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Title: Sustainable investments in the building sector: a critical review of financing tools and methods

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Table of content

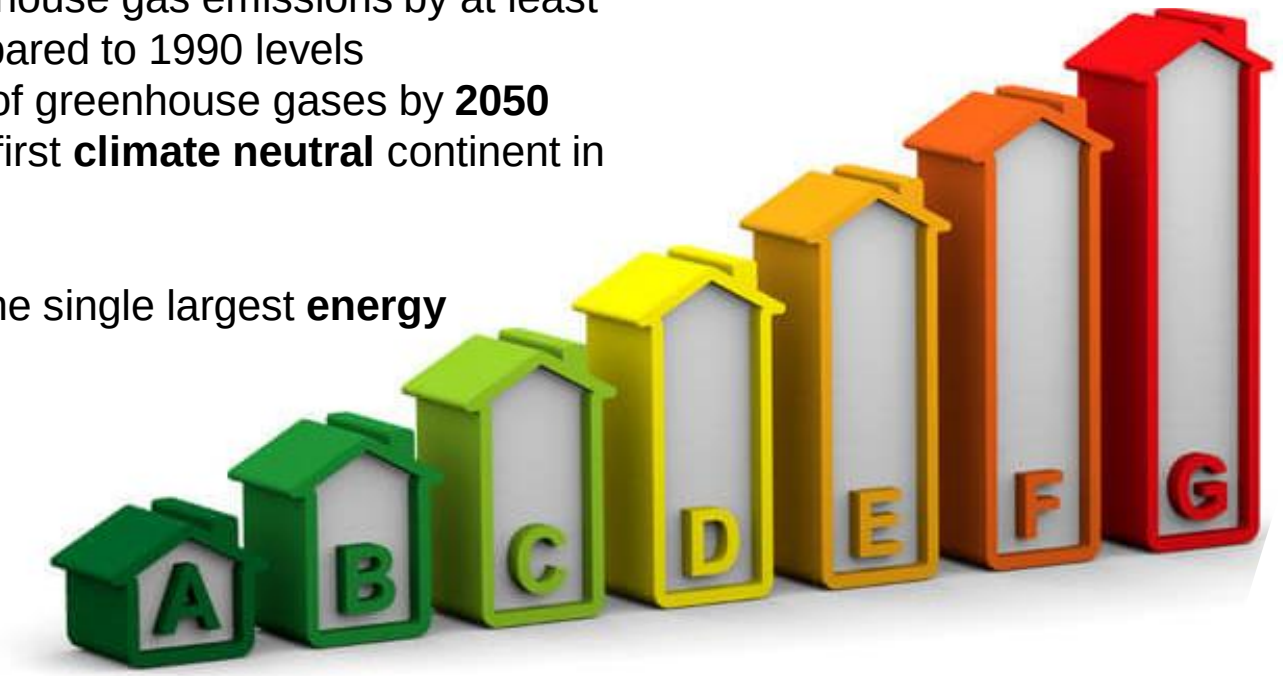
- Introduction
- Scope of the study
- Proposed approach
- Financing tools: Literature review
- Correlation of building and financing typologies
- Results from European case studies
- Discussion
- The ENERGATE project
- Conclusions and future prospects

Introduction (1/3)

- **Energy efficiency** is one of the main priorities of the European Union's energy and climate policy.

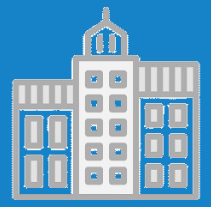
- **European Green Deal**:
  - Reducing net greenhouse gas emissions by at least **55% by 2030**, compared to 1990 levels
  - **No net emissions** of greenhouse gases by **2050**
  - Making Europe the first **climate neutral** continent in the world

- The **building sector** is the single largest **energy consumer** in the EU



Introduction (2/3)

- There is a significant untapped energy efficiency potential in the building sector.
- Several retrofitting measures could improve buildings' energy performance:



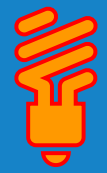
Building envelop

Wall insulation, airtightness, door & window replacement



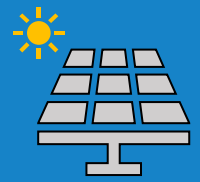
HVAC

Upgrade/ installation of cooling, heating and ventilation infrastructure



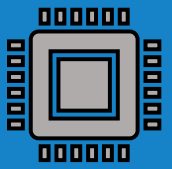
Lighting

Less energy consuming lamps, daylight strategies



Renewable systems

PV panels, micro wind generation, biomass



Automation

Smart appliances, sensors, counters, timers, BEMS

Introduction (3/3)
Barriers of building renovation projects

Technical	Financial	Behavioral
• Inadequate technical **skills** • Improper energy savings prediction - **Energy performance gap** • Improper **maintenance**	• Lack of **awareness** of available financial mechanisms and incentives • **Repayment** uncertainty • Unavailability of **private capital** • High **upfront costs** • **Limited access** to finance	• Consumer's behavior - **rebound effect** • **Split incentives** (owners & renters) • **Disturbance** of occupant's daily life • **Perceived risk** of EE investments

Scope of the study

- Barriers of renovation projects must be overcome so that Energy Efficiency investments in buildings can be incentivised
- The scope of the paper is to:
  - Focus on the **financial aspect** of building renovation projects
  - Explore and categorise the most important **financing instruments**
  - Attempt to correlate **building** and **financing typologies**
  - Set the basis for **standardisation** of Energy Efficiency investments

Proposed approach

1st step
- Background of the study: energy efficiency in buildings, retrofitting measures & barriers
- Specification of the research question: Financing typologies for renovation projects

2nd step
- Literature review of financing tools & methods
- Categorisation of financing schemes

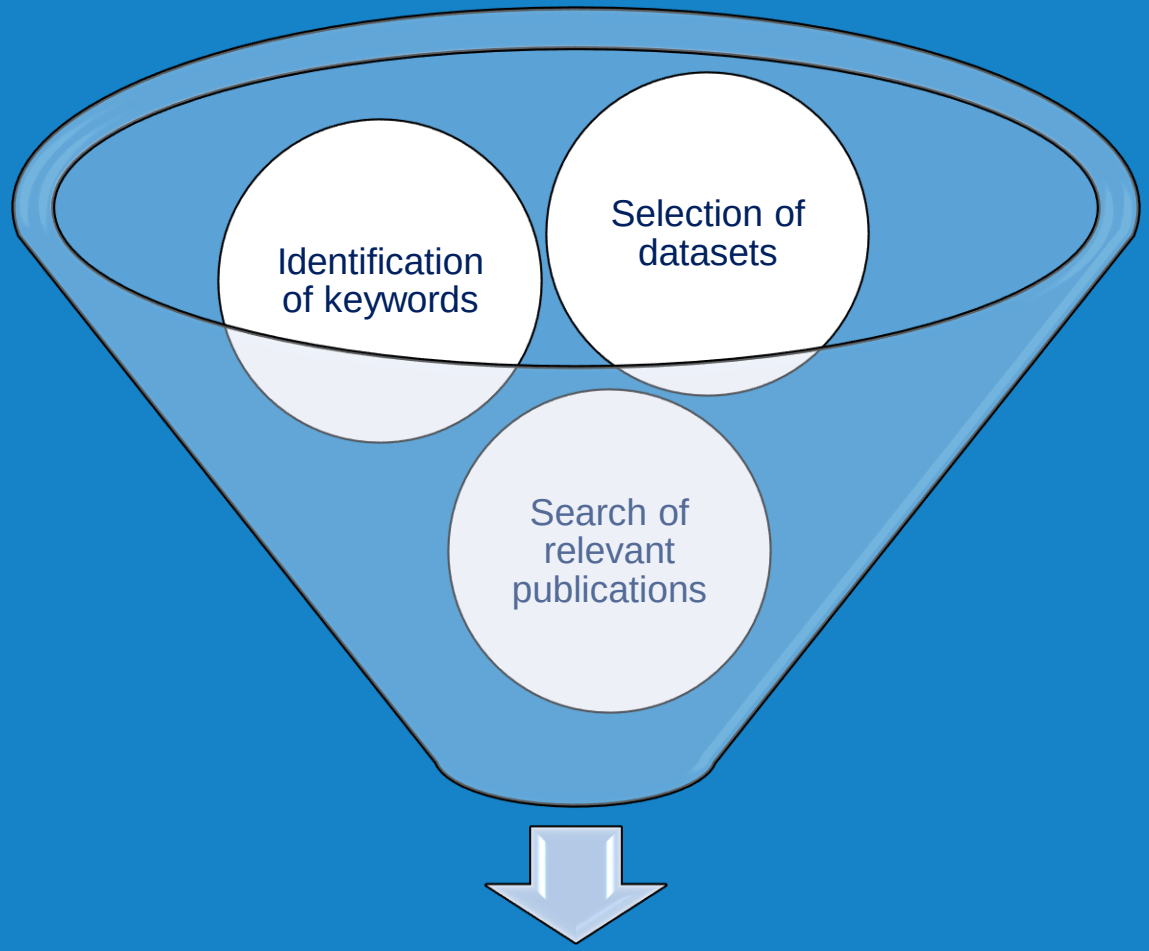
3rd step
- Correlation of financing schemes with building typologies
- Examination of specific examples from European case studies

4th step
- Identification of challenges for different financing methods
- Proposed solution: standardisation of investments through ICT-based platform

5th step
- Conclusions
- Future research prospects

2nd step

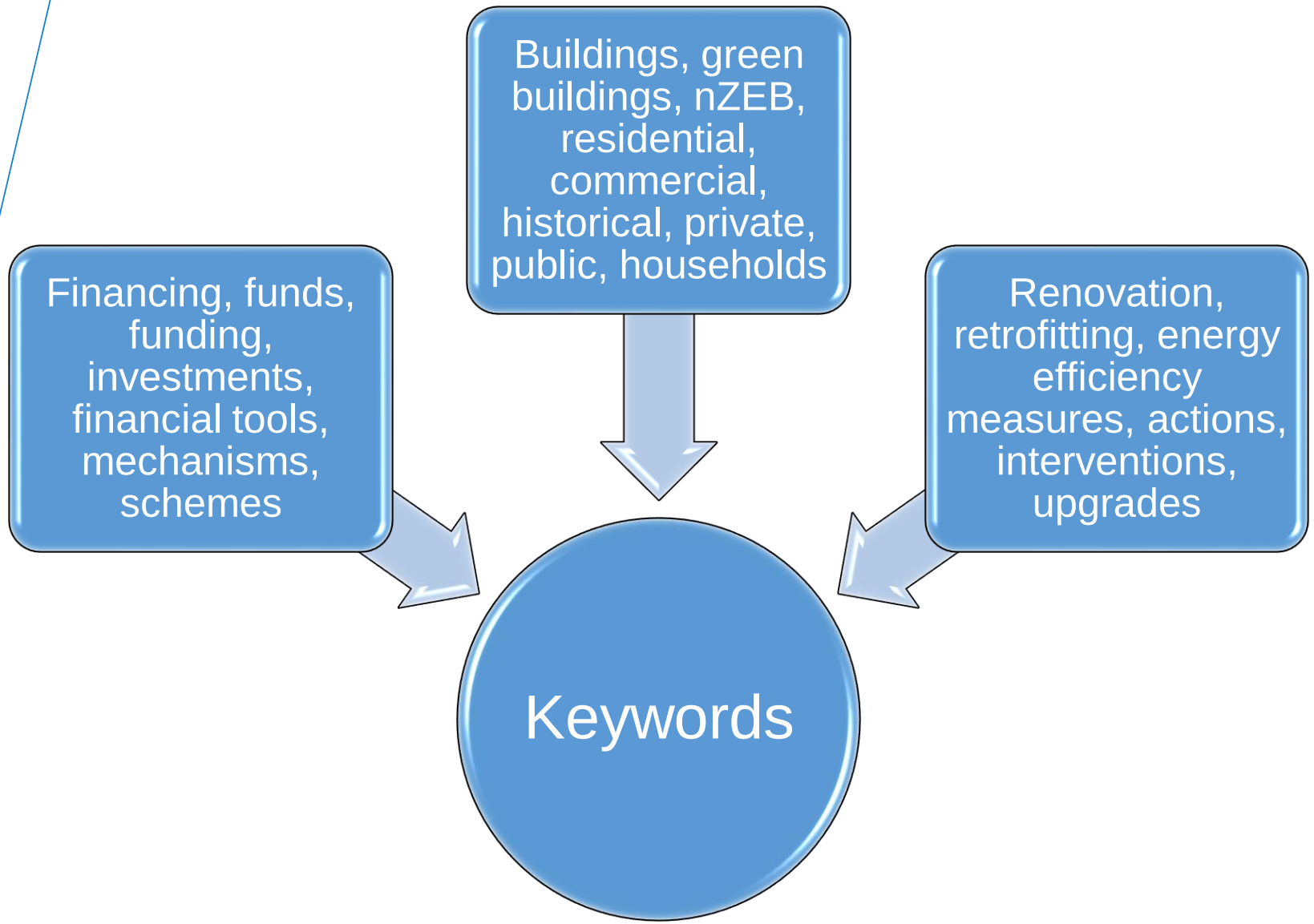
Financing tools: Literature review (1/4)



Identification of financing schemes

2nd step

Financing tools: Literature review (2/4)



2nd step

Financing tools: Literature review (3/4)
Categorisation

Non-repayable funds, EU programs

- Grants
- Subsidies
- Cohesion Policy Funds, RRF, ESIF, EFSI, HORIZON 2020, ELENA, LIFE program

Debt financing

- Loans
- Green loans
- Energy Efficiency Mortgages

Equity financing

- Equity
- Crowdfunding

Funds based on achieved energy savings

- Energy Efficiency Obligations
- Energy Performance Contracting
- Energy Efficiency Feed-in Tariffs

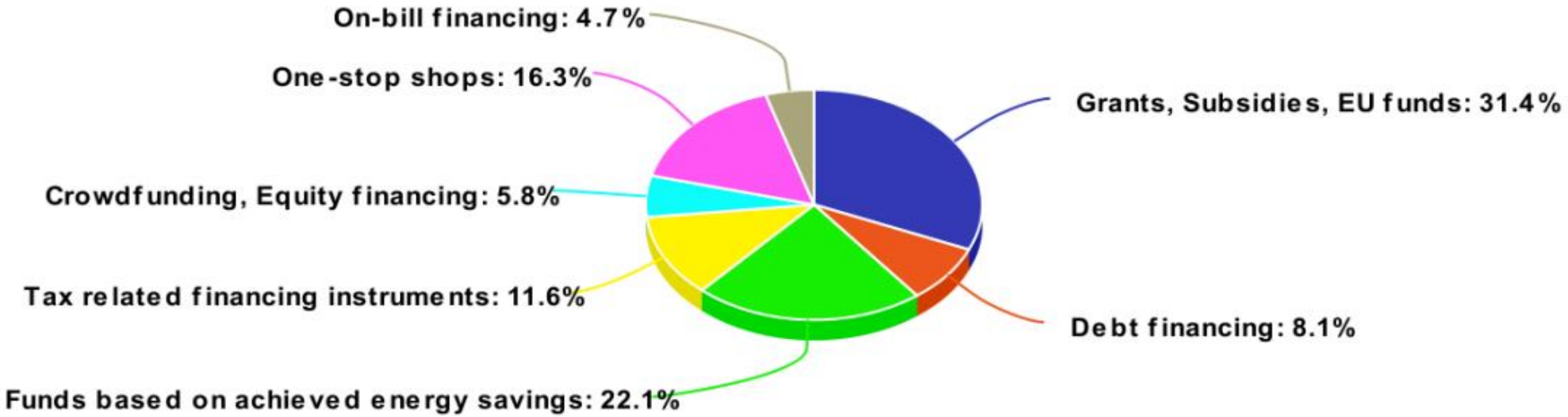
Tax-related financing instruments

- Tax incentives
- Investment Property Taxation
- PACE

Other schemes

- One-stop shops
- On-bill financing

Financing tools: Literature review (4/4)



Traditional financing instruments remain the most prominent in relevant literature, whereas **innovative** financing schemes represent a small percentage of reviewed publications, revealing the need to **furtherly examine** the potential of newer tools.

Source: *Economidou, M., Todeschi, V. and Bertoldi, P., Accelerating energy renovation investments in buildings, EUR 29890 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-76-12195-4, doi:10.2760/086805, JRC117816.*

3rd step

Correlation of building and financing typologies

Financial Mechanism	Building Type	Building Use
Grants & Subsidies	Public & Private	All
Recovery and Resilience Facility (RRF)	Public & Private	All
European Structural and Investment Funds (ESIF)	Public	All Public
European Funds for Strategic Investment (EFSI)	Public & Private	All
HORIZON 2020	Public & Private	All
European Local Energy Assistance	Public & Private	All
LIFE program	Public & Private	All
Cohesion Policy Funds	Public	Commercial, Public
Tax incentives	Public & Private	All
Loans & Energy Efficient Mortgages	Public & Private	All
Energy Efficiency Obligations	Public & Private	Residential, Commercial
Energy Service Companies/ Energy Performance Contracting (ESCOs, ECPs)	Public & Private	Mainly non-residential
On-bill Financing (OBF)	Public & Private	Residential, Commercial
Property Assessed Clean Energy (PACE)	Private	Residential, Commercial
Energy Efficiency feed-in tariffs	Public & Private	All
One-Stop Shops	Public & Private	All
Crowdfunding	Private	Residential, Commercial

3rd step

Results from European Case Studies (1/3)

- **65** Case Studies
with various building typologies

- **17** European Countries
Austria, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Montenegro, the Netherlands, Portugal, Spain, Sweden

- Main Sources:

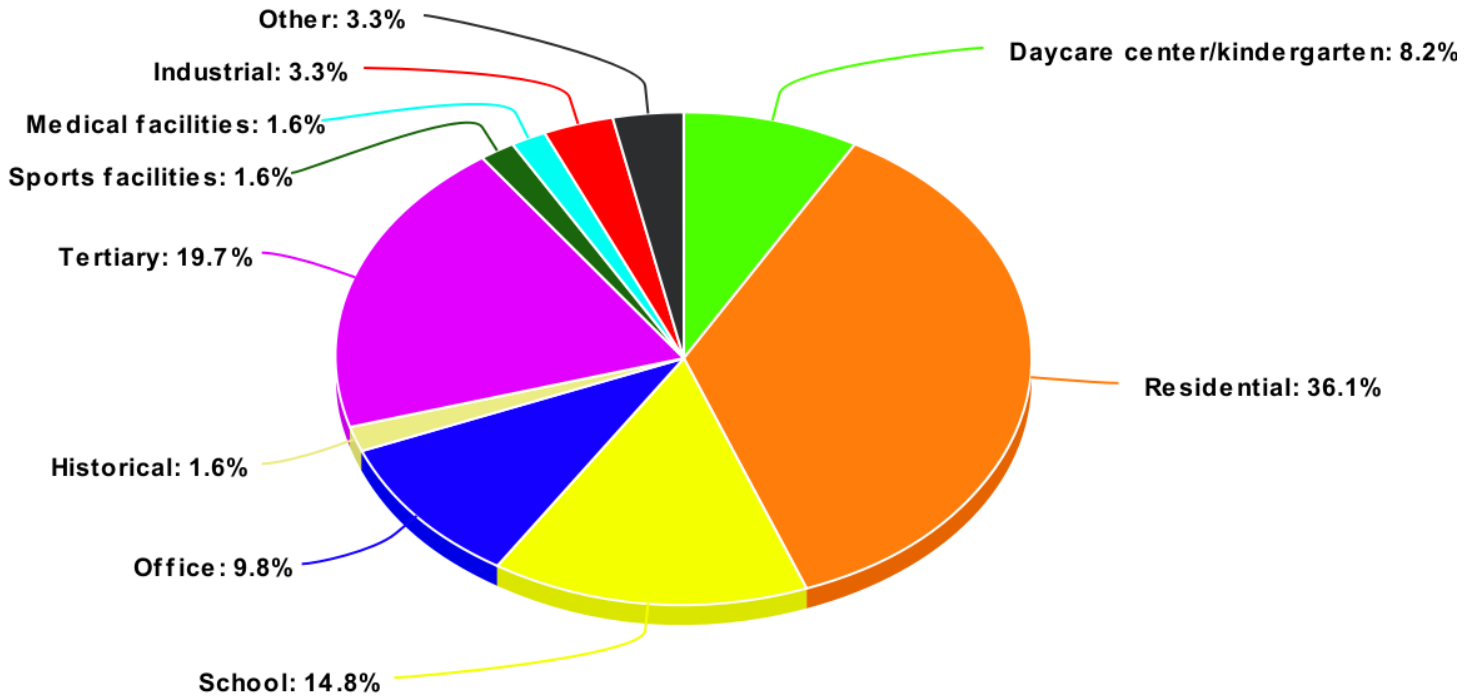
EBC
Energy in Buildings and Communities Programme

TRIPLE-A

3rd step

Results from European Case Studies (2/3)

Building Type

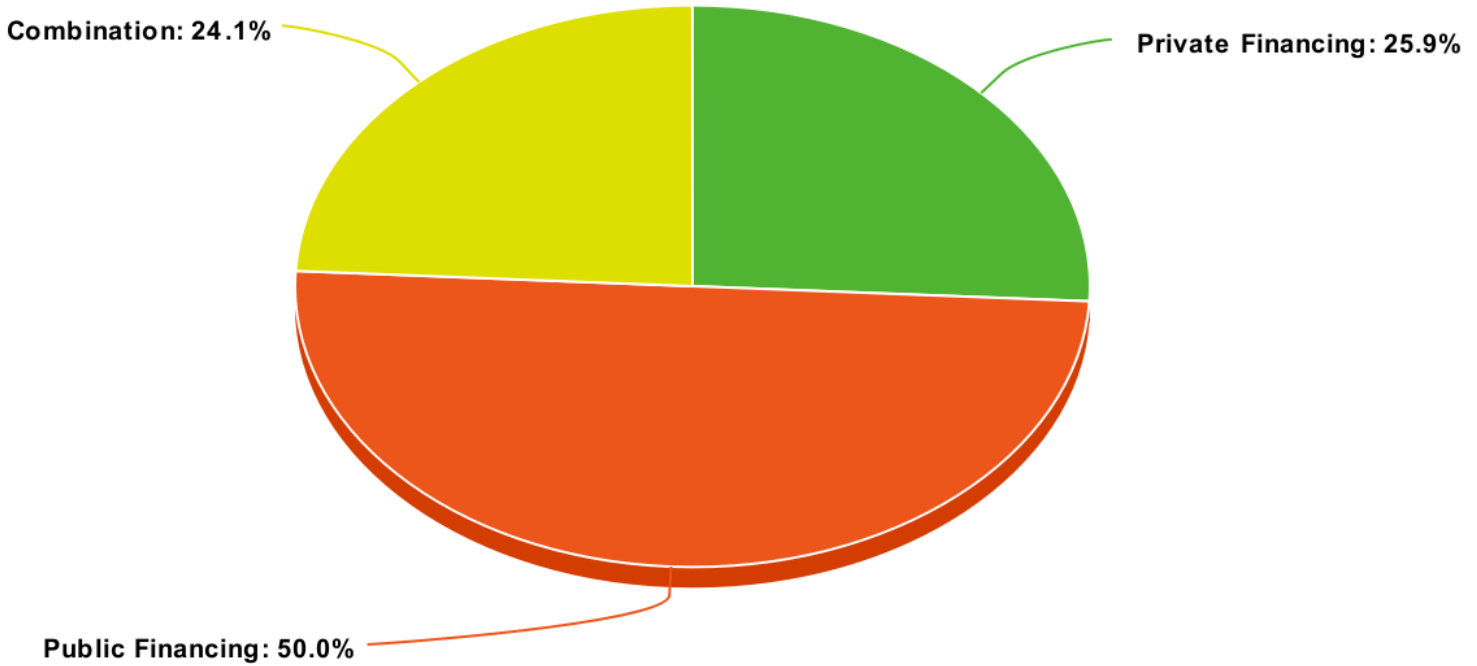


- In case studies of the **residential** sector large **aggregates** of buildings were grouped to be renovated
- A few case studies considered entire **neighborhoods** including both **residential and non-residential** buildings

3rd step

Results from European Case Studies (3/3)

Financing



- The most common financing schemes are grants, subsidies, loans and EPCs
- Public financing was provided by the EU, local governments and municipalities
- Fewer projects were financed exclusively by private investors

4th step

Discussion: Main challenges of financing tools

Grants & Subsidies	• Free ridership • Budget restriction	EEOs	• Lack of motivation to deliver more than the mandated energy savings
Tax incentives	• Dependent on tax collection rate • Lack of awareness	EE-FiTs	• Risk of favoring cheap EE interventions • Complexity
Loans	• Perceived risk • Limited eligibility for vulnerable groups	OBF	• Challenging credit risk evaluation • Risk of no payment
EPCs	• ESCOs could become too indebted • Market immaturity	Crowd-funding	• Online fraud • Weak regulatory framework

4th step

Discussion: How can the challenges be faced?

To encourage investments in renovation projects, it is necessary to:



Provide the most suitable **technical support** for each building typology:

- Select the best renovation strategy
- Find experienced project implementors
- Follow-up on achieved results



Match available projects to **financiers** interested in sustainable investments:

- Effectively collect project-related information
- Properly declare financial and energy–related KPIs
- Aggregate similar projects



Optimise the process through **automated and standardised** procedures

- Create an easy-to-use communication medium
- Provide a risk-free environment
- Enhance based on feedback and validation

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UNIVERSITY OF WEST ATTICA

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The ENERGATE project (1/3)

ENERGATE
ENERGY EFFICIENCY MARKETPLACE

January 2023 – June 2025

Building Renovation Investments made easy, predictable and risk-free

Project Coordinator:

National Technical University of Athens (NTUA)

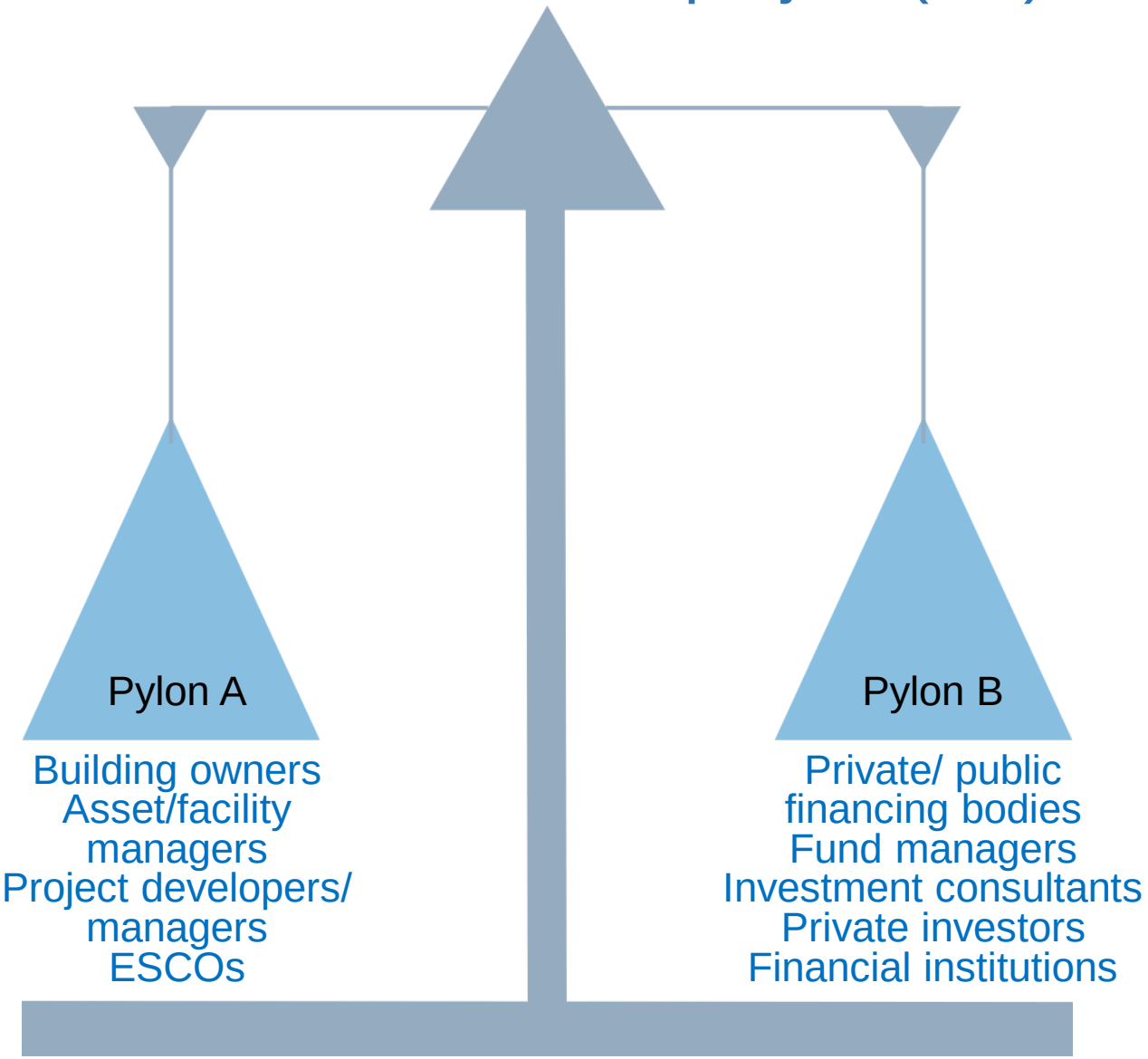
Project Partners:

IEECP INSTITUTE FOR EUROPEAN ENERGY AND CLIMATE POLICY
REHVA Federation of European Heating, Ventilation and Air Conditioning Associations
enerbrain
GGGI
LDK CONSULTANTS
RIGA PLANNING REGION
ENGINEERING THE DIGITAL TRANSFORMATION COMPANY
flexiwatt
SUSTAINABLE CITY CITY NETWORK
EnerSaveCapital
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commuty

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EPU NTUA

The ENERGATE project (2/3)



The ENERGATE project (3/3)



FETCH STAGE

Data collection:
building details
energy consumption
potential retrofitting measures
project entry module



PROCESS STAGE

Aggregation and matchmaking:
Project bundling
Filter application
Matching between project & investor



DELIVER STAGE

Follow-up on realised projects:
Feedback
Validation
M&V protocols
User profile management

Conclusions and future prospects (1/2)

Our research reveals that:

- There is a need to upscale private investment
- Over-reliance on grants is not a sustainable policy
- Business models relying on revolving funds based on achieved EE should be promoted
- Each financing method comes with different barriers, risks and challenges that stakeholders should focus on
- In many cases combining different schemes might be preferable

Our research could be enhanced by:

- Examining more datasets and publications
- Finding more information about real life case studies (e. g. by other EU projects)
- Developing specific strategies for overcoming barriers of identified financing policies

Conclusions and future prospects (2/2)

Contribution to the ENERGATE platform:

- The research sets the basis for examining the incorporation of various financing schemes in the marketplace
- The broad categories of financing methods that a product may be tied to shall comprise Private and Public/ PPP finance
- Small pipelines may be implemented via corporate finance, P4P, EaaS, on-bill, EPC, etc.
- The identified tools could be promoted to the ENERGATE platform users, so that they select their preferred financing method
- Larger pipelines may be implemented as under a project finance method (involving DD, project management and organization, etc.)
- Future research could focus on determining the most important KPIs (e. g. payback time, energy savings etc.) for different financing schemes

THANK YOU

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