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Title: Investigating a Building Typology for Supporting Renovation Investments

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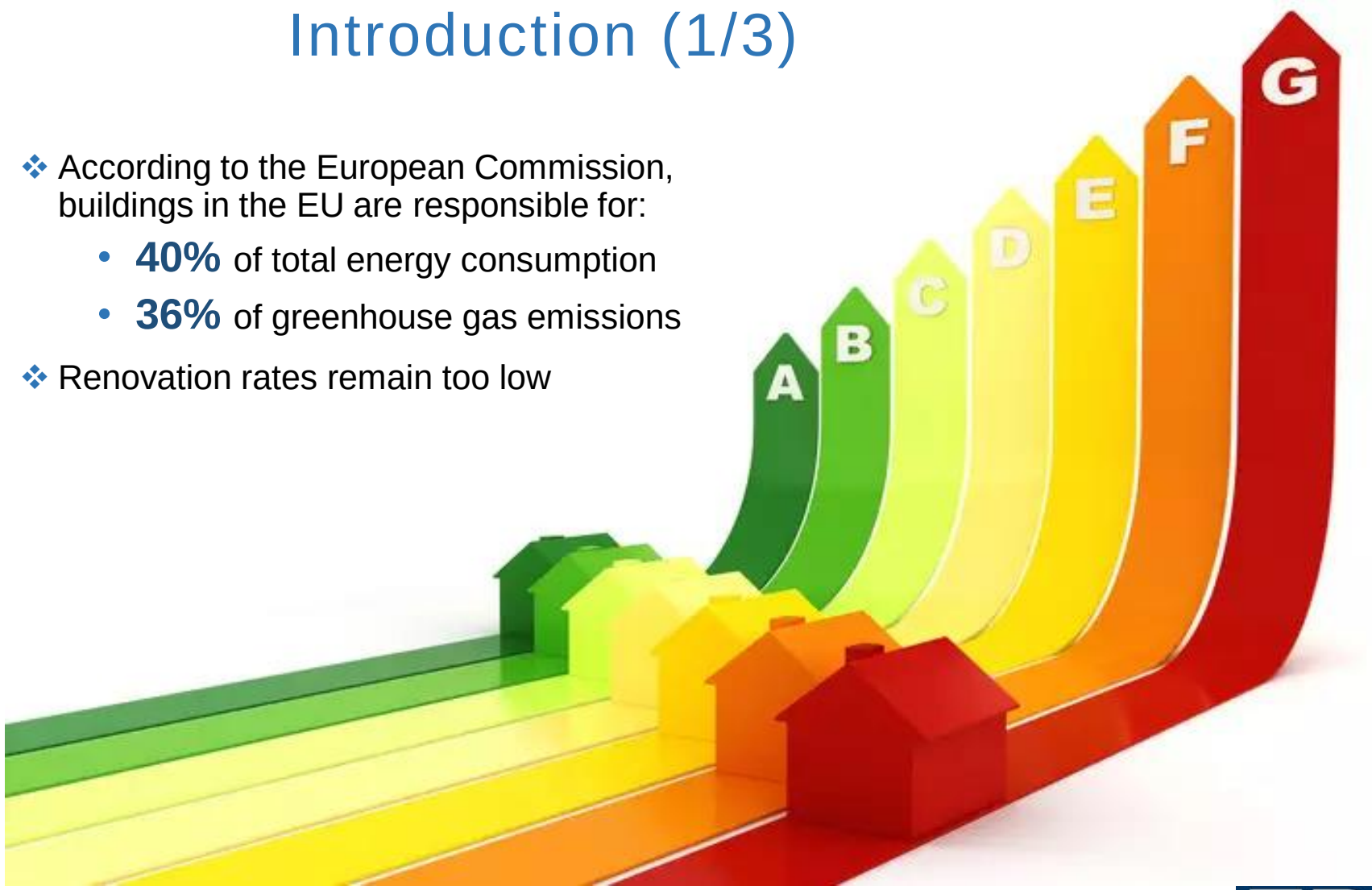
Presenter: Konstantinos Touloumis (NTUA)

Table of content

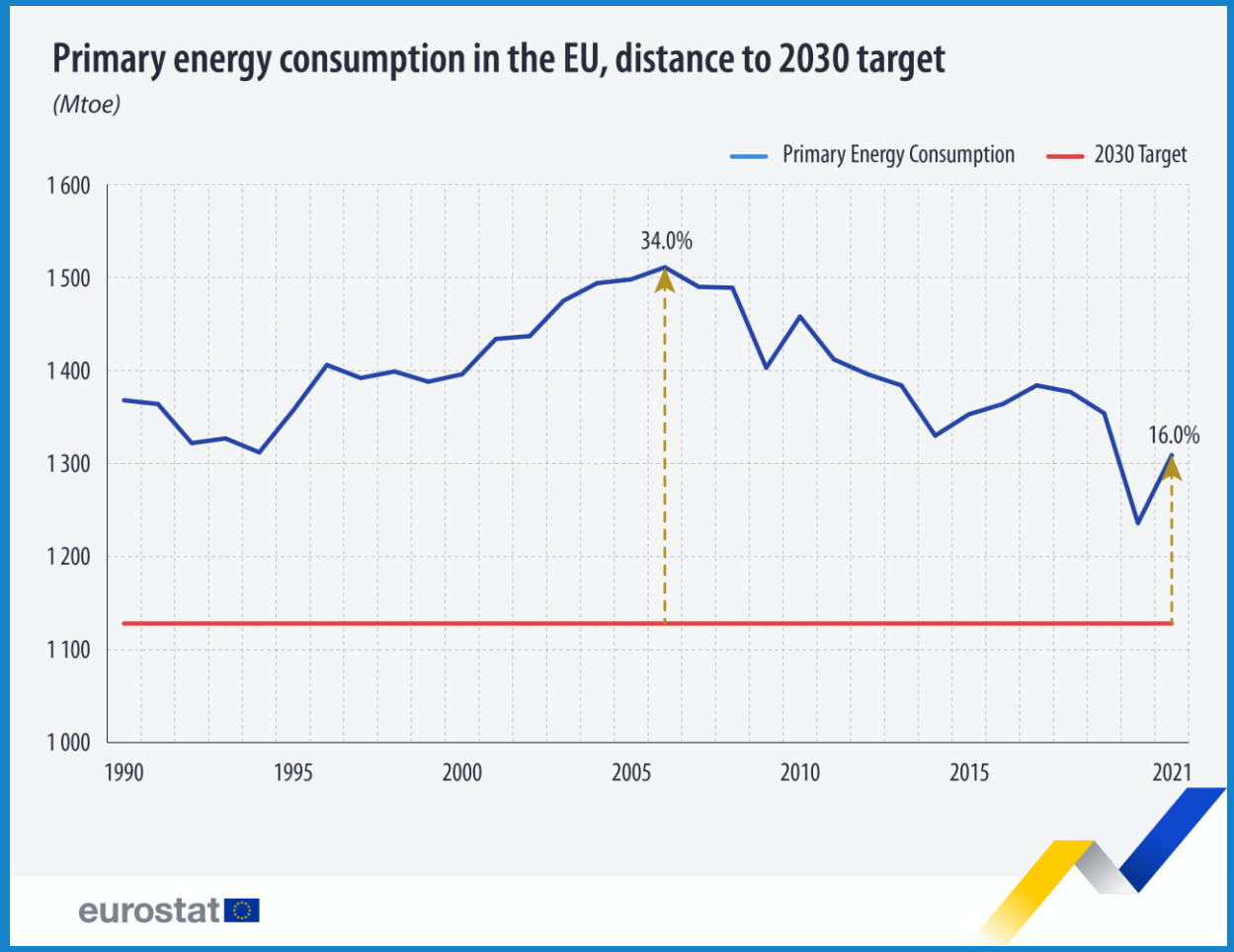
- Introduction
- Scope of the study
- The ENERGATE project
- Proposed approach
  - Existing typologies
  - Identification of building variables, methodology
  - Available datasets
  - Harmonization with frameworks
- The ENERGATE ontology
- Conclusions and future prospects

Introduction (1/3)

- According to the European Commission, buildings in the EU are responsible for:
  - **40%** of total energy consumption
  - **36%** of greenhouse gas emissions
- Renovation rates remain too low



Introduction (2/3)

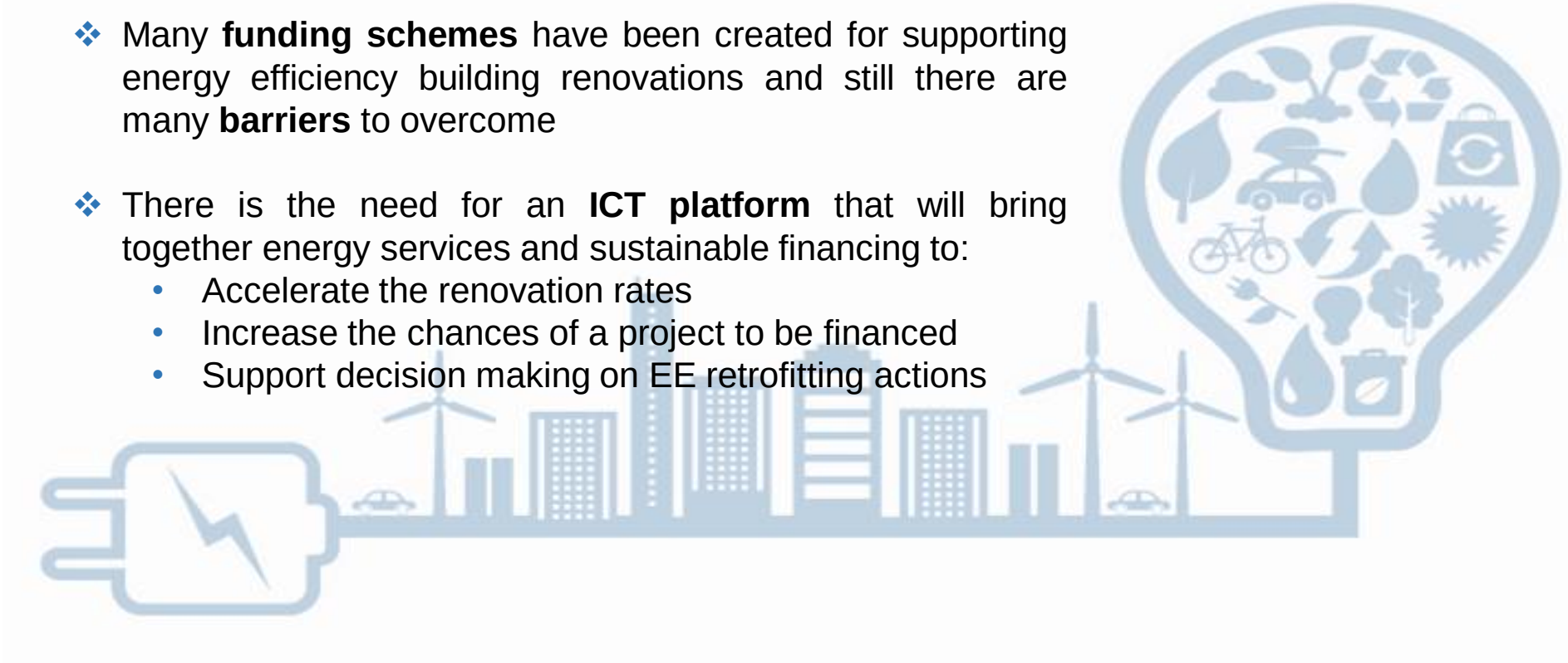


Source: Eurostat, 2022

- Energy efficiency is one of the main priorities of the European Union's energy and climate policy.
- Reaching energy transition targets is a challenge.
- There is a significant untapped energy efficiency potential in the building sector.
- Building renovation needs to be upscaled.

Introduction (3/3)

- The building sector might stay as it is in the long-term future due to the **low building demolition and renovation rates**
- Many **funding schemes** have been created for supporting energy efficiency building renovations and still there are many **barriers** to overcome
- There is the need for an **ICT platform** that will bring together energy services and sustainable financing to:
  - Accelerate the renovation rates
  - Increase the chances of a project to be financed
  - Support decision making on EE retrofitting actions



Scope of study

- An integral part of such a platform is the **efficient representation of buildings** and their **typology**
- The scope of the paper is to:



Define a **building typology** to support sustainable energy efficiency **investments**



Specify the most important **variables** which influence buildings' renovations



Propose a schema as a basis for the **modeling** of building variables in ICT-based **platforms**

The ENERGATE project (1/4)

Project Coordinator:

National Technical University of Athens (NTUA)

Project Partners:

Smart energy marketplace for sustainable investments

January 2023 – June 2025

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The ENERGATE project (2/4)

The ENERGATE vision

Enable easy, predictable and risk-free renovation investments



Project development of retrofitting actions



Access to sustainable finance for renovation projects



Business matchmaking in a user-friendly ICT-enabled platform

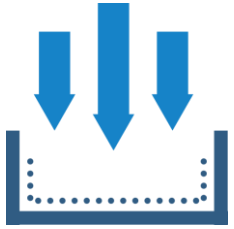
The ENERGATE project (3/4)

Supply side:
Asset managers
Building owners
Project developers
ESCOs



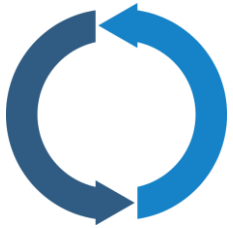
Demand side:
Investors
Financial institutions
Public & Private funds

FETCH STAGE



Collection of project-related information

PROCESS STAGE



Matchmaking and aggregation of EE products with appropriate financing

DELIVER STAGE



Follow-up on realised projects: feedback & validation

Proposed approach

1st step
- Specification of the research question: Building typologies to support renovation investments
- Creation of an appropriate methodology

2nd step
- Investigation of existing building typologies
- Focus on ICT approaches

3rd step
- Examination of relevant datasets
- Identification of variables

4th step
- Matching variables with existing data models
- ENERGATE Ontology

5th step
- Conclusions
- Future research prospects

Existing Typologies (1/2)

TABULA initiative

Investigation of building typologies with the aim of assessing **refurbishment** scenarios, estimating future energy **consumption**, calculating energy **savings**.

Network of European Research Infrastructures for Earthquake Risk Assessment and Mitigation

European **building classification**.

Gem Building Taxonomy

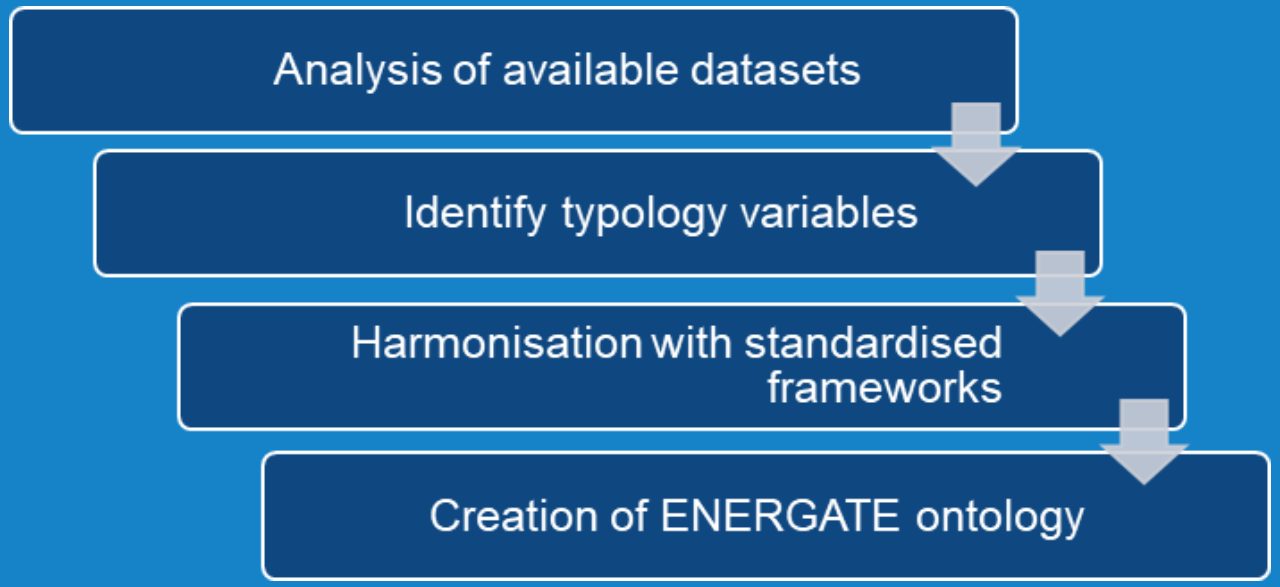
Characterising assets according to attributes that can influence the likelihood of damage due to the effects of **natural hazards**.

Existing Typologies (2/2)

ICT approaches on building typologies & data models

FIWARE	Brick Schema	SAREF	Project Haystack
Standards to promote smart applications: **entities** containing harmonised description of building data	Data model defining a set of **classes** and **properties** that can be used to represent different aspects of a building	Data model for buildings defining a set of **classes** and **properties** representing data provided by smart devices and systems	Protocol providing **labels** and **classifications** to describe data provided by different building systems

Identification of building variables



Available Datasets

eurostat

Final energy consumption, GPD per capita, U-Values



Building stock, energy consumption, energy mix, energy performance and technical building systems, energy certifications

iNSPiRe
Systemic energy renovation of buildings

Average consumption for different uses (heating, cooling, lighting etc.)

BuiltHub

Data relevant to EU buildings

DE-RISKING ENERGY EFFICIENCY PLATFORM (DEEP)

Building type, ownership, size, floor area, energy demand, retrofitting measures

MATRYCS

Information of renovation projects (building types, base energy consumption, annual energy consumption after renovation, retrofitting measures)

TRIPLE-A

EE financing of project fiches

ΠΑΝΕΠΙΣΤΗΜΙΟ ΔΥΤΙΚΗΣ ΑΤΤΙΚΗΣ
UNIVERSITY OF WEST ATTICA

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Categorisation of typology variables

Identification variables

Include variables that aim to identify the data registry

Measured elements

The measures data that refer to the building's consumption and renovation

Harmonisation with standardised frameworks (1/2)

Identification Variables

Variable	Description	FIWARE	HAYSTACK	SAREF	BRICK
Identifier	Unique identifier of the entity	Id	id		
startDate -endDate	The timestamps	dataCreated-dataModified	date - dateTime	Has timestamp	TimeShape
nutsName	The geographic area where a service or offered item is provided	AreaServed	geoCountry	location	Location
location	The location of the building	location	geoPlace	location	Location
Year Built	The year in which the building was made			hasBuiltYear	YearBuilt
topic	The sector of the building in which measuredElemenet is referred		feature		
feature	The feature of the topic in which the measuredElement is referred		feature		
measuredElement	Data value type		val		
Value	Integer or floating point numbers annotated with an optional unit		number	hasvalue	
Unit	Unit identifier from standard unit database		unit	Is measured in	
Sources	A sequence of characters identifying the provider of the harmonised data entity	dataProvider-source	uri	Value source	

Harmonisation with standardised frameworks (2/2)

Measured elements

Variable	Description	FIWARE	HAYSTACK	SAREF	BRICK
TotalFloorArea	Area of a shape or floor space		area	FloorArea	Space
HeatedFloorArea	Heated area of building			Heating_Zone	Heated_Area_Fraction
CooledFloorArea	Cooled area of building			Cooling_Zone	Cooled_Area_Fraction
Floor U-Value	The rate of transfer of heat through a structure			Thermal Transmittance (entity)	Variety of tags like
Wall U-Value	The rate of transfer of heat through a structure				Thermal_Transmittance
Roof U-Value	The rate of transfer of heat through a structure			uValue (property)	U_Value
Windows U-Value	The rate of transfer of heat through a structure				Thermal_Resistance
share of ownership	Owner of the building/type of ownership	owner		hasOwnership	Ownership_Percentage
ShareofPeopleOccupancy	People present at the building	peopleOccupancy	occupancy	Occupancy	Occupancy PercentageShape
Temperature	The external temperature in the location of building			Temperature rating	Temperature_Sensor
SpaceHeatingConsumption	Associated with a heating process		heat	Energy_Consumption	Heating
SpaceCoolingConsumption	Cooling mode or process		cooling	Energy_Consumption	Cooling
DHWConsumption	Domestic water flows from the referent to this entity		domesticWaterRef	Energy_Consumption	
LightingConsumption	Systems associated with illumination in the built environment		lighting	Energy_Consumption	Electric_Energy
CookingConsumption	Energy consumed in cooking			Energy_Consumption	
TotalEnergyConsumption	Energy consumed per unit time		power	Energy_Consumption	Energy_Meter
NaturalGas	Fossil fuel energy source consisting largely of methane and other hydrocarbons		naturalGas	Fuel (the type of energy that is used), Energy_Consumed (the quantity of fuel that is used)	NaturalGas
OilandPetroleum	Petroleum based oil burned for energy		fuelOil		FuelOil
SolidFuels	Solid Fuels used to energy production				(Different tags for solid fuels like pellets, biomass, etc)
Electricity	Electrical energy consumed per unit time		elec-power		Electricity
Renewables	Energy that produced by renewable fuels				(Different tags for renewable energy sources like solar, wind)
CO_2	Greenhouse gas emission of carbon dioxide (CO_2) into the air		co2-emission		Carbon_Dioxide_Emissions

Creation of ENERGATE ontology (1/5)



Building:
Variables describing and quantifying building components and relevant information

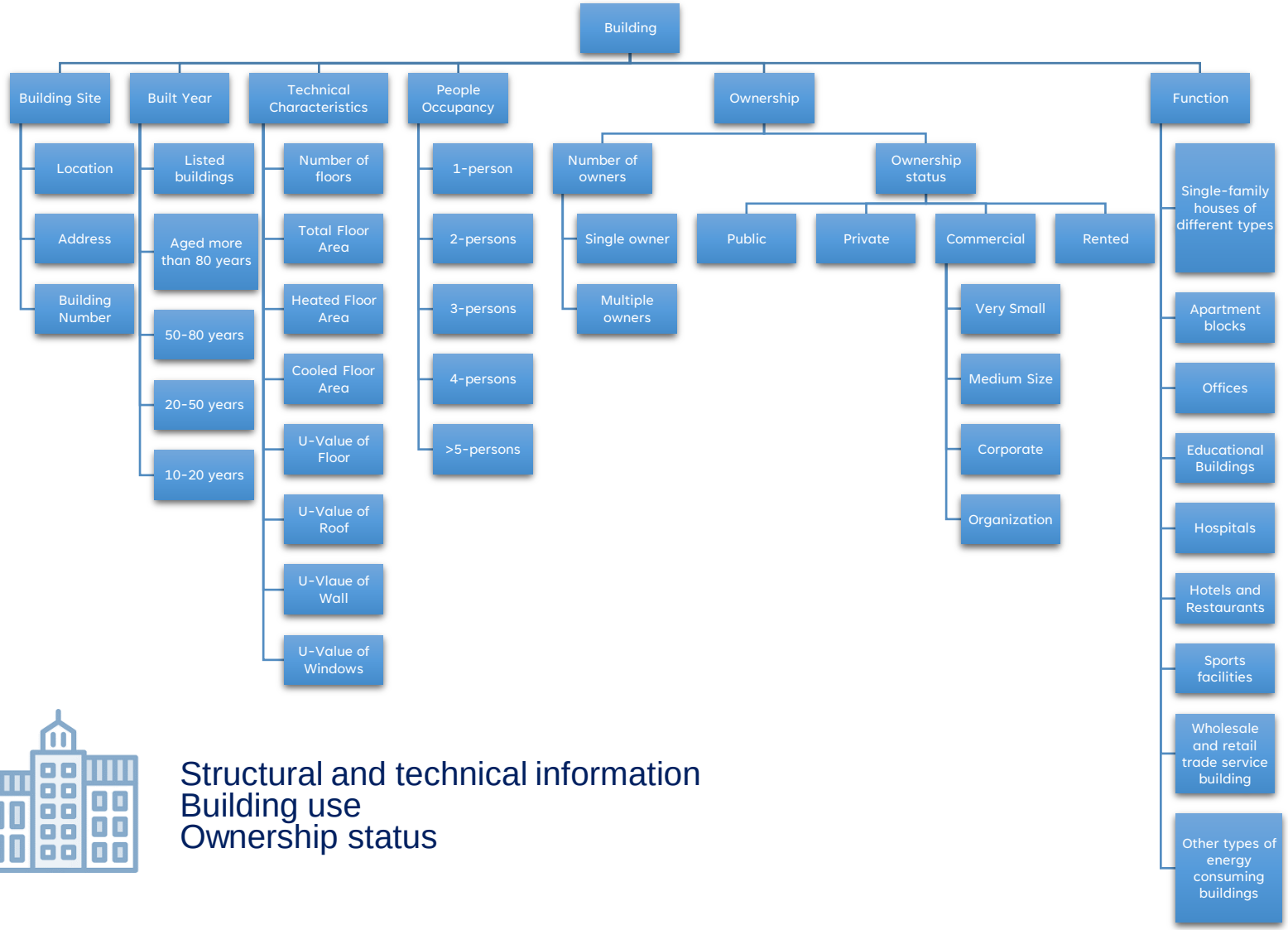


Energy:
Variables describing energy related elements of a building (e. g. energy consumption)



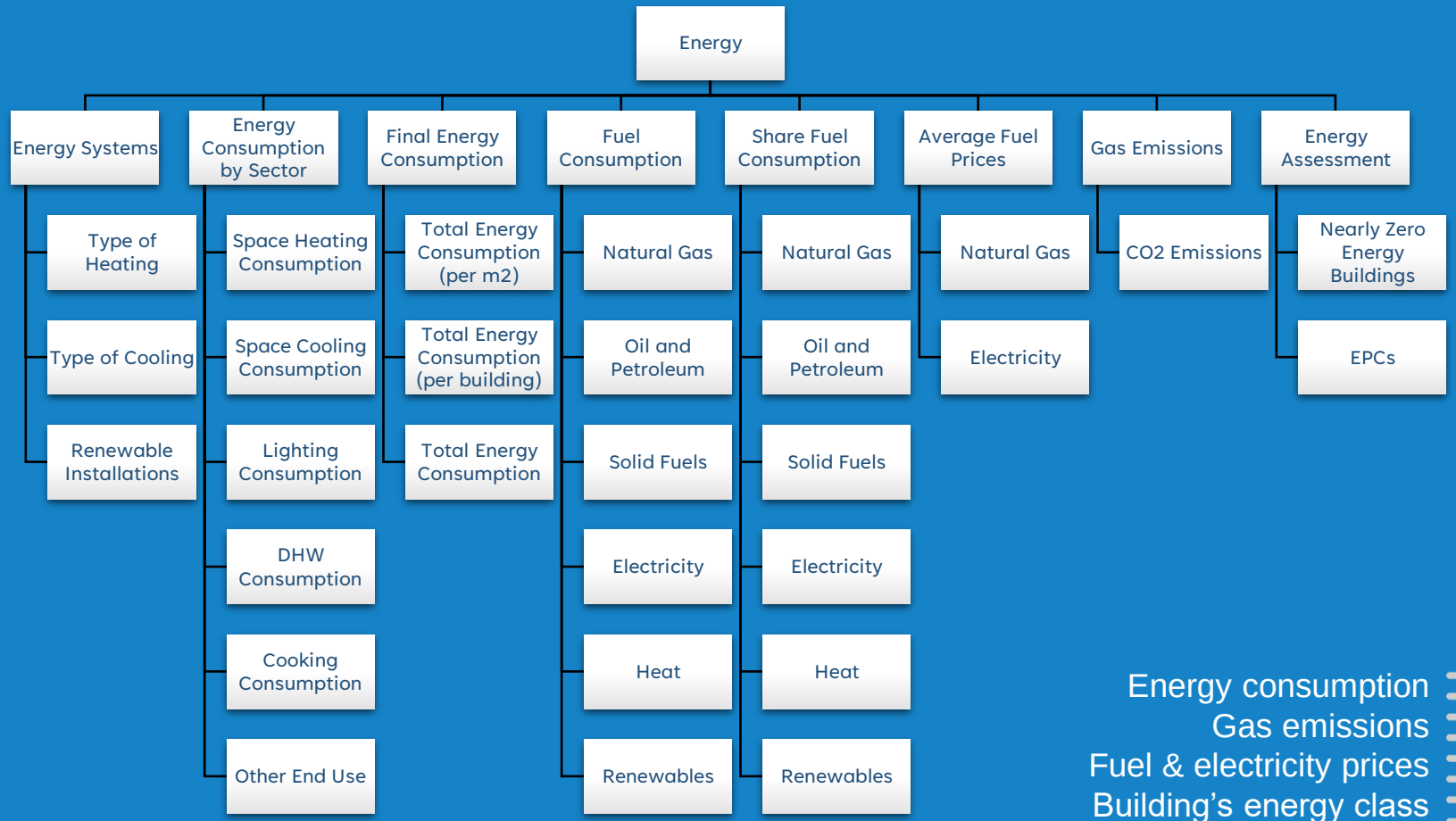
Economics:
Economic variables related to the building, building owner, city/country of the building

Creation of ENERGATE ontology (2/5)



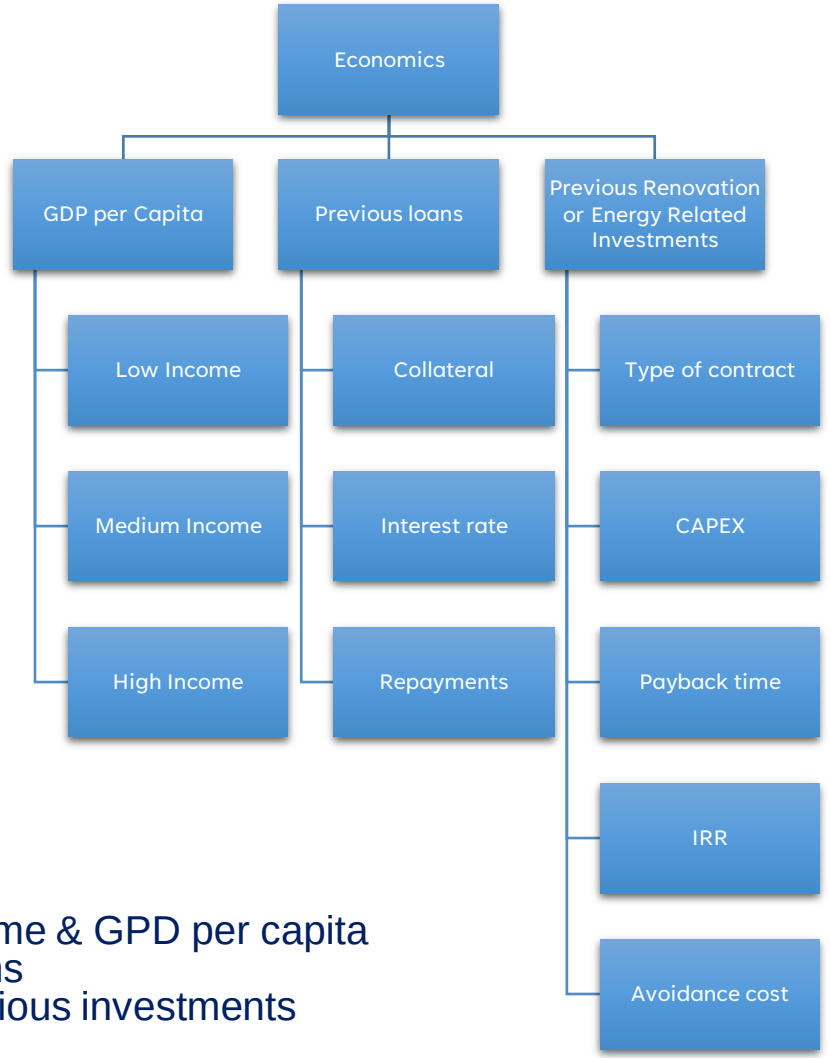
Structural and technical information
Building use
Ownership status

Creation of ENERGATE ontology (3/5)



Energy consumption
Gas emissions
Fuel & electricity prices
Building's energy class

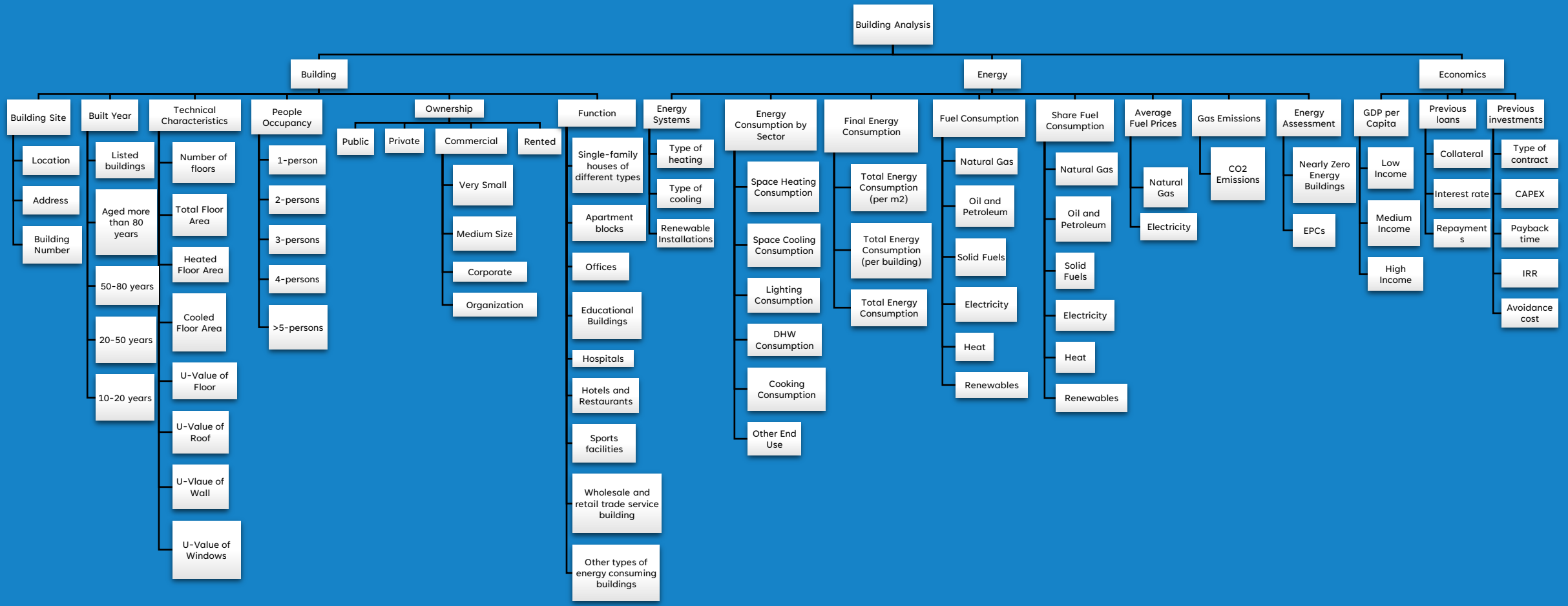
Creation of ENERGATE ontology (4/5)





Income & GPD per capita
Loans
Previous investments

Creation of ENERGATE ontology (5/5)



Conclusions and future prospects

In the context of the ENERGATE project, the proposed model will:

- Create a basis for the **project entry module** of the **supply side.**
- Support **data collection** processes from the **pilot organisations** participating in the project.
- Form a basis for specifying future research for aggregation and matchmaking on EE renovations.

Beyond the project, the proposed model will:

- **Define a building typology** focusing more on **energy efficiency** (unlike previous typologies focusing on seismic aspects).
- Assist stakeholders interested in **modelling building typologies** within **ICT-based** platforms.
- Create a basis for standardised and effective **data gathering** for renovation investments.

THANK YOU

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