monitoring, control and maintainance of BEMS system => ESCO takes full responsibility for the delivery of guaranteed functions
- Improved living and working conditions through better temperature control, humidity regulation and air quality
- Customers are willing to pay additional fee for guaranteed comfort level => additional operating fee will be used to pay back investment costs

EnPC business model including comfort guarantees



Source: own elaboration based on https://renovation-hub.eu/business-models/enhanced-energy-performance-contracting/

ESCO guarantees comfort
Customer benefits from better temperature control, humidity regulation and air quality

Operation fee for comfort guarantees are used to pay back investment costs => Contract duration gets reduced

Summary and outlook

- Long payback periods and contract durations as main barrier for EnPC
- EnPCs with flexibilities or comfort guarantees reduce contract duration
- EBENTO one-stop-shop supports building renovation with EnPC through digital tools (monitoring, simulation, contract)
- EBENTO One-Stop-Shop support all actors in involved in building renvoation (e.g. Citizens, ESCOs, urban planners)
- EBENTO One-Stop-Shop and enhanced EnPCs will be tested in four pilot

Thank you for your attention

Clemens Mayer, Joanneum Research

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MĀPIHI: Māori and Pacific Housing Research Centre

Beyond the measurables of decarbonisation:
Exploring the agency of circular economies in the Pacific

Associate Professor Michael Davis

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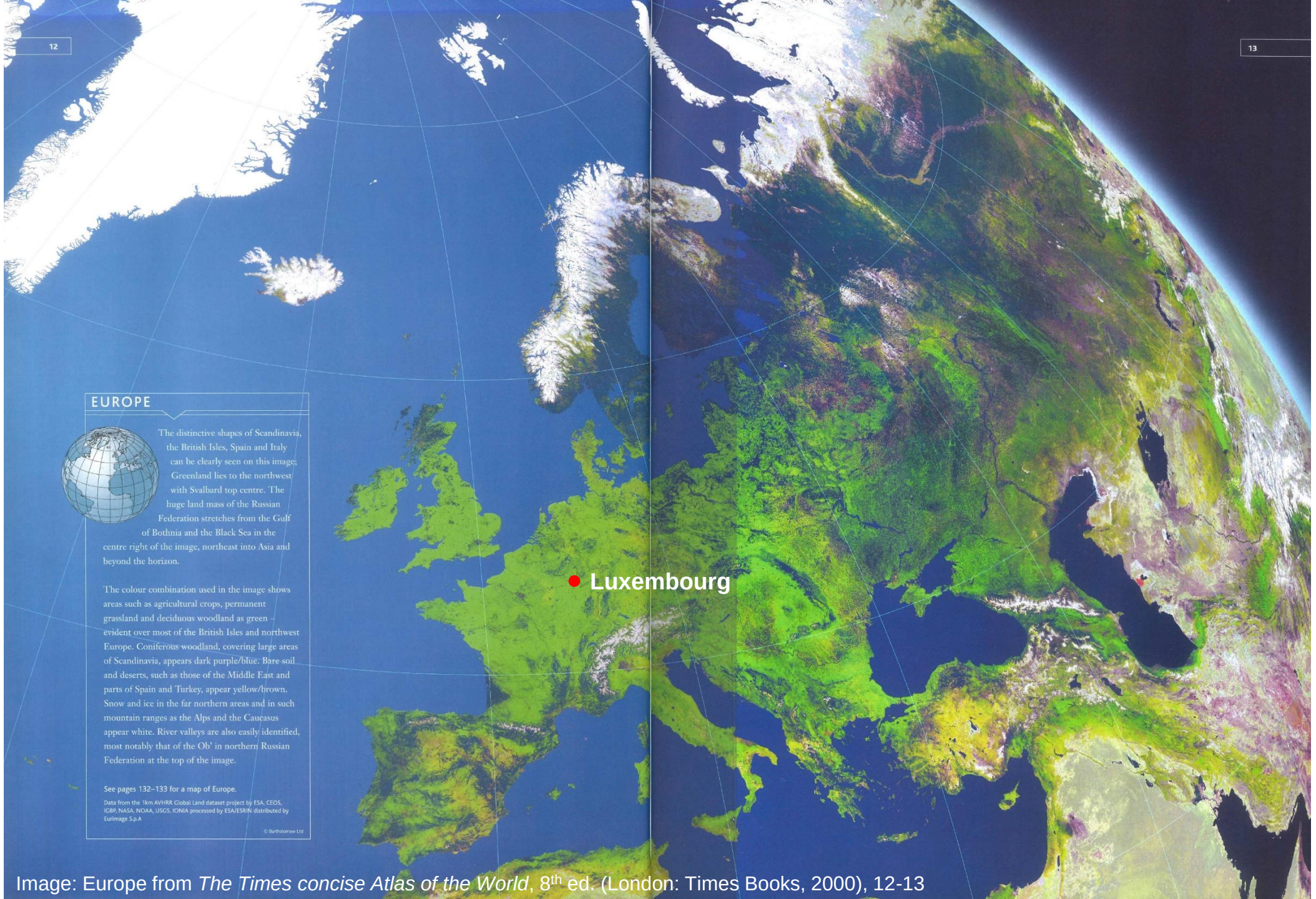


Image: Europe from *The Times concise Atlas of the World*, 8th ed. (London: Times Books, 2000), 12-13

provocation: In the Pacific, the concern for circularity is embedded in the way we do things. The circulation of building materials is about supporting and sustaining social, economic, and cultural connections between people and place.

Image: Oceania from *The Times concise Atlas of the World*, 8th ed. (London: Times Books, 2000), 8-9

MĀPIHI

- **University-level research centre**
- **Comprised of over 20 Indigenous researchers**
- **Research supports Māori and Pacific whānau to live in healthy, sustainable and affordable homes**
- **Project partnerships with communities, NGOs, local and central government agencies and industry**

Flagship University Research Centres

- **MĀPIHI:** Māori and Pacific Housing Research Centre
- Te Aka Mātauranga Matepukupuku Centre for Cancer Research
- Centre for Brain Research
- Centre for Pacific and Global Health
- Ngā Ara Whetū Centre for Climate, Biodiversity, and Society
- Centre for Co-Created Ageing Research CCREAT-AGE
- James Henare Research Centre

MĀPIHI Team

- Multidisciplinary researchers from faculties across the university.
- Pacific and Māori academics with strong research backgrounds in relevant fields.
- Established relationships with Pacific and Māori and communities.
- 14 PhD students
- Strategic recruitment currently underway

- **Dr Michael Davis** (Samoa; Architecture)
- **Dr Tumanako Ngawhika Fa'aui** (Fasi Moe Afi 'A Tungī, Tonga; Ngāti Uenukukopako, Ngāti Te Roro o te Rangi, Te Arawa; Civil Engineering)
- **Dr Charmaine 'Ilaiū Talei** (Tatakamōtonga, Houma, Tonga; Architecture)
- **Dr Kilisimasi Latu** (Tonga; Engineering)
- **Dr Sam Manuela** (Manihiki, Atiu, Rarotonga; Psychology):
- **Dr Karamia Müller** (Lalumanu, Samoa; Architecture; MĀPIHI Codirector)
- **Dr Sereana Naepi** (Nakida in Naitasiri, Na Gone Ni Colo, Fiji; Sociology)
- **Associate Professor Vili Nosa** (Avatele, Hakupu, Niue; Pacific Health, Medical and Health Sciences)
- **Seuta'afili Dr Patrick Thomsen** (Vaimoso, Samoa; Global Studies, Cultures, Languages and Linguistics)
- **Peseta Fa'amatuainu To'oto'oolea'ava Lama Tone** (Fasito'o Uta, Lufilufi: Upolu, Pu'apu'a, Sāvai'I, Samoa; Architecture)
- **Associate Professor Yvonne Underhill-Sem** (Cook Islands; Pacific Studies)
- **Dr 'Ema Wolfgramm-Foliaki** (Tonga, Education and Social Work)
- **Professor Deidre Brown** (Ngāpuhi, Ngāti Kahu; Architecture; MĀPIHI Codirector)
- **Dr Claire Charters**, (Ngāti Whakaue, Tūwharetoa, Ngāpuhi and Tainui; Law)
- **Dr Shiloh Groot** (Ngāti Pikiao, Ngāti Uenukukopako; Psychology)
- **Dr Mark Harvey** (Ngāti Toa, Ngāti Raukawa; Dance Studies)
- **Lena Henry** (Ngāpuhi, Ngāti Hine, Te Rarawa; Urban Planning)
- **Ayla Hoeta (**Waikato Tainui, Ngaati Tahinga; Design Programme**)**
- **Professor Anthony Hoete** (Ngāti Awa, Ngāti Rānana; Architecture)
- **Dr Tia Reihana** (Ngāti Hine; Dance Studies)

- **Dr Catherine Wright**, Research Operations Manager
- **Lalson Joseph**, Research Operations Coordinator

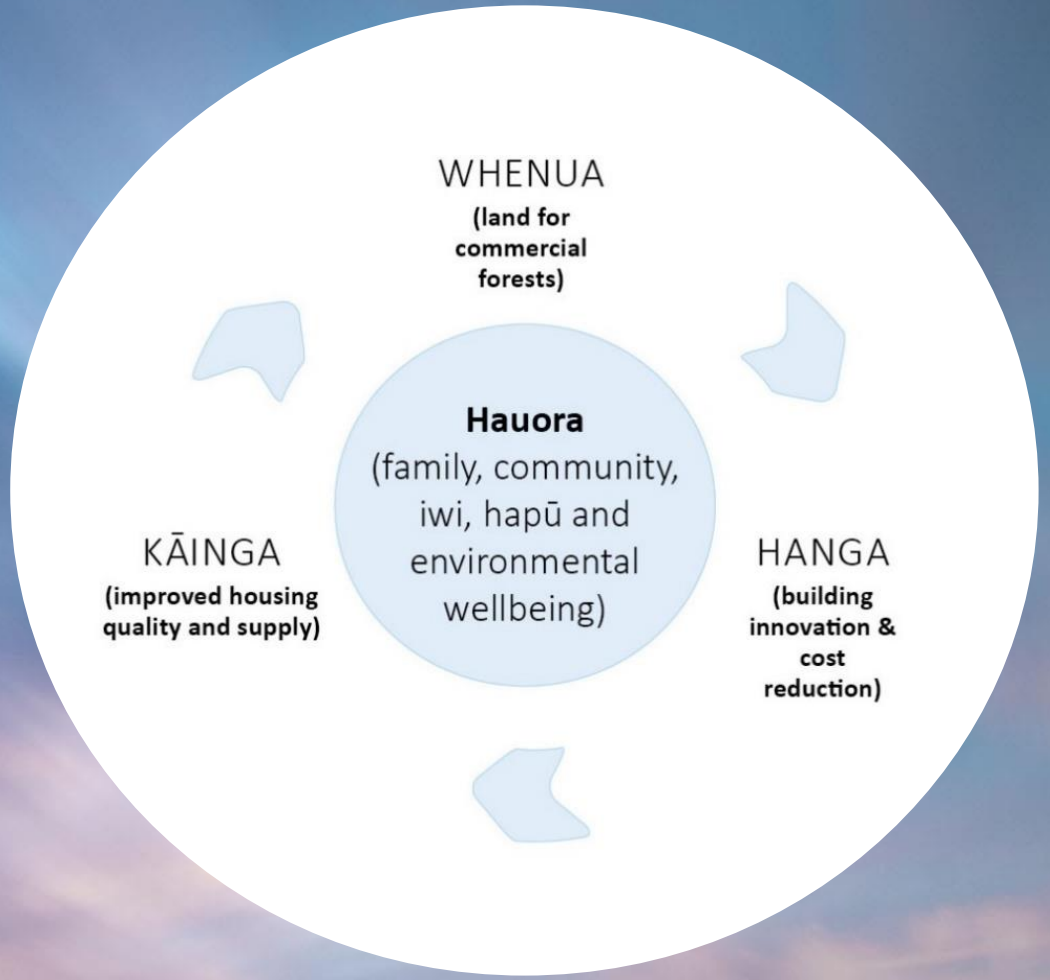
MĀPIHI Mission

MĀPIHI: Māori and Pacific Housing Research Centre is committed to improving housing quality and supply for Māori and Pacific communities in Aotearoa New Zealand and the Pacific through impactful research that is manaaki-centred (uplifting mana) and based on **Pacific values**, tikanga Māori, expert knowledge.

Whakahā

(verb: to breathe life)

Our Work Programmes



HOUSING

Yes to more social housing, but housing quality would be even better

Cooperative housing is in its infancy in Aotearoa, but if it were tweaked for social housing tenants it may help get them out of state housing and enable their home-ownership aspirations

by **Charmaine ‘Ilaiū Talei** 09/10/2023

Dr Karamia Müller says it’s important to build research platforms for the types of graduates needed to confront housing challenges. Photo: Chris Loufte

> “You can create intensification, but that’s not the same as creating community.”
>
> **Dr Karamia Müller, co-director, Māori and Pacific Housing Research Centre**
> Waipapa Taumata Rau, University of Auckland

NEWS

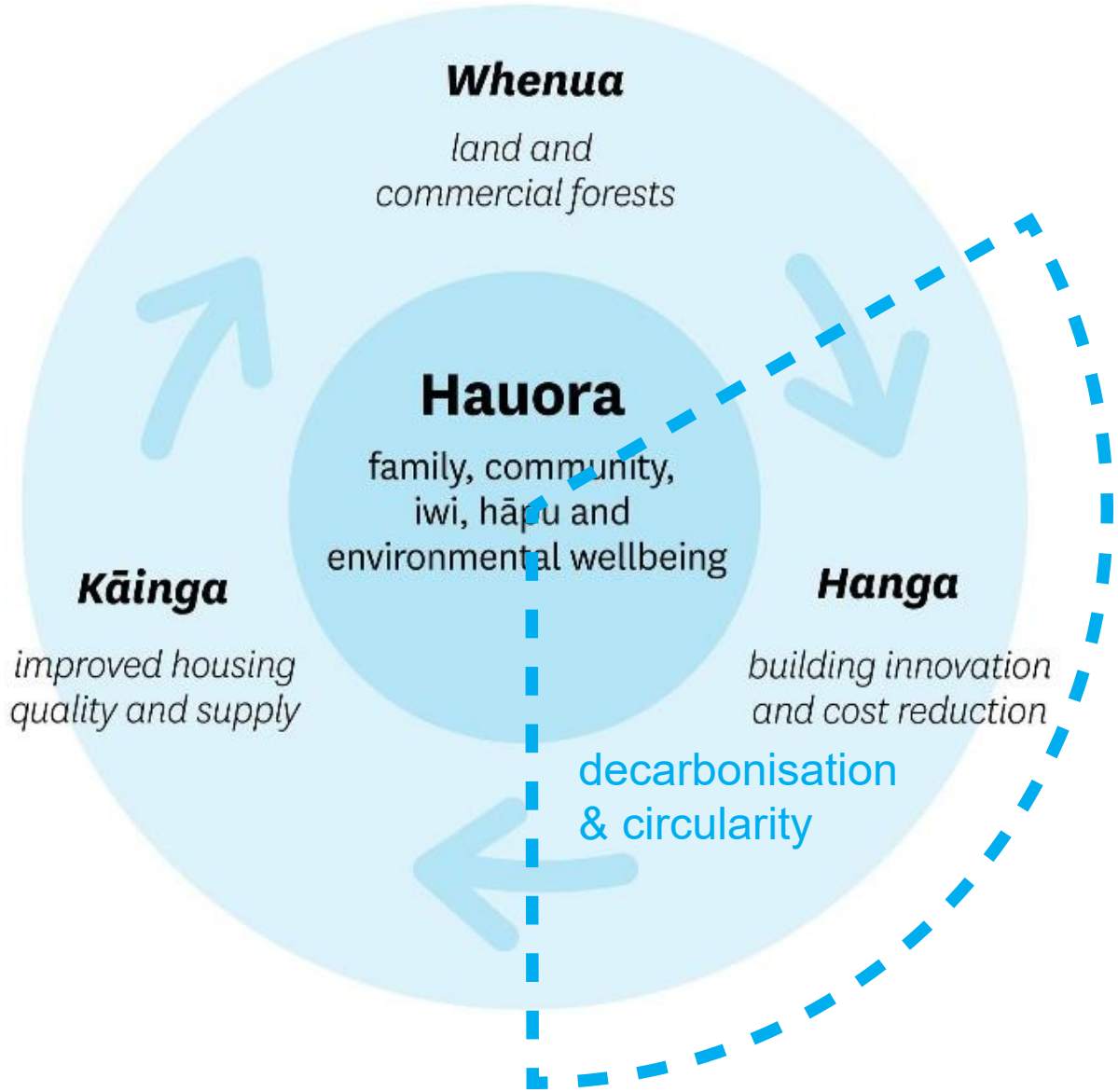
Researcher says rent-to-buy schemes can lift Pacific home ownership rates

An Auckland university housing expert says there are a number of new schemes being developed that can get more Pacific families into a home.

Rent-to-build schemes are seen as a key way to get more Pacific families onto the housing ladder.

MĀPIHI 2024 Aotearoa research priority areas:

- Housing intensification/wellbeing nexus for Māori and Pacific people
- Simplified information platform for communities wanting to develop papakāinga and Pacific-led housing
- Self-sustaining Māori and Pacific housing industries


Whenua
land and
commercial forests
Hauora
family, community,
iwi, hāpu and
environmental wellbeing
Kāinga
improved housing
quality and supply
Hanga
building innovation
and cost reduction
decarbonisation
& circularity

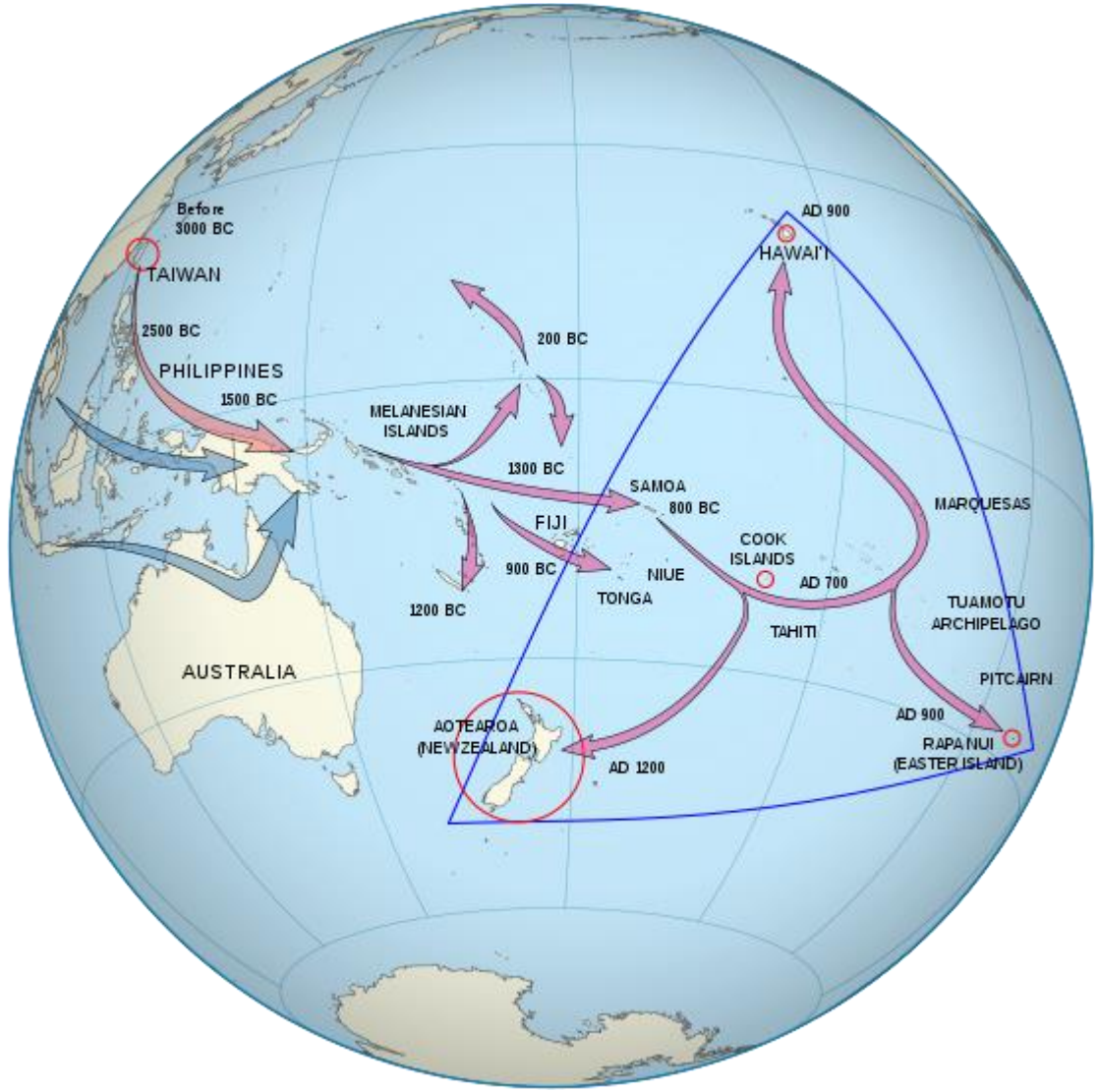


Image: https://www.worldhistory.org/image/10691/polynesian-migration-map/

research questions:

- **How might circular economic initiatives unfolding in Europe be rescaled for the Pacific?**
- **How might our traditional networks be exercised to effect their embedding and further innovation?**
- **What might we offer to a European economy in return?**

how might we:

- **Downscale the economic nodes (from cities to islands)**
- **Re-scale geographical networks (for extensive distances)**
- **Re-model the infrastructural means (for water transport) … for their application in a Pacific context.**

MĀPIHI offers in return:

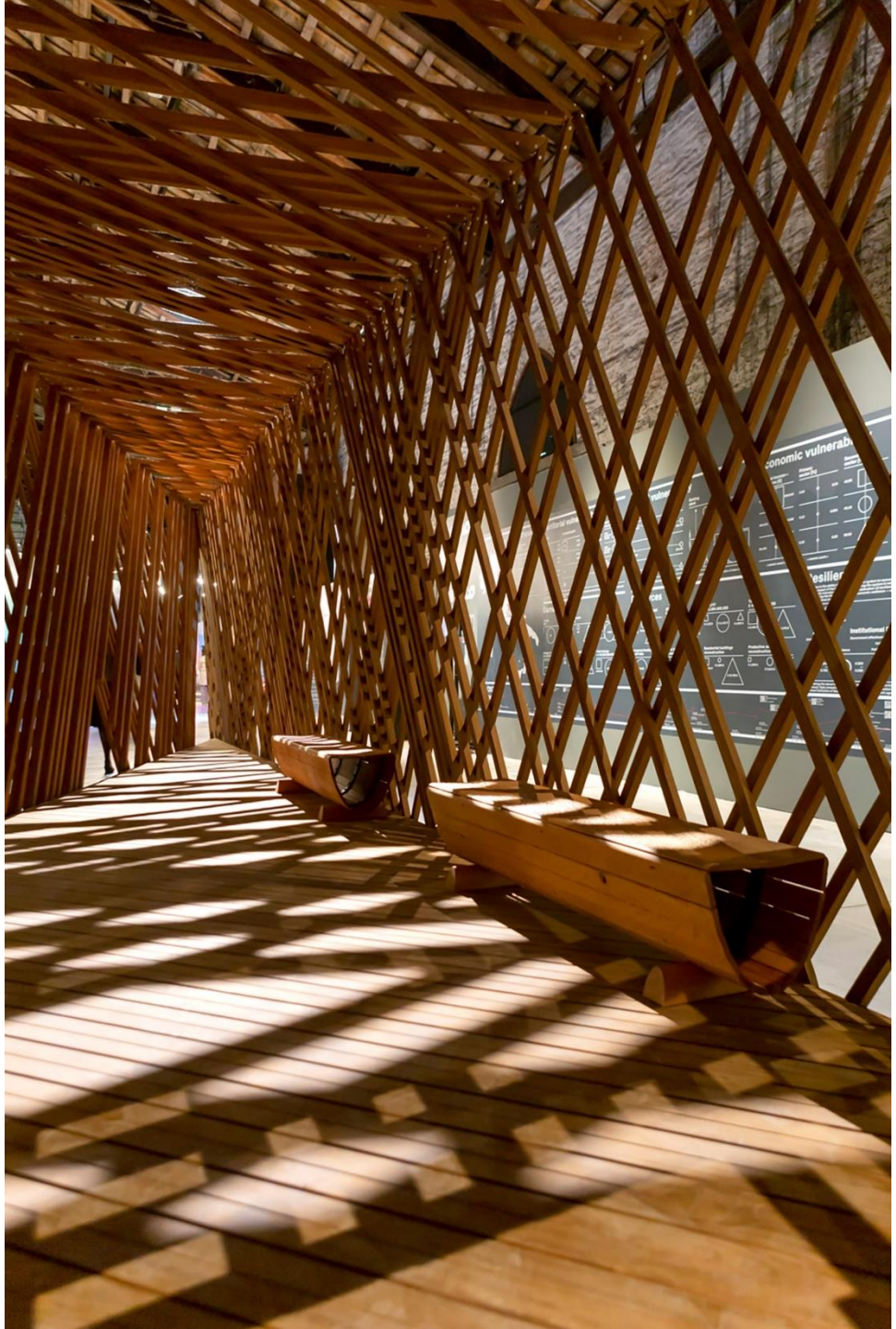
- **Innovative circular practices that might be rescaled for much larger economies**
- **A lens to understand the social and cultural systems in place in the Pacific**
- **A network and related body of knowledge that connects to 1/3 of the planet.**

Fale tufitufi, Ngeleia, Tonga. Photo: Charmaine ‘Ilaiu Tale

Cleaning up in Wairoa following Cyclone Gabrielle Photo: RNZ / Jonty Dine

photograph: Marcella Grassi

Image: Catalogo del Padiglione Italia: Comunita Resilienti alla Biennale Architettura 2021, vol 1 (Rome: D Editore, 2021)



ABODO

Kāinga Ora
Homes and Communities

photograph: Marcella Grassi

photograph: Mark Smith

erente al contesto ambientale e sociale locali.

Un terzo aspetto positivo dell'uso del legno è legato all'economia circolare, riconoscendo il ruolo del legname recuperato e ricondizionato nel ridurre sia la domanda di materiali vergini sia la produzione di rifiuti edili. I rifiuti da costruzione e demolizione rappresentano uno dei più grandi flussi di rifiuti in tutto il mondo e circa la metà dei rifiuti totali destinati alle discariche della Nuova Zelanda (Inglis, 2007; Storey, Gjerde, Charleson, Pedersen, 2005), il 20% dei quali, in peso, è rappresentato da materiali lignei (BRANZ Ltd., 2019). La combinazione di un approccio circolare con un processo creativo per il recupero e il riutilizzo di legname può non solo prolungare la vita del materiale, contribuendo così al raggiungimento del *SDG 12 – Responsible Consumption and Production* (UN, 2015, sec. 12.5), ma mantenere inoltre una manifestazione della nostra storia e dei nostri valori culturali attraverso metodologie di progettazione ad alta qualità e basate sulla ricerca.

Il risultato di tali riflessioni all'Università di Auckland è rappresentato da un padiglione in legno di circa 30 m^2 costruito con materiali di provenienza locale e non tossici che creano una struttura non gerarchica in cui tutti gli elementi hanno le stesse dimensioni e sono fabbricati con metodologie contemporanee. I materiali avanzati utilizzati nel padiglione reinterpretano le tecniche tradizionali e le conoscenze locali alla luce dell'innovazione tecnologica nella produzione di componenti in legno. Il padiglione è intersecato da una seduta costruita con pannelli di rivestimento esterno in legno di kauri recuperati da residenze sociali[6] in Nuova Zelanda e ricondizionati con l'utilizzo di processi di fresatura avanzati.

6 - Public housing provided by the government or Crown-owned corporations and offered at low-cost rent to residents on low to moderate incomes across Nuova Zelanda.

Il padiglione dell'Università di Auckland include il progetto di una seduta realizzata attraverso il riuso di doghe di rivestimento in legno di kauri provenienti dal rivestimento esterno di residenze sociali demolite nel 2019. Nel costruito locale, l'edificio è un apparato organico composto da "ossa", ovvero la struttura lignea a piccoli elementi diffusi, e "pelle", ovvero il rivestimento esterno esposto agli agenti atmosferici.

Image: A state house, Catalogo del Padiglione Italia: Comunita Resilienti alla Biennale Architettura 2021, vol 1 (Rome: D Editore, 2021), 240.

photographs: Mark Smith

photograph: Mark Smith

Image: Oceania from *The Times concise Atlas of the World*, 8th ed. (London: Times Books, 2000), 8-9

MĀPIHI: Māori and Pacific Housing Research Centre

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- **Dr Karamia Müller: k.muller@auckland.ac.nz**
- **A Prof: Michael Davis: m.davis@auckland.ac.nz**

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Presentation of COST Action CA21103 – ITC

CircularB – Implementation of Circular Economy in the Built Environment

European Cooperation in Science and Technology

AI for Sustainability in the Construction Industry

Autors: Camila Cervantes, Luís Bragança

Presented by: Camila Cervantes

SUSTAINABLE PLACES 2024

circular B

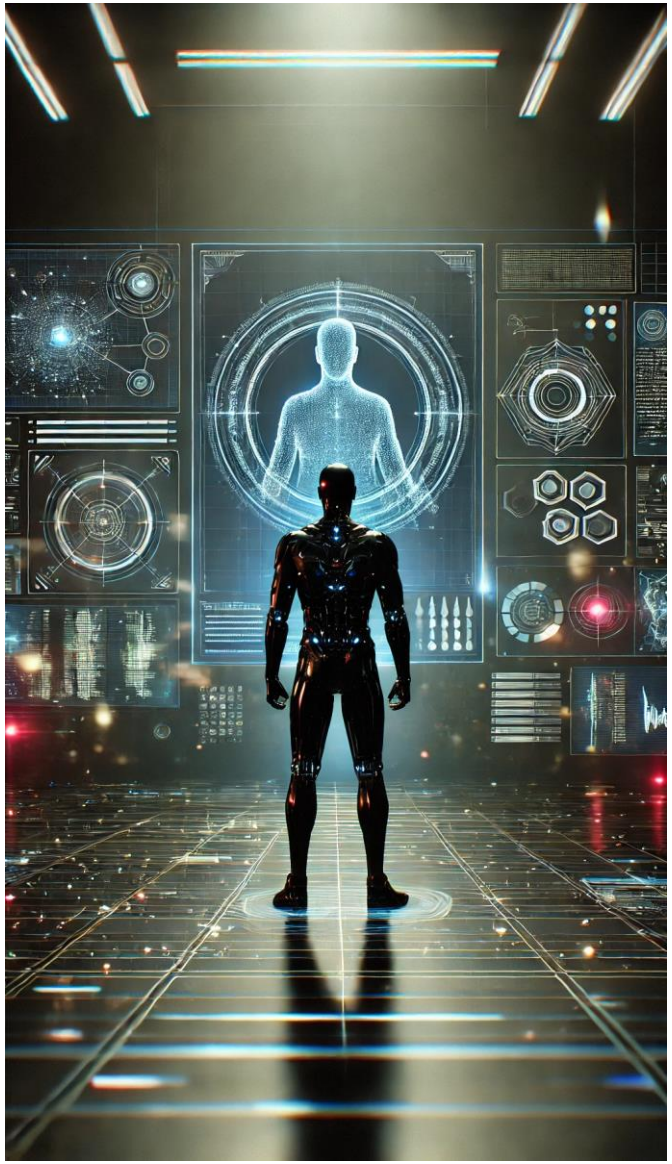
AI for Sustainability in the Construction Industry

- The construction industry is shifting toward innovative technologies like **Artificial Intelligence (AI)** and **Augmented Reality (AR)** to meet the demands for sustainability and operational efficiency.
- These technologies are transforming project planning, execution, and management processes.

Objective: The study explores how the integration of **AI** and **AR** enhances processes in construction, focusing on sustainability and operational efficiency.

Core areas:

- Real-time visualization of construction projects using AR.
- The synergy between AR, AI, and Building Information Modeling (BIM).



Tracking and Sensing Technologies:

- AR uses tracking and sensing systems to provide real-time updates on construction progress.

Key benefits:

- Improved decision-making: AR helps project managers identify and address issues in real time.
- Efficiency: Reducing the time spent on corrections by providing real-time insights.
- Waste reduction: Precise execution reduces the amount of wasted material on-site.

•**AR and BIM**:
Augmented Reality works in tandem with **Building Information Modeling (BIM)** to create **digital twins** of construction projects.

- **Sustainability**:
- The precise execution enabled by Arki and AI reduces material waste, contributing to **sustainable construction** practices.
- These technologies align with **Sustainable Development Goals (SDGs)**, promoting responsible consumption and climate action.
- **Real-world impacts**:
- **Resource optimization**: Arki allows for the efficient use of materials, reducing overall resource consumption.
- **Energy savings**: With reduced rework and better planning, construction sites using Arki and AI see a decrease in energy usage.

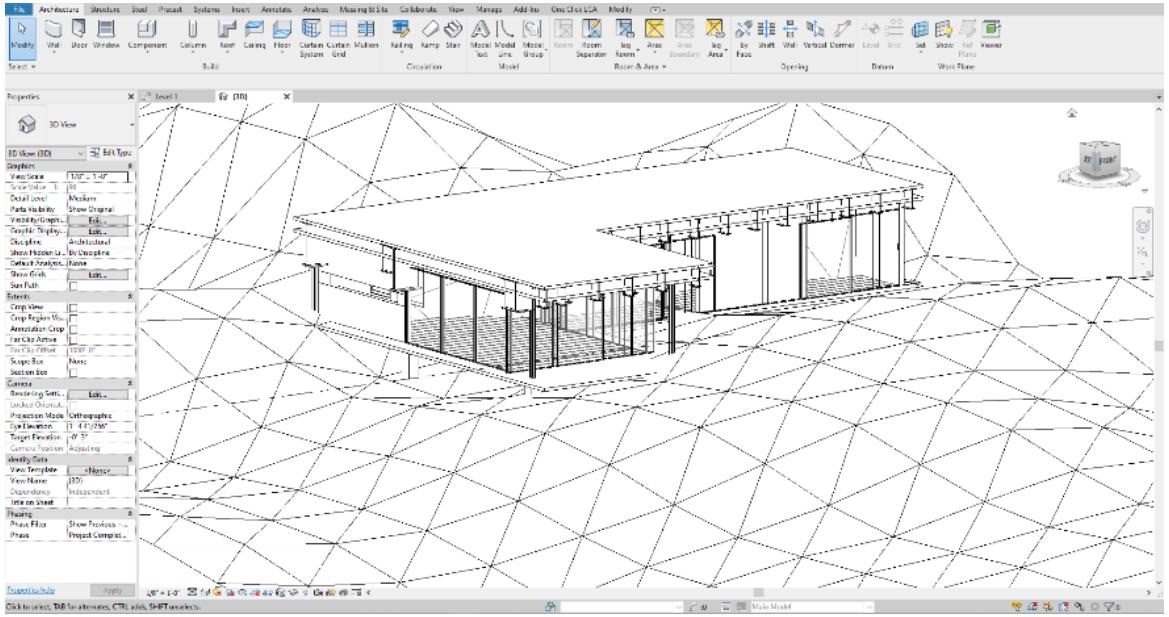
Case study:

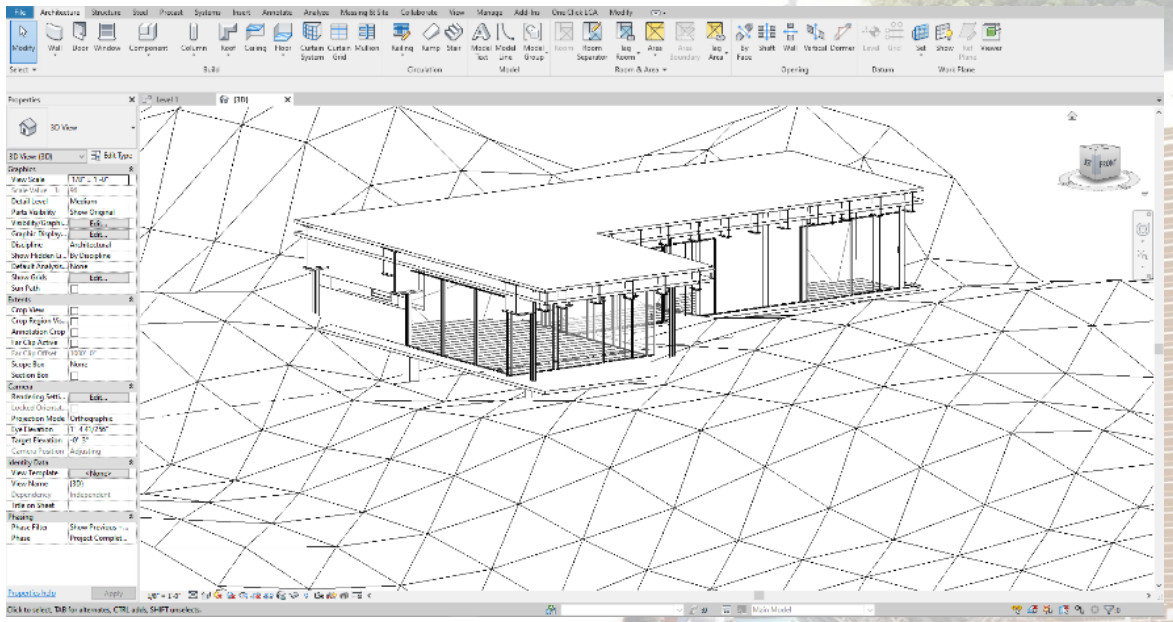
Arki program and its impact on improving construction defect management and sustainability.

Using Arki, contractors can view BIM models directly on the job site, ensuring precision in placement and construction.

Arki uses AI-based image recognition to inspect quality and identify issues before they escalate, reducing costly rework.

AI for Sustainability in the Construction Industry





Communication:

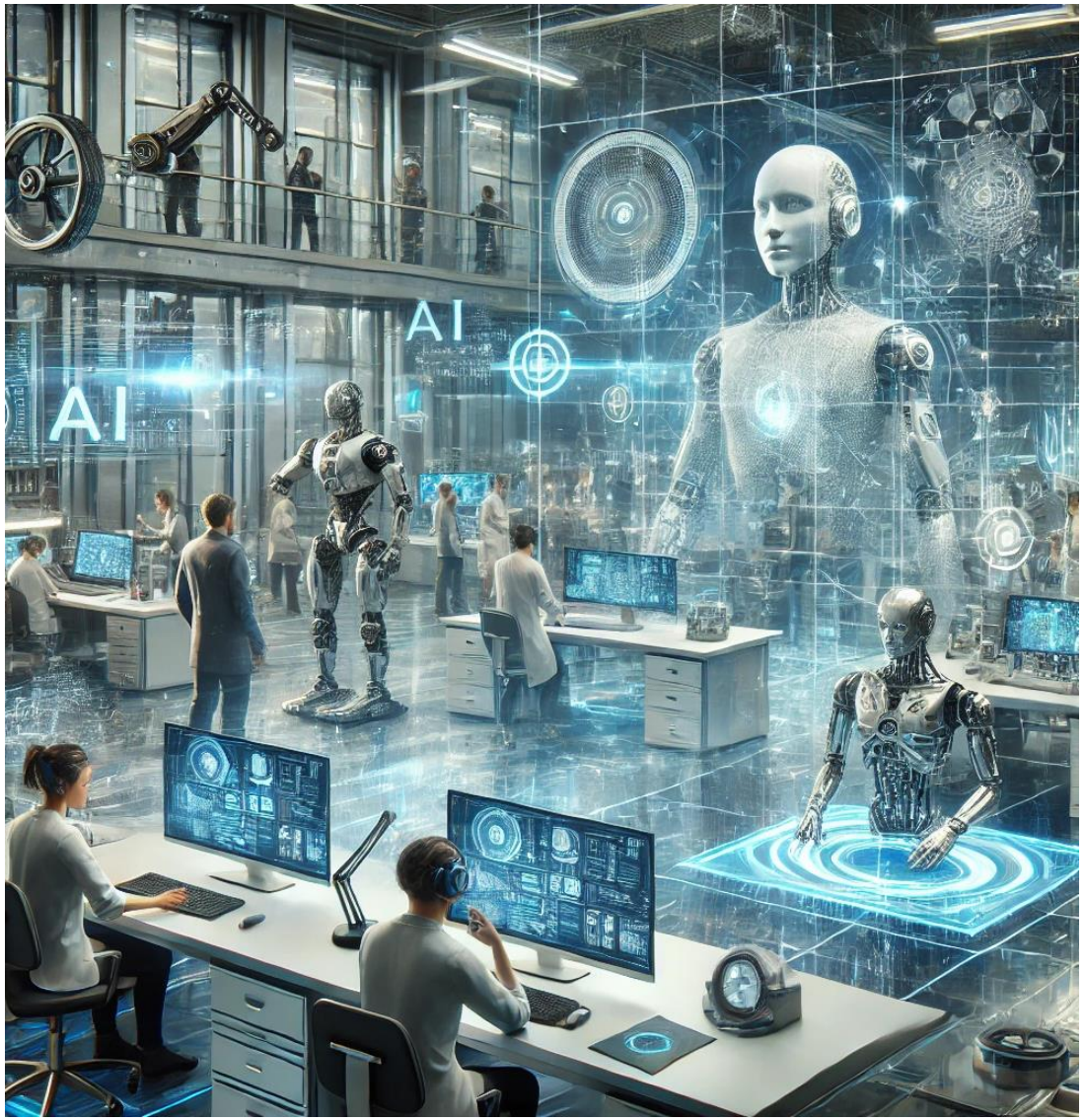
- Arki facilitates communication between stakeholders by providing shared visualizations of construction progress.

Visualization:

- It offers immersive 3D models that help contractors and architects better understand the construction process.

Defect management:

- Arki's AI algorithms detect defects early, reducing the need for manual inspections.



Future Research and Implementation

- **Future directions**:
- Integrating Arki with **5G** and **IoT** technologies for faster data processing and real-time insights.
- Research on how AI can optimize resource allocation and reduce carbon emissions further.

Thank you!

Camila Cervantes

Email: cami_cervantes@hotmail.com

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SMART LAB

Using low-cost sensors and a Living Lab approach towards the roll-out of the Smart Readiness Indicator: A case study of a small European city

24/09/2024

Dr Niall Buckley

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seai SUSTAINABLE ENERGY AUTHORITY OF IRELAND

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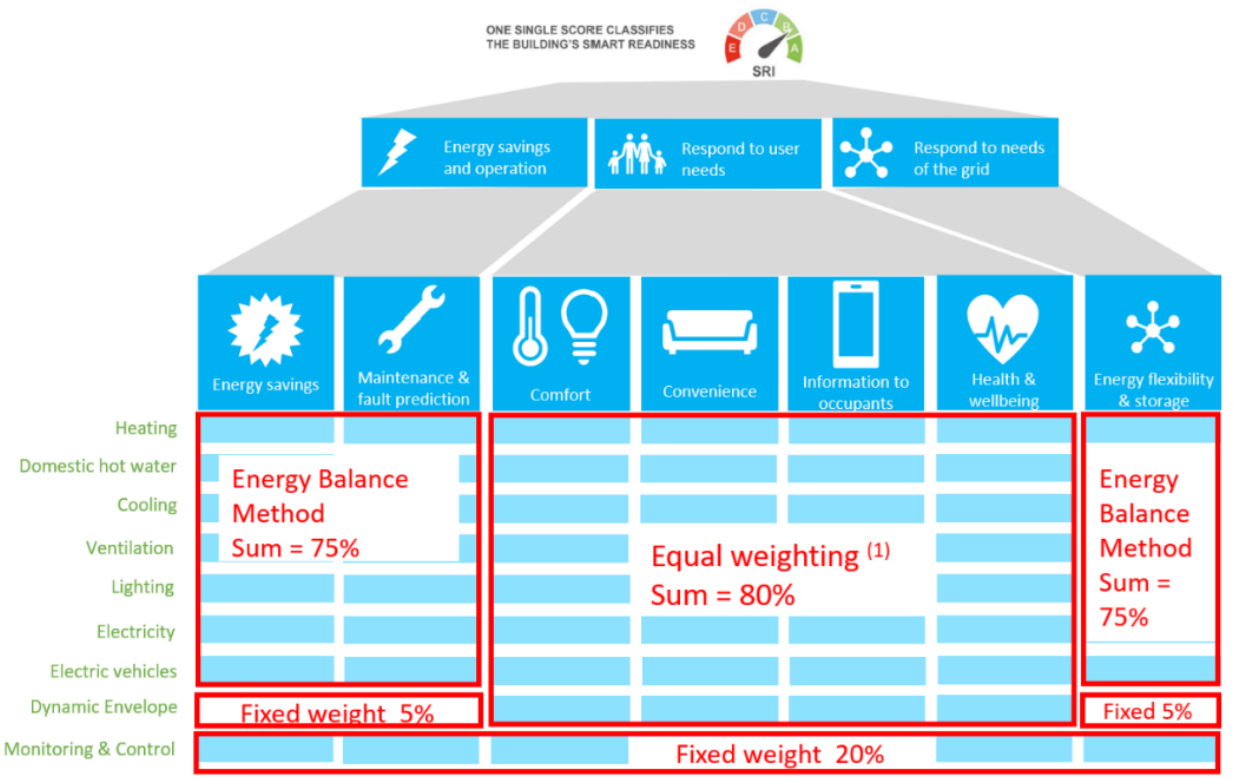
Overview

- Introduction
- The project
- Initial assumptions
- Method
- Results
- Conclusion

SMART LAB

Introduction Smart Readiness Index



https://x-tendo.eu/wp-content/uploads/2020/01/SRI_F1_guidance-document_X-tendoV_Reviewed_Beta_v_final.pdf

- To improve the building performance using nascent technologies
- Main focus on increasing energy efficiency by optimising building systems
- A improvement that works in parallel with current EPC method

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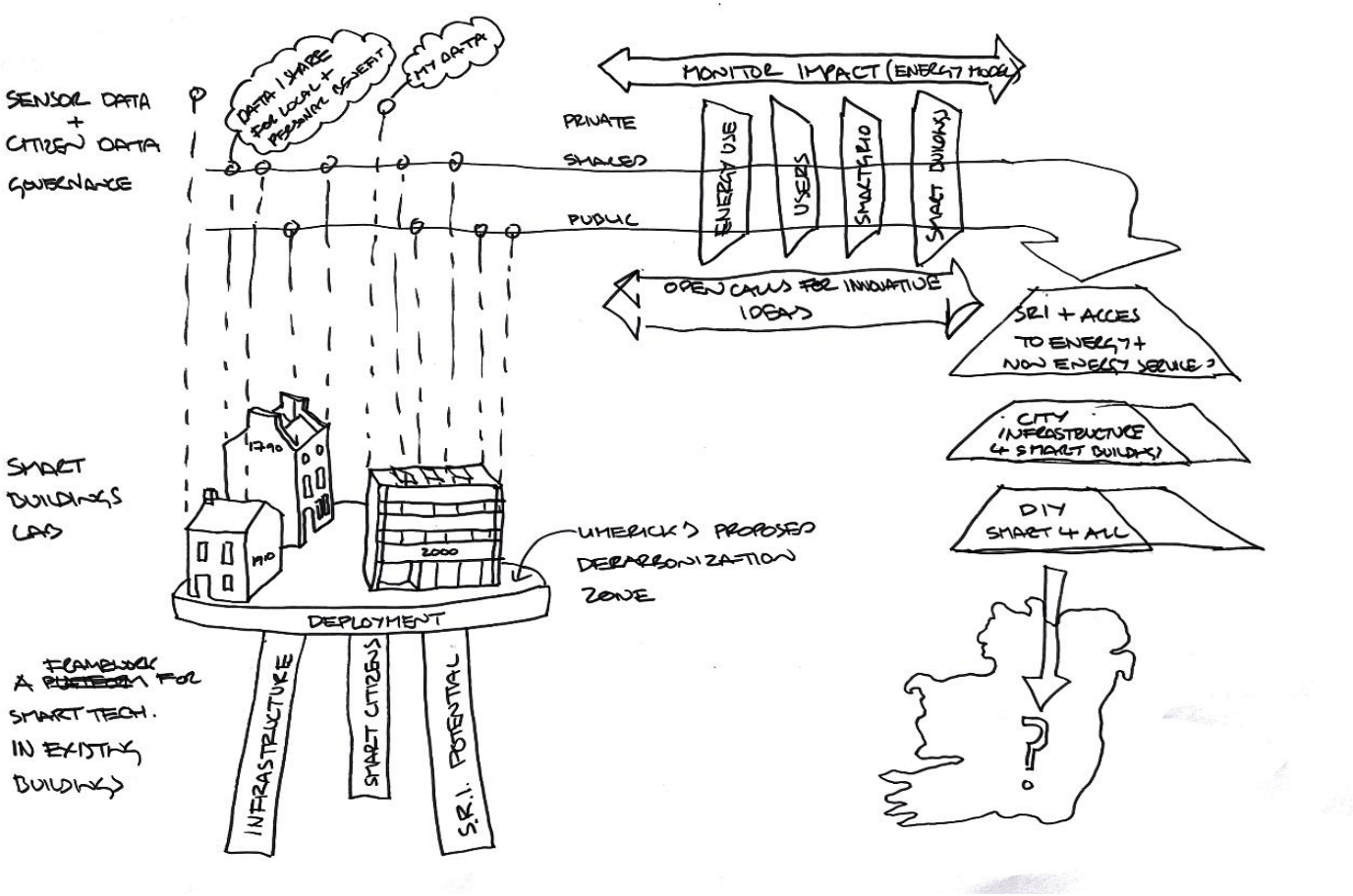

- Public engagement via Living Lab towards smarter cities
- DIY and Low-cost off the shelf sensors
- Empowering the public

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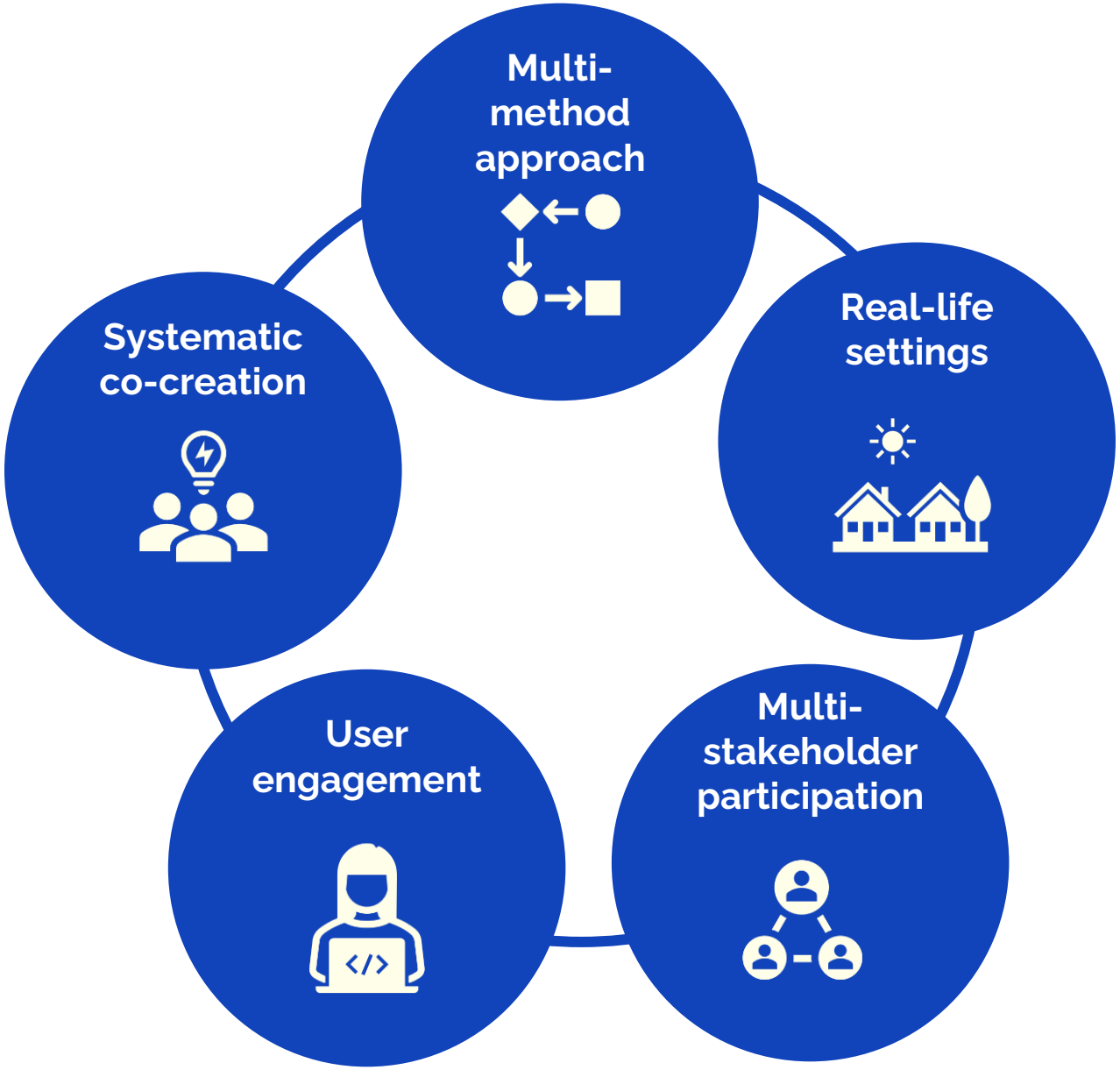
Assumptions

- People would care more about energy and cost
- Off the shelf sensors could improve energy efficiency by changing behaviour
- Sensors focusing on energy will be most popular
- SRI improvement would be best tackled by energy sensors
- IAQ sensors would help understand energy use (correlation between temp, air quality, energy use)

Method

Living Labs: Common elements



Adapted from Malmberg Et al. 2017, p. 11

Method

- Promote smart technology to the public via living lab workshops and demos on IoT devices
- Invite participants to install two IoT devices in their buildings both residential and non-residential
- Setup dashboards for participants to monitor their devices
- Get iterative feedback from participants' to

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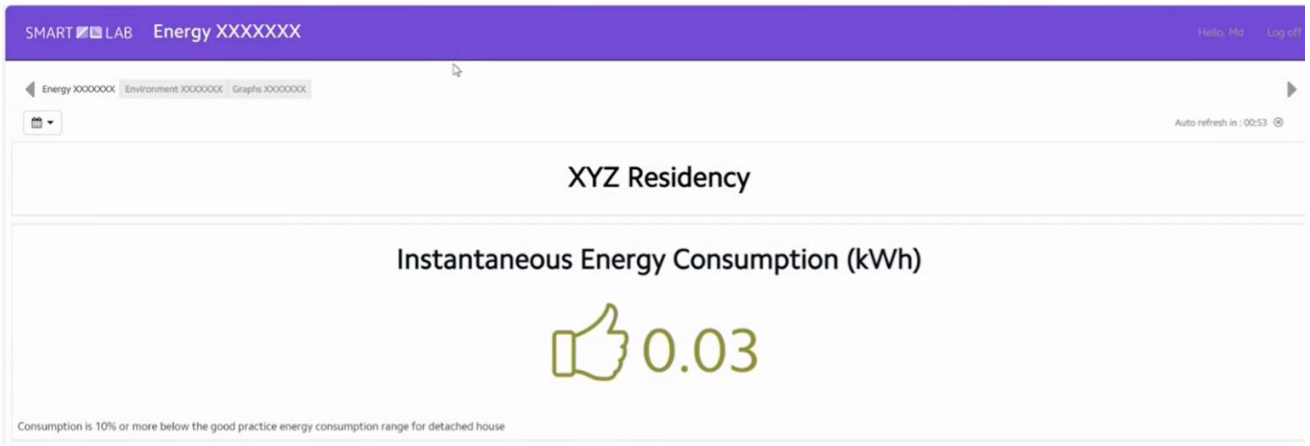
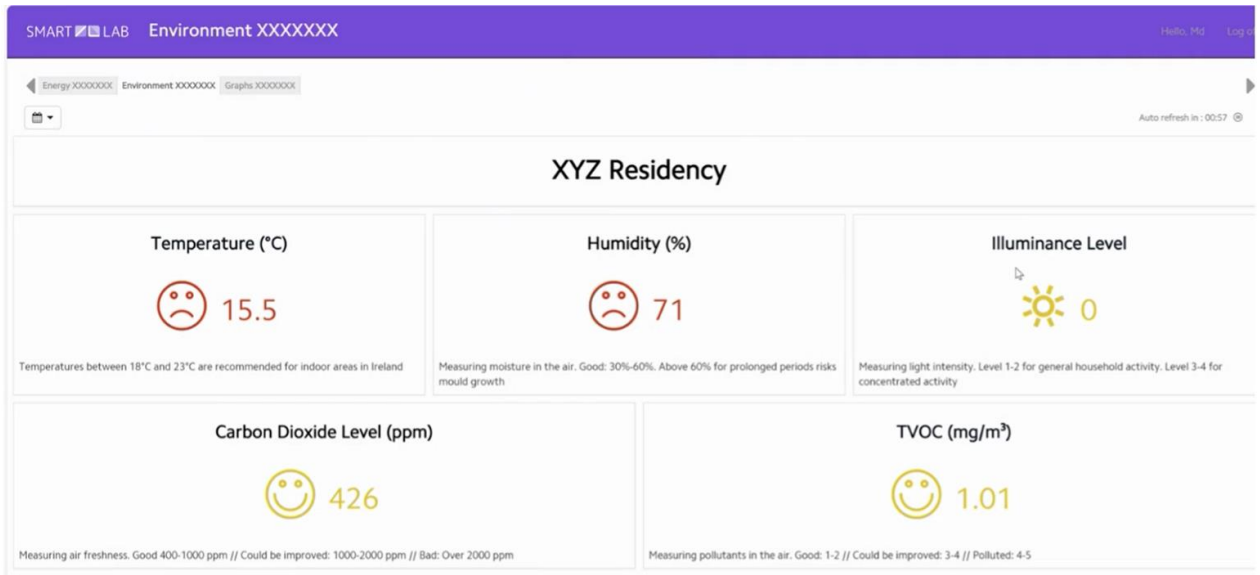
Vutility Hot drop Energy Sensor
Reichlet AM307 IAQ Sensor
Watteco Flasho Sensor

Method





- Easy to read user-friendly dashboards for both energy and IAQ sensors
- Energy sensors benchmarked to building estimated energy loads based on survey data

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METHOD

- 59 buildings received sensors
- 35 Non-res
- 24 Residential
- 160+ sensor's installed

Resident (owner)

- Strong capacity to effect change in energy & environmental behaviour, smart technology use and building smartness level.
- Strong opportunity to effect change in having full control of own building, limited by lack of options in energy & smart services market, financial incentives, and community energy schemes.
- Strongly motivated to make changes, for financial, environmental, and health reasons.

Resident (renter)

- Medium capacity to effect change in energy & environmental behaviour and smart technology use, with limited capacity to make changes to building fabric, energy source or system.
- Strong opportunity to embrace smart services when provided, with limited opportunity for non-owners in community energy schemes and retrofit initiatives.
- Strongly motivated to make changes, for financial, environmental, and health reasons, though motivation frustrated by lack of opportunity.

Office & Retail (manager)

- Medium capacity to effect change in energy & environmental behaviour, smart technology use and energy source, with limited capacity to make changes to building fabric.
- Strong opportunity to embrace smart services as part of business model. Access to community energy and retrofit depends on relationship to building (owner/lease/rent etc).
- Strong financial and environmental motivation to make changes, with health motivation lower in non-residential users.

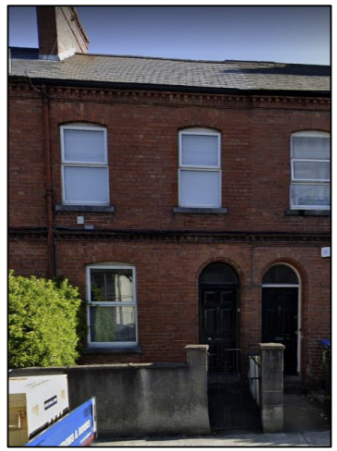
Institution (steward)

- Strong capacity to effect change in energy & environmental behaviour, smart technology use and building smartness level, though financial challenges are significant in older and larger buildings.
- Strong opportunity to embrace smart services, play central role in community energy schemes, and access specialised funding streams where available.
- Strongly motivated to make changes for financial and environmental reasons, with sense of legacy a significant motivator.

RESULTS – SRI Use Case

- No Sensors

1. Original State

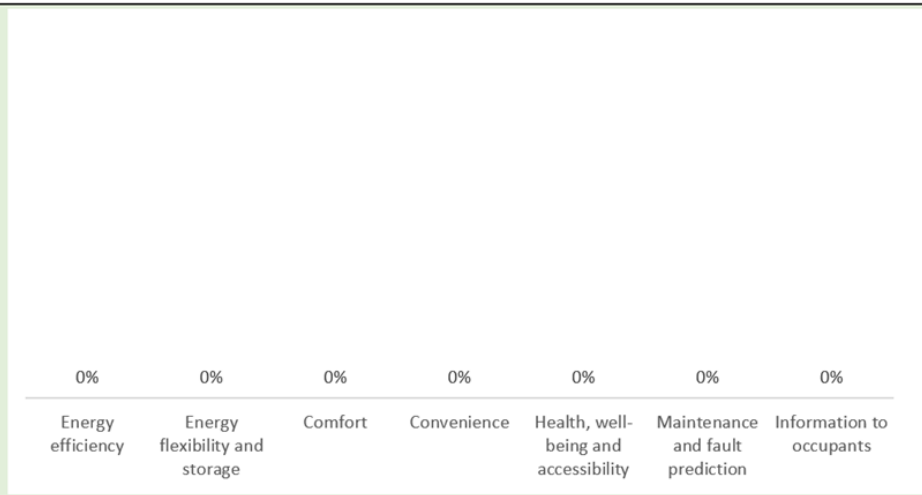


Period	Pre-1940 Heritage Buildings
Use Type	Residential
Smartness	G
TABULA typology	Terraced house, solid brick wall. "Typical redbrick house found in Dublin, Cork, Limerick etc from late 1800s up to 1930s. Often includes a flat roof extension to rear. Suited to a mix of internal and external wall insulation. Suspended timber floors are common that can be retrofitted with insulation" (30).
Sample Limerick Address	Joseph Street. Built 1901. Single family home.

TOTAL SRI SCORE	0%	SRI CLASS	G

IMPACT SCORES

Energy efficiency	0%
Energy flexibility and storage	0%
Comfort	0%
Convenience	0%
Health, well-being and accessibility	0%
Maintenance and fault prediction	0%
Information to occupants	0%



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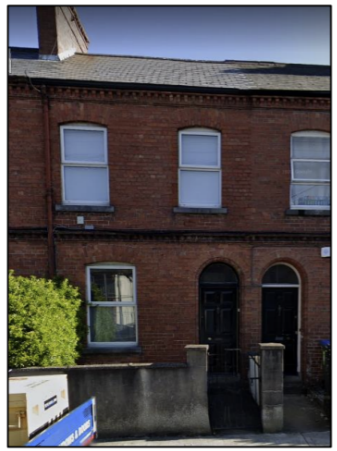
RESULTS

Project sensors

1. Original thermostat
2. Smart meter monitor
3. IAQ monitor



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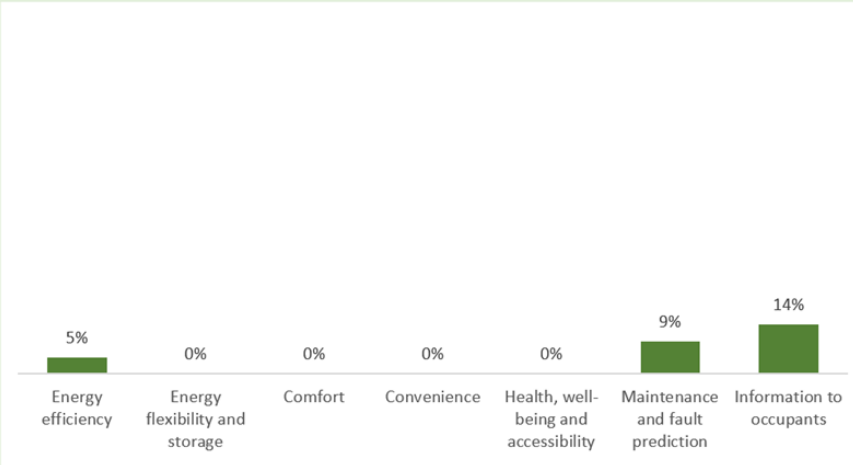
Sample Limerick Address	Joseph Street. Built 1901. Single family home.

TOTAL SRI SCORE	3%	SRI CLASS	G

IMPACT SCORES

Energy efficiency	5%
Energy flexibility and storage	0%
Comfort	0%
Convenience	0%
Health, well-being and accessibility	0%
Maintenance and fault prediction	9%
Information to occupants	14%



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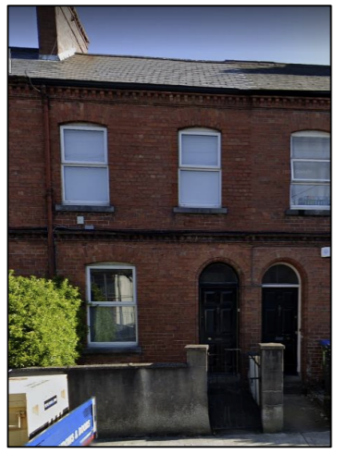
RESULTS

- Optimal “Low cost” sensors

1. Smart emersion, control, and DSO signal enabled
2. Smart heating monitor and control



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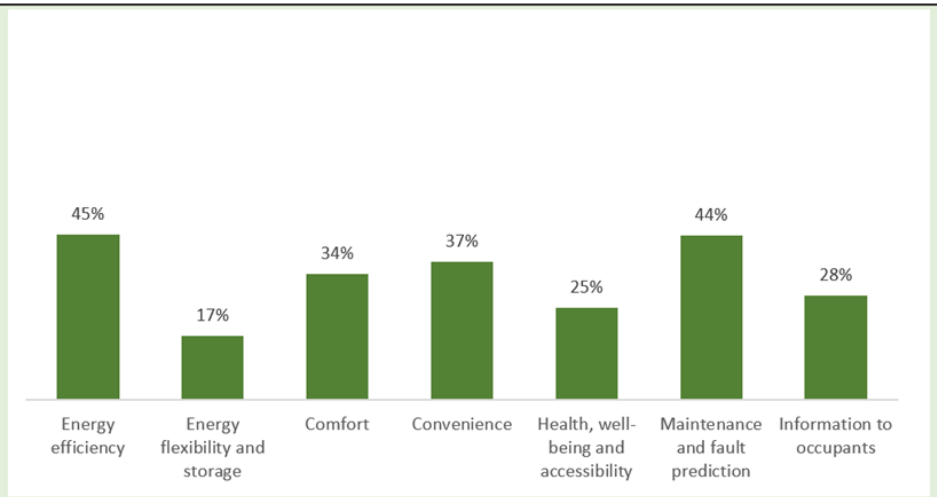
Sample Limerick Address	Joseph Street. Built 1901. Single family home.

TOTAL SRI SCORE	30%	SRI CLASS	F

IMPACT SCORES

Energy efficiency	45%
Energy flexibility and storage	17%
Comfort	34%
Convenience	37%
Health, well-being and accessibility	25%
Maintenance and fault prediction	44%
Information to occupants	28%



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RESULTS

- This SRI has the ability to receive signals from the GRID but there's no way of knowing that from the SRI grade
- SRI grades demonstrate roughly how smart a building is, but not specifically
- SRI themes can be a little subjective making room for interpterion, technically the IAQ sensor battery warning can be classed as fault detection which improves the SRI

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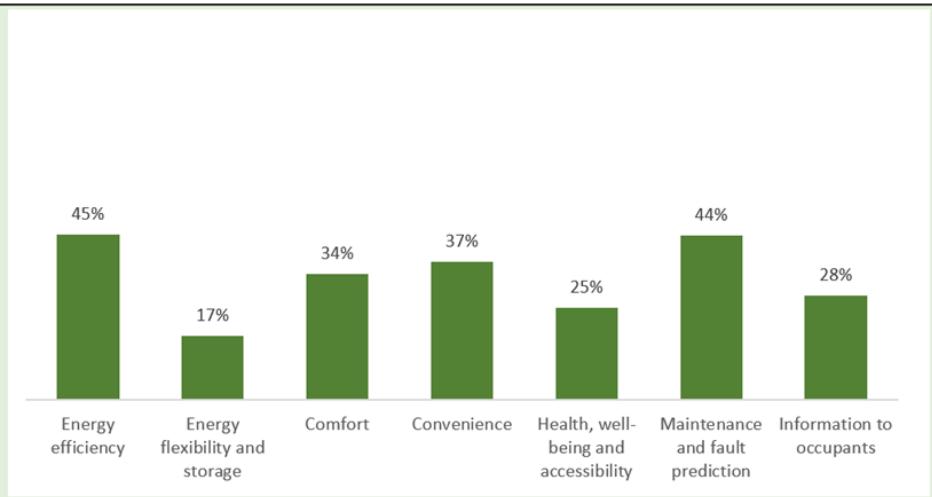

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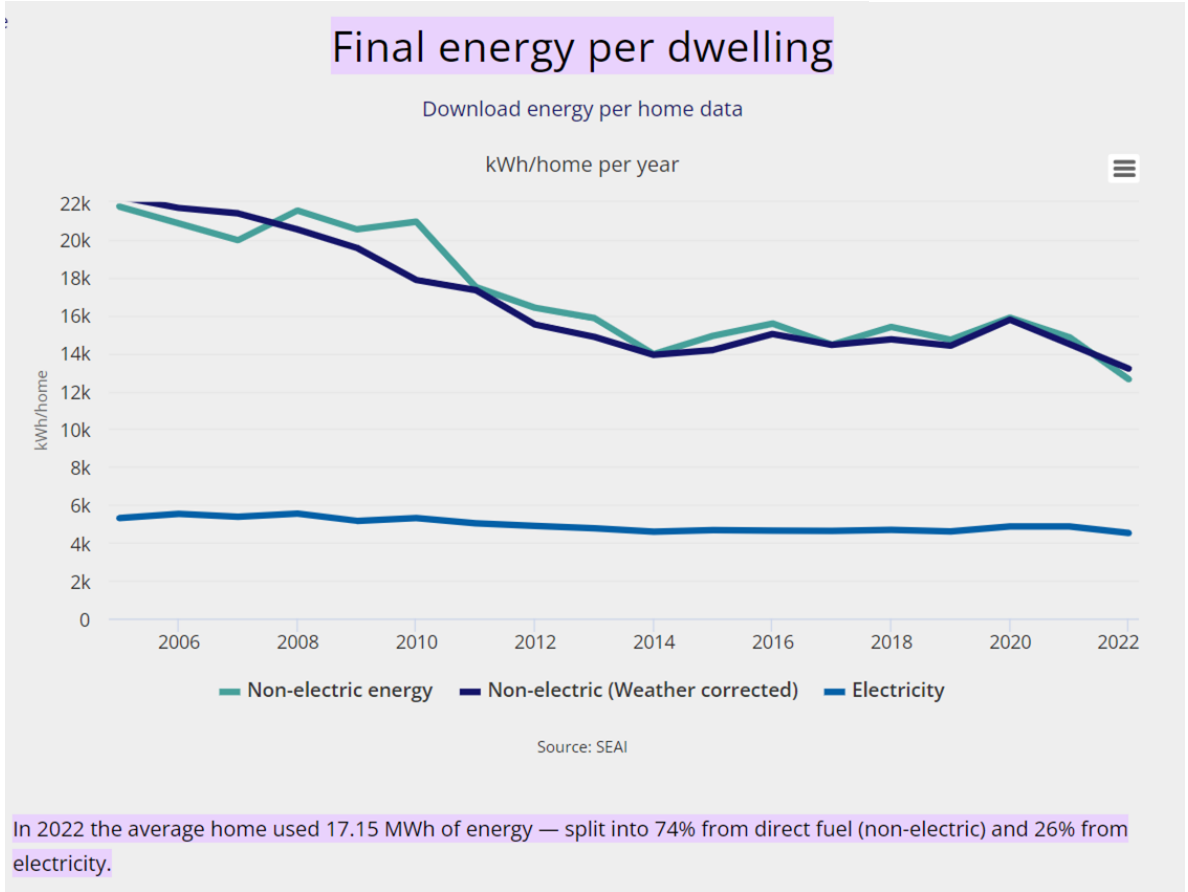
Discussion

- Participants most inquisitive about IAQ data
- Some participants put priority on IAQ over energy use or bills, in one case increasing the temp to mitigate mould and humidity issues
- IAQ user interface was easier to monitor and interpret than energy dashboards as they were in the room with occupants and didn't require login, passive updates
- Grey area on what makes a building smart… smart plug, smart bulbs, smart valves?

Energy has been derived from National stats from the SEAI

- Big push towards Electric Vehicles ,Heat Pumps, and Solar PV

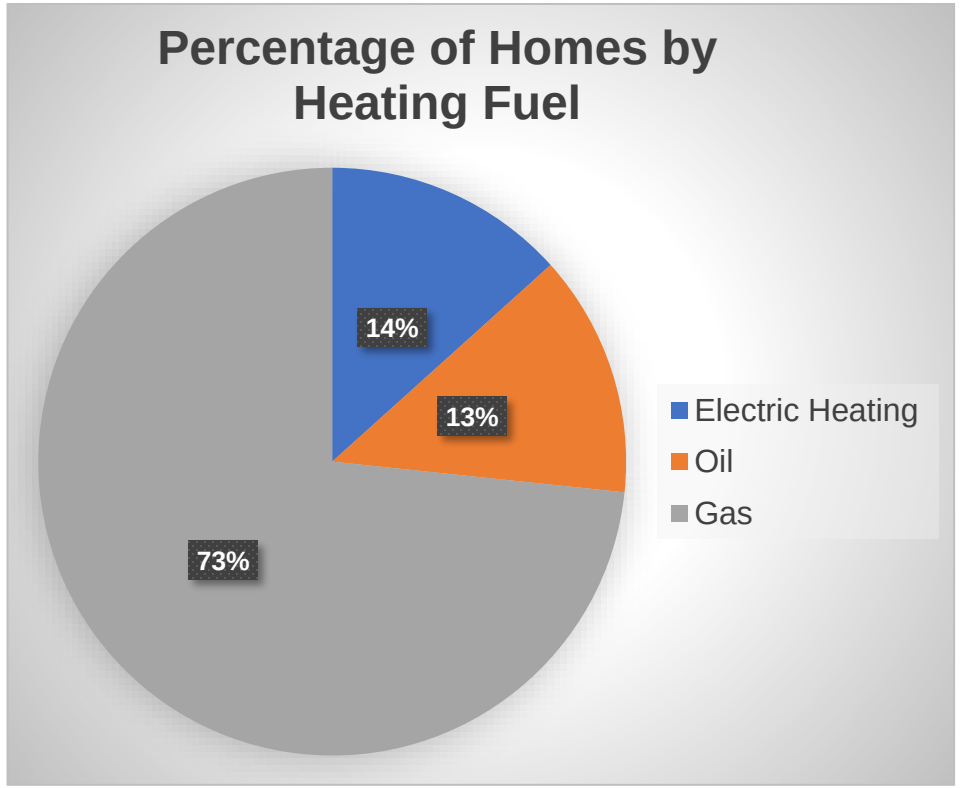


In 2022 the average home used 17.15 MWh of energy — split into 74% from direct fuel (non-electric) and 26% from electricity.

SMARTLAB Energy Meter Sample

Most homes sampled in SAMRTLAB have gas powered Combi Boilers

However, sample does not include apartments which have a larger share of electric



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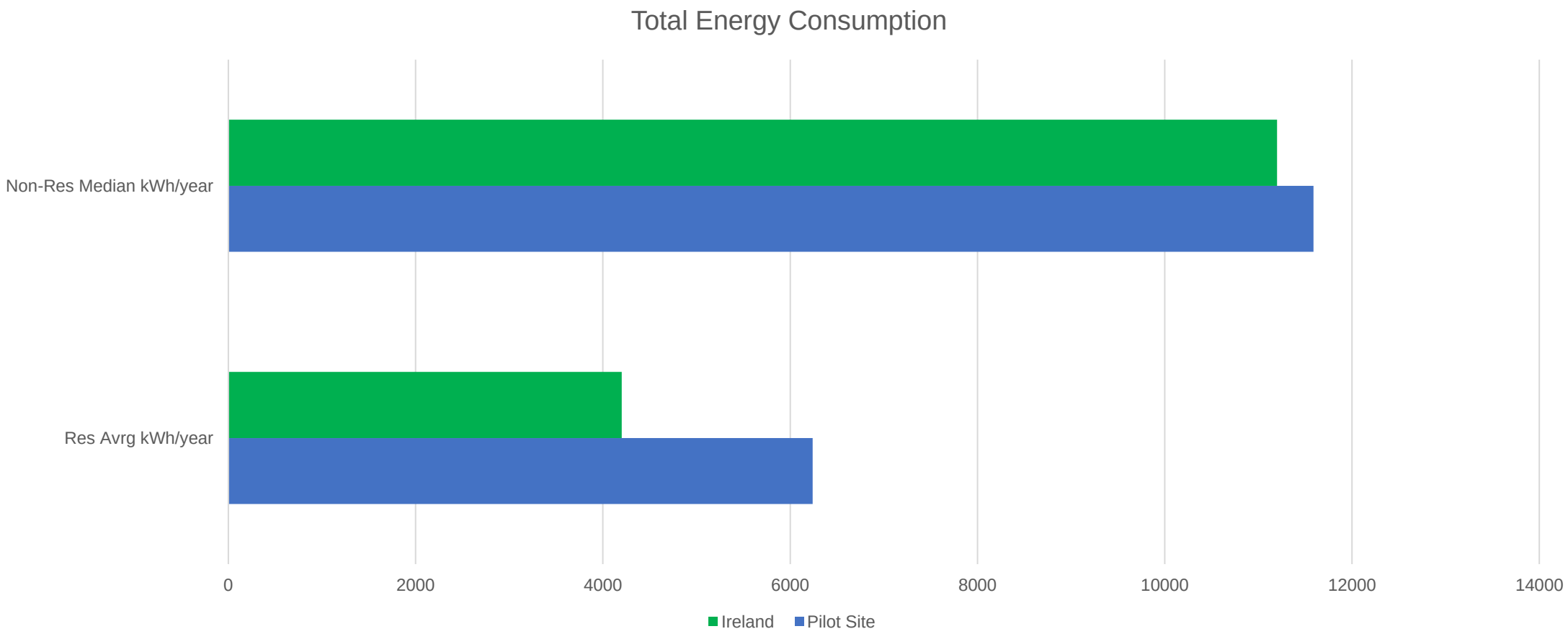
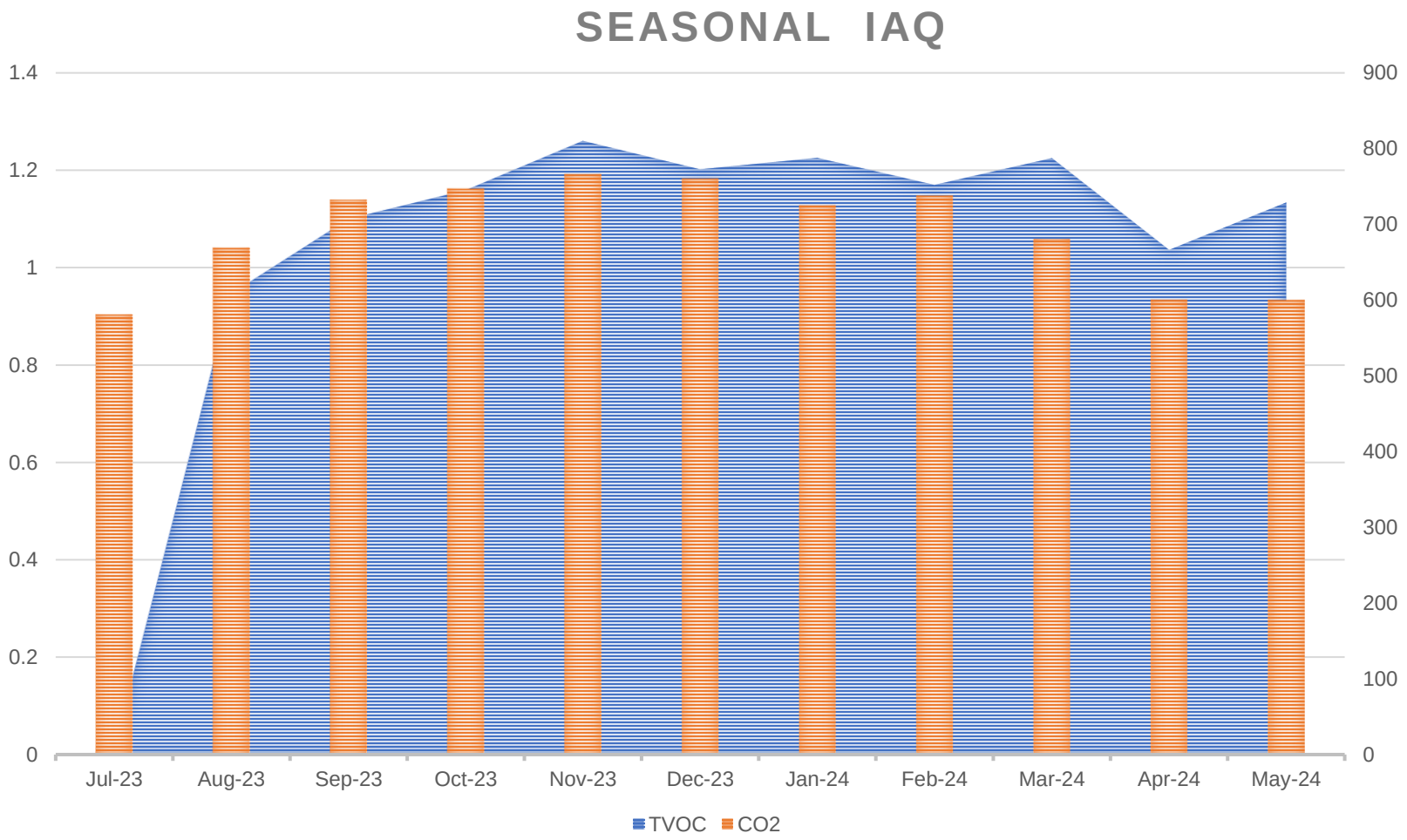
SMARTLAB Energy Meter Sample



IAQ – Seasonal

- IAQ Degrades in the winter
- Close windows and doors keeps in heat but also contaminants
- IAQ index's a level 2 = Fine



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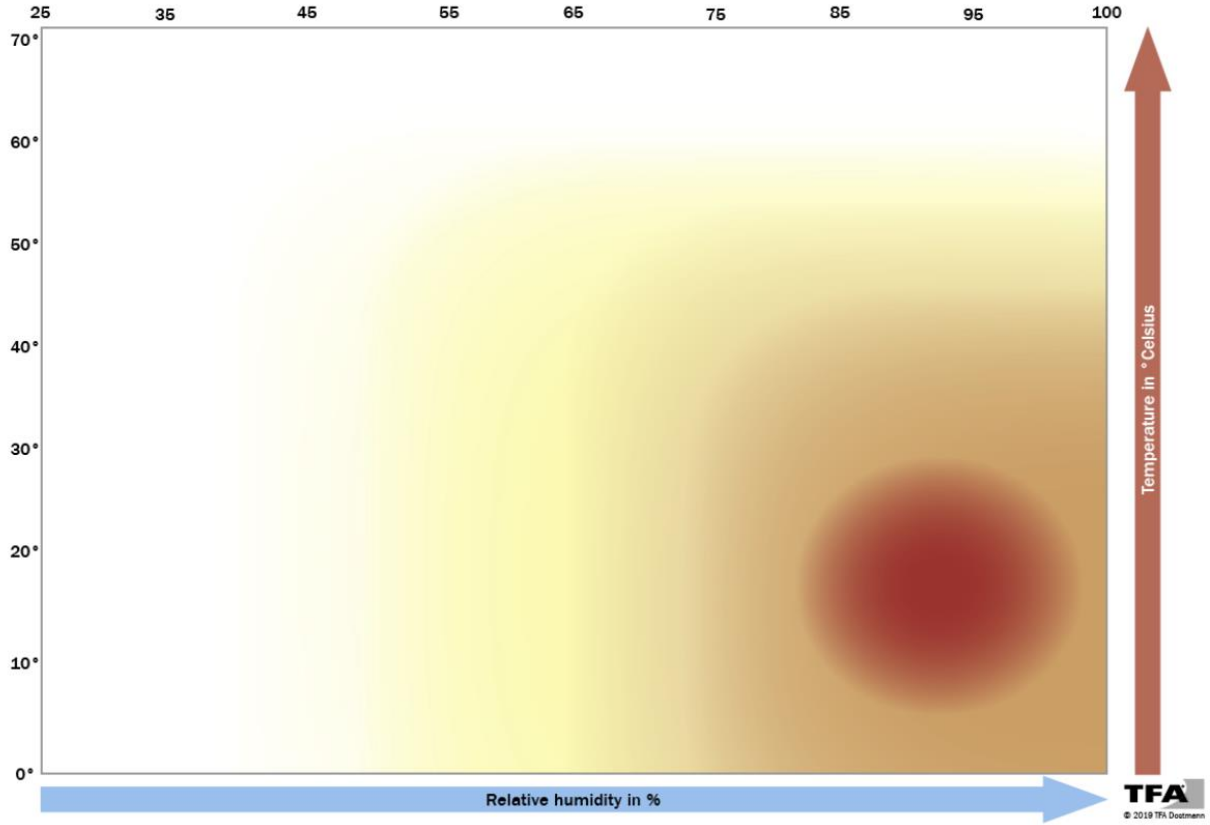
Performance based on sensor location Mould

- Recommended that humidity levels in winter range from 30% to 40%
- Recommended that temperatures range between 20 and 24 degrees Celsius
- Anything over 50% risks mold



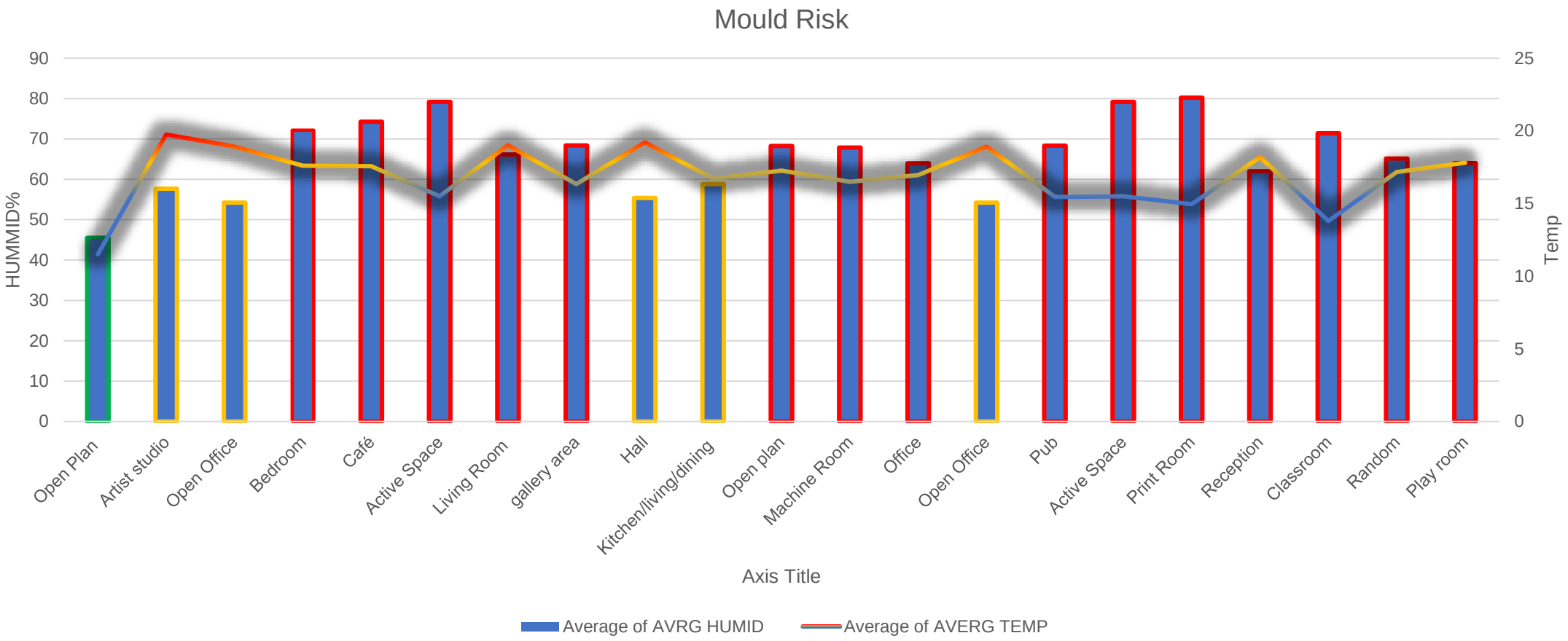
At what humidity levels does mould develop in rooms?

https://www.mayoclinic.org/diseases-conditions/mold-allergy/symptoms-causes/syc-20351519

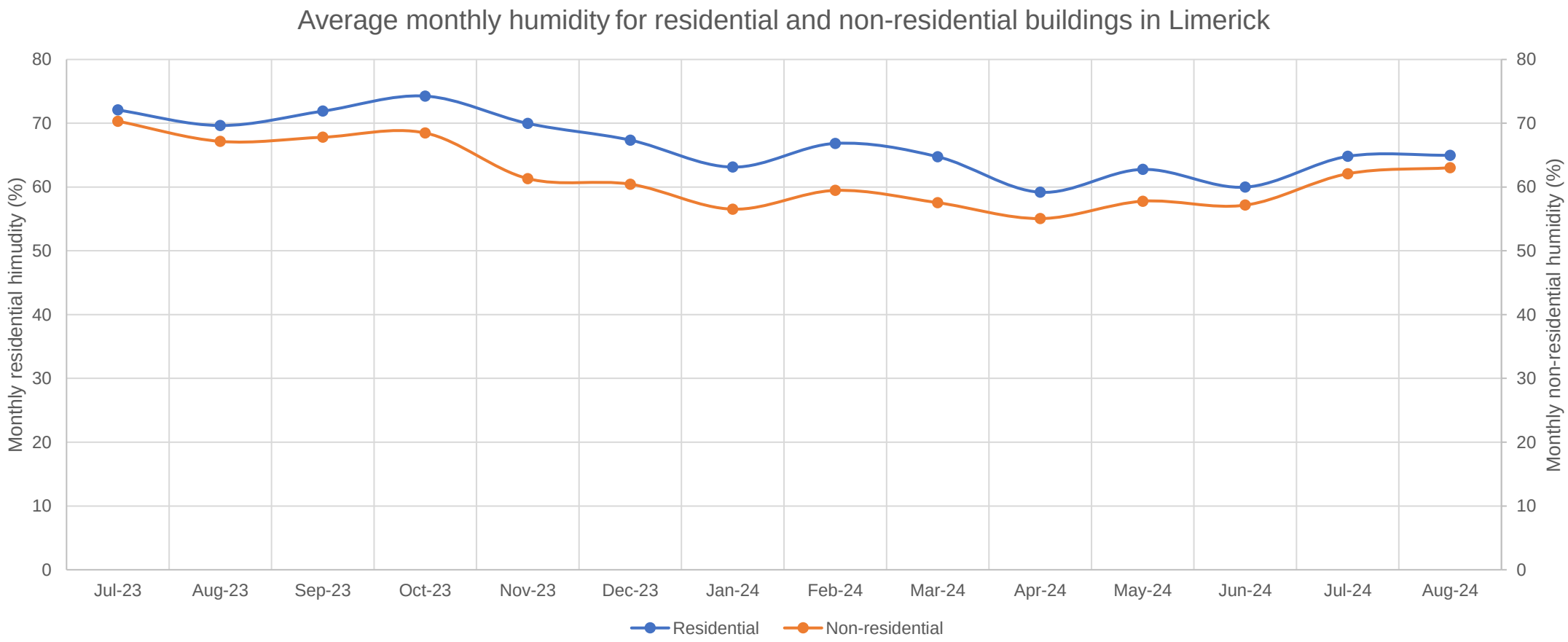
https://www.matrixremediation.com/info/good-temperature-mold-growth#:~:text=What%20is%20the%20ideal%20humidity,condensation%2C%20levels%20should%20be%20lower.

https://www.tfa-dostmann.de/en/humidity/how-to-prevent-mould/#:~:text=At%20a%20relative%20humidity%20of,moisture%20the%20air%20can%20hold.

Performance based on sensor location
Mould Risk

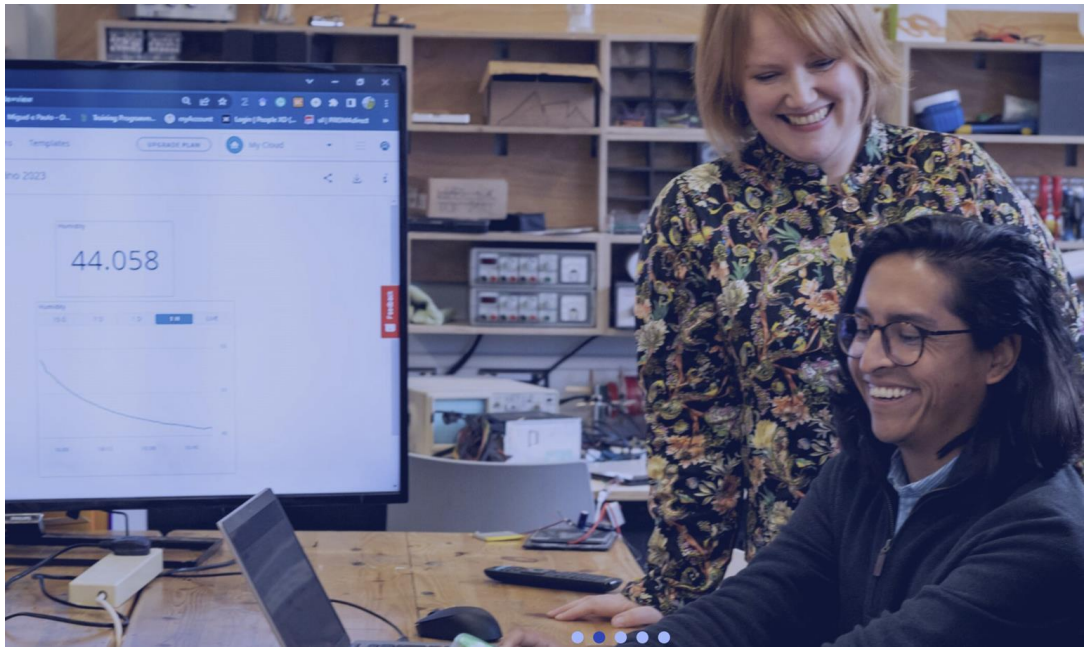


Total Sensors



Conclusions

- Assumptions were challenged
- Big focus on IAQ, partially due to ease of use
- SRI is difficult to improve with low-cost sensors
- Energy consumption is increasing in pilot site
- SRI is somewhat subjective and does not help inform on buildings capabilities
- Living lab very successful with getting participants and feedback



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Questions?

Dr Niall Buckley

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Dr Madeleine Lyes

Madeleine.Lyes@ul.ie Living Lab Expert

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