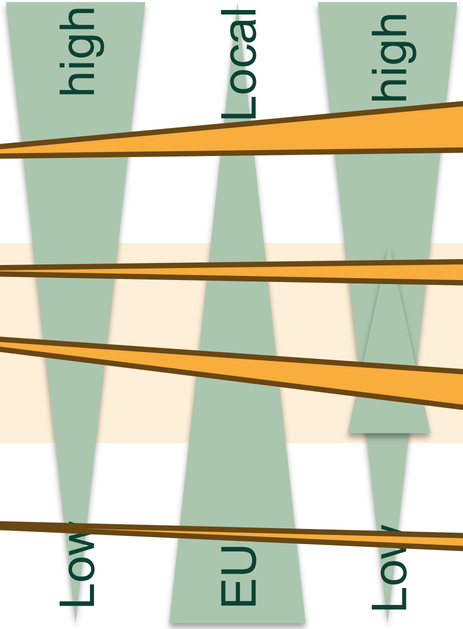
The Role of Buildings Data Hubs in the Energy Transition

Data sources and uses **define the need for data hubs** for energy transition decision makers and implementers, to deliver on the latest EED revision and EPBD recast.

Judit Kockat
BPIE - Buildings Performance Institute Europe

The Role of Data Sources

Sources	details	territory& availablty	record frequency



- Dititalisation initiatives, Smart building projects and Energy communities
- Facility Management
- Cadastres
- Census
- Utilities, energy providers
- National Building Observatories new with EPBD recast
- Building Stock Observatories

spacial,
temporal,
scope,
e.g. IAQ

Real-time,
15‘
annually,
eventually

Examples

Real time, 15‘, measured data, GIS, detailed scope such as Indoor Air temperature, all buildings

Spacial & structural data, updated upon permit

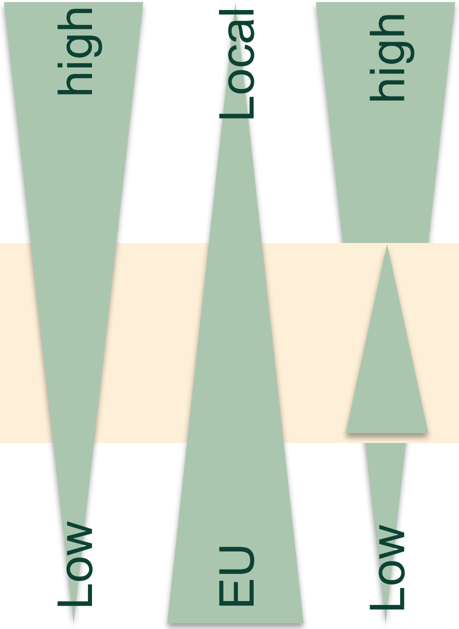
Every 3 - 10 years, detailed, surveyed, sample basis

Annually, incl. public bldgs.

The Role of Data Sources in Enabling Energy Transition Actions

Sources	details	territory& availablty	record frequency	Use

- Dititalisation initiatives, Smart building projects and Energy communities
- Facility Management
- Cadastres
- Census
- Utilities, energy providers
- National Building Observatories EPBD
- Building Stock Observatories



spacial, temporal, scope, e.g. IAQ

Real-time, eventually, , e.g. IAQ

- Detect material and system failures immediately
- Electricity and heat flexibilisation services (incl. DSM)
- Enable local optimization e.g. through neighbourhood „energy markets“
- Enable local network planning
- Determine Energy Performance to prioritize/plan energy/emission saving

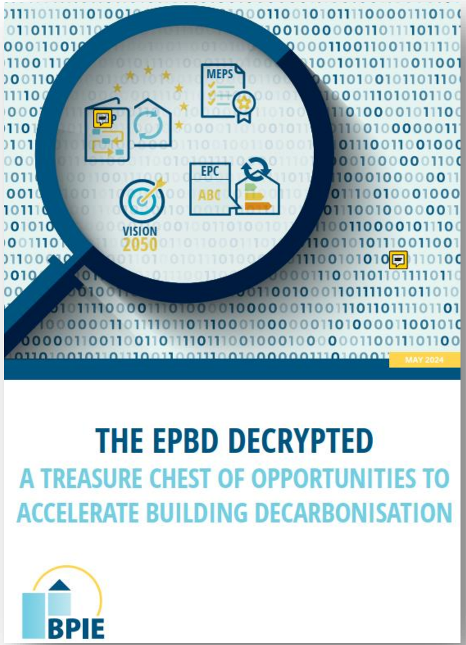
Quantifying current and desired Buildings‘ energy demand & emissions

- Monitor Improvement of the buildng stock .... deliverable coming up
- Quantifying the Building stock (m²)

Worst performing buildings

EPBD recast overview

- Updated standards for new buildings: ZEBs
- Renovation policies for existing buildings: MEPS, NBRPs,
- Planning for the 2050 vision and H&C decarbonisation: NBRPs
- Stronger enabling framework: information (EPCs), advisory, financial support



BPIE briefing
→ last week
bpie.eu/news

IMPLEMENTATION GUIDE
→ not before the end of 2024

The Role of Buildings Data Hubs in the Energy Transition

Sources	details	territory& availablty	record frequency	Use

Sources

- Dititalisation initiatives, Smart building projects and Energy communities
- Facility Manag
- Cadastres
- Census
- Utilities, energ providers
- National Building Observatories
- Building Stock Observatories

high

Local

high

al-time,
ntually,
g. IAQ

e.g. snapshots of the „real“ buildings stock to validate typology data within responsible policy jurisdiction

e.g. time series of aggregate final energy consumption, dissagregated by responsible policy jurisdiction

Use

- Detect material and system failures immediately
- Electricity and heat flexibilisation services (incl. DSM)
- Enable local optimization e.g. through neighbourhood „energy markets“
- Enable local network planning
- Determine Energy Performance to prioritize saving action

Quantifying current and desired Buildings' energy demand & emissions

- Monitor Improvement of the buildng stock
- Quantifying the Building stock (m²)

What a DataHub can provide

- Organize and align, map datasets
- Perform defined validation and quality checks
- Provide one datasource for all stakeholders and uses
- Provide different aggregation levels for different uses
- Provide defined reports
- Organize data uploads and database updates
- Provide standardized analysis and visualisations

Thank you for your attention.

Judit Kockat

Project Manager

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Follow us:

BuiltHub

Thank you.

This project has received funding from the EU's Horizon 2020 program under grant agreement no 957026.

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SUSTAINABLE PLACES 2024

Builthub Workshop

Platform presentation

NTT Data & EURAC

This project has received funding from the EU's Horizon 2020 program under grant agreement no 957026.

BuiltHub

High level architecture

High level architecture

The architecture of the BuiltHub platform is a cloud-native system deployed in the Amazon AWS cloud.

As BuiltHub is an open platform, everyone can benefit from the knowledge and information stored in the data hub, from construction companies to national governments, even property owners.

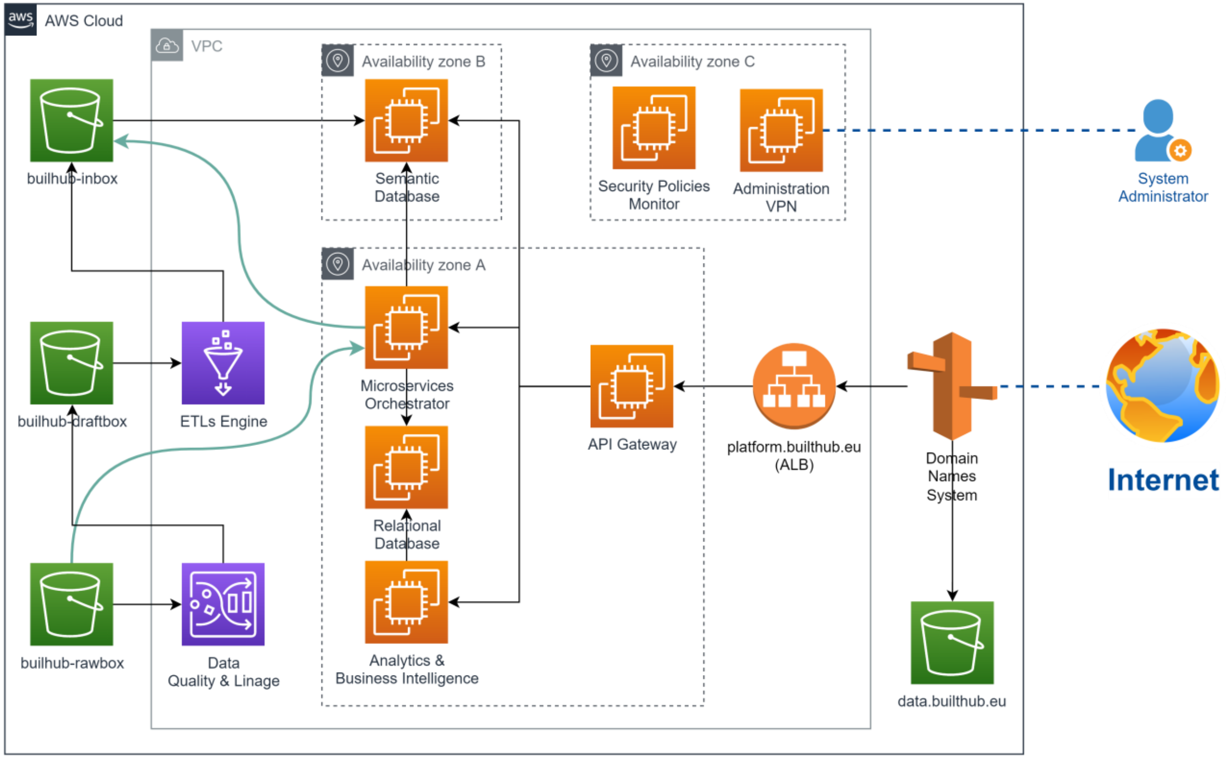
The user will be able to export, filter and visualize building energy performance data, which will allow for the creation of suitable business models, policies and finance strategies. Through BuiltHub services the user will also be able to directly evaluate the data against key performance indicators, scenarios and market and investment parameters.

BuiltHub can also integrate external information from other data sources, not necessarily storing all the data. An example of this could be to integrate information about the population of each desired country from the data source “Wikidata”

High level architecture

BuiltHub has adapted its architecture to support the requirements of privacy, high availability, workload and efficiency of a modern data-intensive platform.

This changes allowed the platform to maintain the data ingestion workflow and improve the security and performance of the platform, as it now runs layers of specific microservices and a more dedicated database.



The building-blocks architecture of BuiltHub

Technical Overview

Challenges

The challenges the platform has come to face can be divided into two major categories:

1. Functional Requirements, that represent the set of specific actions a system must perform to meet user needs and accomplish its intended tasks. They typically describe the system's explicitly stated functionalities, such as user interactions, data processing and mapping, and output.

2. Cross-functional Requirements, which refer to key aspects that cut across multiple functional sectors and define the components of the system. Unlike functional requirements, which focus on specific functionalities or features and provide the overall rationale, cross-functional requirements address concerns that impact the system as an entity. These requirements ensure that the system functions seamlessly and effectively in diverse environments and under various conditions, improving its value.

Cross–functional Requirements

Cross-functional requirements play a major role in the shaping of the technical architecture. They implicitly direct the choice of technologies implicated and the design of the respective components.

Their spectrum can be broken down in discrete pillars on top of which decisions are taken:

- Efficiency, the solution should be cost-effective and easy to develop on
- Reusability, the components should be easily integrated and reusable for multiple purposes
- Security, the platform should be secure
- Scalability, the application should be able to adapt according to the performance needs
- Extensibility, new features and capabilities should not imply a holistic system redesign and implementation
- Fault-tolerance, application errors should not be catastrophic, but easy to recover from

Technology Stack Overview

- Amazon Web Services, including IAM, EC2, S3, Glue, Glue Databrew, Lambda
- Dockerized deployment
- Angular 14 with Highcharts
- Java 17 with Spring Boot 2
- GraphDB
- PostgreSQL with the PostGIS extension
- Knowage, Open-Source Analytics and Business Intelligence Suite

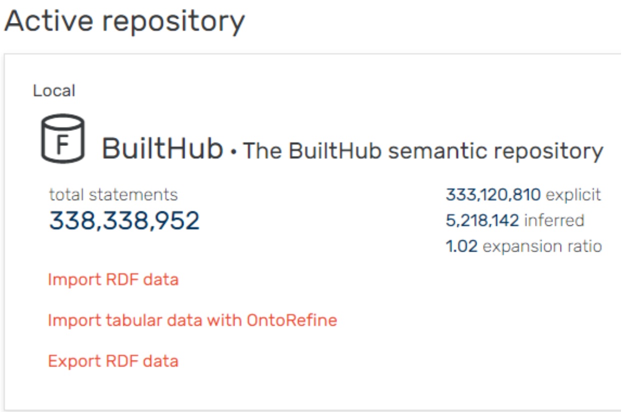
The Data Lakes

GraphDB is a kind of NoSQL graph database. It uses

- graph structures with
- nodes,
- edges, and
- properties

to store and represent data.

It is highly recommended when managing data which is highly connected with complex and large relationships within datasets.

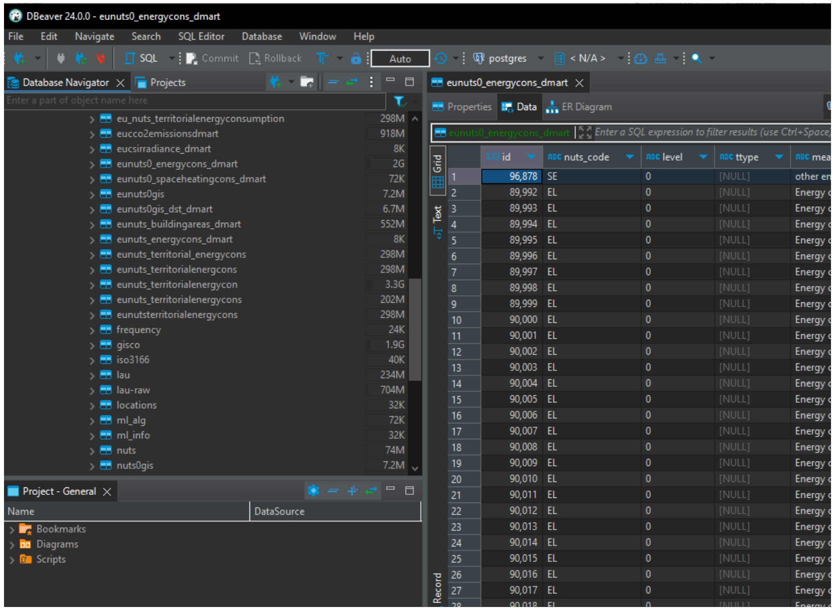


The Data Lakes

PostgreSQL is a potent open-source relational database.

PostGIS, being an extension, comes into the picture to enhance the capabilities of PostgreSQL.

It supports geographic objects, enabling the storing, analysis, and management of Spatial Data.



Querying the Datasets

Datasets

- can reside in more than one data store – database

- are of RDF format
  - They are not limited to the traditional entity-relationship model

  - They present a more evolutive scheme

  - They have "expressions" that best describe their linked data structure

The answer is SPARQL

EUROSTAT: Final energy consumption in households

```
prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
prefix cbhsv: <http://data.builthub.eu/ontology/cbhsv#>

SELECT DISTINCT ?identifier ?startDate ?endDate ?location ?nut:
WHERE {
    ?s  a cbhsv:Dataset014 ;
        dc:identifier ?identifier ;
        dct:temporal/dcat:startDate ?startDate ;
        dct:temporal/dcat:endDate ?endDate ;
        dcat:spatial/skos:prefLabel ?location ;
        cbhsv:measuredElement ?measuredElement;
        cbhsv:siec/skos:prefLabel ?siec ;
        cbhsv:measurementUnit ?msrUnit;
        cbhsv:measurementValue ?msrValue
```

Visualizing the Results

Visualizing the results could present to be a complex and sophisticated task. The semantic model is "machine readable" but might prove to be confusing when it comes to human perception.

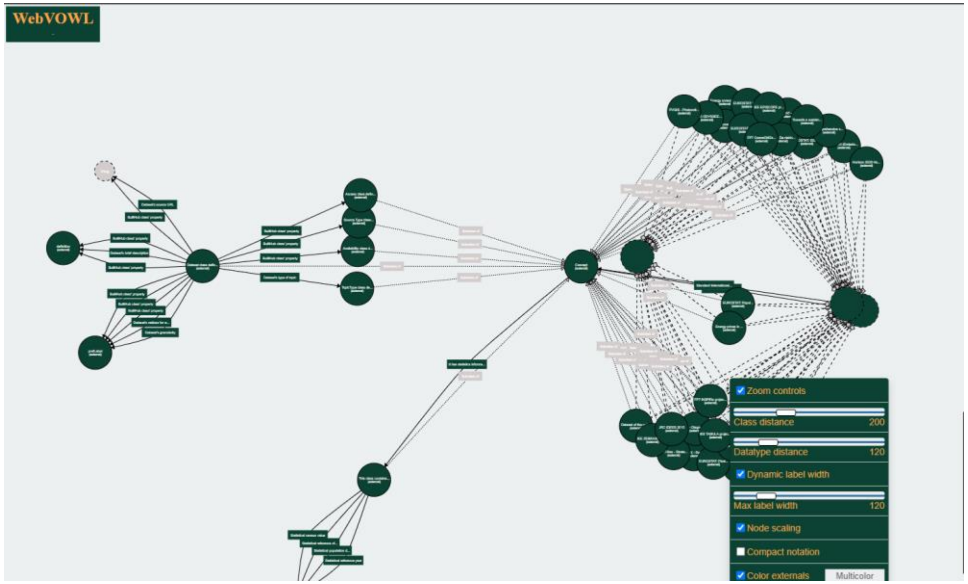
In order to offer a human-centered solution, the ideal approach would be to visualize data entities by creating graphical representations. Thusly, the clustering of data would be analyzed, labeled, and effectively easier to understand and navigate through.

To assist on this cause, we have the following palette of tools

- Highcharts for Angular
- WebVOWL
- Knowage

Visualizing the Results

WebVOWL is a web-based visualization tool for visualizing and exploring ontologies represented in the Web Ontology Language (OWL). It provides interactive visualizations of ontology structures, classes, properties, and relationships, helping users better understand and analyze complex ontologies in a graphical format.

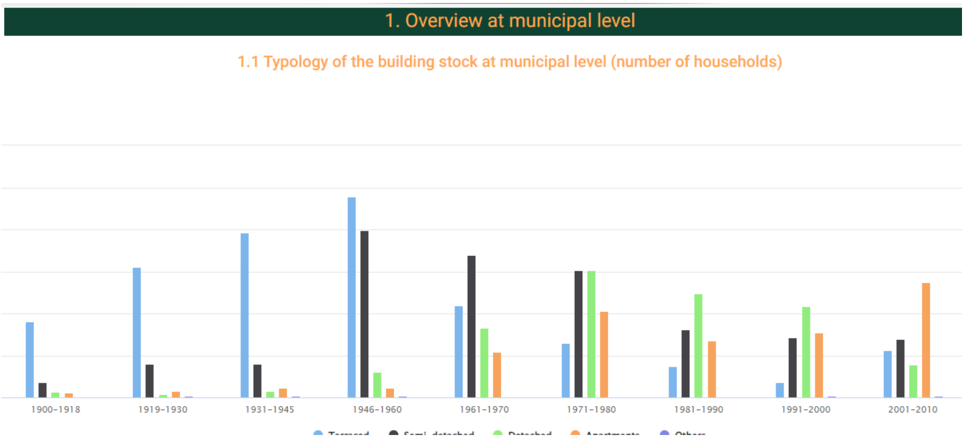


Visualizing the Results

Highcharts is a JavaScript library for creating interactive and visually appealing charts and graphs on web pages. It offers a wide range of chart types.

When used with Angular, Highcharts can be seamlessly integrated into Angular applications to display data-driven visualizations with ease.

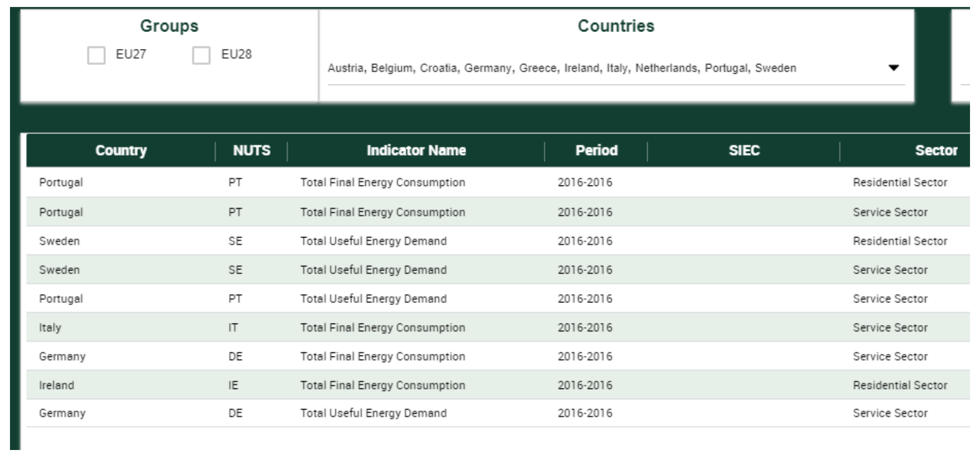
Thusly visualizing the semantic model that resides in the Data Lakes of BuiltHub.



Visualizing the Results

Knowage is an open-source business intelligence and analytics platform that provides tools for data visualization and reporting. It offers a powerful set of features, including dashboards, ad-hoc analysis, OLAP, and advanced analytics.

Data visualizations can be referenced by the Angular frontend, making it easier to create comprehensive visualizations that can be easily extended and presented to the end-user.



Country	NUTS	Indicator Name	Period	SIEC	Sector
Portugal	PT	Total Final Energy Consumption	2016-2016		Residential Sector
Portugal	PT	Total Final Energy Consumption	2016-2016		Service Sector
Sweden	SE	Total Useful Energy Demand	2016-2016		Residential Sector
Sweden	SE	Total Useful Energy Demand	2016-2016		Service Sector
Portugal	PT	Total Useful Energy Demand	2016-2016		Service Sector
Italy	IT	Total Final Energy Consumption	2016-2016		Service Sector
Germany	DE	Total Final Energy Consumption	2016-2016		Service Sector
Ireland	IE	Total Final Energy Consumption	2016-2016		Residential Sector
Germany	DE	Total Useful Energy Demand	2016-2016		Service Sector

Deploying the Platform

The backbone of the platform is composed from a plethora of services, outside the AWS umbrella. These services revolve around the main categories of

- Frontend, client-side applications, providing the graphical user interface discusses previously,
- Middleware, acting as facilitators between third services and applications, orchestrating calls
- Backend applications, server-side programs responsible for managing databases and data processing

The platform uses an elastic and flexible approach when it comes to deployment. The individual services are Dockerized, which means:

- services can allocate exclusive resources,
- scale up / down individually being isolated
- it is simpler to adopt of a continuous integration / continuous delivery solution
- DevOps and Operations in general become easier as respective components are isolated and have their own environment

Q & A

BuiltHub

SUSTAINABLE PLACES 2024

Sustainable operation of buildings data hubs in support of the energy transition

Insights from the Horizon 2020 BuiltHub project

This project has received funding from the EU's Horizon 2020 program under grant agreement no 957026.

Agenda

- **Welcome and introduction** | Alexander Deliyannis, *Sympraxis*
- **The role of buildings data hubs in the energy transition** | Judit Kockat, BPIE
- **Introduction to the BuiltHub data platform and the Building Stock Observatory** | Ulrich Filippi Oberegger, *Eurac*
- **Key aspects of buildings data hubs setup and operation** | Georgios Pardalis, *NTT DATA*
- **Operational viability and long-term sustainability of buildings data hubs** | Alexander Deliyannis, *Sympraxis*
- **Wrap-up, discussion, Q&A** | All

BuiltHub

SUSTAINABLE PLACES 2024

Operational viability and long-term sustainability of buildings data hubs

Insights from the Horizon 2020 BuiltHub project

This project has received funding from the EU's Horizon 2020 program under grant agreement no 957026.

Structure

- Introduction
  - Sourcing
  - IP considerations
  - AI considerations
- Operational viability of building data hubs
  - Basic operational model
  - Key scenarios
- Long-term sustainability of buildings data hubs
  - EU level
  - National / Regional level
  - Local level
  - Independent operation

- Wrap-up, discussion, Q&A

Introduction

- Why building data hubs?
- Where are we today?

JRC Publications Repository

Home Search Help

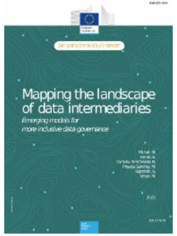
European Commission > JRC > JRC Publications Repository > Mapping the landscape of data intermediaries

Mapping the landscape of data intermediaries

2023 | *Science for policy* | Information society | Innovation and growth

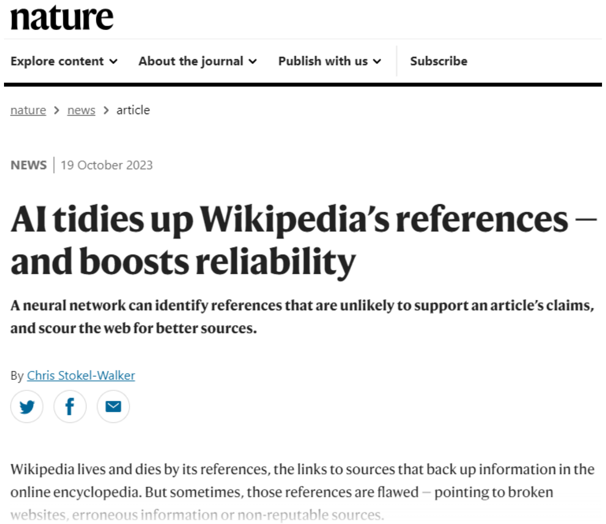
Subtitle: Emerging models for more inclusive data governance

Abstract: The report provides a landscape analysis of key emerging types of data intermediaries. It reviews and syntheses current academic and policy literature, with the goal of identifying shared elements and definitions. An overall objective is to contribute to establishing a common vocabulary among EU policy makers, experts, and practitioners. Six types are presented in detail: personal information management systems (PIMS), data cooperatives, data trusts, data unions, data marketplaces, and data sharing pools. For each one, the report provides information about how it works, its main features, key examples, and business model considerations. The report is grounded in multiple perspectives from sociological, legal, and economic disciplines. The analysis is informed by the notion of inclusive data governance, contextualised in the recent EU Data Governance Act, and problematised according to the economic literature on business models.



Introduction – Sourcing

- Types of sources available
- Systems of reference


nature

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NEWS | 19 October 2023

AI tidies up Wikipedia's references – and boosts reliability

A neural network can identify references that are unlikely to support an article's claims, and scour the web for better sources.

By Chris Stokel-Walker

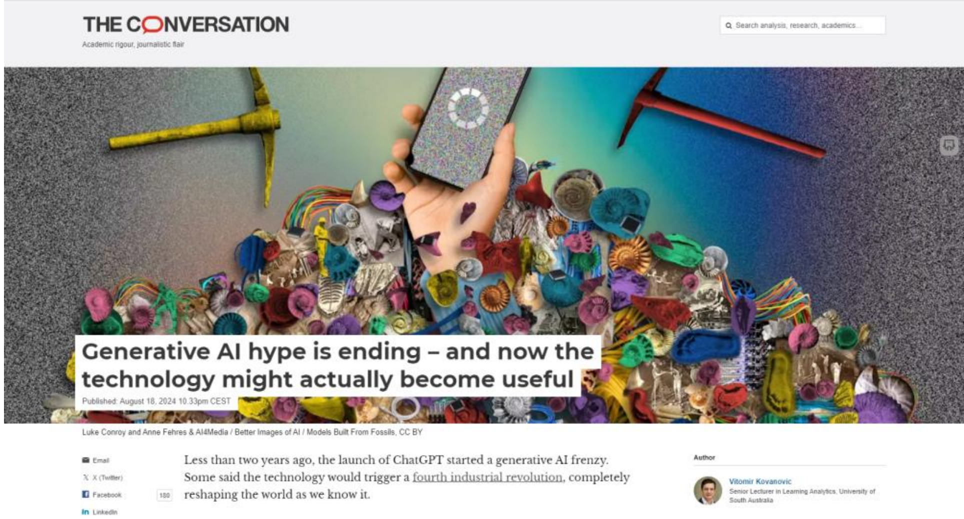
Wikipedia lives and dies by its references, the links to sources that back up information in the online encyclopedia. But sometimes, those references are flawed – pointing to broken websites, erroneous information or non-reputable sources.

Introduction – IP Considerations

- Open Data
- Compensation
- Mixed Models, e.g., “freemium”

Introduction – AI considerations

- Reliability
- Attribution & Transparency
- Competitiveness


THE CONVERSATION

Academic rigour, journalistic flair

Search analysis, research, academics...

Generative AI hype is ending – and now the technology might actually become useful

Published: August 18, 2024 10.33pm CEST

Luke Conroy and Anne Fehres & AI4Media / Better Images of AI / Models Built From Fossils, CC BY

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Facebook 180
LinkedIn

Less than two years ago, the launch of ChatGPT started a generative AI frenzy. Some said the technology would trigger a fourth industrial revolution, completely reshaping the world as we know it.

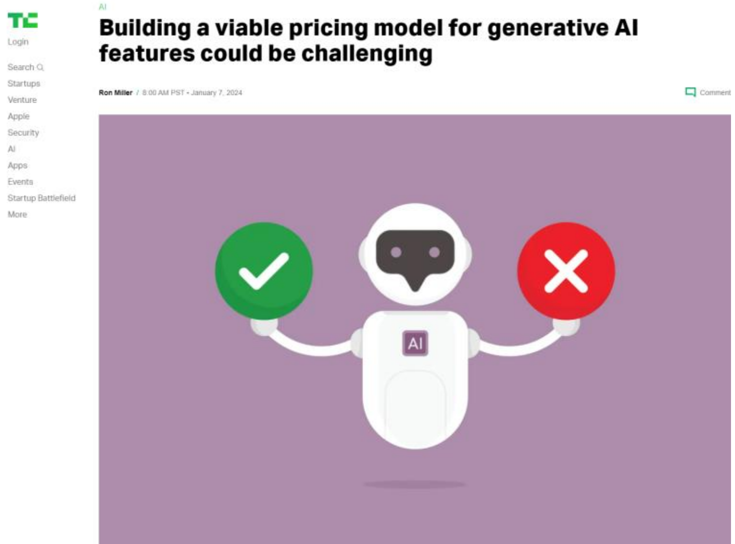
Author

Vitomir Kovanovic

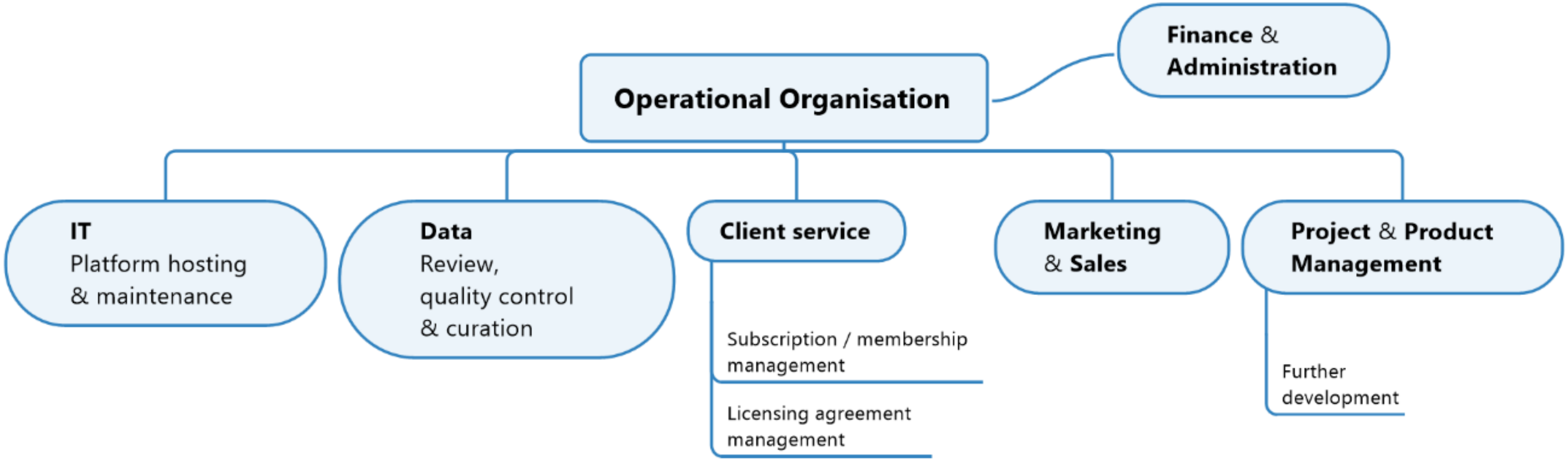
Senior Lecturer in Learning Analytics, University of South Australia

Operational viability of building data hubs

- What we mean
- Public sector clients – authorities
- Private sector clients – real estate, insurance agencies etc.



Operational viability – Basic operational model



Operational viability – Key scenarios

- MVP
- Conservative
- Ambitious

Operational viability – Key scenario – MVP

Forecast

Revenues (in €)	2025	2026	2027
Subscriptions (Basic only)	€ 44,550	€ 178,200	€ 320,760
Projects	€ 0	€ 0	€ 0
Subsidies	€ 240,000	€ 240,000	€ 240,000
Total Revenue	€ 284,550	€ 418,200	€ 560,760

Forecast

Cost of Goods Sold (in €)	2025	2026	2027
Direct Labor	€ 228,950	€ 240,398	€ 252,417
Content Integration Expert (1)	€ 72,300	€ 75,915	€ 79,711
IT Leader (0)	€ 0	€ 0	€ 0
IT Maintenance Team (2)	€ 96,400	€ 101,220	€ 106,281
Customer Service (1)	€ 60,250	€ 63,263	€ 66,426
Other Direct Expenses	€ 0	€ 0	€ 0
New (external) data licensing	€ 0	€ 0	€ 0
Total Cost of Goods Sold	€ 228,950	€ 240,398	€ 252,417

Operational viability – Key scenario – Conservative

Forecast

Revenues (in €)	2025	2026	2027
Subscriptions (Basic & Licensing) Edit	€ 74,250	€ 534,600	€ 1,033,560
Basic Access	€ 44,550	€ 178,200	€ 320,760
Licensing	€ 29,700	€ 356,400	€ 712,800
Totals	€ 74,250	€ 534,600	€ 1,033,560
Projects Edit	€ 81,938	€ 344,138	€ 542,017
# Billable Hours	1,140	4,560	6,840
€ Hourly Rate	€ 72	€ 75	€ 79
Subsidies Edit	€ 320,000	€ 320,000	€ 320,000
€ Revenue Only	€ 320,000	€ 320,000	€ 320,000
Total Revenue	€ 476,188	€ 1,198,738	€ 1,895,577

Forecast

Cost of Goods Sold (in €)	2025	2026	2027
Direct Labor	€ 397,650	€ 493,448	€ 597,831
Content Integration Expert (2-4) Edit	€ 144,600	€ 227,745	€ 318,843
IT Leader (1) Edit	€ 96,400	€ 101,220	€ 106,281
IT Maintenance Team (2) Edit	€ 96,400	€ 101,220	€ 106,281
Customer Service (1) Edit	€ 60,250	€ 63,263	€ 66,426
Other Direct Expenses	€ 60,000	€ 60,000	€ 60,000
New (external) data licensing Edit	€ 30,000	€ 30,000	€ 30,000
External AI services Edit	€ 30,000	€ 30,000	€ 30,000
Total Cost of Goods Sold	€ 457,650	€ 553,448	€ 657,831

Operational viability – Key scenario – Ambitious

Forecast

Revenues (in €)	2025	2026	2027
Subscriptions (Basic & Licensing)	**€ 129,690**	**€ 825,660**	**€ 1,583,010**
Basic Access	€ 80,190	€ 320,760	€ 543,510
Basic Licensing	€ 49,500	€ 504,900	€ 1,039,500
Totals	€ 129,690	€ 825,660	€ 1,583,010
Projects	**€ 90,131**	**€ 377,344**	**€ 594,316**
# Billable Hours	1,254	5,000	7,500
€ Hourly Rate	€ 72	€ 75	€ 79
Subsidies	**€ 320,000**	**€ 320,000**	**€ 320,000**
€ Revenue Only	€ 320,000	€ 320,000	€ 320,000
Total Revenue	**€ 539,821**	**€ 1,523,004**	**€ 2,497,326**

Forecast

Cost of Goods Sold (in €)	2025	2026	2027
Direct Labor	**€ 397,650**	**€ 493,448**	**€ 597,831**
Content Integration Expert (2-4)	€ 144,600	€ 227,745	€ 318,843
IT Leader (1)	€ 96,400	€ 101,220	€ 106,281
IT Maintenance Team (2)	€ 96,400	€ 101,220	€ 106,281
Customer Service (1)	€ 60,250	€ 63,263	€ 66,426
Other Direct Expenses	**€ 360,000**	**€ 360,000**	**€ 360,000**
New (external) data licensing	€ 240,000	€ 240,000	€ 240,000
External AI services	€ 120,000	€ 120,000	€ 120,000
Total Cost of Goods Sold	**€ 757,650**	**€ 853,448**	**€ 957,831**

Long term sustainability of building data hubs

- What we mean

BUSINESS

Stanford study suggests remarkable savings made possible by clean energy transition: 'Reliable and inexpensive'

"The results provide countries with concrete evidence and the confidence that 100% clean, renewable grids are not only lower in costs but are also just as reliable as the current grid system."

By Jeremiah Budin / March 11, 2024

Long term sustainability of building data hubs

- EU level
- National / regional level
- Local level
- Independent operation

Relevant European initiatives (indicative)

- Building Stock Observatory & National Building Observatories
- INSPIRE
- Open Data Spaces
- Data Governance Act
- AI Regulation
- Mistral.ai, etc.

Wrap-up, discussion, Q&A

- Viability –mid-term– is achievable and important for developing building/energy information hubs
- Sustainability –long-term– implies recognition of the strategic importance of such hubs for the transition
- AI has a key role to play –interfaces, big data, pattern recognition– but expertise will remain important both upstream (inputs) and downstream (outputs)
- Transition initiatives should be supported by information collection, organisation and interpretation
- The EPBD, among other regulatory frameworks, recognises this factor
- The link of such initiatives to market needs can support their long-term contribution of relevant and reliable data

BPIE

CARTIF

NTT DATA

eurac research

ICLEI
Local Governments for Sustainability
EUROPE

RI.SE

TEAM sympraxis

TU WIEN
TECHNISCHE UNIVERSITÄT WIEN
Vienna | Austria

BuiltHub

Thank you for your attention!

www.builthub.eu

Intro to BuiltHub and Building Stock Observatory

Workshop “Building data hubs supporting energy transition”

Ulrich Filippi Oberegger, project coordinator (Eurac Research)

Contact me at: ulrich.filippi@eurac.edu

This project has received funding from the EU's Horizon 2020 program under grant agreement no 957026.

BuiltHub

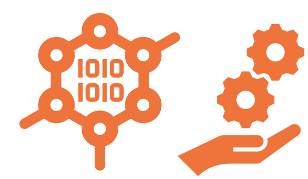
BuiltHub in Brief

4 year-project, October 2020 - September 2024

Main results

- **Roadmap** for constant data flow to EU Building Stock Observatory (BSO)
- **Community** for data collection, transformation, services
- **Web platform** offering data and services
- **Coordinated action** among associated projects

Visit us at https://builthub.eu/



BuiltHub Data

Legend	
A	Building stock related datasets
B	Socio-economic datasets
C	Climatic datasets

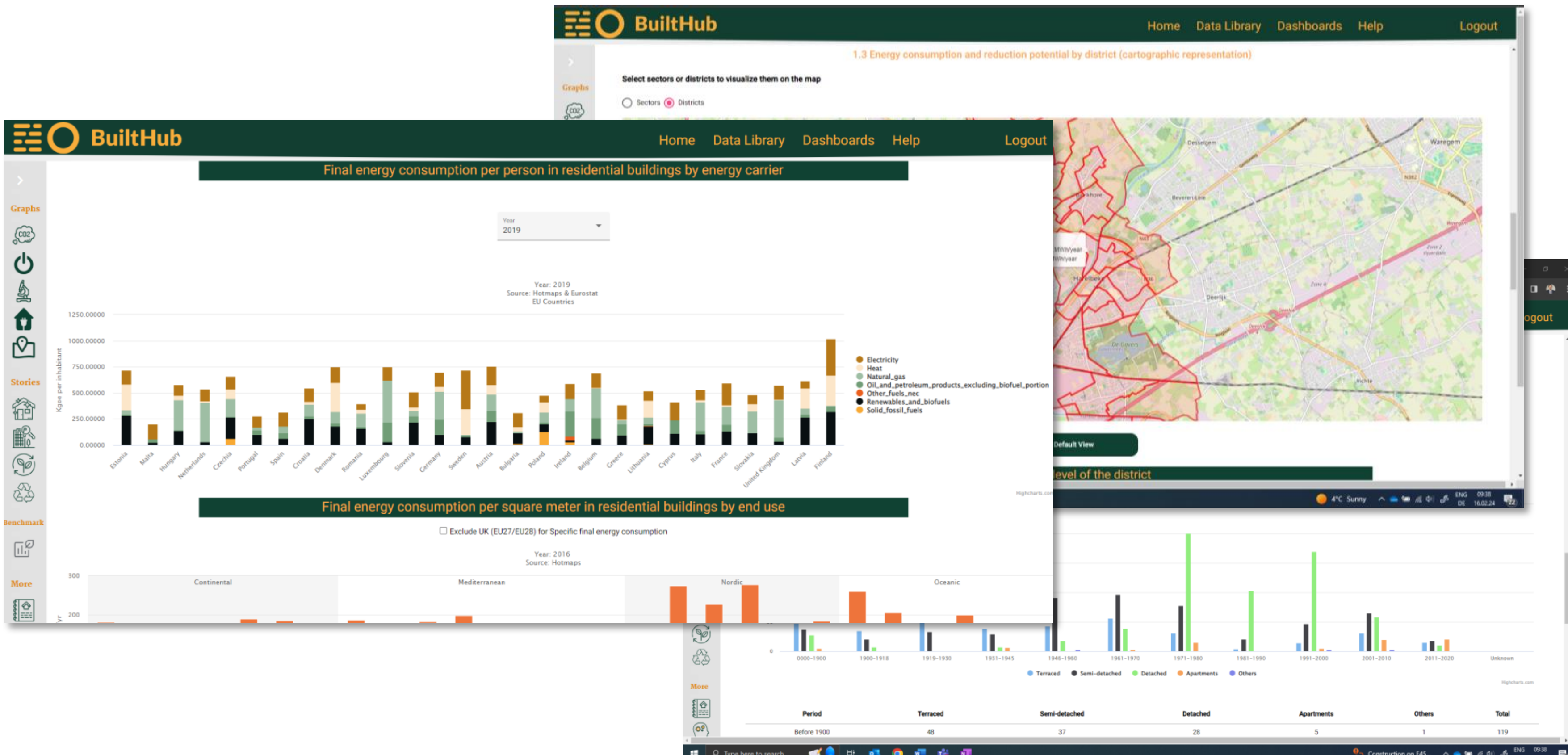
Dataset number	Topic type	Name	Content
1	A	Horizon 2020 HotMaps project: Building stock analysis	Complete building stock analysis for the EU27+UK. Values related to final energy consumption and useful energy demand for space heating, space cooling and domestic hot water, construction materials and methodologies, technologies used and building stock data/information (thermal transmittancy, building stock vintages and characteristics, household occupancy related data, etc.) can be found both for the residential and the non-residential sectors per building types and construction vintages.
2	A	IEE TABULA project: Typology Approach for Building Stock Energy Assessment	Building stock data and data focused on technical systems for heating, cooling and domestic hot water production in different buildings types are the main outputs of this dataset. Final energy consumption and envelope performance data are available as well.
…	…	…	…
28	C	EDGAR (Emissions Database for Global Atmospheric Research) CO2 Emissions	Carbon Dioxide (CO_2) emissions by country and sector (Buildings, Transport, Other industrial combustion, Power Industry and other sectors) have been collected for the years between 1970 and 2018 and are reported expressed in $MtCO_2$/year.
29	C	CORDEX - Regional climate model data on single levels for Europe	Climatic data for Europe expressed in daily, monthly and seasonal mean values as well as 3 or 6 hours resolution. Data for air temperature at 2 m, wind speed, atmospheric pressure and hum idity can be found.
30	C	PVGIS - Photovoltaic Geographical Information System	This GIS dataset contains data related to the solar radiation. It takes into account both day and night-time periodsexpressing the solar radiation raster map in W/m2.
…	…	…	…

D3.1 Inventory structure and main feature and datasets
https://builthub.eu/resource?uid=533

BuiltHub Platform

Check it out for free

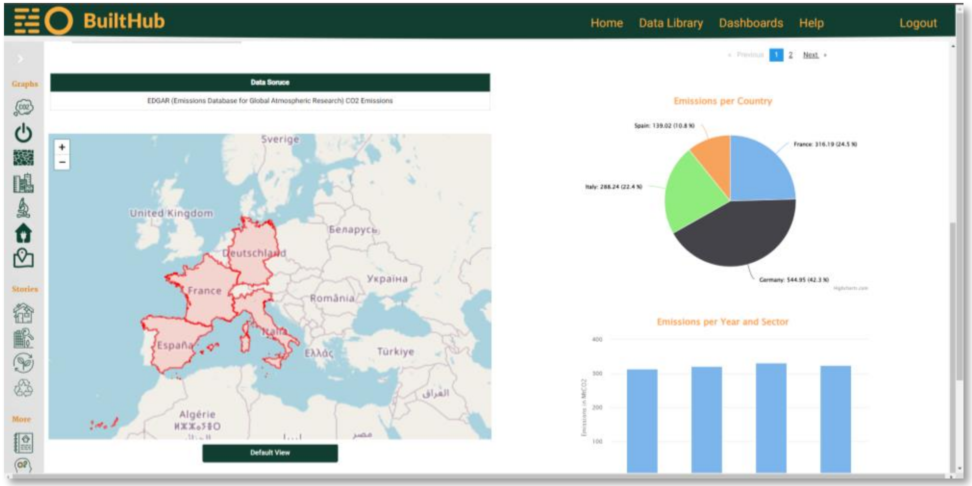
https://platform.builthub.eu/



Monitor Building Stock Decarbonisation

Emissions dashboard

- Features
  - Track building sector emissions across countries and years
  - Compare against other sectors (industry, power, transport, other)
- Rationale
  - Mitigate climate change
  - Monitor alignment with European Green Deal targets
- Target stakeholders
  - Government agencies, to set regulations, provide incentives, and implement policies
  - International organisations, to track global trends and guide on emissions policy
  - Industry associations, to promote sustainable practices while maintaining competitiveness



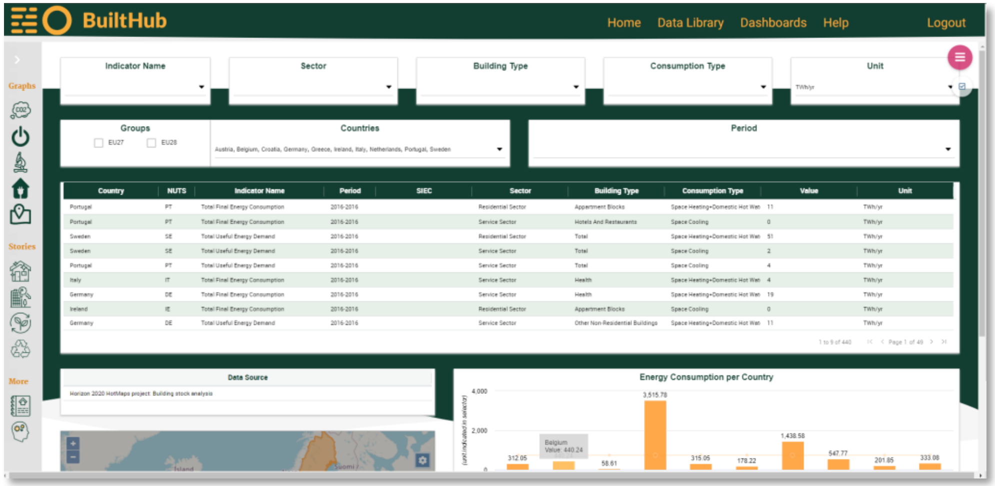
Monitor Energy Consumption in Buildings

Energy dashboard

- Features
  - Segmentation of building sector by country, residential/services, building type, construction period, energy use

- Rationale
  - Increase energy resilience
  - Identify worst-performing buildings
  - Monitor alignment with European Green Deal targets

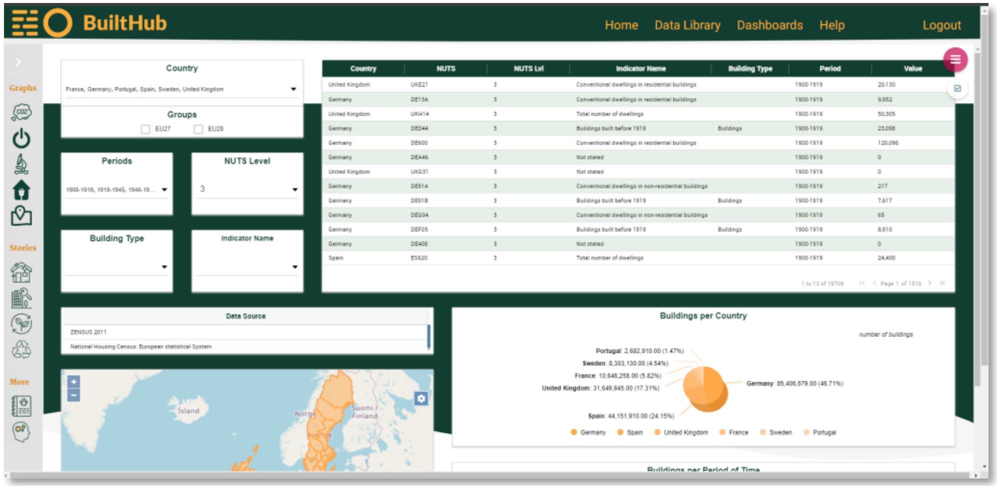
- Target stakeholders
  - Government agencies, to set regulations, provide incentives, and implement policies
  - International organisations, to track global trends and guide on energy policy
  - Energy companies and building owners/managers, to benchmark against their own portfolio



Track Census Data

Census dashboard

- Features
  - Number of buildings and dwellings by location and construction period
  - From NUTS* 0 (national) to NUTS 3 (small regions) level
- Rationale
  - Relate emissions and energy consumption to figures per building/dwelling
  - Allow unit-normalised assessment of energy/emissions performance across the years
- Target stakeholders
  - Regional government, to assess the scale of energy efficiency and decarbonisation programs in different regions
  - Building sector professionals, to assess market size targeting buildings of a specific construction period



*NUTS = Nomenclature of Territorial Units for Statistics

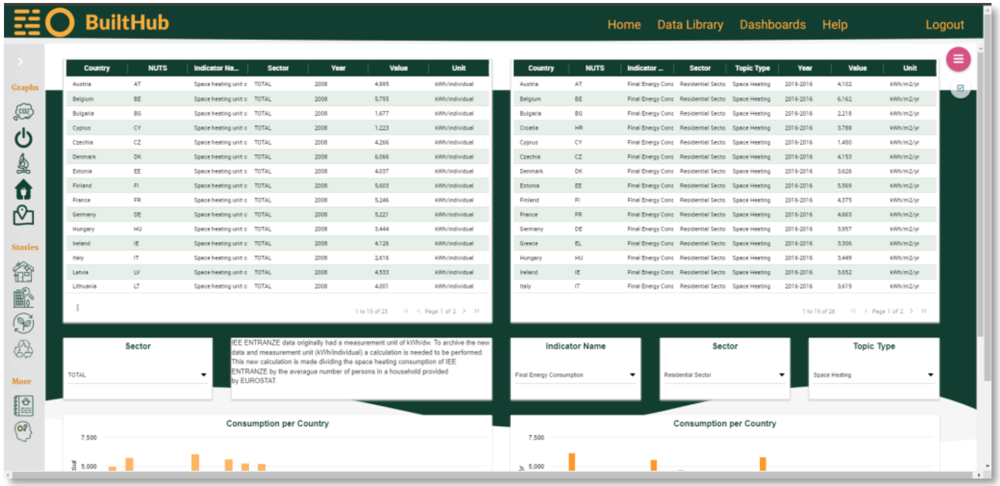
Compare Two Datasets

Comparison dashboard

- Features
  - Compare two datasets on the same subject

- Rationale
  - Assess dataset reliability
  - Quantify uncertainty

- Target stakeholders
  - Data providers, to validate their own data
  - Analysts and researchers, to check the reliability and quantify the uncertainty of the data; to spot errors or outliers



Investigate Raster Data

Geo information dashboard

- Features
  - Displays raster data across Europe
  - Displays markers for various layers

- Rationale
  - Explore raster data such as solar irradiance
  - Show geographical distribution of markers such as energy infrastructure and emissions hotspots

- Target stakeholders
  - Government agencies responsible for energy policy, to guide infrastructure investments
  - Regional planners, to identify areas with high potential for renewable energy

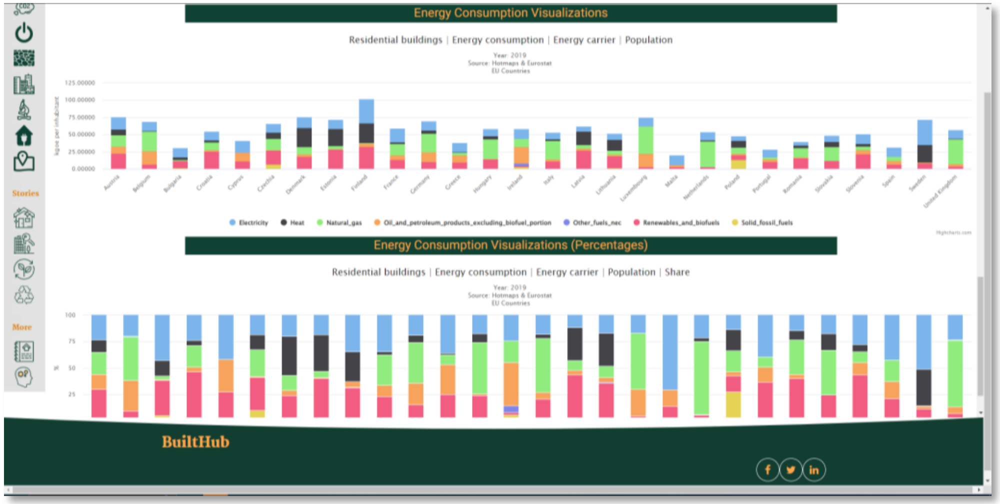
Identify Renovation Potential

Renovation dashboard

- Features
  - Building energy consumption by country, construction period, end use (space heating, space cooling, domestic hot water), and fuel (electricity, heat, gas, etc.)

- Rationale
  - Identify energy conservation measures targeted to specific building stock segments
  - Extract building characteristics from construction period
  - Pre-retrofit baseline, necessary to quantify post-retrofit energy and emissions savings

- Target stakeholders
  - Government agencies and policy makers, to formulate policies and incentives aimed at reducing energy consumption in buildings
  - Real estate managers, to benchmark their building's performance against similar buildings and make informed decisions about energy retrofits

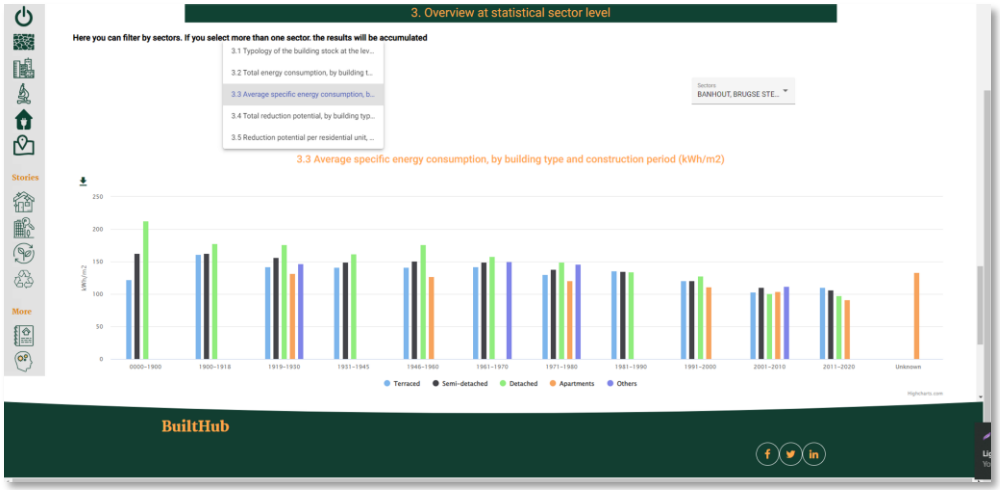


Renovation Potential in 3 Belgian Towns

Be Reel! project

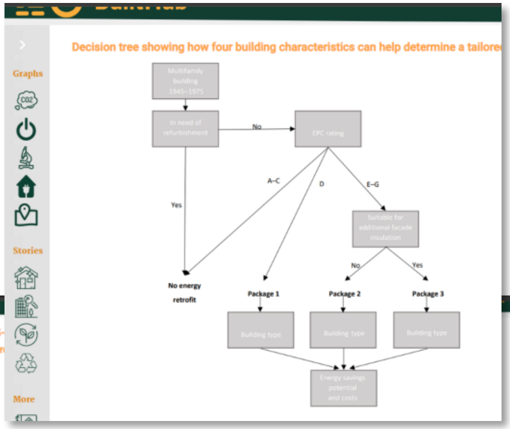
- Features
  - Building types, construction period, number of buildings, floor area, energy consumption, and energy saving potential in three Belgian towns, at district level
- Rationale
  - Identify town- or district-specific energy conservation measures by building stock segment

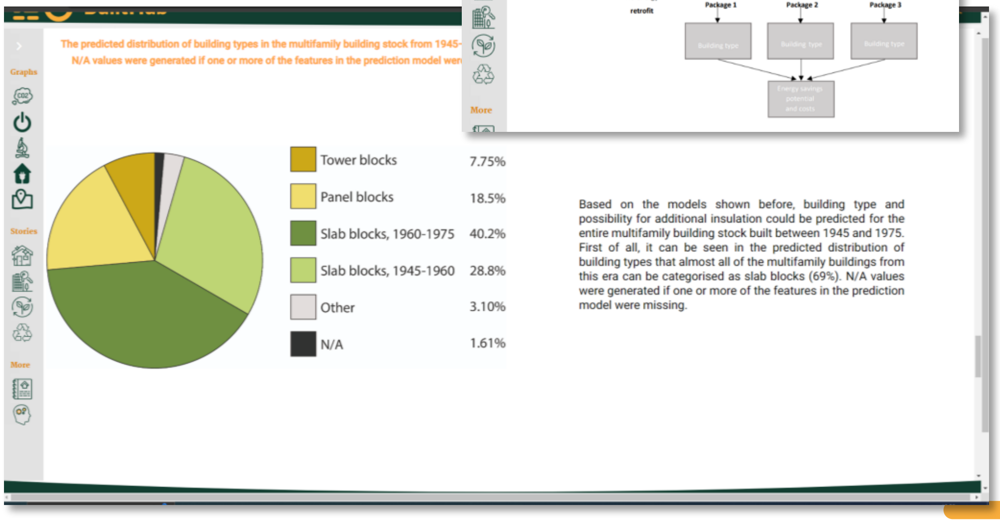
- Target stakeholders
  - Urban planners and city officials, to optimise energy infrastructure, identify areas of high energy consumption, and prioritise retrofits
  - Building owners and managers, to benchmark their building's performance against similar buildings and make informed decisions about energy retrofits



ML for Swedish Renovation Strategies

- Features
  - Enrich building databases with building features (building type, façade material, eave overhang) extracted from images from Google Street View
  - Build decision tree determining the retrofit
- Rationale
  - Identify building type
  - Identify feasible energy retrofit option depending on building type and features
  - Identify energy saving potentials and associated costs
- Target stakeholders
  - Building owners, to identify suitable retrofit options and respective energy savings and costs
  - Financial institutions, to assess costs and risks





BSO

BSO in Brief

“Web tool to monitor the energy performance of buildings across Europe”

Visit the BSO at https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/eu-building-stock-observatory_en

- Factsheets
- Database

Factsheets

Country

EU27

EU27

1. Building Stock

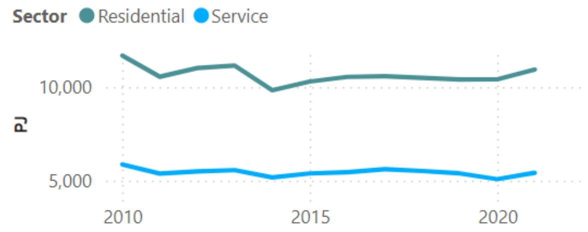
	Buildings 2020	Floor area (sqm) 2020
total	111.58M	27,229M
residential	101.47M	18,408M
services	10.11M	8,821M

**Occupied stock (primary and secondary residencies)*
Source: MODERATE project

Useful floor area by sector and construction period in the year 2020 (for residential occupied building stock only)
Source: MODERATE project

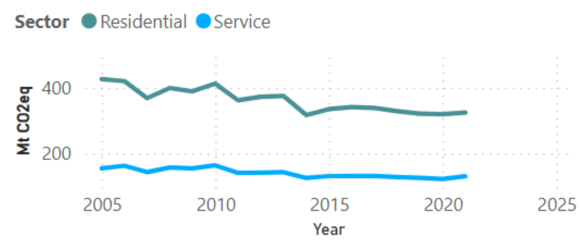
2. Energy Consumption and GHG Emission

In 2021, final energy consumption was at 10941.66 PJ in residential sector and 5420.89 PJ in services sector.



Final energy consumption in residential and services sectors
Source: Eurostat

In 2021, direct emissions due to fossil fuel use were at 324.74 Mt CO2eq in residential sector and 129.90 Mt CO2eq in services sector.



Direct GHG emissions in residential and services sectors
Source: EEA

Factsheets

3. Social Aspects

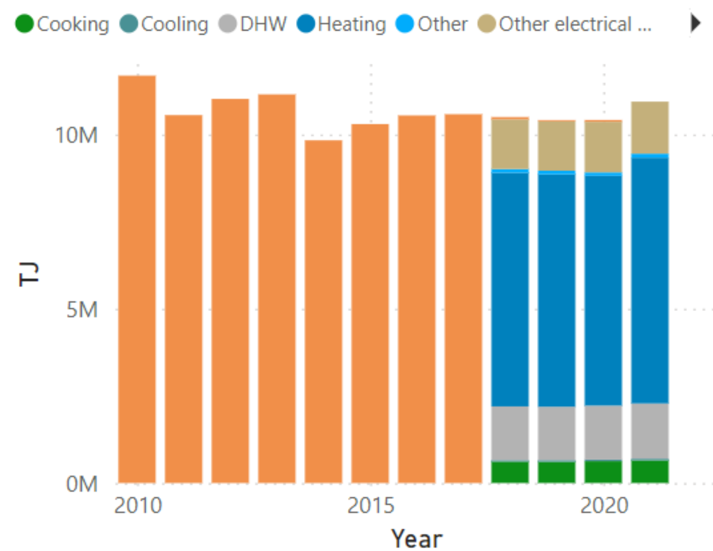
In 2022, 6.9 % of the total population was having arrears on their utility bills while 9.3 % was not able to keep their home adequately warm over the cold periods of the year. In 2020, about 14.8 % of total population was living in a dwelling with leaking roof, damp walls or rotten windows, frames or floor.

Arrears on utility bills	Inability to keep house adequately warm	Dwelling with leaking roof, damp walls or rotten frames
6.9 %	9.3 %	14.8 %

Source: Eurostat SILC

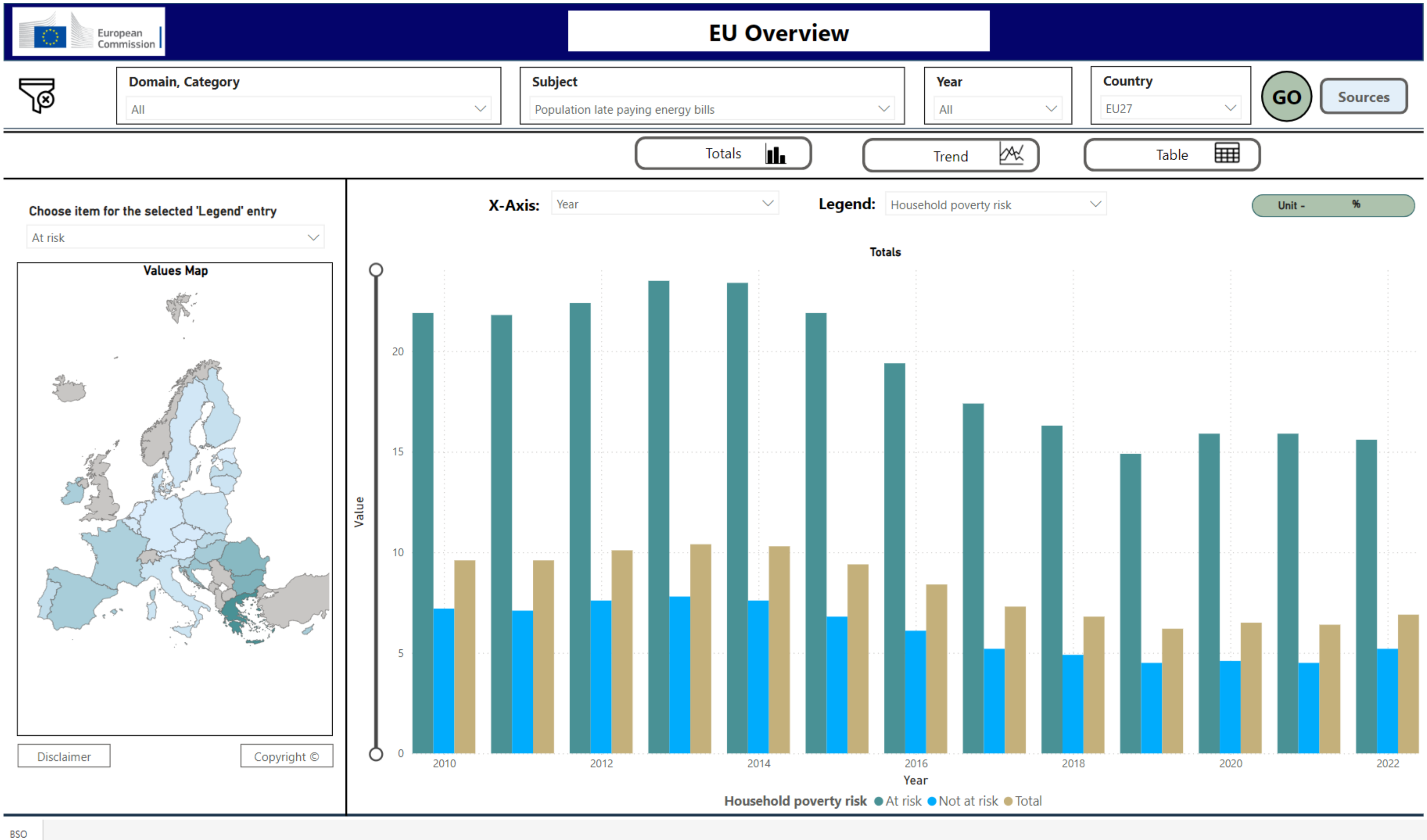
4. Energy use in households

In 2021, households consumed 64.4% for space heating, 14.5% for domestic hot water, 0.5% for space cooling, 13.6% for lighting and electric appliances and 5.9% for cooking.



Final energy consumption in households by end-use
Source: Eurostat

Database


European Commission
EU Overview
Domain, Category
All
Subject
Population late paying energy bills
Year
All
Country
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GO
Sources
Totals
Trend
Table
Choose item for the selected 'Legend' entry
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Year
Legend:
Household poverty risk
Unit - %
Totals
Value
0
5
10
15
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2010
2012
2014
2016
2018
2020
2022
Year
Household poverty risk ● At risk ● Not at risk ● Total
BSO

BuiltHub Consortium