EPISCOPE Workshop

Towards an energy efficient European housing stock – mapping, modelling and monitoring refurbishment processes

EPISCOPE

Co-funded by the Intelligent Energy Europe Programme of the European Union

BPIE

Welcome

Oliver Rapf (Executive Director)
Buildings Performance Institute Europe

European Commission

EASME

Executive Agency for Small and Medium-sized Enterprises

Renovating Europe's Housing Stock: current research and innovation projects

Philippe Moseley
Project Advisor, H2020 Energy

Executive Agency for SMEs

Photo: SomeDriftwood, Flickr

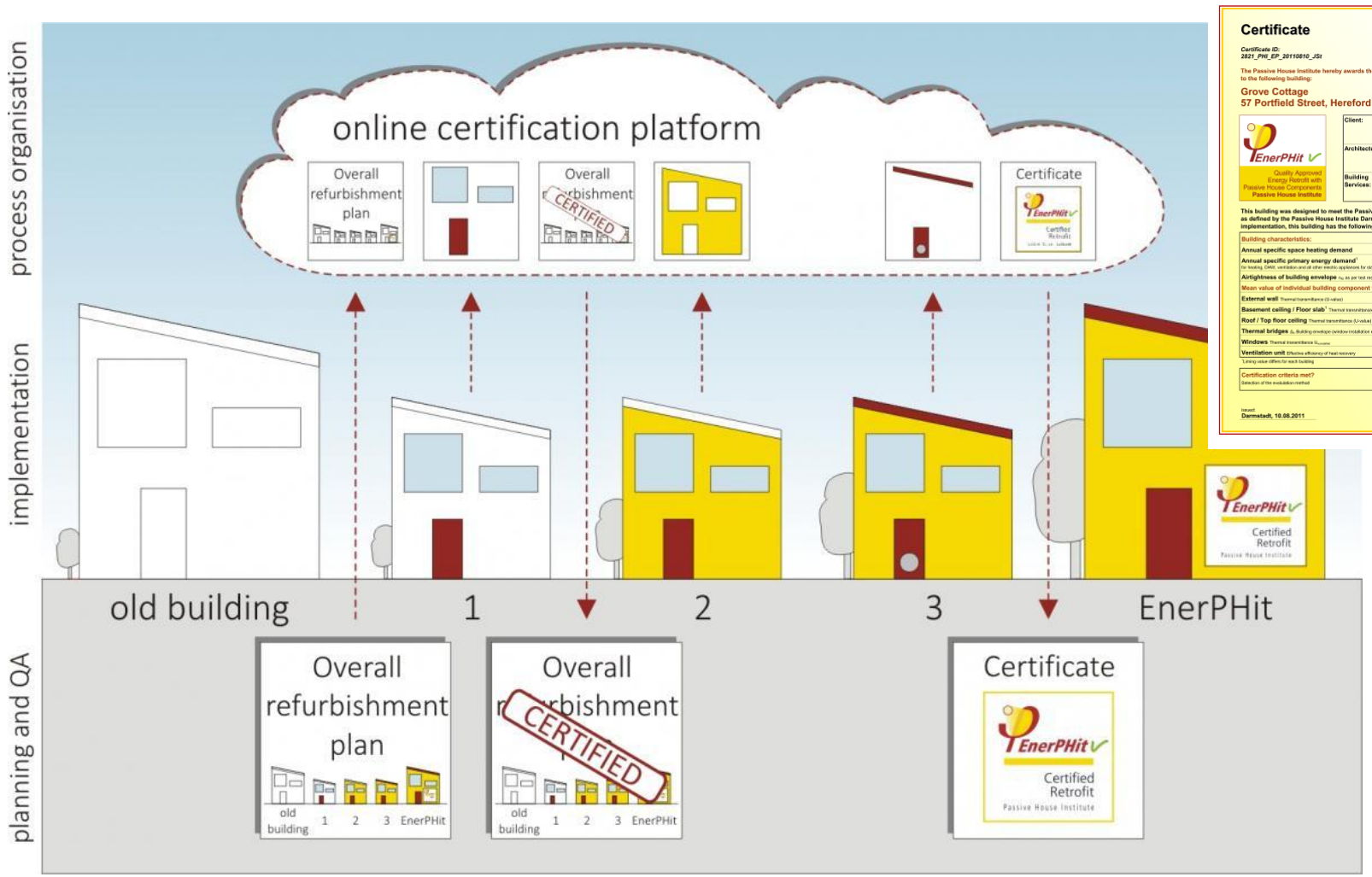
European Commission

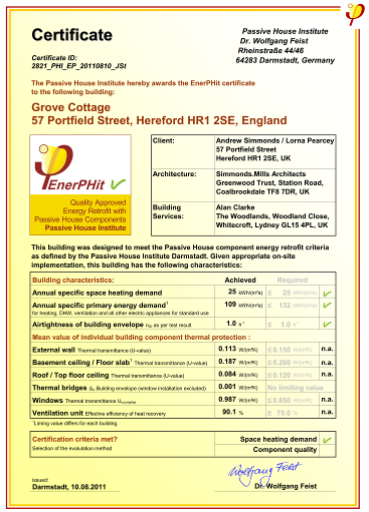
Why is EPISCOPE important?

www.europhit.eu

Step-by-step retrofits to high efficiency standards

Certification criteria and scheme





Certificate

Passive House Institute
Dr. Wolfgang Feist
Rheinstraße 44/46
64283 Darmstadt, Germany

Certificate ID:
2821_PHI_EP_20110810_JSt

The Passive House Institute hereby awards the EnerPHit certificate to the following building:

Grove Cottage
57 Portfield Street, Hereford HR1 2SE, England

EnerPHit
Quality Approved Energy Retrofit with Passive House Components
Passive House Institute

Client:	Andrew Simmonds / Lorna Pearcey 57 Portfield Street Hereford HR1 2SE, UK
Architecture:	Simmonds.Mills Architects Greenwood Trust, Station Road, Coalbrookdale TF8 7DR, UK
Building Services:	Alan Clarke The Woodlands, Woodland Close, Whitecroft, Lydney GL15 4PL, UK

This building was designed to meet the Passive House component energy retrofit criteria as defined by the Passive House Institute Darmstadt. Given appropriate on-site implementation, this building has the following characteristics:

Building characteristics:	Achieved	Required	
Annual specific space heating demand	25 kWh/(m²a)	≤ 25 kWh/(m²a)	✓
Annual specific primary energy demand[1] for heating, DHW, ventilation and all other electric appliances for standard use	109 kWh/(m²a)	≤ 132 kWh/(m²a)	✓
Airtightness of building envelope n_{50} as per test result	1.0 h⁻¹	≤ 1.0 h⁻¹	✓
Mean value of individual building component thermal protection :			
External wall Thermal transmittance (U-value)	0.113 W/(m²K)	≤ 0.150 W/(m²K)	n.a.
Basement ceiling / Floor slab[1] Thermal transmittance (U-value)	0.187 W/(m²K)	≤ 0.260 W/(m²K)	n.a.
Roof / Top floor ceiling Thermal transmittance (U-value)	0.084 W/(m²K)	≤ 0.120 W/(m²K)	n.a.
Thermal bridges Δ_U Building envelope (window installation excluded)	0.001 W/(m²K)	No limiting value	
Windows Thermal transmittance $U_{w,installed}$	0.987 W/(m²K)	≤ 0.850 W/(m²K)	n.a.
Ventilation unit Effective efficiency of heat recovery	90.1 %	≥ 75.0 %	n.a.

[1] Limiting value differs for each building

Certification criteria met? Selection of the evaluation method	Space heating demand	✓
	Component quality	

Issued
Darmstadt, 10.08.2011

Dr. Wolfgang Feist

European Commission

Low Energy
APARTMENT FUTURES

- Aims to improve energy efficiency of **apartment blocks in multiple ownership**
- Explores **different contexts** e.g. different management structures, decision-making procedures
- Developing **bespoke toolkits** for multi-occupancy buildings
- **Identifying lessons** related to multi-ownership buildings

www.lowenergyapartments.eu

Co-funded by the Intelligent Energy Europe Programme of the European Union

Technical Toolkit

- Explains EPC's
- Allows for occupant behaviour
- Covers common areas e.g. stairs

Engagement Toolkit

- Non-technical guidance
- How to engage occupants
- Tips on decision-making

www.lowenergyapartments.eu

European Commission

MORE—
CONNECT

Huygen
INSTALLATIE ADVISEURS

Aims to **answer three basic questions** for end users:

- What do I get?
- What does it cost?
- What is the advantage for me?

www.more-connect.eu

European Commission

MORE—
CONNECT

Huygen
INSTALLATIE ADVISEURS

- Aims to achieve **faster deep renovation** with guaranteed quality and performance
- Develops **prefabricated, multifunctional** renovation elements for building envelope and technical systems
- Offers a **one-stop-shop to the end-user** to renovate their homes
- **Demonstration case studies** in various EU geoclusters

www.more-connect.eu

Energy Efficiency Call 2015
Main results

- EASME evaluated 478 proposals from 54 countries
- 109 proposals recommended for funding
- **47 proposals within Call budget**

Towards Nearly-Zero Energy Buildings

- **3 projects fostering deep renovation**
  - E.g. NZEB refurbishments of social housing in UK, FR and NL, replicating the Energiesprong model
  - E.g. Financing deep renovations by adding new volumes

Engaging citizens

- **4 RIAs developing new ICT tools**
  - Tests done in social housing and public buildings
- **4 projects fostering behavioural change**
  - Covering households and employees
  - E.g. Engaging RES cooperatives in savings measures

Public authorities leading by example

- **7 projects targeting public authorities**
  - Accelerating implementation of the Energy Efficiency Directive

Innovative financing

- **5 projects improving the attractiveness of sustainable energy investments**
  - Multi-stakeholder national platforms to close the gap between investors and project developers
  - New methodology to assess risks/opportunities of an energy transition in the bond and equity markets
  - Framework for valuation and benchmarking of small-sized projects
- **2 Project Development Assistance proposals**
  - Deep retrofit of social housing with energy performance contracts

2016 Call for Proposals

Info Day 8th December 2015

Energy Efficiency Call 2016	Deadline
EE-10: Supporting accelerated and cost-effective deep renovation of buildings	**21 Jan. 2016**
EE-11: Overcoming market barriers and promoting deep renovation of buildings	**15 Sep. 2016**

EASME: more information

EASME-Energy@ec.europa.eu

http://ec.europa.eu/easme

@H2020EE, @PhilippeMoseley

EPBD & data needs

EPISCOPE Workshop
18 November 2015
Brussels

Vasco Ferreira
Directorate-General for Energy
Energy Efficiency Unit

Political context

Energy Union Communication

Rethink energy efficiency as an energy source in its own right

*This means increasing energy efficiency, **in particular in the building sector**, and promoting an energy-efficient and decarbonized transport sector as well as efficient products.*

*9. In 2015 and 2016, the Commission will **review all relevant energy efficiency legislation***

*10. The Commission will develop a **Smart Financing for Smart Buildings** initiative to make existing buildings more energy-efficient, facilitating access to existing funding instruments*

Better enforcement

- Transposition and implementation of EED and EPBD:
  - **Support MS with good practice and guidance**
  - **Infringement procedures**

- Assessment of the EPBD *'Ex-ante conditionalities'* for European Structural and Investment Funds:
  - **Dialogue with the Member States**
  - **EPBD Articles 3,4 and 5 and Article 11**

European Commission

Energy Performance of Buildings (recast) Directive review

Article 19

Review

The Commission, assisted by the Committee established by Article 26, shall evaluate this Directive by 1 January 2017 at the latest, in the light of the experience gained and progress made during its application, and, if necessary, make proposals.

EPBD review

In parallel to enforcement, focus on data collection to better know where we are:

- Broad **public consultation**
- **Specific studies** to feed the evaluation and impact assessment
- **Building stock observatory**
- Analysis of the long-term **renovation strategies**
- Assessment of the **cost-optimal calculations**
- **Concerted Action** new 'book'

'Evaluate first' principle

Online public consultation:

30 June - 31 October 2015

Member States targeted consultation:

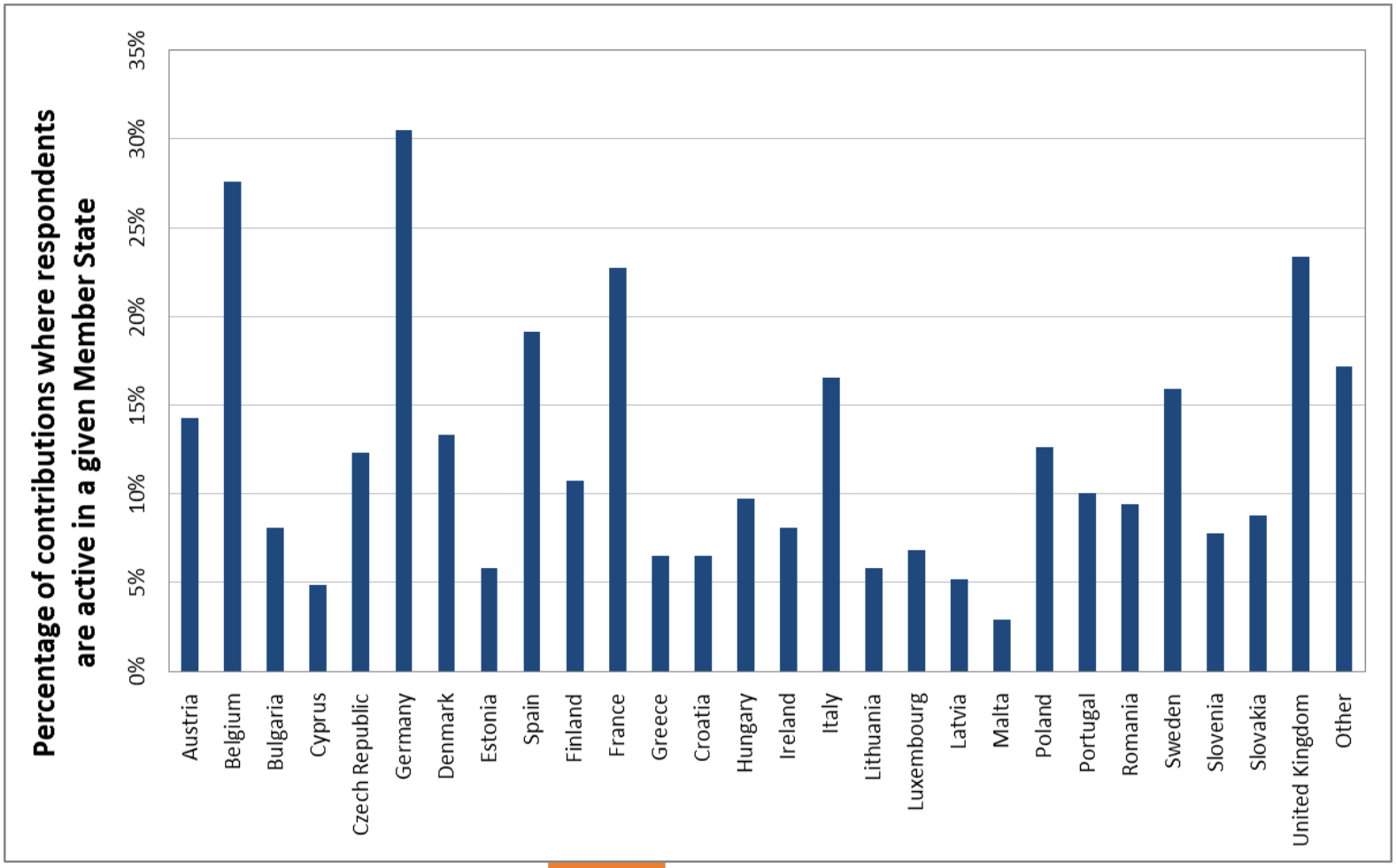
25-27 November 2015 - Concerted Action EPBD

Targeted technical workshops:

December 2015

Public consultation

more than 300 replies



Public consultation on the evaluation

Focus on the current EPBD	Additional areas to be explored
• Overall assessment • Facilitating enforcement and compliance • Energy Performance Certificates • **Energy efficient renovation of the building stock** • Financing energy efficiency in buildings and creation of markets • Ensuring new highly efficient buildings using a higher share of renewables	• Energy poverty and affordability of housing • 'Smartness' of the building • Links between the EPBD and district and city levels, smart cities, and heating and cooling networks • **Awareness, information and building data** • Operational management and maintenance

On-going studies

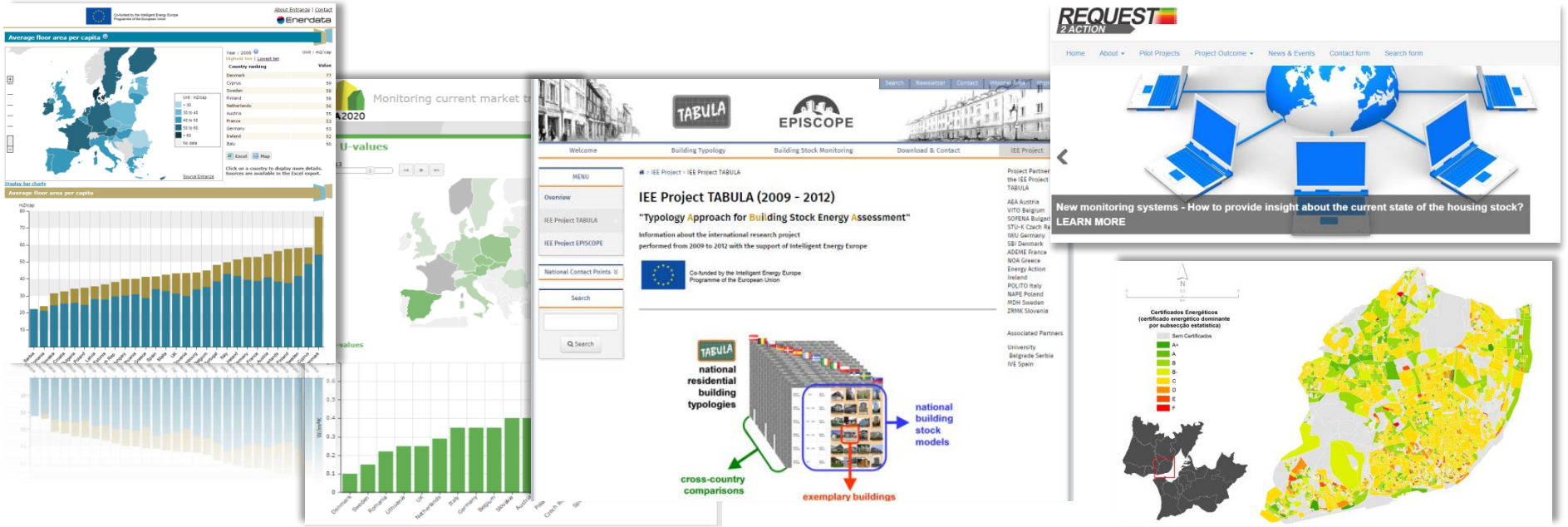
- Specific **studies** to feed the **Evaluation** and **Impact Assessment**, and macro-economic **modelling** for buildings:
  - **Evaluation** of the application of the Energy Performance of Buildings Directive (EPBD) and assessment of policy options and resulting impact in the framework of the EPBD review
  - The **macroeconomic and other benefits of Energy Efficiency** (employment generated, GDP, health, poverty alleviation, public budget, competitiveness and value of buildings) with particular focus on the buildings sector;

European Commission

DATA NEEDED

EU Building Stock Observatory

Generate, combine and make accessible data on the characteristics of EU building stock at national level in **one single database in DG Energy's website** (Feb.2016)



Impact Assessment - Option mapping

- Baseline scenario- no EU policy change
- Options of improving implementation and enforcement or doing less/simplification
- Alternative policy approaches, including on:
  - **Comparability of building information**
  - **EPC reliability and availability of data**
  - **NZEB**

[…]

Option mapping (cont.)

[…]

- Alternative policy instruments
  - **Voluntary agreement with financial institutions**
- Alternative/differentiated scope
  - **Example of embedded energy**
  - **Explore general indoor climate aspects**
- Options that take account of new technological developments- 'smartness'

[…]

European Commission

Thank you!

Vasco Ferreira

vasco.ferreira@ec.europa.eu

Mapping, modelling and monitoring of residential building stocks in 16 European countries – an introduction to the EPISCOPE project

Britta Stein, Institut Wohnen und Umwelt GmbH

18 November 2015

EPISCOPE Experts' Workshop in Brussels

Co-funded by the Intelligent Energy Europe Programme of the European Union

Background

- Ambitious CO_2 reduction and energy efficiency targets for the next decades on European and national levels
- High theoretical potential for energy savings in the (European) building sector, but poor evidence for the success in terms of the achievement of the climate protection targets
- Whether the promoting forces concerning building refurbishments are appropriate for attaining the climate protection targets is not certain
- Sufficient availability of reliable primary data about the state and dynamics of refurbishment and the resulting energy performance is questionable
- **Key concern**: How to track the process?
- **Main idea:** Development of targeted monitoring approaches, combined with scenario analyses and national building typologies
- **Starting Point:** IEE projects DATAMINE (2006-2008) and TABULA (2009-2012)

Image: Fersing / pixelio.de

Co-funded by the Intelligent Energy Europe Programme of the European Union

Overview

Duration

➔ April 2013 to March 2016

Consortium

➔ 17 Partners from 16 European countries & 1 associated partner

➔ Universities, research institutes, engineering companies, & Buildings Performance Institute Europe

Key Contents

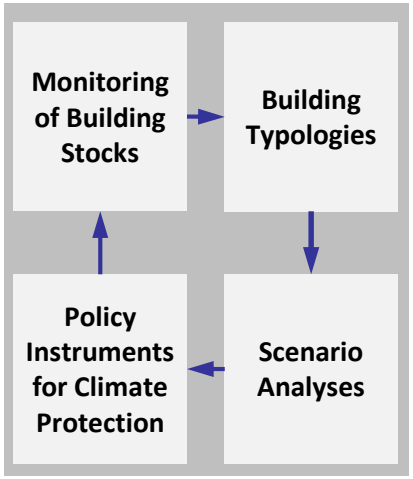
➔ Setup or upgrade and extension of **national building typologies**

➔ Identification of a concerted set of **energy performance indicators** reflecting the energy refurbishment state

➔ Implementation of **case studies**, either on local, regional or national level

➔ Application of **scenario calculations** for the considered housing stocks and portfolios incl. setup of building stock models

➔ Recommendations how a **regular monitoring** can be achieved



Co-funded by the Intelligent Energy Europe Programme of the European Union

Starting Point: Residential Building Typologies

Building Size Classes

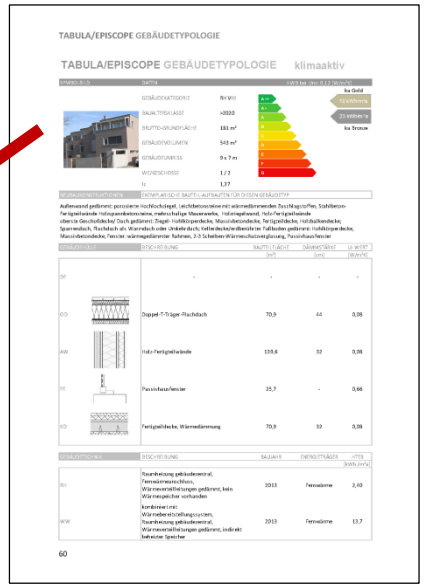
Construction Year Classes

	Region	Construction Year Class	Additional Classification	SFH Single-Family House	TH Terraced House	MFH Multi-Family House	AB Apartment Block
1	national (Gesamt-Österreich)	... 1919	generic (Standard / allgemein typisch)	AT.N.SFH.01.Gen	AT.N.TH.01.Gen	AT.N.MFH.01.Gen	AT.N.AB.01.Gen
2	national (Gesamt-Österreich)	1919 ... 1944	generic (Standard / allgemein typisch)	AT.N.SFH.02.Gen	AT.N.TH.02.Gen	AT.N.MFH.02.Gen	AT.N.AB.02.Gen
3	national (Gesamt-Österreich)	1945 ... 1960	generic (Standard / allgemein typisch)	AT.N.SFH.03.Gen	AT.N.TH.03.Gen	AT.N.MFH.03.Gen	AT.N.AB.03.Gen
4	national (Gesamt-Österreich)	1961 ... 1980	generic (Standard / allgemein typisch)	AT.N.SFH.04.Gen	AT.N.TH.04.Gen	AT.N.MFH.04.Gen	AT.N.AB.04.Gen
5	national (Gesamt-Österreich)	1981 ... 1990	generic (Standard / allgemein typisch)	AT.N.SFH.05.Gen	AT.N.TH.05.Gen	AT.N.MFH.05.Gen	AT.N.AB.05.Gen
6	national (Gesamt-Österreich)	1991 ... 2000	generic (Standard / allgemein typisch)	AT.N.SFH.06.Gen	AT.N.TH.06.Gen	AT.N.MFH.06.Gen	AT.N.AB.06.Gen
7	national (Gesamt-Österreich)	2001 ... 2009	generic (Standard / allgemein typisch)	AT.N.SFH.07.Gen	AT.N.TH.07.Gen	AT.N.MFH.07.Gen	AT.N.AB.07.Gen
8	national (Gesamt-Österreich)	2010 ...	generic (Standard / allgemein typisch)	AT.N.SFH.08.Gen	AT.N.TH.08.Gen	AT.N.MFH.08.Gen	AT.N.AB.08.Gen

Latest building size class = new built (current requirements + NZEB concepts)

Example from Austria (AEA)

Illustration through example buildings
picture, floor and envelope areas, real existing buildings, showing characteristic values (e.g. U-values) and benchmarks for energy performance



IWU Institut Wohnen und Umwelt

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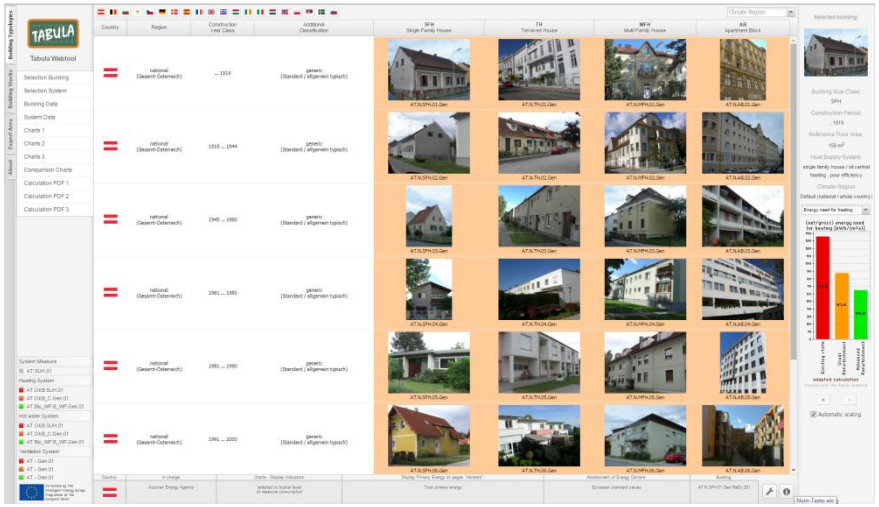
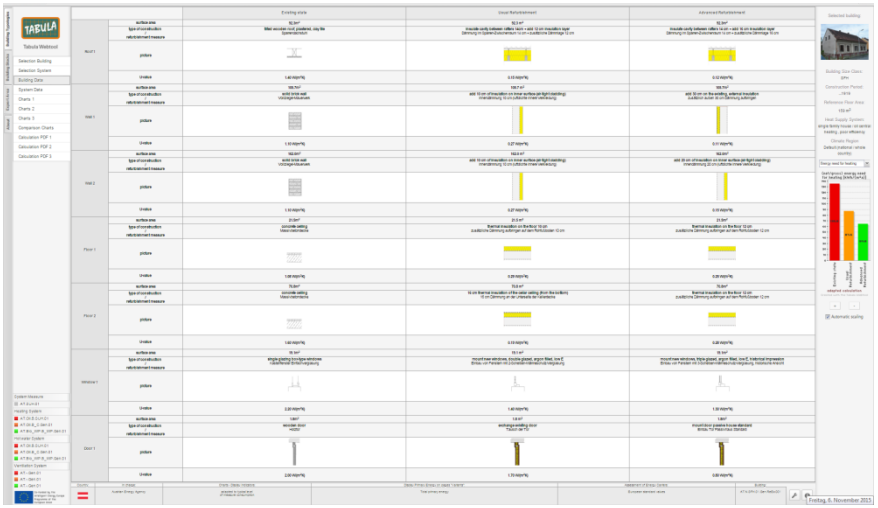
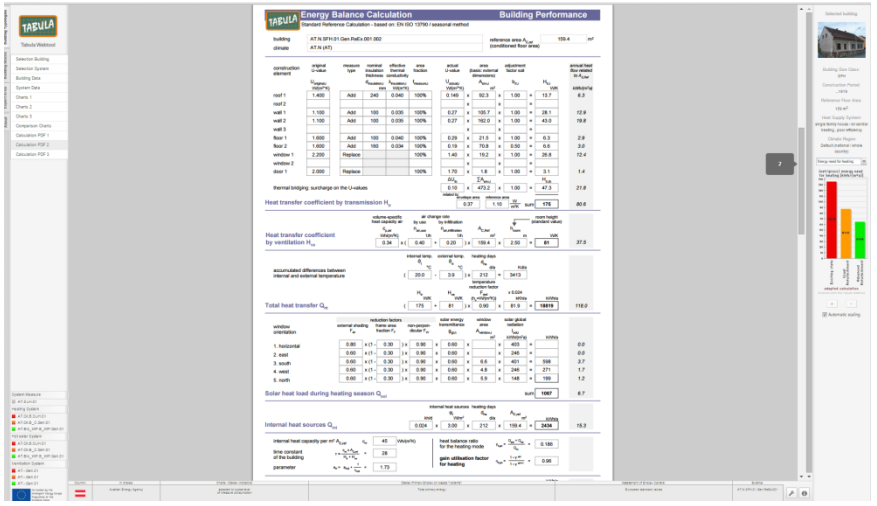
TABULA WebTool / Building Typologies

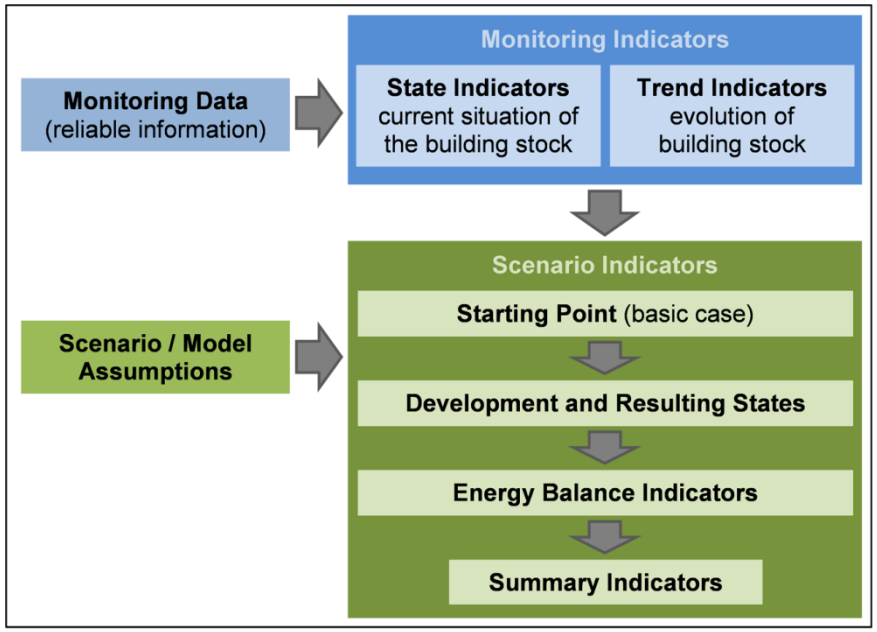






Energy Performance Indicators

- Discussion and definition of a set of energy performance indicators
- Generally applicable set of quantities which – in case of a regular update – can deliver the basic information necessary to observe and understand the development of energy performance in residential building stocks
- Indicator scheme to enable comparisons between actions of energy performance tracking (summary indicators)



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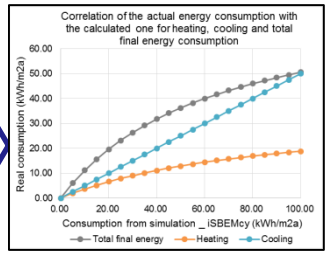
Case Studies / Scenario Calculations on local, regional or national level

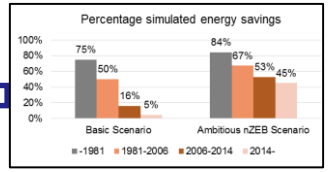
EPISCOPE

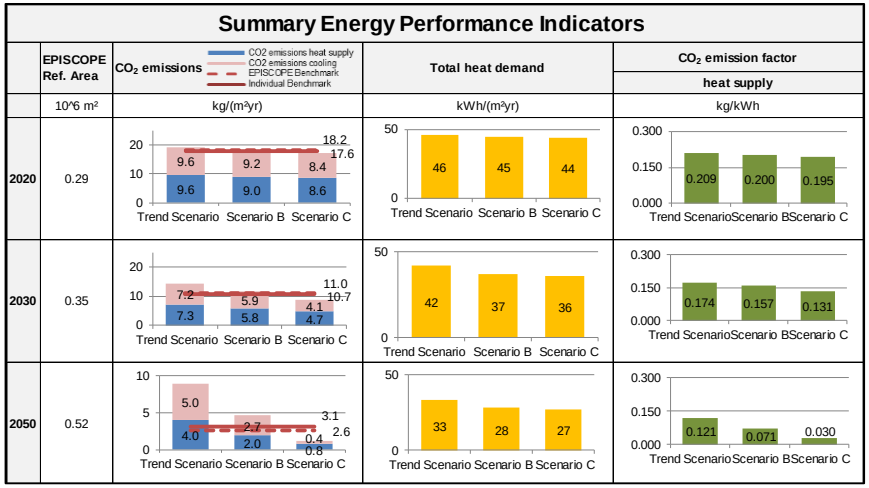
- Individual building stock models to map the current (refurbishment) state and energy performance
- Determination of the relation between calculated demand and actual consumption
- Identification of dynamics and trends, particularly refurbishment rate/s
- Consideration of different scenarios / comparison to benchmarks resulting from European, national or individual targets
- Use of summary indicators for comparability

Example from Cyprus (CUT)



Future Energy Upgrading Scenarios	Trend Scenario			Moderate Scenario			Ambitious (nZEB) Scenario		
	2020	2030	2050	2020	2030	2050	2020	2030	2050
Total Percentage of dwellings with roof U-value <0.75W/m2K, windows U-value <3.2W/m2K and walls U-value <1.38W/m2K /total stock	28%	26%	20%	33%	46%	55%	26%	19%	5%
Total Percentage of dwellings with roof U-value <0.4W/m2K, windows U-value <2.25W/m2K and walls U-value <0.4W/m2K /total stock (nZEB)	0%	18%	45%	0%	18%	45%	8%	45%	95%
Onsite RES contribution for heating (%) in the complete building stock	44%	49%	53%	46%	56%	78%	45%	58%	84%
Onsite RES contribution for cooling (%) in the complete building stock	0%	2%	7%	3%	17%	50%	0%	18%	70%
RES contribution in the grid electricity production (%) in the complete stock	13%	24%	46%	13%	24%	46%	17%	34%	64%





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Example from Norway (NTNU/SINTEF)

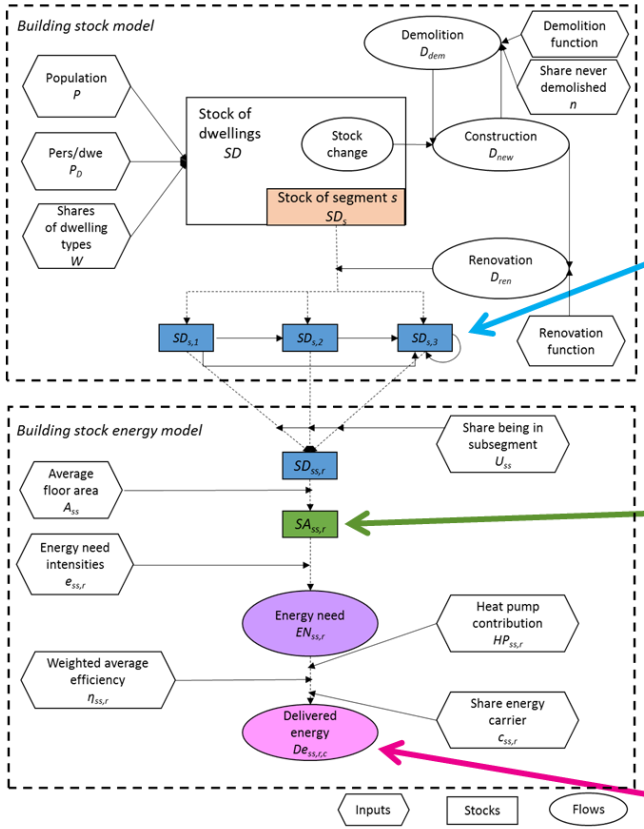
Dynamic Material Flow Analysis (MFA) model

Model in layers

Stock and flows of
Dwellings
Floor area
Energy demand

Modelling is based on:

- Population statistics 1800 - 2100
- Mass balance equations
- Probability functions of technical lifetime and renovation cycles
- Archetype specific data on floor area and energy intensity



Basis for applications

Component substitution:
- Energy efficiency
- Market opportunities

Materials:
- Input demand
- Waste flows

Energy / Emissions:
- National plans
- Roadmaps

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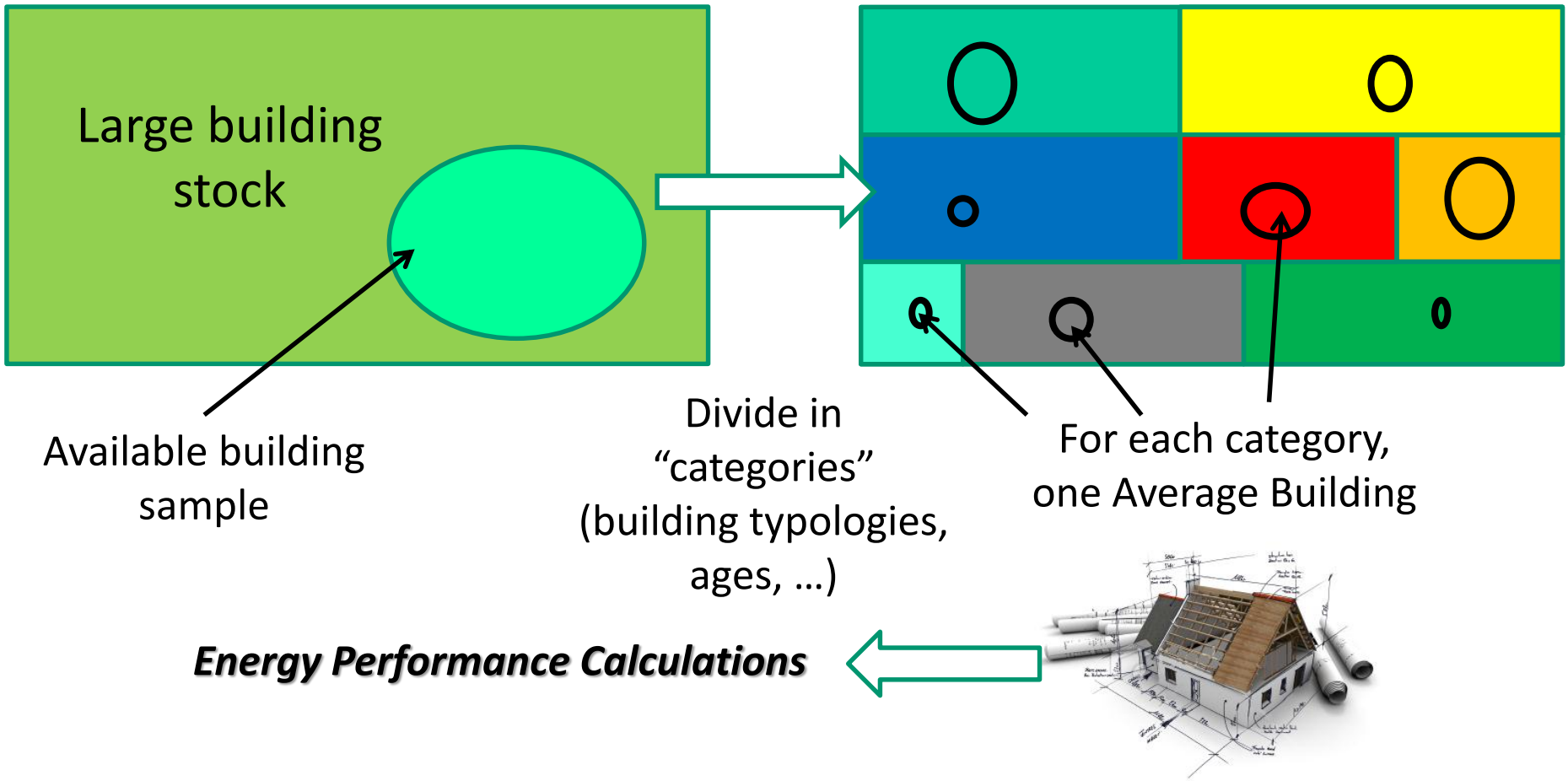
Definition of Average Buildings for Building Stock Modelling

EPISCOPE

Illustration by POLITO / Italy



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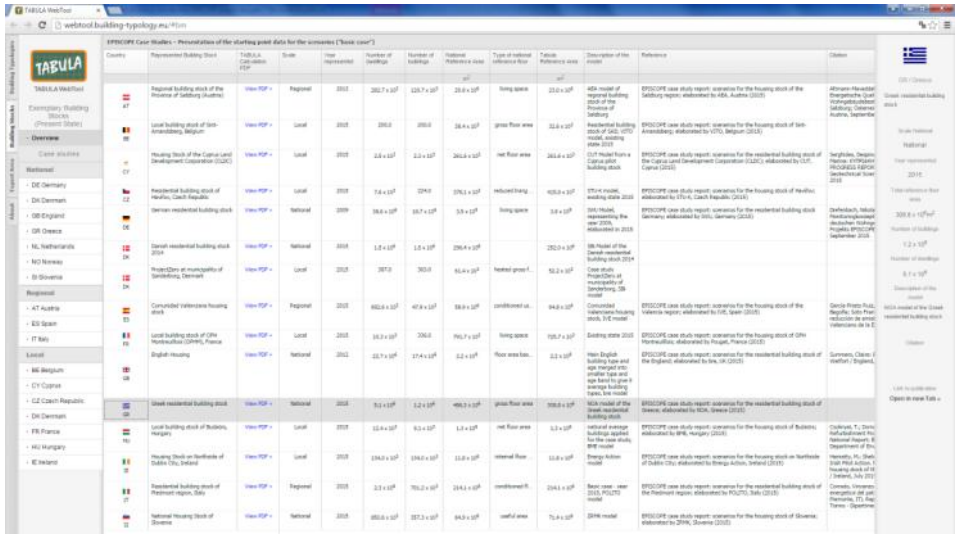
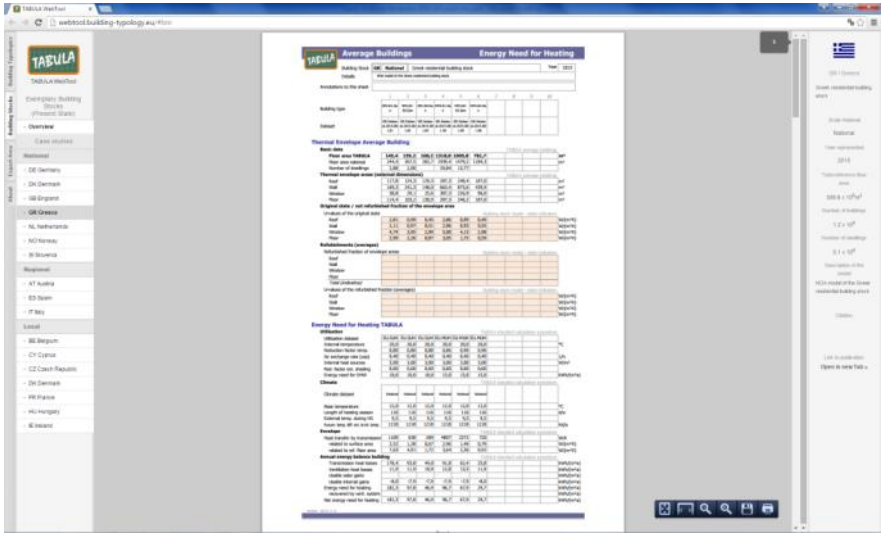
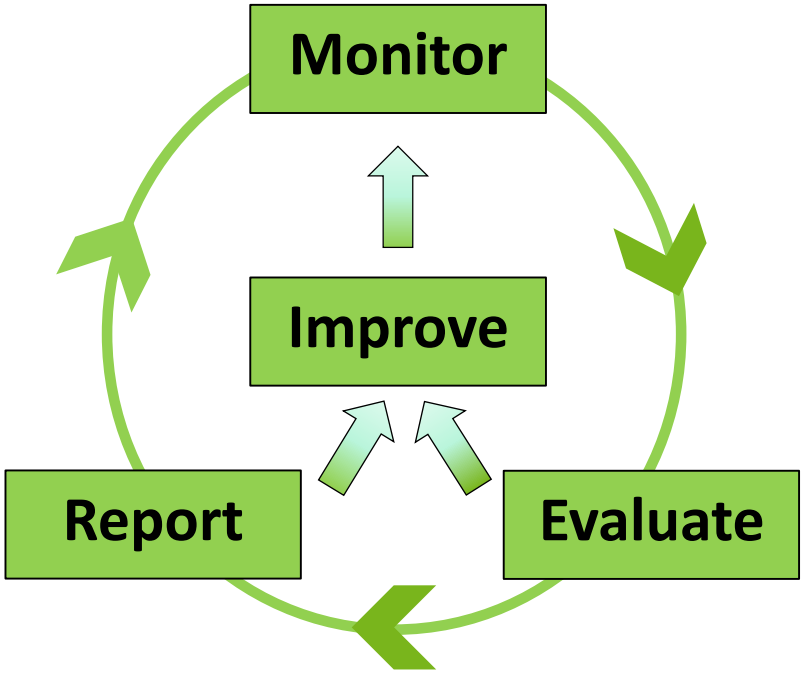
TABULA WebTool / Building Stocks





Building Stock Monitoring

- Description and evaluation of existing data sources
- Discussion on the availability of reliable, primary data (sources)
- Concepts for closing gaps and introducing a regular monitoring



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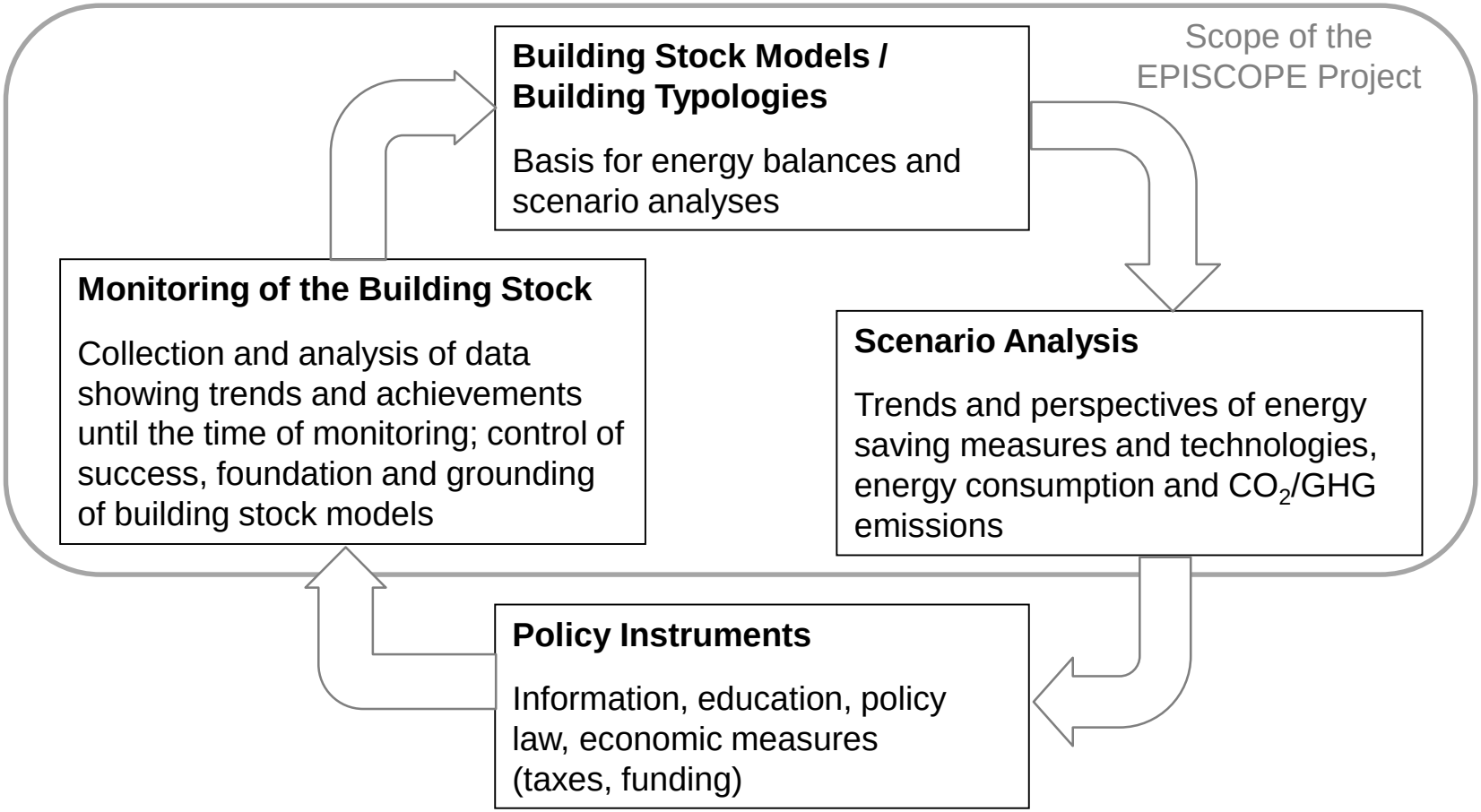
Stages of climate protection strategies for building stocks



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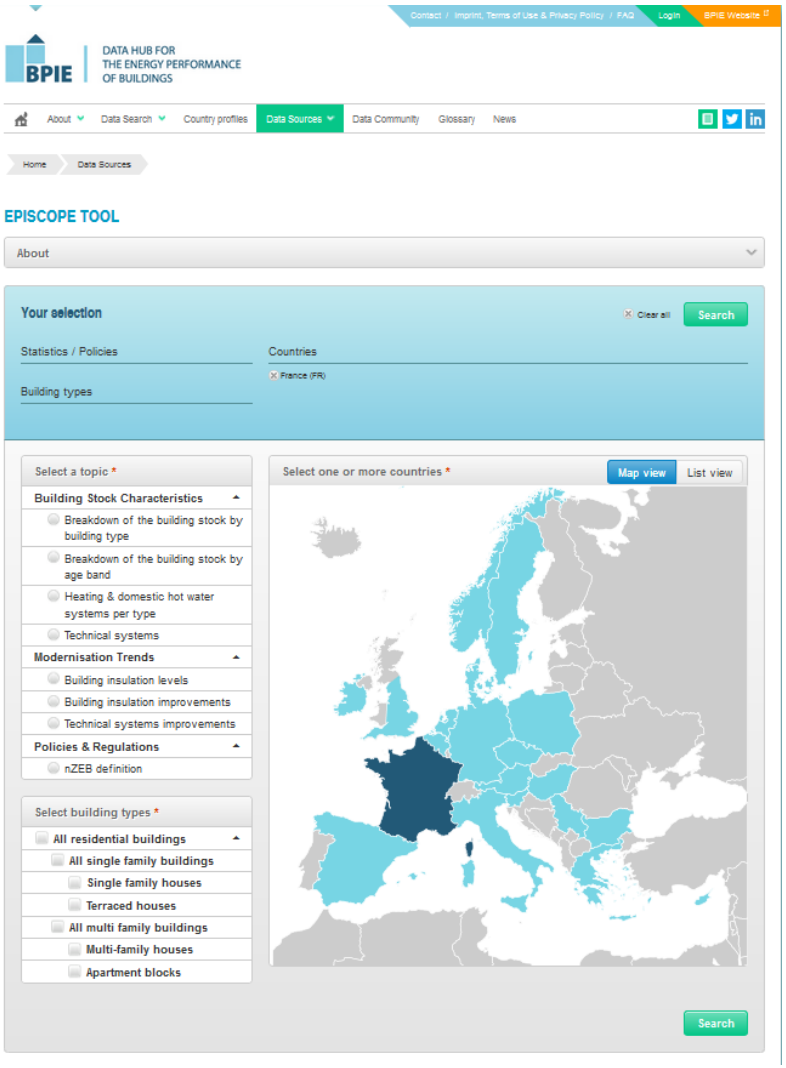
BPIE Data Hub / EPISCOPE Tool

- Dedicated web tool to present outcomes of the EPISCOPE project
- Presentation of the project, methodology, and project partners



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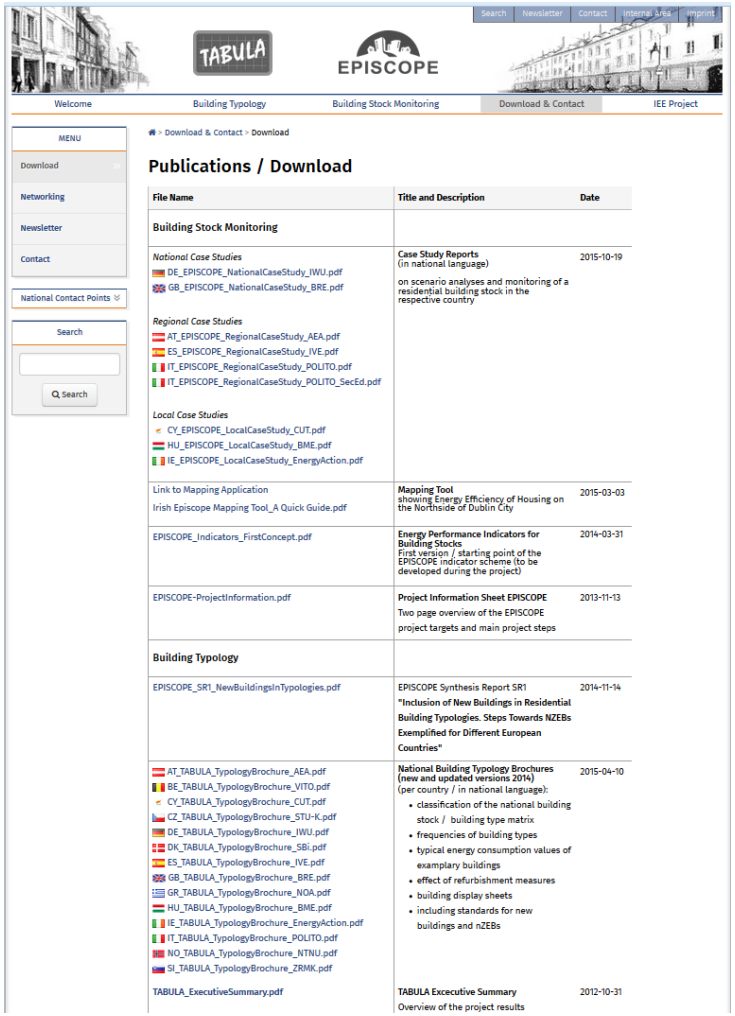
Available Publications

- National building typology brochures
- First synthesis report “Inclusion of New Buildings in Residential Building Typologies”
- Working paper “Energy Performance Indicators for Building Stocks”
- Descriptions of case studies and case study reports in the respective national languages
- The TABULA WebTool
- Further tools (Mapping tool Northside Dublin)

are available on the project website

http://episcope.eu/communication/download/

- Upcoming: Synthesis Reports 2-4 including summaries of the scenario analyses and monitoring concepts in English language



More information available at:

www.episcope.eu

Thank you for your attention!

Britta Stein

Institut Wohnen und Umwelt

b.stein@iwu.de

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Morning Session:

Mapping and modelling of residential building stocks

Moderator: Oliver Rapf, BPIE

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EPISCOPE Workshop

Towards an energy efficient European housing stock – mapping, modelling and monitoring refurbishment processes

18th November 2015 - Brussels

INDICATORS AND "AVERAGE BUILDINGS" TO MAP AND TRACK THE ENERGY PERFORMANCE OF BUILDING STOCKS

Vincenzo Corrado

Department of Energy
Politecnico di Torino - ITALY

Co-funded by the Intelligent Energy Europe Programme of the European Union

EPISCOPE

Overview

- Indicators for monitoring and scenario calculations of building stocks:
  - System of indicators intended to document basic information on the building stock energy performance
- "Average buildings" for building stock modeling:
  - "Average buildings" scheme used in EPISCOPE to be displayed by the TABULA *WebTool*
  - Example of the Italian approach

Indicators for monitoring of building stocks

- General data
  - number of buildings
  - number of apartments
  - reference floor area
- Building envelope characteristics
  - state and trend of thermal insulation improvement
  - levels of thermal insulation (*U*-values of walls, floors, windows …)
- Heat supply systems and energy carriers
  - state and trend of heat generators replacement
  - types of space heating and DHW systems
  - types of heat generators
  - energy carriers for space heating and DHW
  - special systems (technologies using RES, mechanical ventilation, etc.)
- Energy consumption
  - final energy by energy carrier (measured values)

Summary indicators for scenario calculations of building stocks

OVERVIEW

Reference years

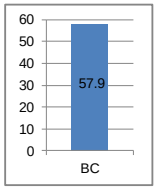
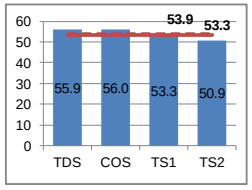
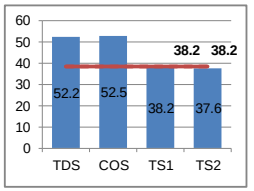
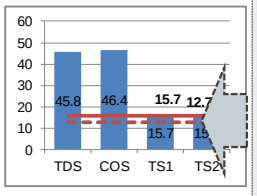
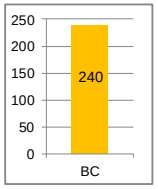
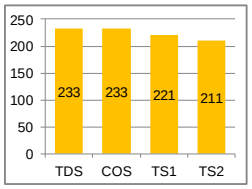
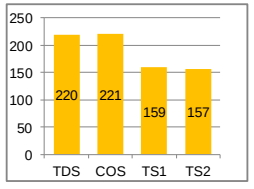
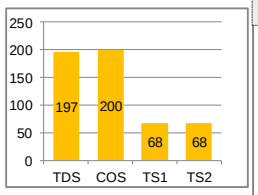
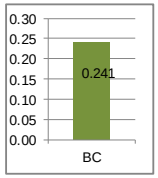
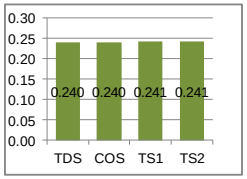
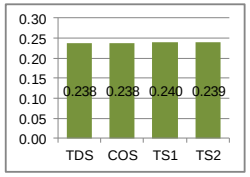
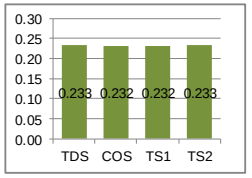
Summary indicators

Building stock size [m²]

Indicator#1 CO_2 emissions $m_{CO2,heat\ supply}$ [kg/m²a]

Indicator#2 Total heat demand q_{total} [kWh/m²a]

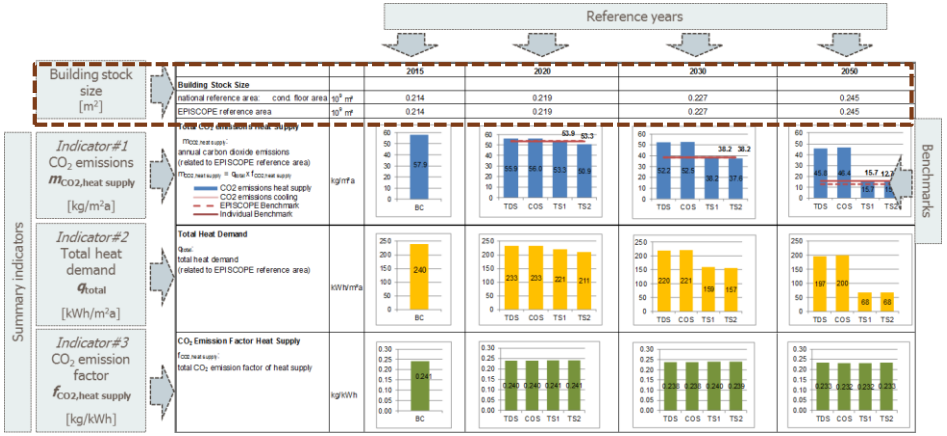
Indicator#3 CO_2 emission factor $f_{CO2,heat\ supply}$ [kg/kWh]

		2015	2020	2030	2050
Building Stock Size					
national reference area: cond. floor area	10^9 m²	0.214	0.219	0.227	0.245
EPISCOPE reference area	10^9 m²	0.214	0.219	0.227	0.245
Total CO_2 emissions Heat Supply $m_{CO2,heat\ supply}$: annual carbon dioxide emissions (related to EPISCOPE reference area) $m_{CO2,heat\ supply} = q_{total} \times f_{CO2,heat\ supply}$ CO2 emissions heat supply CO2 emissions cooling EPISCOPE Benchmark Individual Benchmark	kg/m²a				
Total Heat Demand q_{total}: total heat demand (related to EPISCOPE reference area)	kWh/m²a				
CO_2 Emission Factor Heat Supply $f_{CO2,heat\ supply}$: total CO_2 emission factor of heat supply	kg/kWh				

Benchmarks

In addition, a break-down of the final energy by energy carrier.

Summary indicators for scenario calculations of building stocks

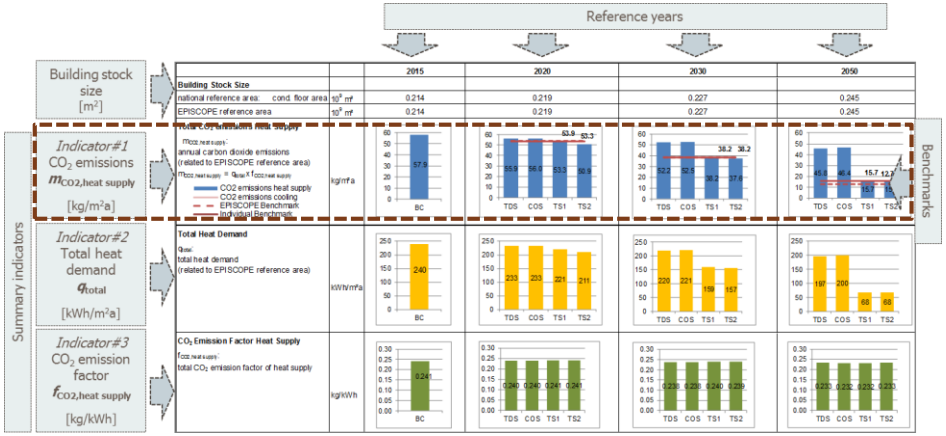


BUILDING STOCK SIZE [m²]

- National reference area: reference area used in the country
- EPISCOPE common reference area: according to TABULA definition *"conditioned floor area based on internal dimensions"*

Available quantity	$A_{C,ref}$ [m²]
conditioned floor area based on internal dimensions	= $A_{C,intdim}$
conditioned floor area based on external dimensions	= 0,85 · $A_{C,extdim}$
conditioned living area	= 1,1 · $A_{C,living}$
conditioned useful floor area	= 1,4 · $A_{C,use}$

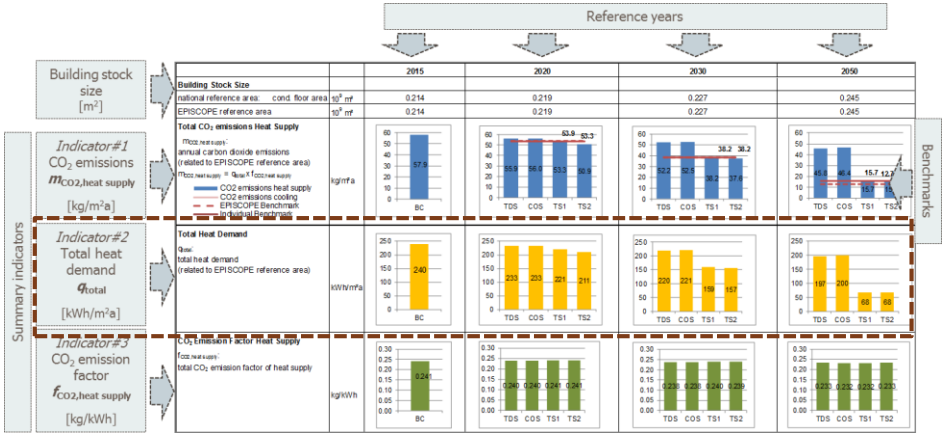
Summary indicators for scenario calculations of building stocks



INDICATOR#1 CO_2 emissions (**$m_{CO2,heat\ supply}$** [kg/m²a]):

- Pure CO_2 emissions caused by building heat supply (heating and hot water supply, including auxiliary electric energy, and mechanical ventilation).
- It includes not only the on-site CO_2 emissions of heating systems but also the CO_2 emissions for district heating and for electricity production (used for heat supply and auxiliary energy).
- CO_2 equivalents of other greenhouse gases are not considered.

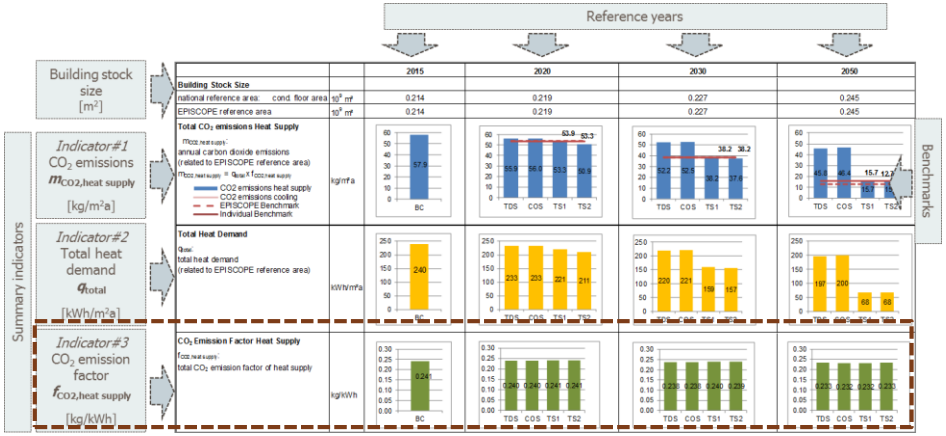
Summary indicators for scenario calculations of building stocks



INDICATOR#2 Total heat demand (q_{total} [kWh/m²a]):

- It includes:
  - the energy need for space heating,
  - the energy need for domestic hot water,
  - the heat losses of the distribution and storage subsystems inside the building (space heating and DHW systems).

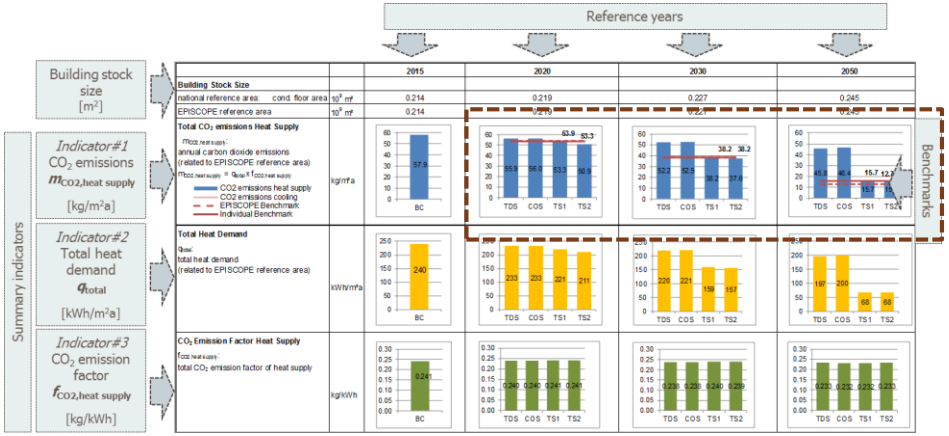
Summary indicators for scenario calculations of building stocks



INDICATOR#3 CO_2 emission factor of heat supply ($f_{CO2,heat\ supply}$ [kg/kWh]):

$$f_{CO2,heat\ supply} = \frac{m_{CO2,\ heat\ supply}}{q_{total}}$$

Summary indicators for scenario calculations of building stocks

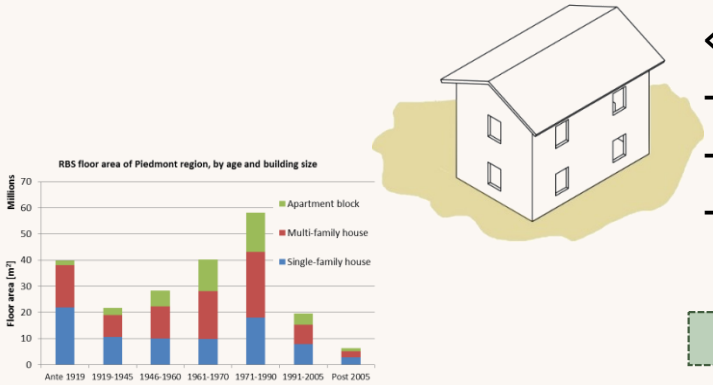


BENCHMARKS of $m_{CO2,heat\ supply}$:

- continuous red line: individual benchmarks of the country
- dashed red line: common EPISCOPE benchmarks
  - the benchmarks are derived from a translation of general EU climate protection targets (20% emissions reduction by 2020, 40% reduction by 2030, 80% reduction by 2050, compared to 1990).

Average buildings for building stock modeling

*An "**average building**" is a theoretical building (archetype) with geometrical and thermo-physical characteristics equal to the average of the building stock (BS) subset, which it represents.*



«Average building», classified by:
- country/region/climatic zone
- building size (e.g. single-family house)
- construction period

Geometry
Building envelope properties
Thermal system features

Energy performance (EP)

Frequency in the BS

Average of the BS subset

EP of the BS subset

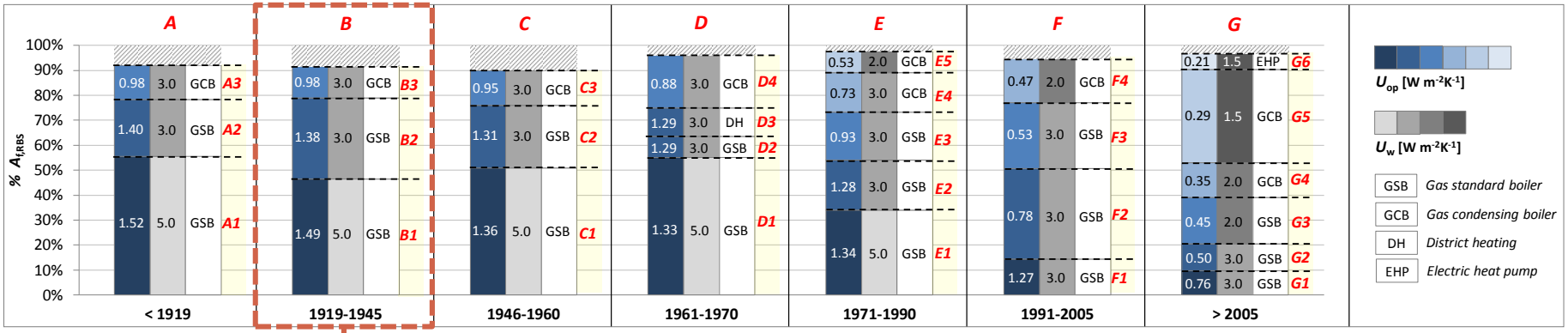
Average buildings for building stock modeling

- Advantages of representing a "complex building stock" in form of "average buildings":
  - **Model simplification**
    The use of average buildings allow to simplify the building stock modeling by applying the building typology approach.
  - **Communication of results**
    The indicators about the total building stock are easily sizable, large numbers can be pictured.
  - **Practical relevance of the model output**
    The results can be used as benchmarks to compare features and energy consumptions of distinct real buildings. Projections can be easily done for other subsets of the same building stock.

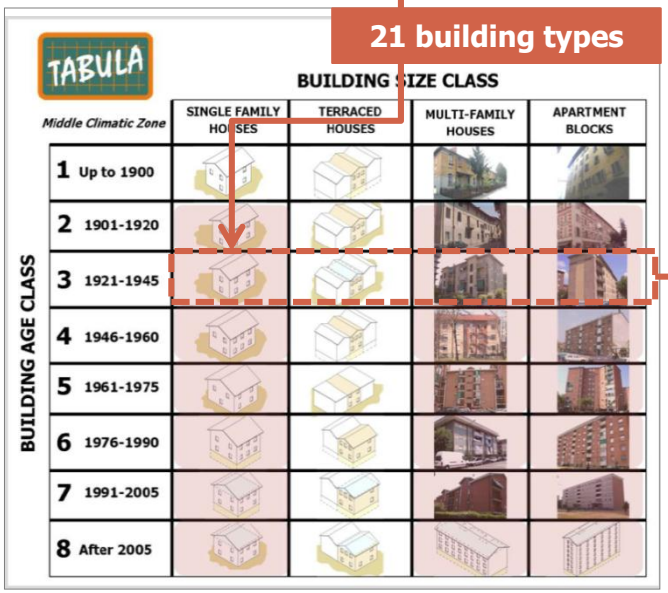
Average buildings for building stock modeling

Example: Piedmont region (Italy)

EPISCOPE *Basic Case* indicators

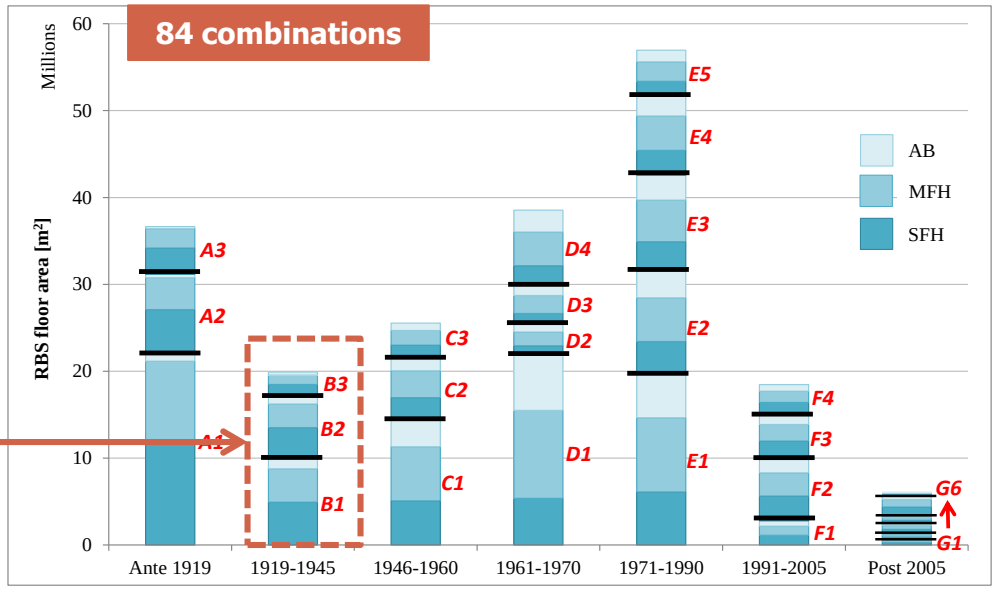


21 building types



TABULA *Building Type Matrix*

84 combinations

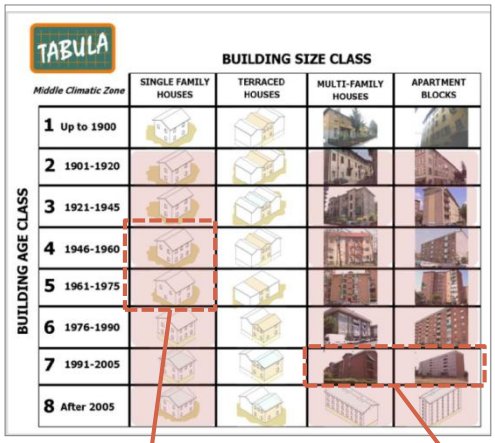


Frequency of the building types in the building stock

Average buildings for building stock modeling

Example: Piedmont region (Italy) → TABULA WebTool

1. Split of the building stock in several building types (2-10) by defining:
   - **one or several age bands** which may be equal to single or several merged construction year classes of the national building typology
   - **one or several building size classes** (e.g. 4 classes or 2 merged classes, "SFH+TH" and "MFH+AB")
2. Assignment of the total **thermal envelope area** divided by the number of buildings represented by each building type.



Average Buildings — **Energy Need for Heating**

Building Stock: IT — Residential building stock of Piedmont region (IT) — Year: 2015

Details: Basic case - year 2015

Annotations to this sheet:

	1	3	4	5	6	7	8	9	10
Building type	SFH I	SFH II	SFH III	SFH IV	SFH V	MFH I	MFH II	MFH III	MFH IV	MFH V
Dataset	IT.MidClim.2015.001.MidClim.SFH-TH.01-	IT.MidClim.2015.001.MidClim.SFH-TH.04-	IT.MidClim.2015.001.MidClim.SFH-	IT.MidClim.2015.001.MidClim.SFH-	IT.MidClim.2015.001.MidClim.SFH-	IT.MidClim.2015.001.MidClim.MFH-AB.01-	IT.MidClim.2015.001.MidClim.MFH-AB.04-	IT.MidClim.2015.001.MidClim.MFH-	IT.MidClim.2015.001.MidClim.MFH-	IT.MidClim.2015.001.MidClim.MFH-

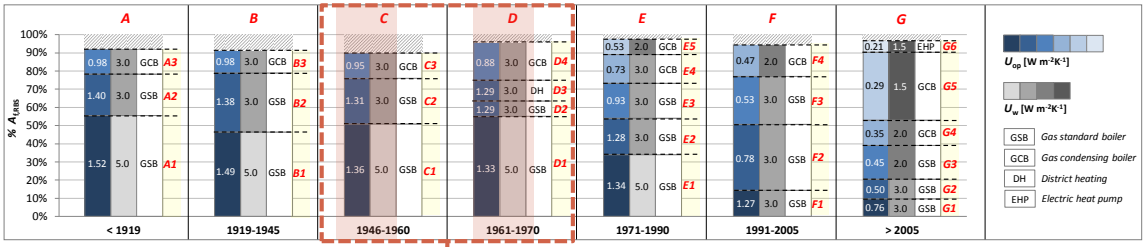
Thermal Envelope Average Building

Basic data								TABULA average buildings		
Floor area TABULA	**115,0**	**156,3**	**199,1**	**171,8**	**173,9**	**1035,0**	**822,0**	**1088,0**	**975,0**	**829,4** m²
Floor area national	115,0	156,3	199,1	171,8	173,9	1035,0	822,0	1088,0	975,0	829,4 m²
Number of dwellings	1,00	1,00	1,00	1,00	1,00	15,92	10,02	11,96	15,00	12,96
Thermal envelope areas (external dimensions)								TABULA average buildings		
Roof	75,0	124,5	132,9	96,0	96,4	652,8	186,7	403,5	373,5	305,0 m²
Wall	210,9	239,8	243,8	223,1	223,3	822,2	1196,8	1065,8	1012,0	885,4 m²
Window	16,8	21,9	27,3	23,9	24,1	80,3	97,2	120,9	147,9	104,0 m²
Floor	65,0	107,8	115,1	96,0	96,4	652,8	186,7	403,5	373,5	305,0 m²

Average buildings for building stock modeling

Example: Piedmont region (Italy) → TABULA WebTool

3. Assignment of ***U*-values** and **area fraction of refurbished** thermal envelope areas to each building type.

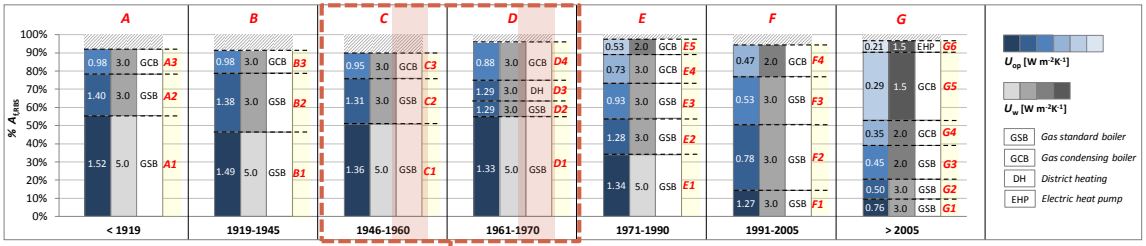


TABULA **Average Buildings** **Energy Need for Heating**

Building Stock	IT	Residential building stock of Piedmont region (IT)							Year	2015	
Details	Basic case - year 2015										
Annotations to this sheet											
	1	2	3	4	5	6	7	8	9	10	
Building type	SFH I	SFH II	SFH III	SFH IV	SFH V	MFH I	MFH II	MFH III	MFH IV	MFH V	
Dataset	IT.MidClim.2015.001.MidClim.SFH-TH.01-	IT.MidClim.2015.001.MidClim.SFH-TH.04-	IT.MidClim.2015.001.MidClim.SFH-	IT.MidClim.2015.001.MidClim.SFH-	IT.MidClim.2015.001.MidClim.SFH-	IT.MidClim.2015.001.MidClim.MFH-AB.01-	IT.MidClim.2015.001.MidClim.MFH-AB.04-	IT.MidClim.2015.001.MidClim.MFH-	IT.MidClim.2015.001.MidClim.MFH-	IT.MidClim.2015.001.MidClim.MFH-	
Thermal Envelope Average Building											
Original state / not refurbished fraction of the envelope area											
U-values of the original state											Building stock model - state indicators
Roof	1,80	2,20	1,14	0,69	0,30	2,86	1,65	0,97	0,69	0,30	W/(m²K)
Wall	1,47	1,33	1,06	0,74	0,42	1,47	1,33	1,06	0,74	0,42	W/(m²K)
Window	4,63	4,69	2,70	2,69	1,97	4,90	4,90	2,80	2,80	2,00	W/(m²K)
Floor	2,00	2,00	0,98	0,77	0,33	1,87	1,30	0,98	0,77	0,33	W/(m²K)
Refubishments (averages)											
Refurbished fraction of envelope areas											Building stock model - state indicators
Roof											
Wall	22%	25%				21%	25%				
Window	41%	42%				48%	47%				
Floor											
Total (indicative)	*14%*	*14%*				*10%*	*20%*				
U-values of the refurbished fraction (averages)											Building stock model - state indicators
Roof											W/(m²K)
Wall	0,82	0,81				0,82	0,81				W/(m²K)
Window	2,80	2,80				2,80	2,80				W/(m²K)
Floor											W/(m²K)

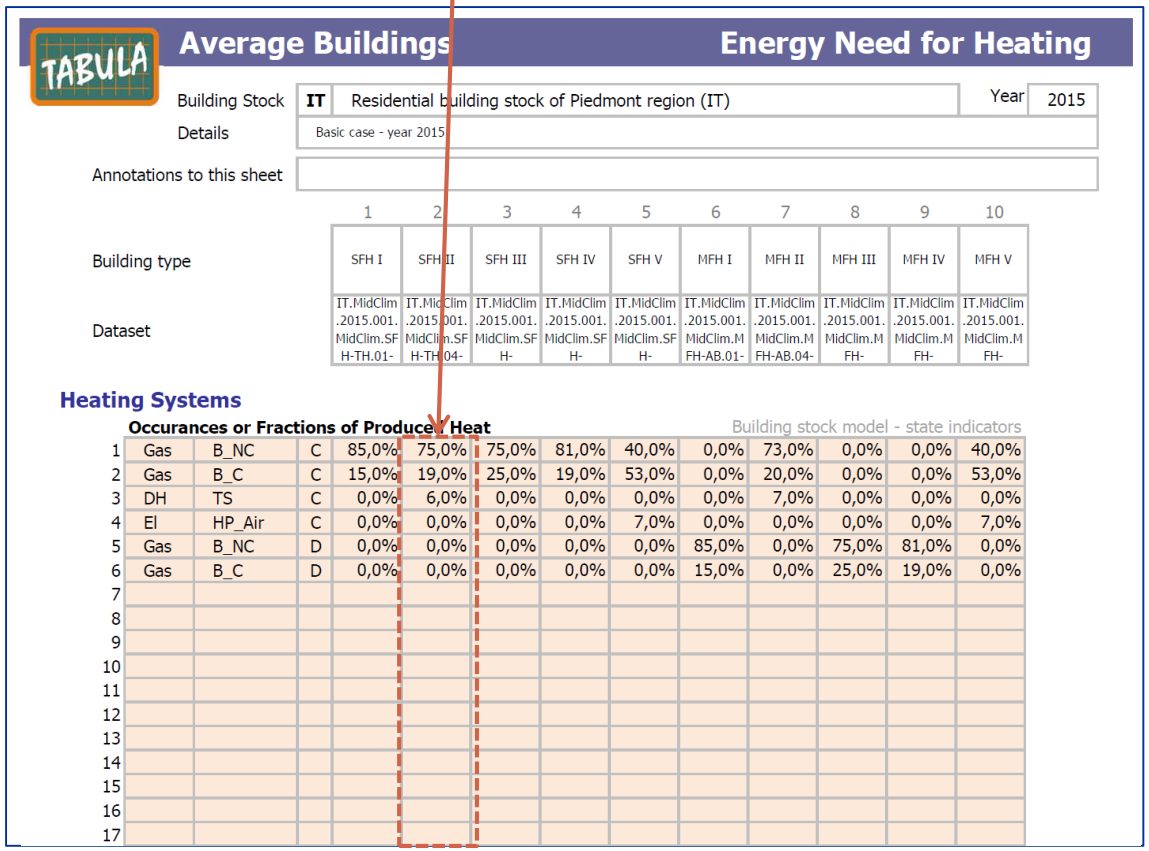
Average buildings for building stock modeling

Example: Piedmont region (Italy) → TABULA WebTool



4. Assignment of the most widespread **heat supply systems** to each building type.

5. Providing the **fractions** of the **heat supply systems types**.



1	Gas	B_NC	C	85,0%	75,0%	75,0%	81,0%	40,0%	0,0%	73,0%	0,0%	0,0%	40,0%
2	Gas	B_C	C	15,0%	19,0%	25,0%	19,0%	53,0%	0,0%	20,0%	0,0%	0,0%	53,0%
3	DH	TS	C	0,0%	6,0%	0,0%	0,0%	0,0%	0,0%	7,0%	0,0%	0,0%	0,0%
4	El	HP_Air	C	0,0%	0,0%	0,0%	0,0%	7,0%	0,0%	0,0%	0,0%	0,0%	7,0%
5	Gas	B_NC	D	0,0%	0,0%	0,0%	0,0%	0,0%	85,0%	0,0%	75,0%	81,0%	0,0%
6	Gas	B_C	D	0,0%	0,0%	0,0%	0,0%	0,0%	15,0%	0,0%	25,0%	19,0%	0,0%
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													

Average buildings for building stock modeling

Example: Piedmont region (Italy) → TABULA WebTool

RESULTS

Projection to the BS

Average Buildings — Simplified Building Stock Projection

Building Stock: IT — Residential building stock of Piedmont region (IT) — Year: 2015

Details: Basic case - year 2015

Annotations to this sheet:

Total Building Stock

Building type		1 SFH I	2 SFH II	3 SFH III	4 SFH IV	5 SFH V	6 MFH I	7 MFH II	8 MFH III	9 MFH IV	10 MFH V	Sum
Floor area TABULA	10^6 m²	32	20	18	8	3	29	49	40	12	4	214

All energy quantities in GWh/a

Heating Systems

Heat Demand for Heating — TABULA standard calculation procedure / projection to building stock

	1	2	3	4	5	6	7	8	9	10	Sum
Energy need for heating	7 794	4 961	2 561	818	160	4 396	7 242	4 744	1 134	177	33 987
Net en. need for heating	7 794	4 961	2 561	818	160	4 396	7 242	4 744	1 134	177	33 987
Produced heat	9 517	5 883	2 807	926	165	5 047	8 657	5 091	1 234	184	39 511

Delivered Energy TABULA — TABULA standard calculation procedure / projection to building stock

					1	2	3	4	5	6	7	8	9	10	Sum
1	Gas	B_NC	C		10 631	5 798	2 766	937	80	0	8 305	0	0	88	28 606
2	Gas	B_C	C		1 627	1 274	800	201	98	0	1 974	0	0	109	6 083
3	DH	TS	C		0	360	0	0	0	0	618	0	0	0	978
4	El	HP_Air	C		0	0	0	0	6	0	0	0	0	6	12
5	Gas	B_NC	D		0	0	0	0	0	5 446	0	4 847	1 269	0	11 563
6	Gas	B_C	D		0	0	0	0	0	863	0	1 451	267	0	2 581
7															
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															
	Other systems				0	0	0	0	0	0	0	0	0	0	0
	Auxiliary energy				143	87	79	35	12	47	128	65	19	9	623
	CHP electr. production														0

DHW Systems

Heat Demand for DHW — TABULA standard calculation procedure / projection to building stock

	1	2	3	4	5	6	7	8	9	10	Sum
Energy need for DHW	325	198	179	79	28	436	732	604	175	53	2 808
Produced heat	638	388	270	118	38	706	824	804	232	67	4 086

Delivered Energy TABULA — TABULA standard calculation procedure / projection to building stock

					1	2	3	4	5	6	7	8	9	10	Sum
1	Gas	B_NC	C		732	393	273	126	19	0	0	0	0	33	1 576
2	Gas	B_C	C		107	83	76	25	23	0	0	0	0	40	353
3	DH	TS	C		0	27	0	0	0	0	0	0	0	0	27
4	El	HP_Air	C		0	0	0	0	1	0	0	0	0	2	3
5	Gas	B_NC	D		0	0	0	0	0	798	917	802	250	0	2 767
6	Gas	B_C	D		0	0	0	0	0	119	204	225	49	0	598
7															
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															
	Other systems				0	0	0	0	0	0	0	0	0	0	0
	Auxiliary energy				45	28	25	11	4	41	0	56	16	10	236
	CHP electr. production														0

Version: 2015-08-10

Average Buildings — Summary and Comparison

Building Stock: IT — Residential building stock of Piedmont region (IT) — Year: 2015

Details: Basic case - year 2015

Annotations to this sheet:

Total Building Stock

Building type		1 SFH I	2 SFH II	3 SFH III	4 SFH IV	5 SFH V	6 MFH I	7 MFH II	8 MFH III	9 MFH IV	10 MFH V	Sum
Floor area TABULA	10^6 m²	32	20	18	8	3	29	49	40	12	4	214

Total Heat Need and Final Energy — All energy quantities in GWh/a

Simplified TABULA projection — fuels related to gross calorific value (TABULA standard) — TABULA standard calculation procedure projection to building stock

		1	2	3	4	5	6	7	8	9	10	Sum
Net heat need		8 118	5 158	2 740	897	188	4 832	7 974	5 349	1 309	230	36 794
Produced heat		10 156	6 271	3 076	1 044	203	5 753	9 481	5 895	1 466	251	43 597
Gas		13 098	7 548	3 915	1 290	219	7 226	11 400	7 325	1 836	270	54 127
Oil		0	0	0	0	0	0	0	0	0	0	0
Coal		0	0	0	0	0	0	0	0	0	0	0
Bio		0	0	0	0	0	0	0	0	0	0	0
DH		0	387	0	0	0	0	618	0	0	0	1 005
El (incl. aux. en.)		188	115	104	46	23	88	128	121	35	27	874
Other		0	0	0	0	0	0	0	0	0	0	0
CHP electr. production		0	0	0	0	0	0	0	0	0	0	0

Individual model or total metered consumption — fuels related to gross calorific value; factors for conversion to gross calorific value (TABULA standard) — Individual building stock model

		1	2	3	4	5	6	7	8	9	10	Sum
Net heat need		10 739	6 363	3 681	913	206	5 819	7 413	4 735	1 022	153	41 044
Produced heat		13 846	8 037	4 513	1 043	218	7 030	9 672	5 767	1 112	171	51 409
Gas	1,00	17 831	9 619	5 759	1 290	232	8 803	11 698	7 191	1 396	171	64 990
Oil	1,00	0	0	0	0	0	0	0	0	0	0	0
Coal	1,00	0	0	0	0	0	0	0	0	0	0	0
Bio	1,00	0	0	0	0	0	0	0	0	0	0	0
DH		0	519	0	0	0	0	605	0	0	0	1 125
El		183	113	108	46	20	98	122	160	42	21	913
Other		0	0	0	0	0	0	0	0	0	0	0
CHP electr. production		0	0	0	0	0	0	0	0	0	0	0

Ratio of individual model or total metered consumption to simplified TABULA projection (TABULA balance calibration factors)

	1	2	3	4	5	6	7	8	9	10	Total
Net heat need	132%	123%	134%	102%	109%	120%	93%	89%	78%	67%	112%
Produced heat	136%	128%	147%	100%	107%	122%	102%	98%	76%	68%	118%
Gas	136%	127%	147%	100%	106%	122%	103%	98%	76%	64%	118%
Oil											
Coal											
Bio											
DH		134%					98%				112%
El	97%	99%	104%	100%	89%	113%	96%	132%	121%	77%	105%
Other											
CHP electr. production											

Comparison with the complex model

Thank you for the attention

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Use of Building Typologies and Building Stock Models for (Political) Decision Makers

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немачка сарадња
DEUTSCHE ZUSAMMENARBEIT

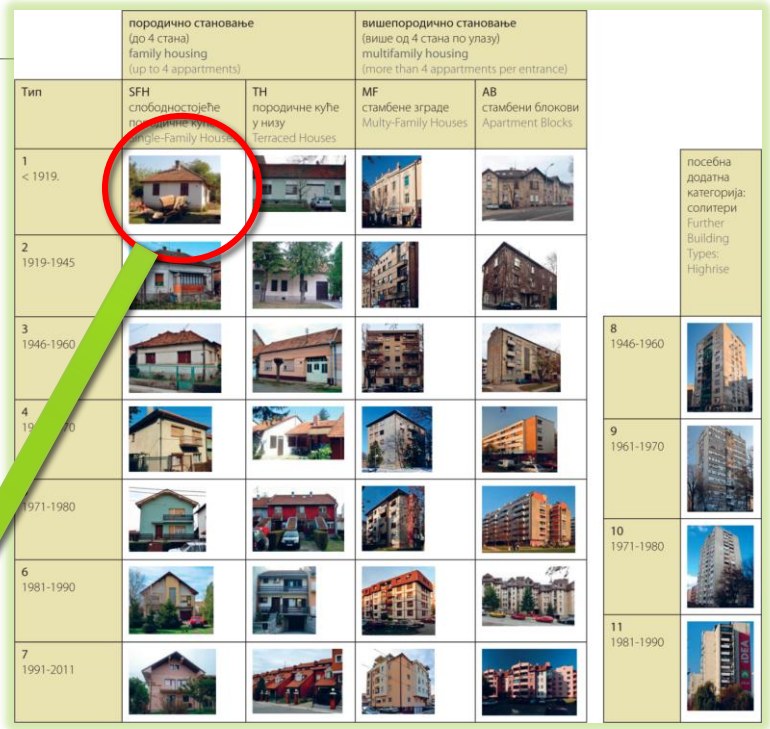
Implemented by:

giz

POSSIBILITIES FOR APPLICATION OF NATIONAL TYPOLOGY FOR STRATEGIC DECISION MAKING ON LOCAL LEVEL

- Characteristics of National typology:
  - derived upon large sample of buildings, representative of entire building stock
  - covers a large variety of building types
  - suitable for decision making on national level

- Restrictions of its application on local level
- Need for development of local typology which takes into account local specificities (building types, energy sources etc.)
- Two tested approaches: TOP DOWN and BOTTOM UP



Locally relevant building type (Vojvodina region)

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TOP DOWN METHOD

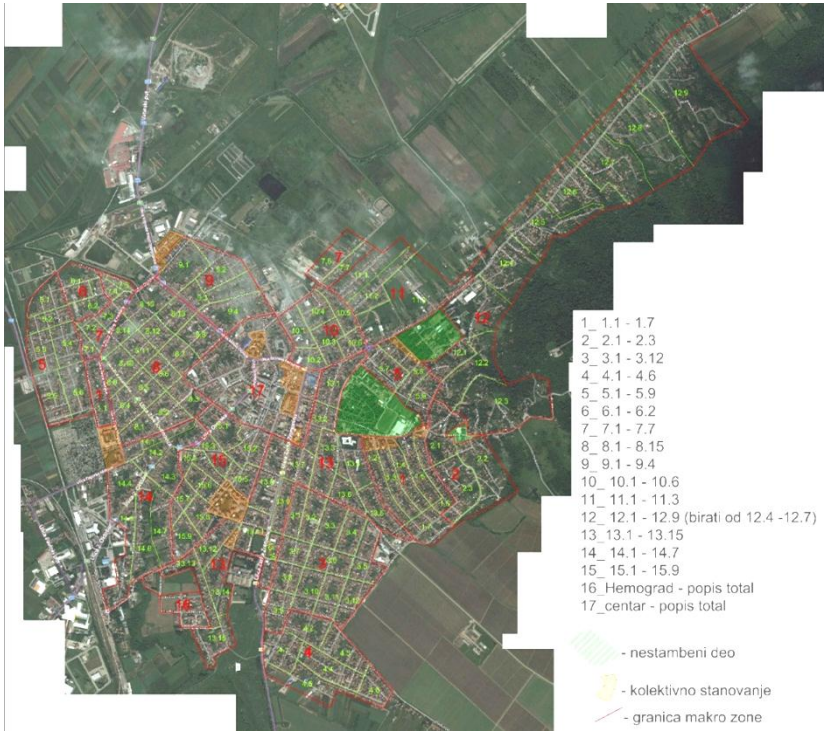
- Based on National typology and data gathered for its formulation
- Quality of results dependant on availability of locally relevant data (number and type of buildings),
- Other available data also used (Census data, yearly statistic data on constructed buildings and apartments, cadastre data, real estate sector data etc.)
- Requires new cluster analysys and definition of locally representative types)
- Formulation of matrix

Building typology for municipality of Vršac derived by TOP DOWN method

EPISCOPE

BOTTOM UP METHOD

- Based on new locally conducted survey
- Individually designed procedure having in mind characteristics of local building stock
- Requires local consultant and support
- Sample size relative to the size of municipality
- Procedure involves spatial zoning on micro and macro zones
- Surveying of all selected micro zones
- Statistical interpolation of results
- Formulation of matrix



Division of area of municipality of Vršac on macro and micro zones for the purpose of local survey

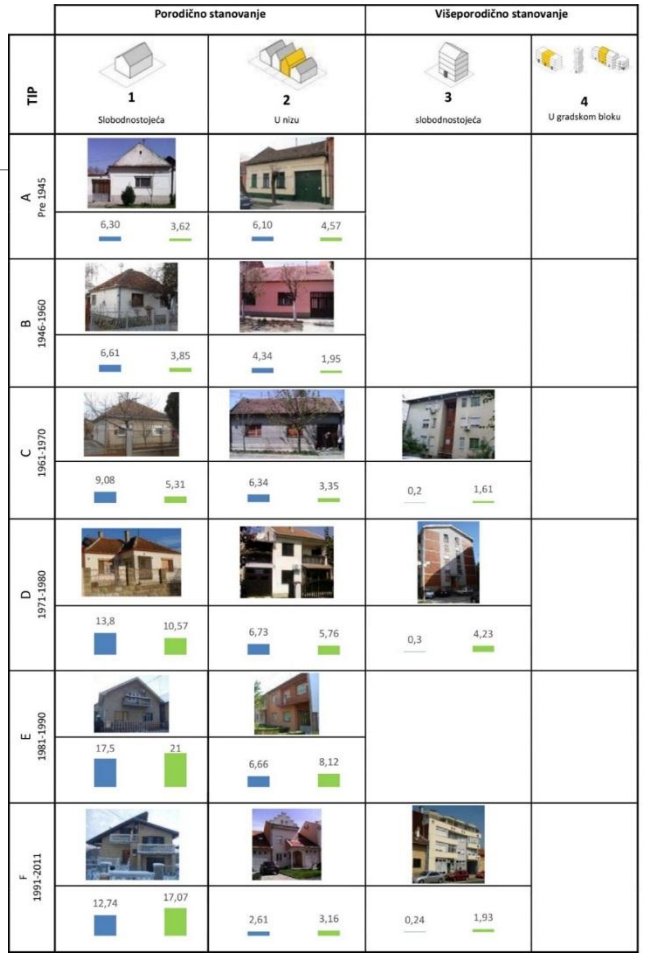
EPISCOPE

TOP DOWN

- Simple methodology
- Dependant of data availability
- Dependant of expert analysis and experience of the team
- Faster data acquisition

BOTTOM UP

- Development of new methodology
- Requires field research for data acquisition
- Dependant of training of local researchers
- Dependant of sample design (size and structure)
- Obtained results are more precise and reliable
- Enables acquisition of specialist data not available from National typology (refurbishment rates, structure of energy carriers)



Building typology for municipality of Vršac derived by BOTTOM UP method

EPISCOPE

TYPE	Family housing		Multi family housing	
	1 detached	2 row house	3 detached	4 Apartment block
A Before 1945				
	8.85 % 3.67 %		0.12 % 0.55 %	
	6.30 % 3.62 %	6.10 % 4.57 %	0.06 % 0.31 %	0.04 % 0.19 %
B 1946-1960				
	10.05 % 4.21 %		0.25 % 1.32 %	
	6.61 % 3.85 %	4.34 % 1.95 %	0.02 % 0.04 %	0.01 % 0.06 %
C 1961-1970				
	13.08 % 5.15 %	1.09 % 0.43 %	0.73 % 5.99 %	0.06 % 1.18 %
	9.08 % 5.31 %	6.34 % 3.35 %	0.20 % 1.61 %	0.06 % 0.49 %
D 1971-1980				
	19.48 % 11.96 %	1.42 % 0.89 %	2.01 % 16.30 %	0.11 % 2.59 %
	13.80 % 10.57 %	6.73 % 5.76 %	0.30 % 4.23 %	0.09 % 1.09 %
E 1981-1990				
	19.55 % 10.96 %	1.58 % 0.99 %	1.39 % 11.80 %	0.05 % 1.35 %
	17.50 % 21.07 %	6.66 % 8.12 %	0.07 % 0.72 %	0.05 % 0.34 %
F 1991-2011				
	17.36 % 10.69 %	1.68 % 1.32 %	1.11 % 8.08 %	0.03 % 0.60 %
	12.74 % 17.07 %	2.61 % 3.16 %	0.24 % 1.93 %	0.06 % 0.58 %

Sivo dole – bottom up Levo broj – po broju Desno broj – po povrsini

POTREBNA ENERGIJA ZA GREJANJE PO TIPU - POSTOJEĆE STANJE

		[kWh/a] SFH	%	[kWh/a] TH	%	[kWh/a] MFH	%	[kWh/a] AB	%	ukupno	%
A	do 45	21.709.368	6,28	17.690.591	5,12	1.397.071	0,40	479.188	0,14	41.276.219	11,94
B	46 - 60	15.006.756	4,34	7.748.371	2,24	149.071	0,04	150.150	0,04	23.054.348	6,67
C	61 - 70	20.813.153	6,02	10.940.083	3,16	6.111.815	1,77	1.379.780	0,40	39.244.831	11,35
D	71 - 80	34.994.867	10,12	26.936.550	7,79	10.653.743	3,08	2.569.850	0,74	75.155.010	21,74
E	81 - 90	77.068.801	22,29	36.162.090	10,46	2.194.781	0,63	608.553	0,18	116.034.225	33,56
F	91 +	40.430.317	11,69	7.489.246	2,17	2.324.107	0,67	736.312	0,21	50.979.982	14,74
ukupno		210.023.263	60,75	106.966.931	30,94	22.830.587	6,60	5.923.834	1,71	345.744.614	100,00

POTREBNA PRIMARNA ENERGIJA ZA GREJANJE PO TIPU - POSTOJEĆE STANJE

		[kWh/a] SFH	%	[kWh/a] TH	%	[kWh/a] MFH	%	[kWh/a] AB	%	ukupno	%
A	do 45	27.013.652	8,56	19.884.476	6,30	2.574.064	0,82	1.328.443	0,42	50.800.635	16,10
B	46 - 60	18.730.758	5,94	9.562.450	3,03	508.500	0,16	310.587	0,10	29.112.295	9,23
C	61 - 70	21.117.003	6,69	7.092.307	2,25	10.934.655	3,47	2.733.420	0,87	41.877.385	13,27
D	71 - 80	28.993.757	9,19	16.722.649	5,30	17.148.613	5,43	4.996.774	1,58	67.861.792	21,51
E	81 - 90	63.259.611	20,05	12.066.548	3,82	3.484.639	1,10	1.283.493	0,41	80.094.291	25,38
F	91 +	33.720.038	10,69	6.200.655	1,97	4.351.993	1,38	1.519.042	0,48	45.791.727	14,51
ukupno		192.834.818	61,11	71.529.085	22,67	39.002.464	12,36	12.171.758	3,86	315.538.125	100,00

EMISIJA CO_2 PO TIPU - POSTOJEĆE STANJE

		[kg CO_2/a] SFH	%	[kg CO_2/a] TH	%	[kg CO_2/a] MFH	%	[kg CO_2/a] AB	%	ukupno	%
A	do 45	5.300.104	3,67	19.884.476	13,75	1.364.247	0,94	702.973	0,49	27.251.799	18,85
B	46 - 60	3.645.197	2,52	9.562.450	6,61	270.185	0,19	102.768	0,07	13.580.601	9,39
C	61 - 70	4.064.464	2,81	7.092.307	4,91	2.186.939	1,51	899.772	0,62	14.243.482	9,85
D	71 - 80	7.027.283	4,86	16.722.649	11,57	3.429.700	2,37	1.643.489	1,14	28.823.121	19,94
E	81 - 90	16.876.227	11,67	12.066.548	8,35	694.834	0,48	423.554	0,29	30.061.162	20,79
F	91 +	7.436.836	5,14	6.200.655	4,29	16.464.231	11,39	504.199	0,35	30.605.921	21,17
ukupno		44.350.111	30,68	71.529.085	49,48	24.410.136	16,89	4.276.755	2,96	144.566.086	100,00

Derived data of energy performance and CO2 emission of municipal stock

Final typology matrix (based on bottom up method) with combined data on type distribution from both methods

EPISCOPE

STRATEGIC IMPORTANCE OF LOCAL TYPOLOGIES FOR DECISION MAKERS

- Local typology provides local government with reliable data regarding:
  - energy consumption and its structure (by building types, installed systems, fuels in use)
  - possibilities of energy savings through refurbishment (buildings and systems)
  - potential for reduction of CO_2
  - structure of energy carriers and potential for their substitution
- Acquired data can be used for evaluation of investments, production capacities (building materials), planning of refurbishment activities etc.

EPISCOPE

STRATEGIC IMPORTANCE OF LOCAL TYPOLOGIES FOR DECISION MAKERS

- Provides reliable database for
  - local consulting services
  - strategic decision making in terms of building refurbishment
  - Energy related decision making (production, transport, use)
  - Local support scheme for public private partnership in building refurbishment activities

EPISCOPE

EPISCOPE Scenario Approaches and Results

Introduction to the Poster Session

Tobias Loga, Institut Wohnen und Umwelt, Darmstadt / Germany

EPISCOPE Experts Workshop
"Towards an energy efficient European housing stock –
mapping, modelling and monitoring refurbishment processes"
on 18th November 2015 in Brussels, Belgium

IWU Institut Wohnen und Umwelt

Co-funded by the Intelligent Energy Europe Programme of the European Union

EPISCOPE Case Studies

Main Question

How can the European climate protection targets be attained in the different building stocks? (focus: heating + DHW)

Steps

- Definition of carbon dioxide benchmarks
- Extrapolation of the current refurbishment trends
- Definition of different technological paths
- Determination of prospective energy consumption and carbon dioxide emissions
- Determination how far targets can be attained by the paths
- Definition of steps which are necessary to monitor the development and compare with selected paths

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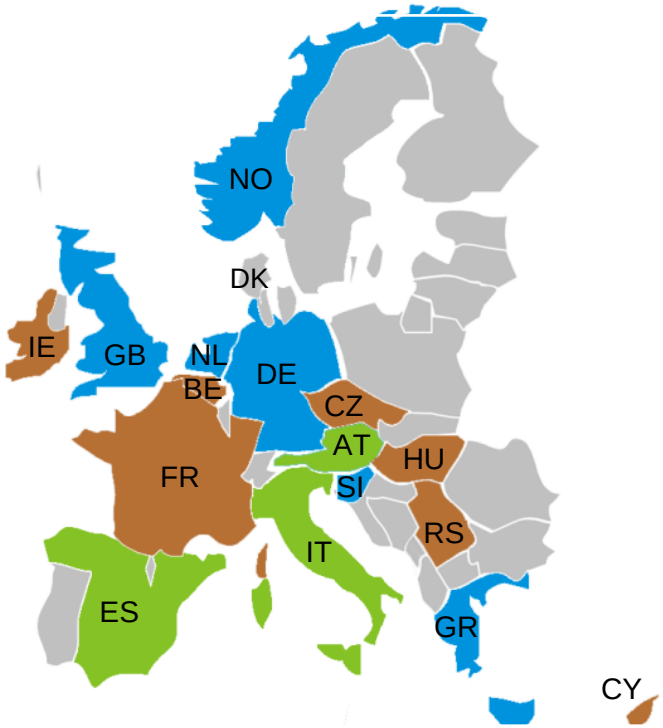
Overview Case Studies



National Case Studies

DE – Germany

GB – Great Britain / England

GR – Greece

NL – The Netherlands (national non-profit housing stock)

NO – Norway

SI – Slovenia

Local Case Studies

BE – Belgium: Housing block in the Sint-Amandsberg district in the city of Ghent

CY – Cyprus: Housing stock of the Cyprus Land Development Corporation CLDC

CZ – Czech Republic: Municipal housing stock in the city of Havířov

FR – France: Social housing stock of OPH Montreuillois in the city of Montreuil

HU – Hungary: City of Budaörs

IE – Ireland: Municipal housing stock on the Northside of Dublin City

RS – Serbia: Municipality of Vršac

SI – Slovenia: Municipality Kočevje

Regional Case Studies

AT – Austria: Bundesland Salzburg

ES – Spain: Comunidad Valenciana

IT – Italy: Piedmont Region

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CO_2 Emission Benchmarks

Two types

- **Individual (national or regional) climate protection targets**
- **EPISCOPE Benchmarks**

EPISCOPE Benchmark

Rough and straightforward translation of general EU climate protection targets (compared to 1990: 20% until 2020 / 40% until 2030 (/ 80% until 2050):

Carbon dioxide emissions (pure CO_2) in kg/(m²a)

- **2020**: $m_{benchmark,2020} = 0{,}95 \times m_{2015} \times A_{ref,2015} / A_{ref,2020}$ **("2015 minus 5 %")**
- **2030**: $m_{benchmark,2030} = 0{,}70 \times m_{2015} \times A_{ref,2015} / A_{ref,2030}$ **("2015 minus 30 %")**
- **2050**: $m_{benchmark,2050} = 0{,}25 \times m_{2015} \times A_{ref,2015} / A_{ref,2050}$ **("2015 minus 75 %")**

$m_{2015} = m_{CO2,heat\ supply,2015}$ (floor area-related CO_2 emissions of the year 2015) [kg/(m²a)]

$A_{ref,year}$ = EPISCOPE reference area of the building stock in the observed year [m²]

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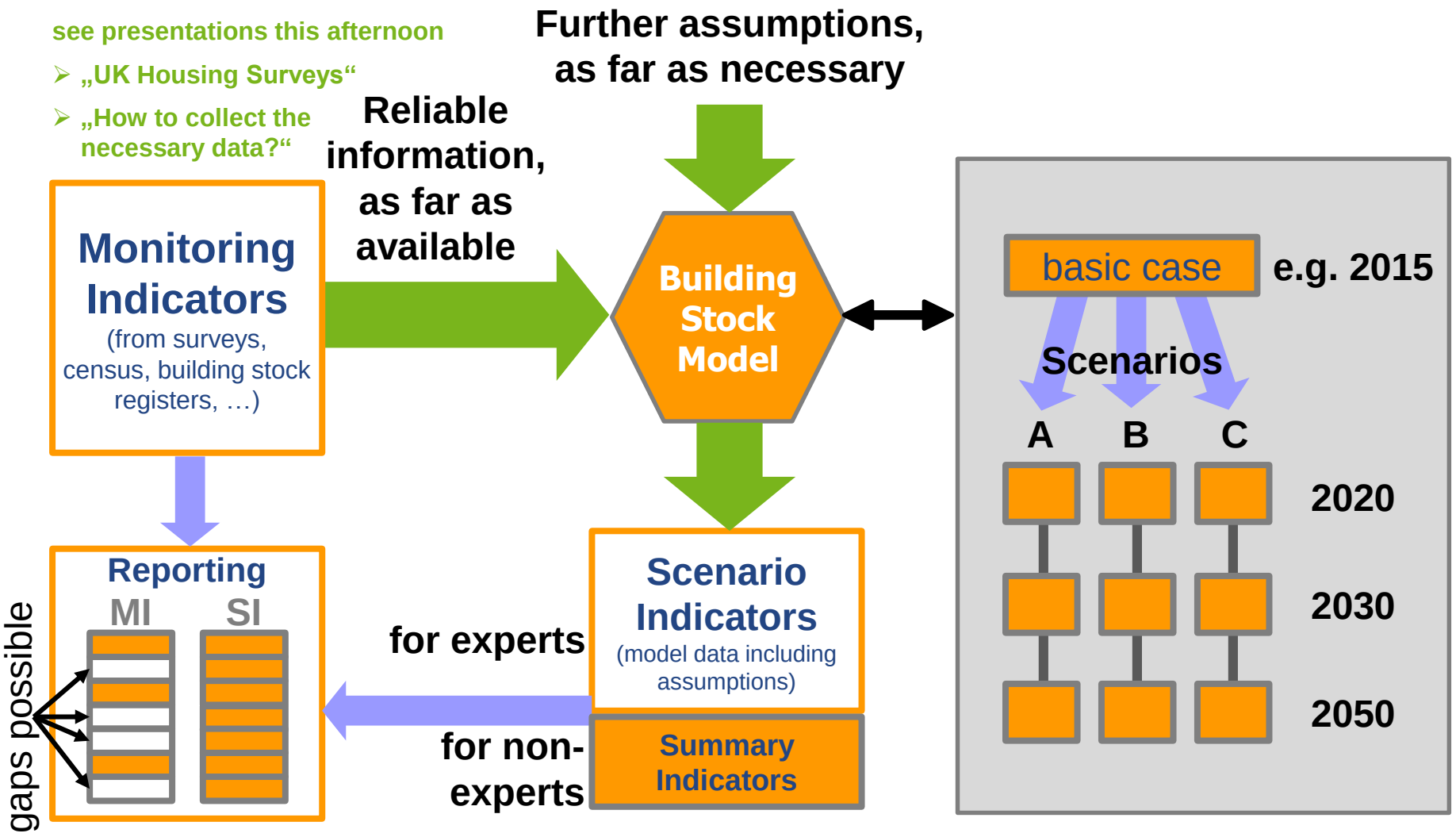
Scenario Calculations



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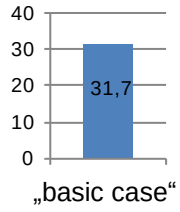
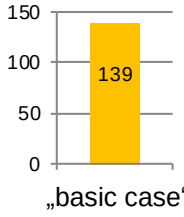
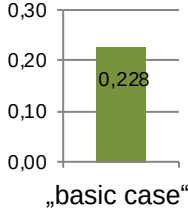
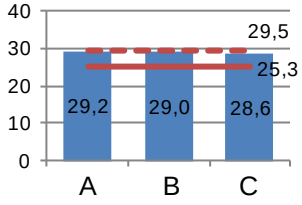
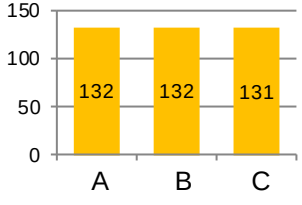
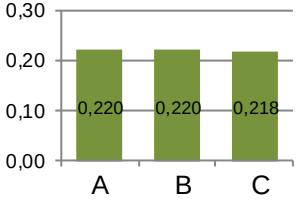
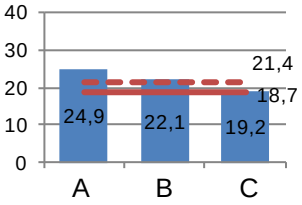
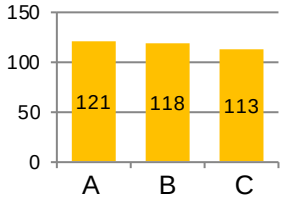
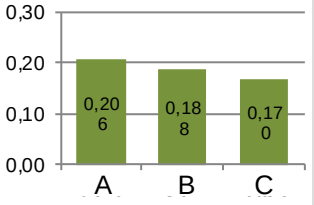
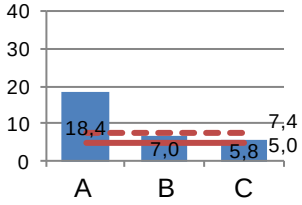
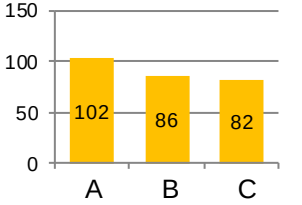
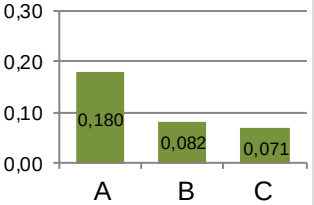
Scenario Summary Indicators
(for public information → see posters)

EPISCOPE

	EPISCOPE Ref. Area	CO_2 emissions	Total heat demand	CO_2 emission factor heat supply
	10^9 m²	kg/(m²yr)	kWh/(m²yr)	kg/kWh
2015	3,95			
2020	4,03			
2030	4,10			
2050	4,23			

$m_{CO2,heat\ supply}$:
annual carbon dioxide emissions (related to EPISCOPE reference area)

- CO2 emissions heat supply
- CO2 emissions cooling
- EPISCOPE Benchmark
- Individual Benchmark

q_{total}:
total heat demand (related to EPISCOPE reference area)

$f_{CO2,heat\ supply}$:
total CO_2 emission factor of heat supply

$$f_{CO2,heatsupply} = m_{CO2,heatsupply} / q_{total}$$

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Scenario Indicators / Basic Case
(for experts)

EPISCOPE

1. Basic Data

		1	2	3	4	5	6	7	8	9	10	
Building type		TH ...1918	TH 1919 ...1964	TH 1965 ...	SFH ...1918	SFH 1919 ...1964	SFH 1965 ...	AB ...1918	AB 1919 ...1964	AB 1965 ...		
Total Building Stock								Building stock model - state indicators				Total
Number of buildings	10^3	2 771	5 601	4 020	522	1 305	2 862	135	76	137		17 428
Number of dwellings	10^3	2 970	5 800	4 270	570	1 430	3 070	930	1 120	2 560		22 720
Floor area national	10^6 m²	305	511	344	113	195	413	67	67	148		2 163
Floor area TABULA	10^6 m²	305	511	344	113	195	413	67	67	148		2 163

Example: English Housing Stock (bre)

2. Building Insulation

Original state / not refurbished fraction of the envelope area												
U-values of the original state								Building stock model - state indicators				
Roof		0,88	0,64	0,52	0,88	0,64	0,52	0,32	0,32	0,19		W/(m²K)
Wall		1,93	1,77	0,93	1,93	1,77	0,93	1,93	1,77	0,93		W/(m²K)
Window		4,06	3,59	3,74	4,13	3,62	3,89	4,22	3,71	4,25		W/(m²K)
Floor		0,59	0,59	0,59	0,72	0,72	0,72	0,45	0,45	0,45		W/(m²K)
Refubishments (averages)												
Refurbished fraction of envelope areas								Building stock model - state indicators				
Roof		42%	55%	56%	52%	56%	60%	7%	13%	19%		
Wall		11%	52%	54%	17%	55%	57%	7%	40%	46%		
Window		62%	76%	74%	57%	75%	81%	48%	86%	91%		
Floor												
Total (indicative)		*23%*	*43%*	*43%*	*26%*	*43%*	*46%*	*11%*	*41%*	*48%*		
U-values of the refurbished fraction (averages)								Building stock model - state indicators				
Roof		0,16	0,15	0,15	0,16	0,15	0,15	0,12	0,12	0,10		W/(m²K)
Wall		0,74	0,47	0,31	0,74	0,47	0,31	0,74	0,47	0,31		W/(m²K)
Window		2,58	2,58	2,58	2,58	2,58	2,58	2,58	2,58	2,58		W/(m²K)
Floor												W/(m²K)

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Scenario Indicators
(for experts)

EPISCOPE

3. Main Heat Supply Systems

Example: English Housing Stock (bre)

Heating Systems				TH.01	TH.02-03	TH.04-08	SFH.01	SFH.02-03	SFH.04-08	AB.01	AB.02-03	AB.04-08	
Occurances or Fractions of Produced Heat										Building stock model - state indicators			
1	Gas	B_C	C	90%	100%	90%	50%	90%	90%	80%	85%	60%	
2	El	E_Storage	D	10%		10%	10%			20%	15%	40%	
3	Oil	B_C	C				40%	10%	10%				

DHW Systems													
Occurances or Fractions of Produced Heat										Building stock model - state indicators			
1	Gas	B_C	C	90%	95%	90%	50%	80%	80%	80%	90%	60%	
2	El	E_Immersio	C	10%	4%	10%	10%	10%		20%	10%	40%	
3	Oil	B_C	C		1%		40%	10%	10%				

4. Energy Balance Indicators

Separate individual model or total metered consumption

bre model of English housing | All energy quantities in GWh/a | Heating + DHW

fuels related to gross calorific value

factors for conversion to gross calorific value (TABULA standard)

										Individual building stock model	Total	per m²
Net heat need		59 100	86 200	47 100	22 700	33 100	53 500	13 100	10 900	16 900	342 600	158
Produced heat		80 700	116 600	61 700	31 700	45 900	72 900	16 000	13 300	19 000	457 800	212
Gas	1,00	71 100	111 000	57 500	15 800	39 200	63 400	12 200	11 100	12 400	393 700	182
Oil	1,00	4 100	1 500	500	12 200	3 800	7 400	100	36	50	29 686	14
Coal	1,00	0	0	0	0	0	0	0	0	0	0	0
Bio	1,00	0	0	0	0	0	0	0	0	0	0	0
DH		0	0	0	0	0	0	0	0	0	0	0
El		3 300	2 200	3 300	1 500	1 400	1 200	3 000	1 400	5 400	22 700	10
Other / not specified		0	0	0	0	0	0	0	0	0	0	0
Sum final energy		*76 500*	*114 700*	*61 300*	*29 500*	*44 400*	*72 000*	*15 300*	*12 536*	*17 850*	*0*	*446 186*	*206*

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„Average Buildings“ in the EPISCOPE Project

Scenario Indicators „Basic Case“
→ simplified building stock model
based on TABULA calculation procedure
(Excel workbook TABULA.xlsm)

General idea / benefit for the Case Studies:

- → Plausibility control for individual energy balance model (basic case): input data + output data
- → Dissemination of comparable existing state analyses = scenario starting point

→TABULA WebTool demonstration in the afternoon

Further possibilities:

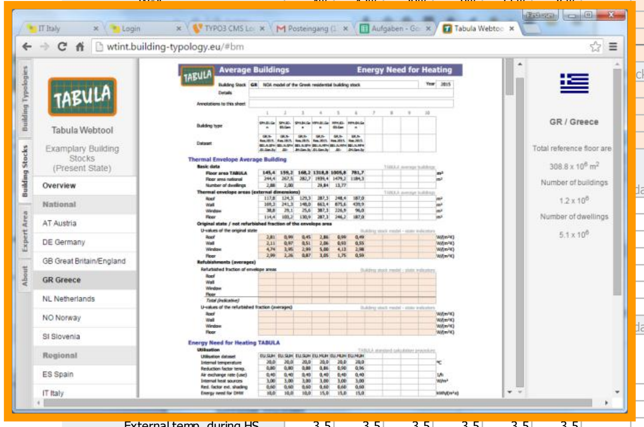
- → Direct use of TABULA.xlsm by partners as a simple model
- → Dissemination: Tracking and use of simplified TABULA building stock calculations by third parties (TABULA.xlsm + tabula-calculator.xlsx)

TABULA – Average Buildings – Energy Need for Heating

Building Stock: CZ | Local | Residential building stock of Havířov (CZ) — Year 2015
Details: Existing state 2015
Annotations to this sheet:

	1	2	3	4	5	6	7	8	9	10	
Building type											
Dataset	CZ.PilotAction.2015.001H.MFH-AB.01-	CZ.PilotAction.2015.001H.MFH-AB.04-	CZ.PilotAction.2015.001H.MFH-AB.05-	CZ.PilotAction.2015.001H.AB-AB.01-	CZ.PilotAction.2015.001H.AB-AB.04-	CZ.PilotAction.2015.001H.AB-AB.05-					
Thermal Envelope Average Building											
Basic data (TABULA average buildings)											
Floor area TABULA	**1142,1**	**2295,5**	**677,1**	**1821,3**	**2286,1**	**1736,6**					**m²**
Floor area national	1038,3	2086,8	615,6	1655,7	2078,3	1578,7					m²
Number of dwellings	21,00	41,09	10,50	31,97	44,19	30,04					
Thermal envelope areas (external dimensions) (TABULA average buildings)											
Roof	365,1	752,3	198,5	502,7	477,9	480,9					m²
Wall	894,7	1306,3	500,9	1407,4	1423,9	1205,8					m²
Window	170,7	491,4	152,3	347,9	514,2	514,0					m²
Floor	394,8	752,2	176,4	499,7	515,9	475,4					m²
Original state / not refurbished fraction of the envelope area											
U-values of the original state (Building stock model - state indicators)											
Roof	1,00	0,80	0,50	1,00	0,80	0,50					W/(m²K)
Wall	1,40	1,20	0,80	1,40	1,20	0,80					W/(m²K)
Window	2,70	2,80	2,80	2,70	2,80	2,80					W/(m²K)
Floor	1,10	1,00	0,90	1,10	1,00	0,90					W/(m²K)
Refubishments (averages)											
Refurbished fraction of envelope areas (Building stock model - state indicators)											
Roof	4%	42%	29%	8%	65%	36%					
External temp. during HS	3,5	3,5	3,5	3,5	3,5	3,5					
Accum. temp. diff. ext. to int. temp	3498	3498	3498	3498	3498	3498					Kd/a
Envelope (TABULA standard calculation procedure)											
Heat transfer by transmission	2231	2893	864	3550	2219	2183					W/K
related to surface area	1,22	0,88	0,84	1,29	0,76	0,82					W/(m²K)
related to ref. floor area	1,95	1,26	1,28	1,95	0,97	1,26					W/(m²K)
Annual energy balance building (TABULA standard calculation procedure)											
Transmission heat losses	150,6	99,6	100,8	150,3	77,7	99,4					kWh/(m²a)
Ventilation heat losses	39,3	40,3	40,3	39,3	40,8	40,3					kWh/(m²a)
Usable solar gains	-7,4	-10,5	-11,0	-9,3	-11,0	-14,3					kWh/(m²a)
Usable internal gains	-14,6	-14,5	-14,4	-14,5	-14,5	-14,3					kWh/(m²a)
Energy need for heating	168,0	115,0	115,7	165,7	93,0	111,1					kWh/(m²a)
recovered by vent. system											kWh/(m²a)
Net energy need for heating	168,0	115,0	115,7	165,7	93,0	111,1					kWh/(m²a)

Version: 2015-10-14



Summary: Common Scenario Tasks of the EPISCOPE Case Studies

EPISCOPE

- **Define the „Basic Case“:**
  coherent model of building stock „today“, e.g. 2015
  process monitoring state indicators + model assumptions to close information gaps
- **Calculate the energy balance (Basic Case)**
  process energy consumption data (monitoring indicators)
  => calibration of the energy balance model
- **Carry out scenario analysis**
  Define a trend and 2 to 4 other scenarios
  Calculate the development of the energy consumption
- **Document results of trend and other scenarios**
  => scenario indicators: state & energy balance indicators
  for certain years e.g. 2020,2030,2040,2050
- **Determine summary indicators**
  for different scenarios / years
  => compliance with energy saving / climate protection targets
  => overview of structural development (insulation & heat supply)
- **Define a simplified TABULA building stock projection**
  „Average Buildings“ for the basic case

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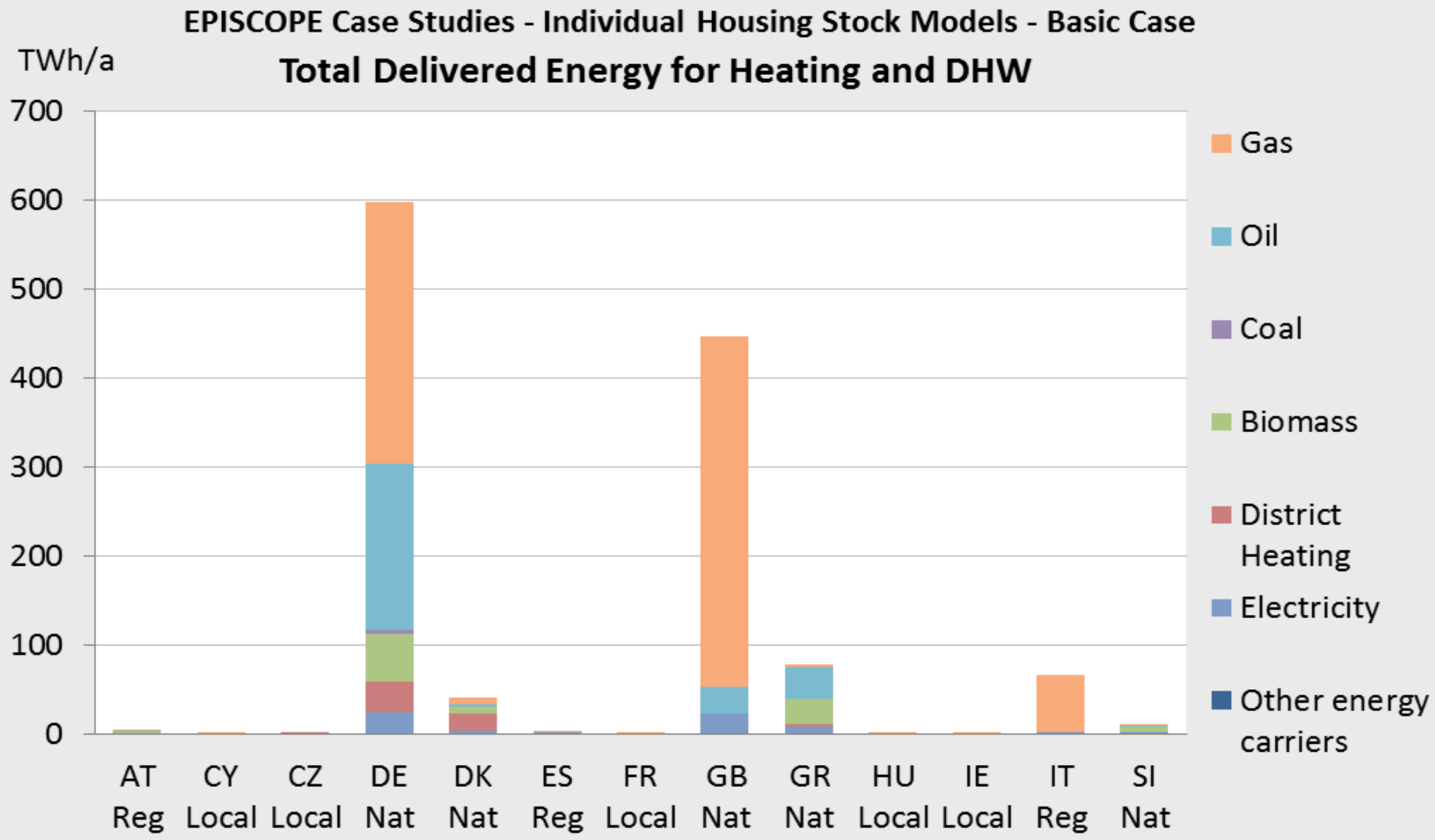
Basic Case – Model Results



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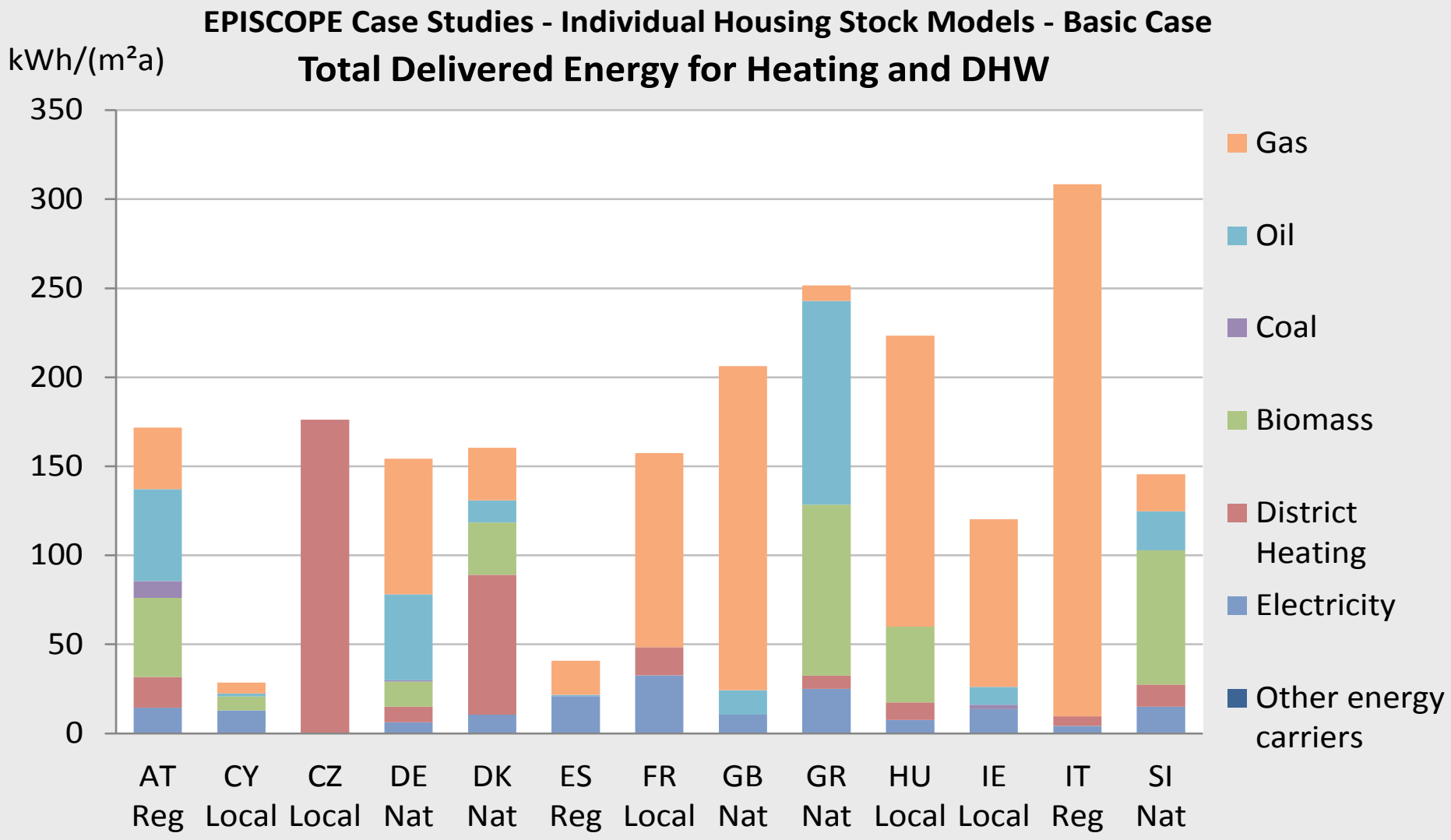
Basic Case – Model Results



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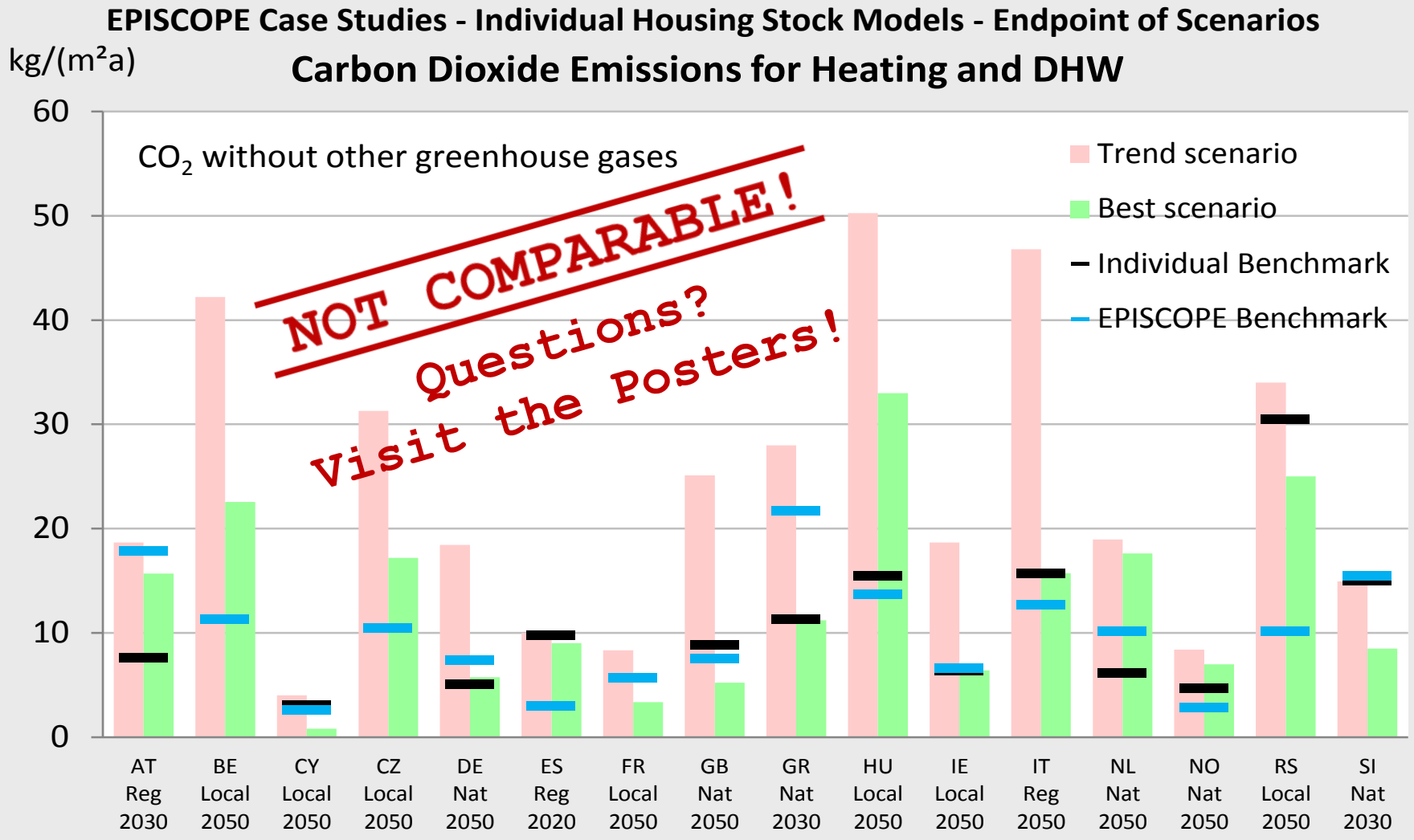
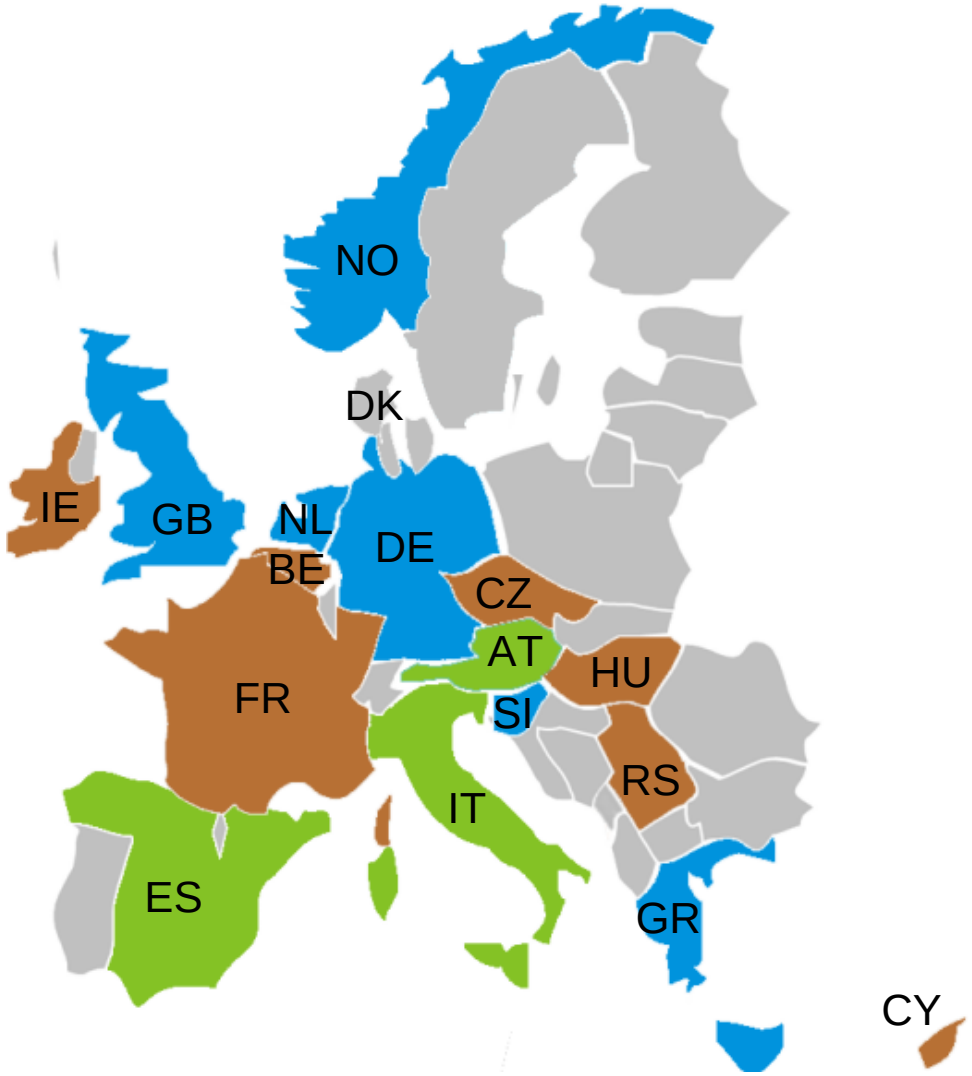
CO_2 Benchmarks / Endpoint of Scenarios

Individually designed paths (target or development oriented)

EPISCOPE



Lunch Break + Poster Session



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Questions / Discussion

EPISCOPE

BPIE

Afternoon Session:

Monitoring of building stocks - Lessons learned from data collection – a run through different approaches

Moderator: Elena Dascalaki, NOA

EPISCOPE

BPIE

UK Housing Surveys: An example to follow?

John Riley & Jack Hulme
Building Research Establishment (BRE)
18 November 2015

Part of the BRE Trust

Format of presentation

1. The English Housing Survey

2. Energy Follow-Up Surveys

Co-funded by the Intelligent Energy Europe Programme of the European Union

EPISCOPE

Overview of English Housing Survey (EHS)

The English Housing Survey (EHS)

- Longest running national housing survey (since 1967)
- Owned by **UK Government.**
- **Annually**
  - 13,300 household interviews
  - 6,200 physical inspections

- BRE is key delivery partner, particularly on physical survey

- Results published annually (DCLG web site)
- Dataset used within and outside government.

- BRE provides similar support to **Scottish, Welsh and Northern Ireland surveys.**

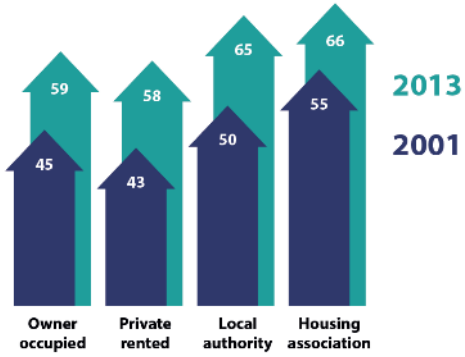
- **Purpose:** EHS provides the Government with information for the development of housing policies directed at the repair, improvement, and energy efficiency of the housing stock of all tenures.

Information collected in the EHS

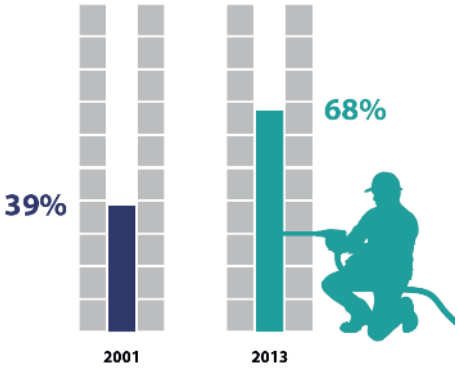
- Age, type, tenure, size, storeys, material, construction
- Amenities and services
- Repair costs
- Improvement costs
- Health, safety and security
- Heating and energy efficiency
- Local environment
- Household composition
- Household income
- Value and equity

Example outputs

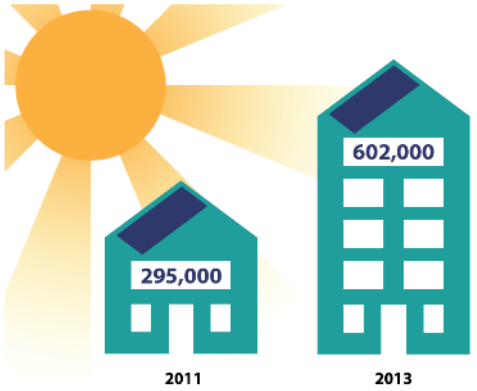
The private rented and local authority sectors showed the largest increases: average SAP* rose by 16 and 15 points respectively.



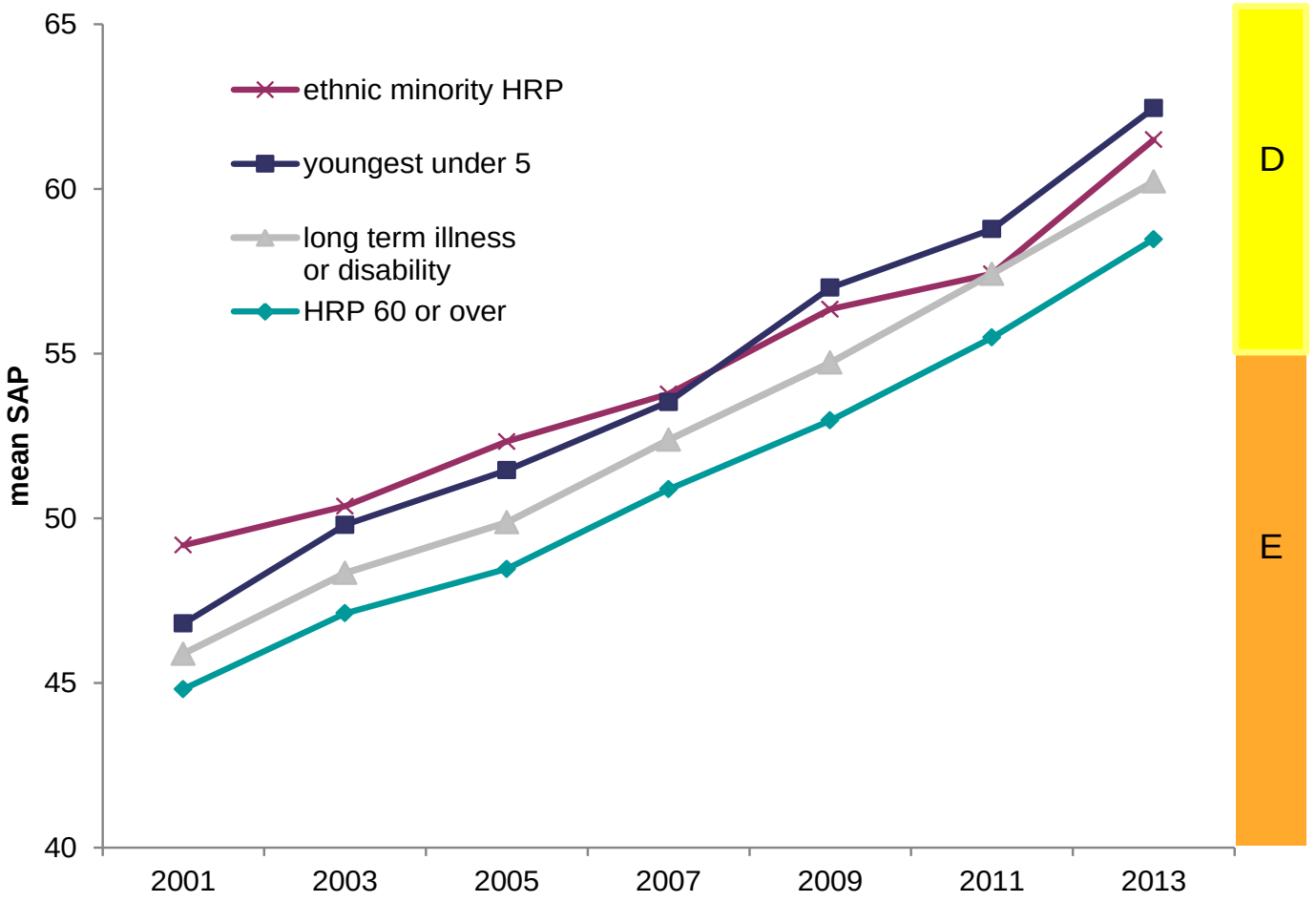
10.8 million homes (68%) were estimated to have cavity wall insulation in 2013, an increase from 5.8 million (39%) in 2001.



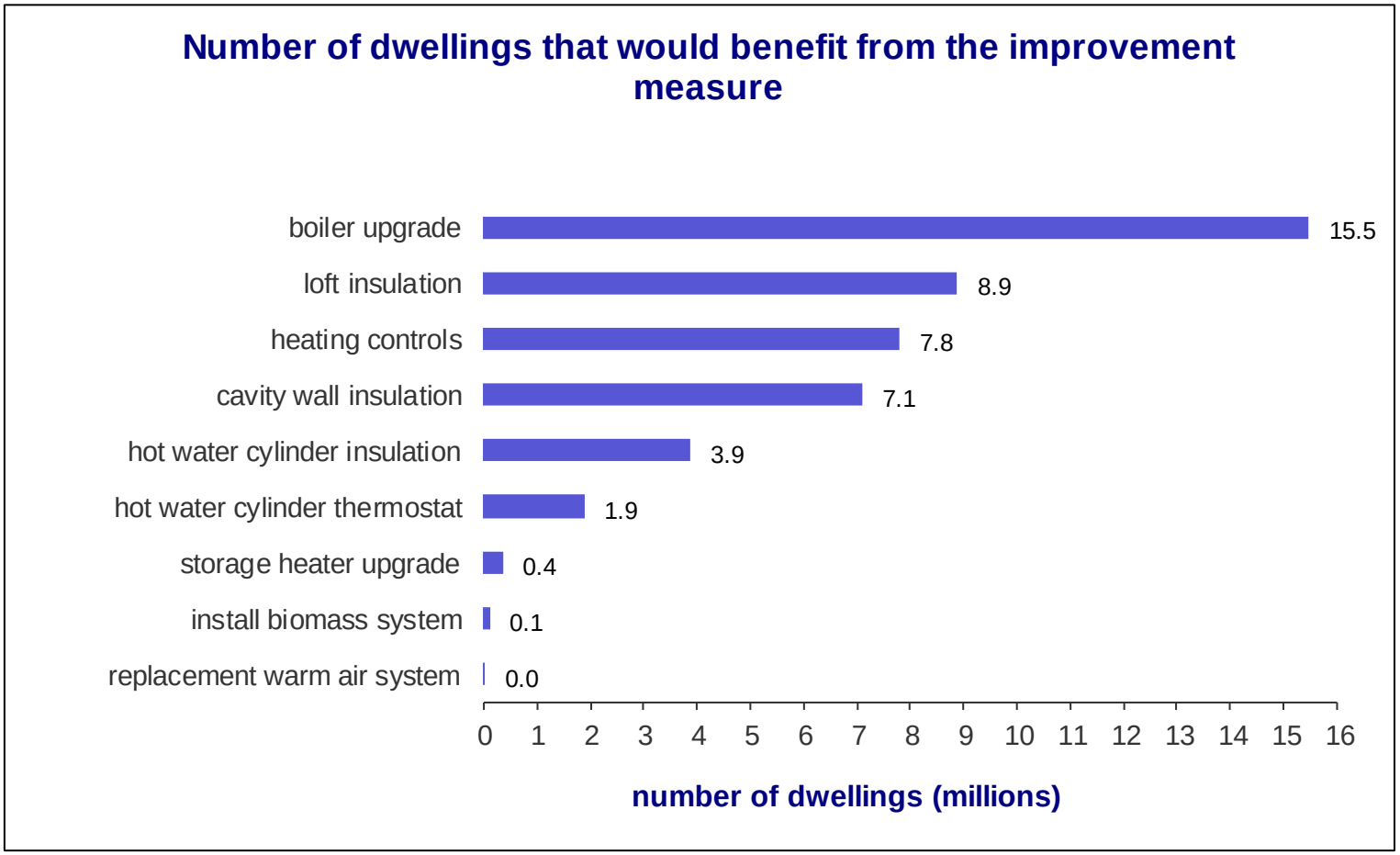
In 2013 an estimated 602,000 homes had some form of solar panel(s) for renewable energy, more than double the number in 2011 when around 295,000 had these.



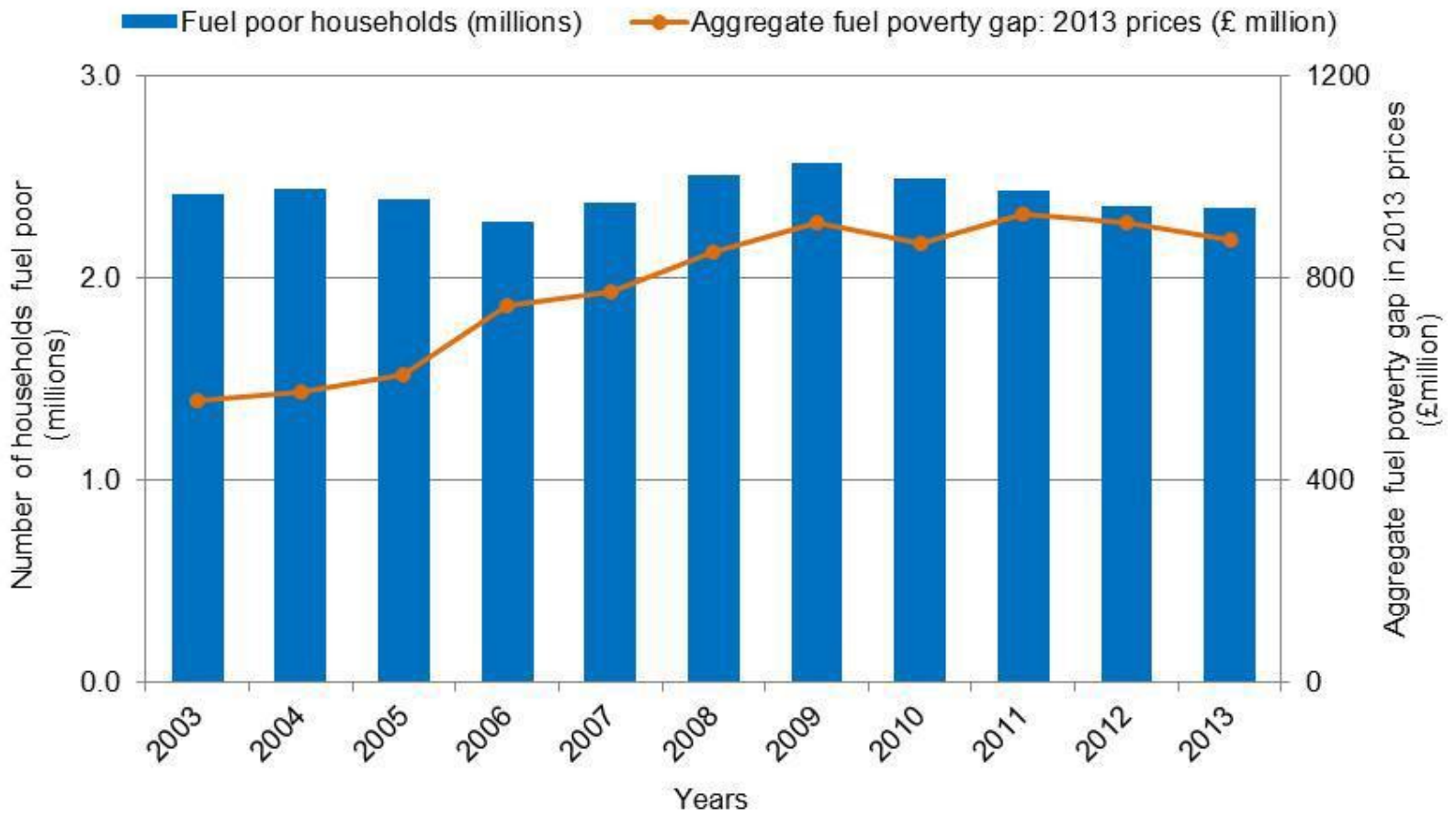
Energy efficiency rating over time



Improvement potential



Tracking fuel poverty



Energy Follow-Up Surveys

2

EHS follow-up surveys

- EHS provides a “bank” of high quality data that we can build on using follow-up surveys.
- EHS already two surveys (interview and physical)
  - Can follow-up with a specialist 3rd survey
- Examples:
  - 1998 Energy Follow-Up Survey
  - 2002 Fuel Consumption Follow-Up Survey (Meter reads)
  - 2011 Energy Follow-Up Survey
  - 2011/12 U-values study
  - 2012-16 Solid Wall Insulation Research
  - 2015 Cold Appliances Follow-Up
  - 2015-16 Cavity Wall Follow-Up Survey

EFUS 2011 Household Interview (2,616 cases)

- Ownership
- Patterns of use
  - Heating
  - Appliances
  - Cooking
  - Cooling
  - Lighting
  - Conservatories

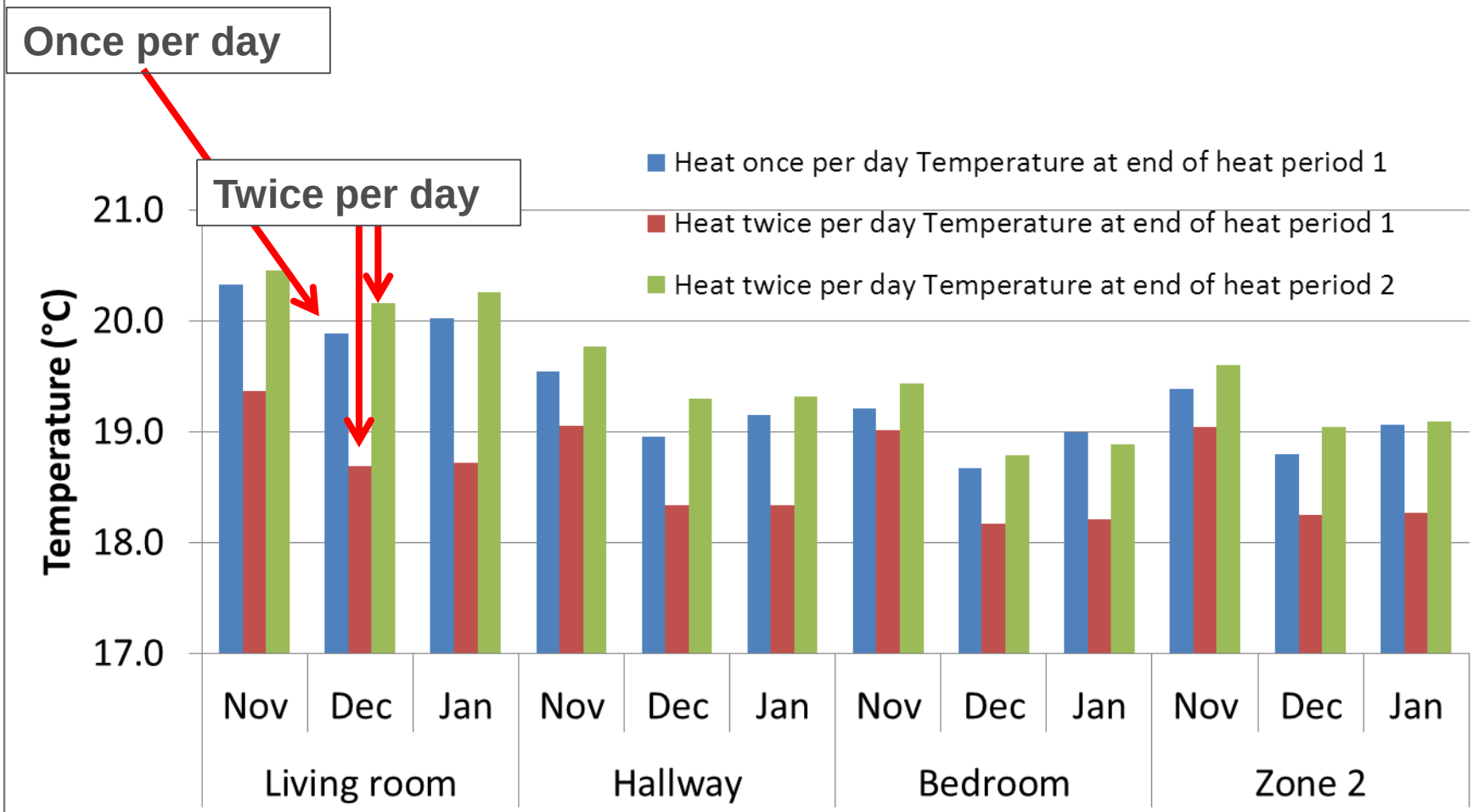
EFUS 2011 monitoring

- Internal temperature (3 rooms)
  - Every 20 minutes for 1 year
  - 823 households

- Gas and electric meter readings
  - 1,345 households

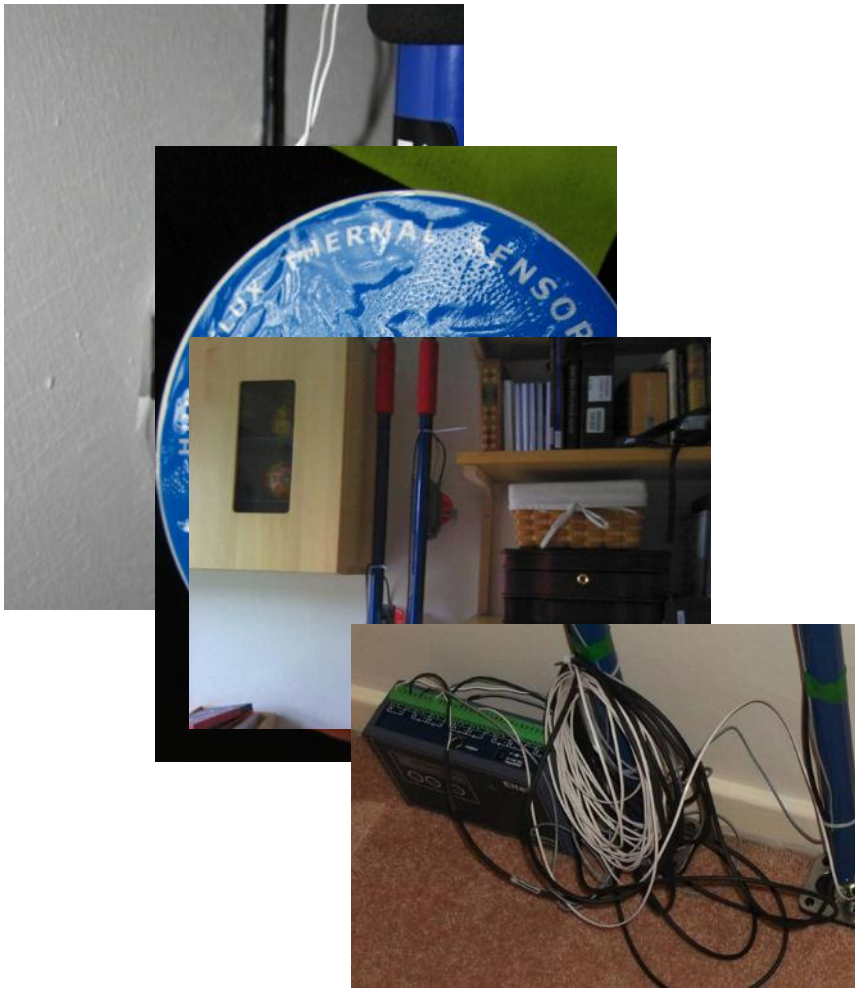
- Electricity monitoring
  - Every 10 seconds
  - 6 to 9 months data
  - 79 households

Demand temperatures



U-values monitoring

- Direct measurement of wall U-values
  - Measurements for two weeks
  - Heat flux transducer, thermistor sensors, loggers.
  - Allows determination of wall U-values
  - 300 properties of different wall types.

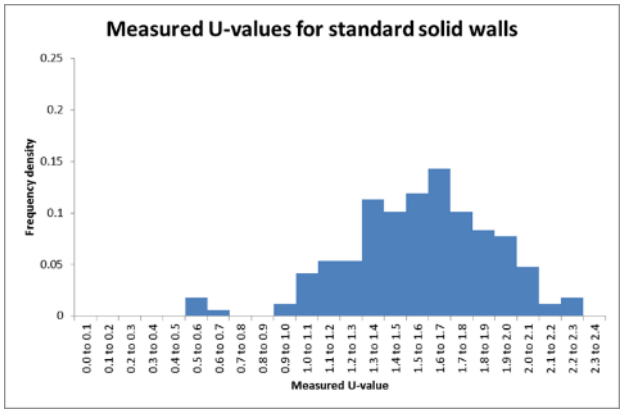


U-values

Wall type	Number of cases	Typical RdSAP U-values W/m²K	Measured U-values: mean W/m²K*	Difference to typical RdSAP value
Uninsluated solid wall, standard	85	2.1	1.57	-25%
Uninsulated solid wall, non-standard	33	2.1	1.28	-39%
Uninsulated cavity	50	1.6	1.38	-14%
Insulated cavity	109	0.5	0.67	+34%

= Losing *less* heat than assumed

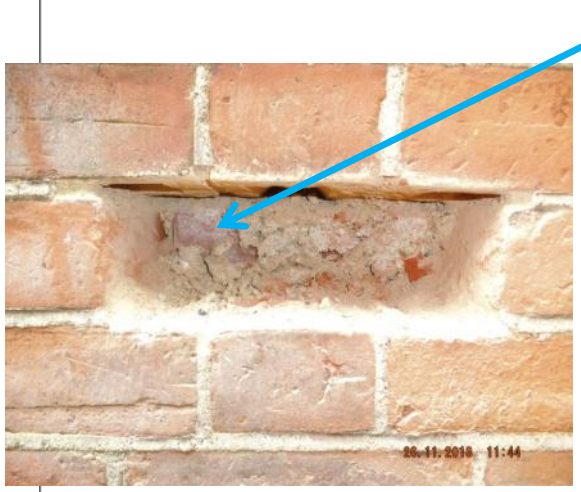
= Losing *more heat* than modelled



Default U-values are significantly different to reality.

Estimated energy savings may be overstated.

Brick sample removal



Key messages

In the UK Primary data collection is an essential tool.

- Tracking of and development of policies
- Targeting homes and households

Detailed monitoring is needed for:

- Developing new knowledge
- Challenging existing assumptions
- Updating critical models and methods

UK Housing Surveys: An example to follow?

John Riley & Jack Hulme
Building Research Establishment (BRE)
18 June 2015

Part of the BRE Trust

Co-funded by the Intelligent Energy Europe Programme of the European Union

EPISCOPE

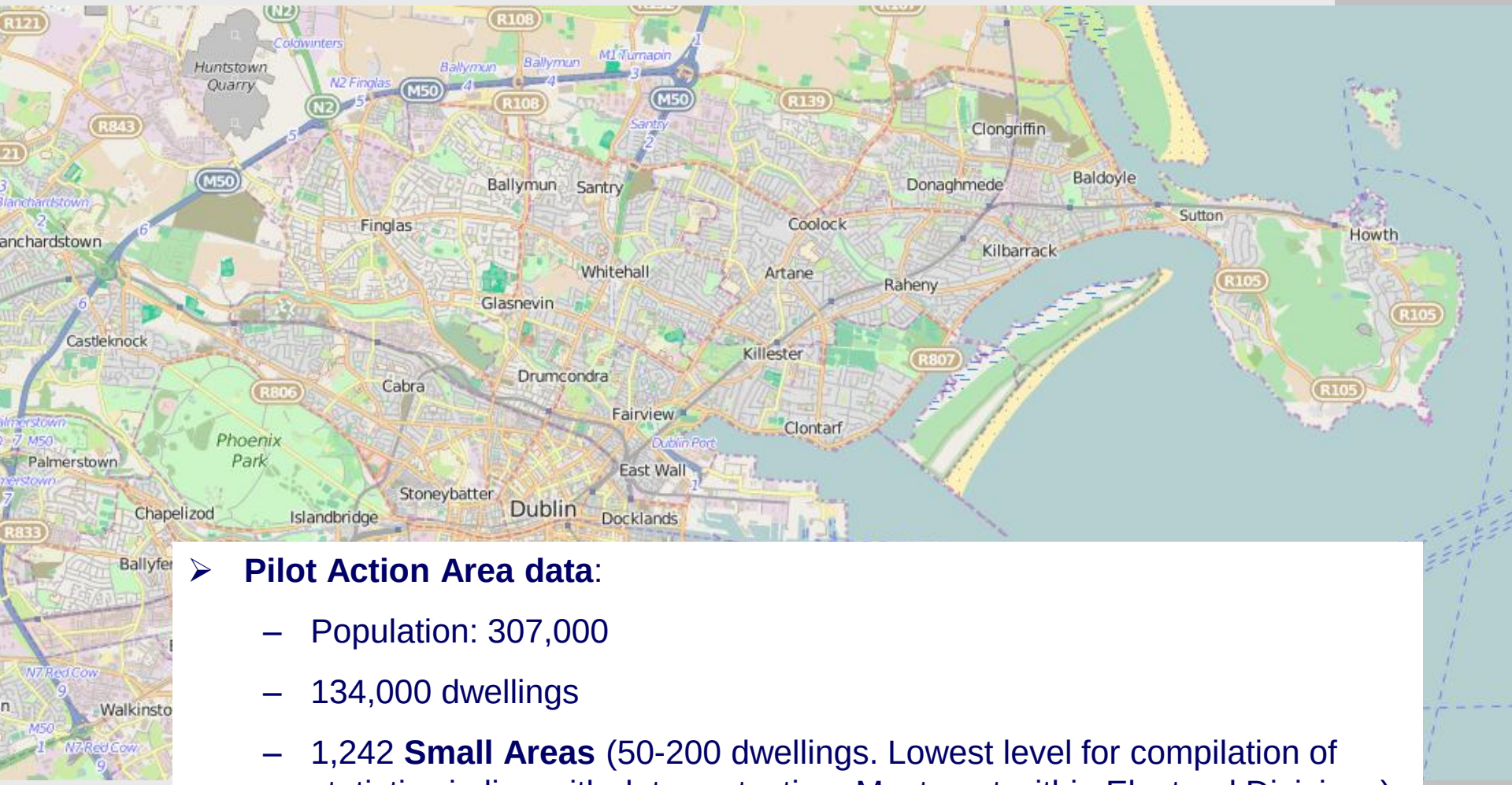
Use of Different Data Sources for a Local Monitoring Approach

18th November 2015

EPISCOPE Workshop

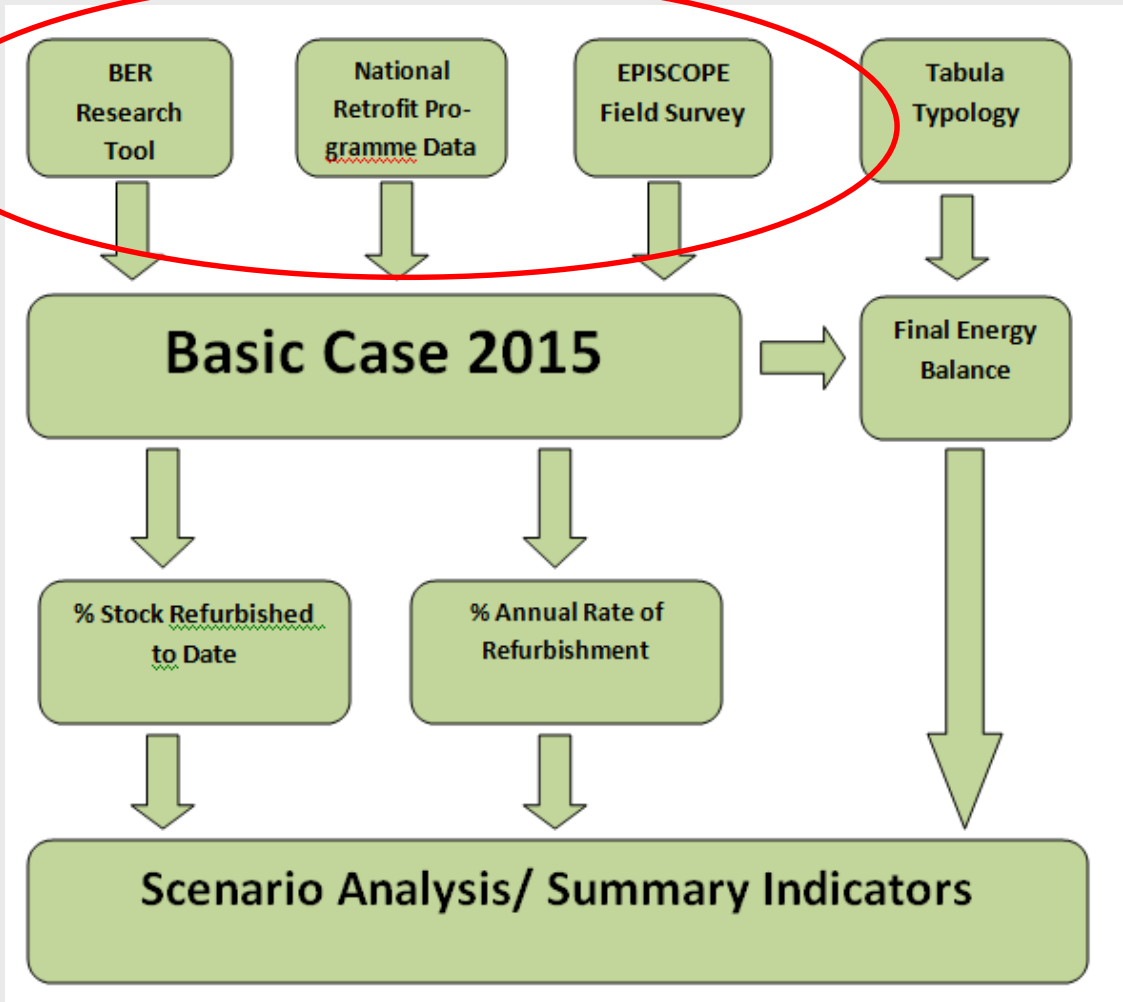
Michael Hanratty, Energy Action Ltd

EPISCOPE Pilot Action: Northside of Dublin City



- **Pilot Action Area data**:
  - Population: 307,000
  - 134,000 dwellings
  - 1,242 **Small Areas** (50-200 dwellings. Lowest level for compilation of statistics in line with data protection. Must nest within Electoral Divisions)
  - 93 **Electoral Divisions** (smallest legally defined administrative areas in the State for which Small Area Population Statistics are published from the Census)

EPISCOPE Irish Pilot Action: Building Stock Energy Performance Indicators



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Ireland: EPC (BER) status

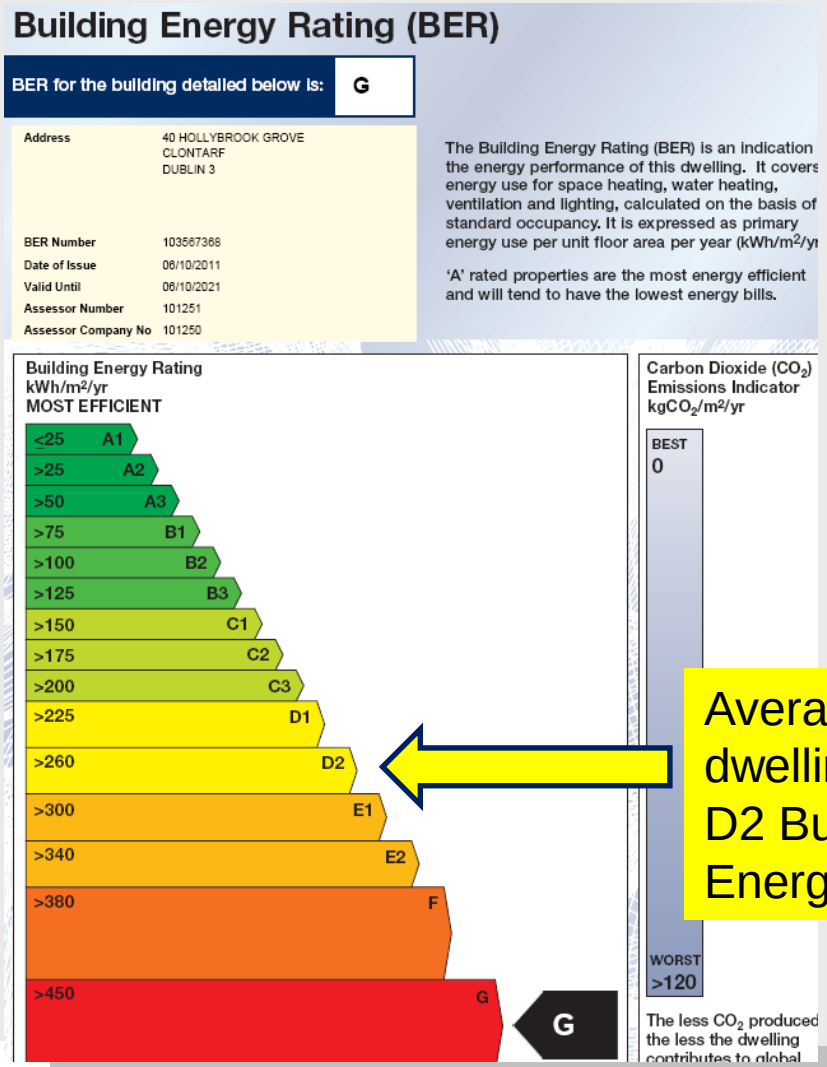
Nr of dwellings: 1,650,000

Dwellings with EPCs: 585,000 (35%)

EPCs required for:

- *Sale*
- *Rental*
- *Energy upgrades of social housing*
- *Grant-aided energy upgrades of private dwellings*

National EPC database managed by Sustainable Energy Authority of Ireland (SEAI)



Average Irish dwelling has a D2 Building Energy Rating

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State Indicators of the Basic Case (2013)

Basic Case *(Starting Point of Trend and Scenario Calculation)* **:**		
Basic Data	Complete building stock	Old building stock
	bs...2013/2013	bs...2010/2013
number of dwellings	30720	30552
number of houses	16965	16848
number of apartments	13755	13704
national reference area [m²]	84	83.92
TABULA/EPISCOPE reference area [m²]		
Building insulation: state of modernisation		
walls		
insulation improved (from original state)	14.2%	13.9%
insulation improved (area-weighted)	16.7%	16.4%

Building insulation: Detailed information		
levels of wall insulation (area-weighted):		
level 0 (U > 0,6 W/m²K)	49.0%	49.3%
level 1 (0,6 W/m²K >= U > 0,27 W/m²K)	40.2%	40.3%
level 2 (0,27 W/m²K >= U > 0,21 W/m²K)	9.6%	9.5%
level 3 (U <= 0,21 W/m²K)	1.2%	0.9%

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State Indicators: Wall Refurbishment Qualifiers

Age Band	Wall U value (default)	Wall improvement qualifier (U=<)
1700-1977	2.1	0.6
1978-1982	1.1	0.6
1983-1993	0.6	0.45
1994-1999	0.55	0.37
2000-2005	0.55	0.27
2005-2010	0.37	0.21
2011 onwards	0.27	0.21

- Example for walls shown: similar qualifiers for roofs, floors, windows etc

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Trend Indicators:
Walls improved from BER Research data

Year	All stock	Old stock	all stock trend	old stock trend
2009	8344	8344		
improved	308	308		
ratio 2009	3.69%	3.69%		
2010	13360	13360		
improved	829	829		
ratio 2010	6.21%	6.21%	**2.51%**	**2.51%**
2011	18336	18317		
improved	2050	2046		
ratio 2011	11.18%	11.17%	**4.98%**	**4.96%**
2012	23653	23553		
improved	3301	3228		
ratio 2012	13.96%	13.71%	**2.78%**	**2.54%**
2013	30480	30341		
improved	4181	4096		
ratio 2013	13.72%	13.50%	**-0.24%**	**-0.21%**
avg annual trend			**2.51%**	**2.45%**

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State & Trend Indicators – EPC Research Tool

Element	% Elements Refurbished To Date	Annual Refurbishment rate (%)
Walls	14.2%	2.5%
Roofs	34.7%	2.6%
Windows	76.2%	2.2%
Floors	6.0%	6.2%
Boilers	23.9%	2.0%

Homeowner grants for energy upgrades require EPCs so is EPC-based analysis reflected on the ground?

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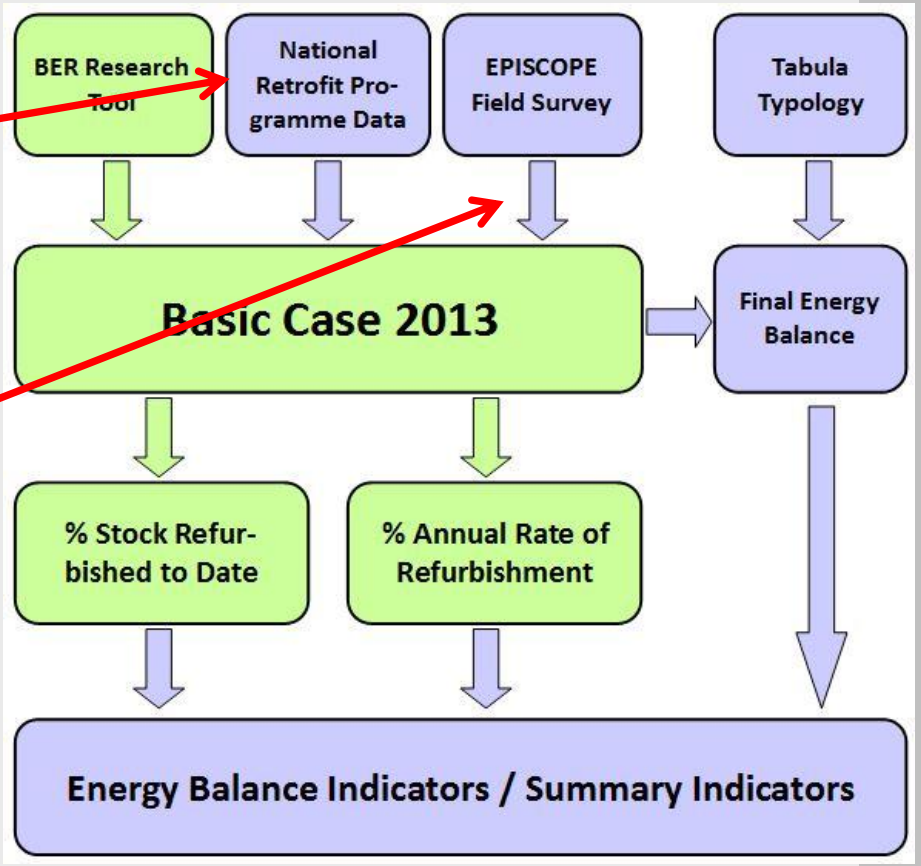
EPISCOPE Field Research: State & Trends

National programme data inadequate

Will a field survey show similar results?



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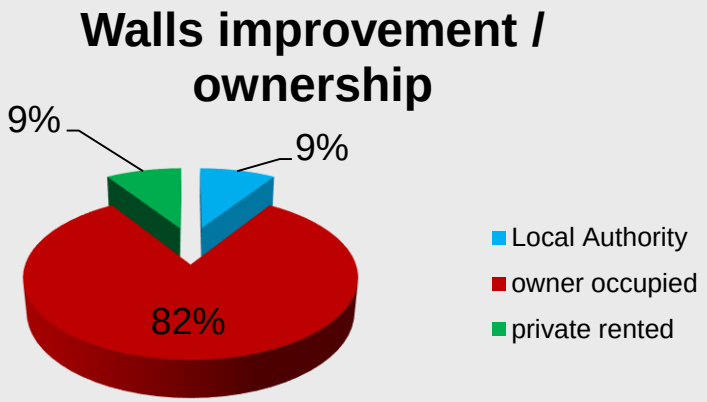
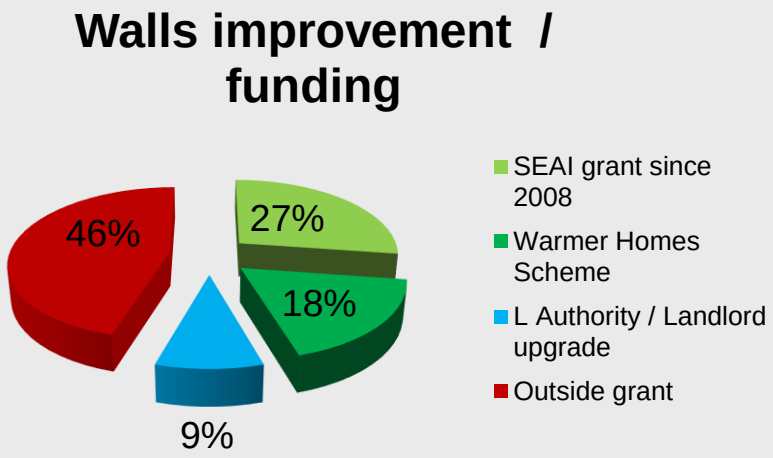
Field Survey: (December 2014- April 2015)

- Randomly selected addresses
- 450 door-knocks needed to complete 100 surveys





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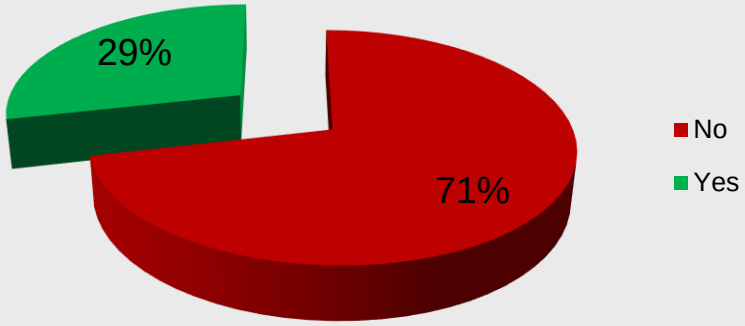
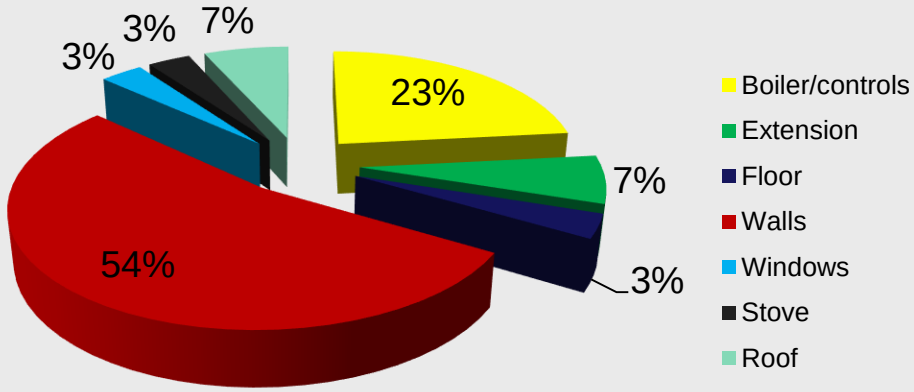
Intention for Energy Upgrades next 2-5 years

Upgrade plans for next 5 years



Upgrade element considered



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Field Survey - Summary Findings

Field Survey Summary									
Element	Refurbishment rate:		Ownership of refurbished dwellings (%)			Funding (%)			
	% to date	Annual rate (%)	Housing Assoc./ Local Authority	Owner occupied	Private rented	SEAI Grant since 2008	Warmer Homes Scheme	Local Auth./ landlord upgrade	Outside grants
Walls	16%	2.2%	25%	69%	6%	25%	13%	25%	38%
Roofs	45%	4.5%	12%	86%	2%	10%	14%	10%	67%
Windows	58%	3.2%	14%	76%	10%	0%	N.A.	21%	79%
Floors	2%	0.0%	0%	100%	0%	0%	N.A.	0%	100%
Boilers	25%	4.2%	4%	88%	8%	4%	N.A.	12%	84%
Controls	7%	0.8%	0%	100%	0%	14%	N.A.	0%	86%

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Aggregated Annual Refurbishment Rates – Northside of Dublin City

Aggregate Trend (annual refurbishment rate):			
Element	**Field survey**	**EPC Research Tool**	**Aggregate trend**
Walls	2.2%	2.5%	**2.4%**
Roofs	4.5%	2.6%	**3.6%**
Windows	3.2%	2.2%	**2.7%**
Floors	2.0%	6.0%	**2.0%**
Boilers	4.2%	2.0%	**3.1%**
Controls	0.8%	N.A.	**0.8%**

Base assumptions for 'business as usual' Trend Scenario

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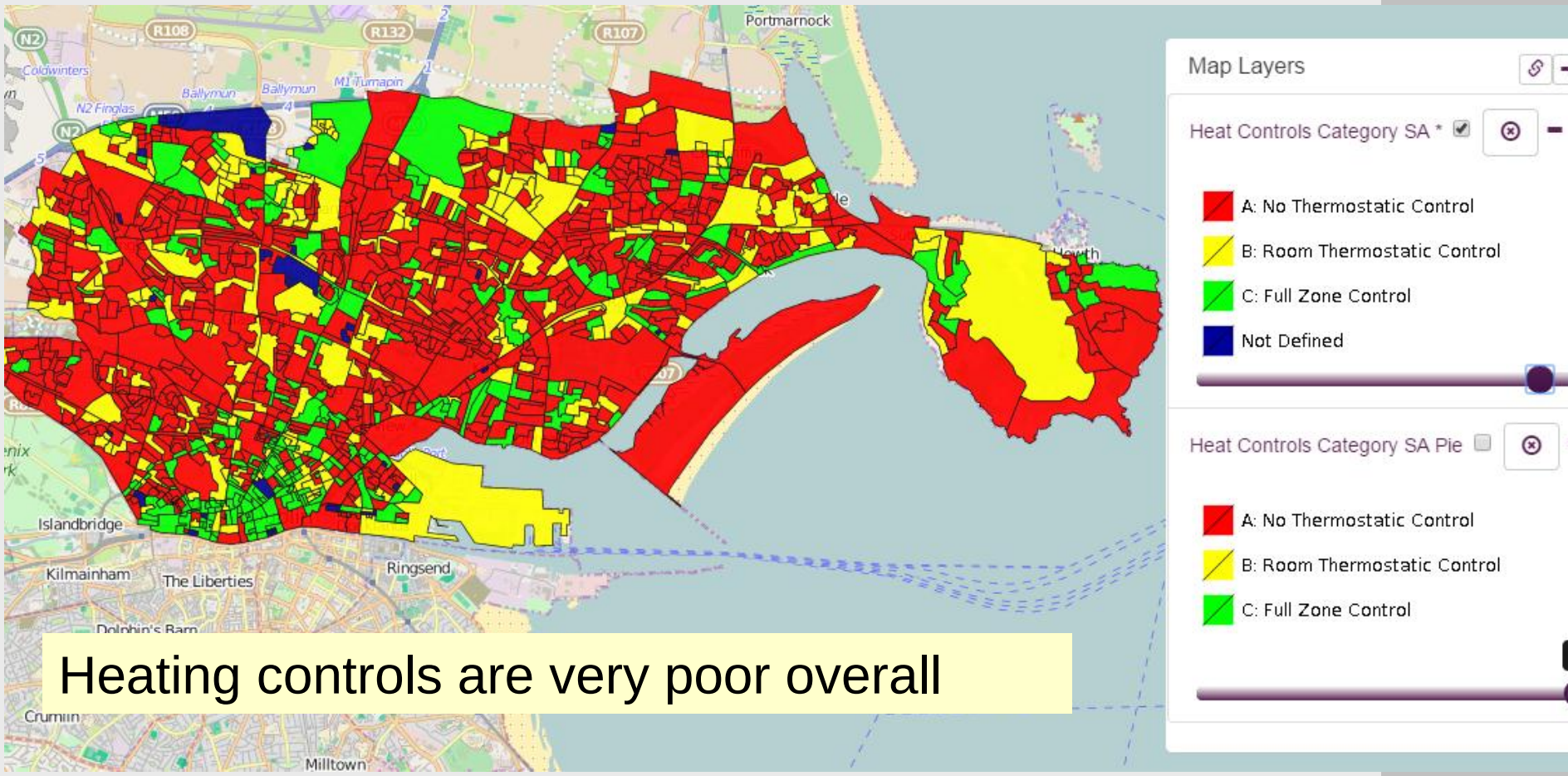
Heating Controls



Heating controls are very poor overall

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Conclusions:

- EPC databases will not accurately indicate energy refurbishment trends but are an important data source
- EPC database records must be saved at key calendar dates or data will be lost
- A field survey process is critical and should be cross-referenced to EPC database analysis and a comprehensive measured energy use survey

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Thank you for listening

michael@energyaction.ie

Analysing the portfolio of a municipal housing agency

Otto Villatoro

EPISCOPE

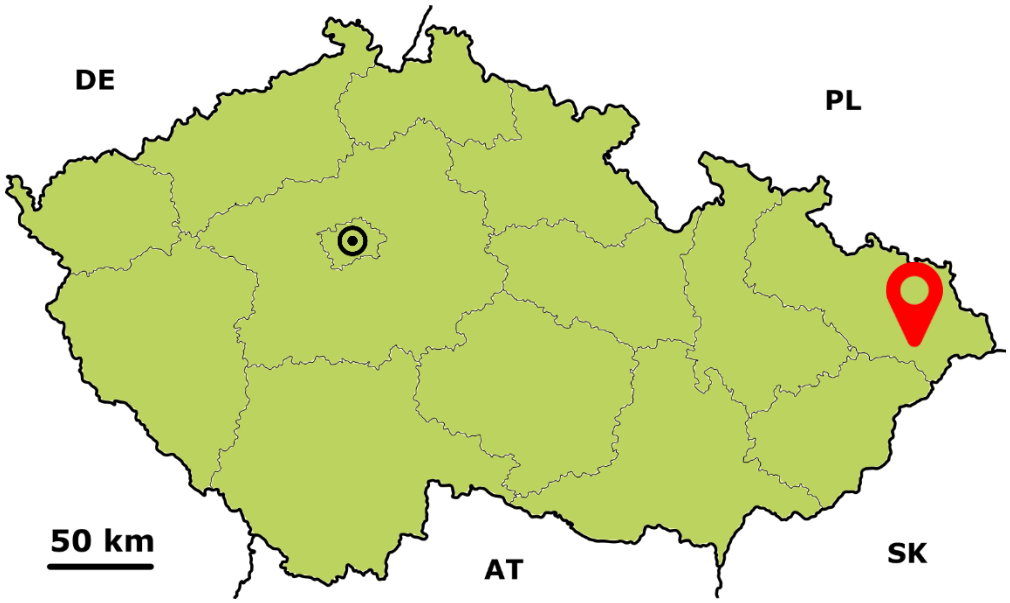
Co-funded by the Intelligent Energy Europe Programme of the European Union

EPISCOPE Workshop

Towards an energy efficient European housing stock – mapping, modelling and monitoring refurbishment processes

Brussels, 18 November 2015

Havířov, Czech Republic



1955

Mining

76,000

Socialist Realism – “Sorela” Architecture

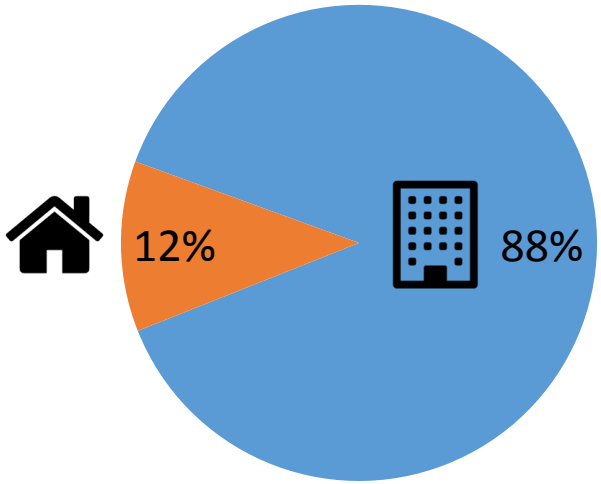
Socialist Realism – “Sorela” Architecture

Large Panel Buildings

Housing Stock of Havířov

34,000 dwellings

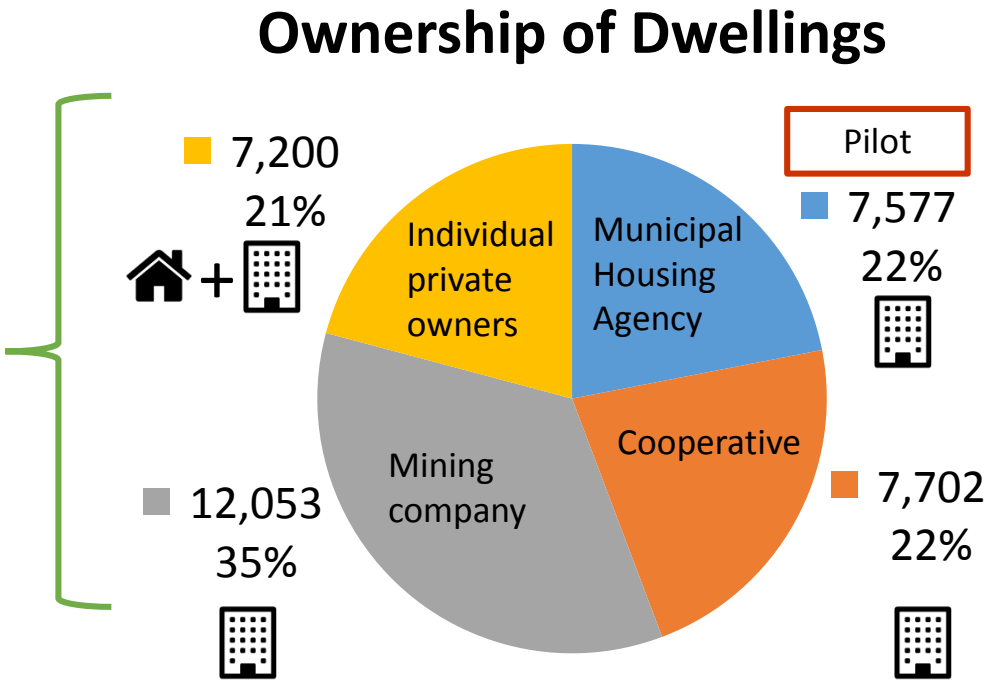
Type of Dwellings



Source: Czech Statistical Office, 2011.

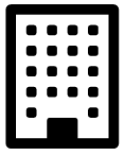
Housing Stock of Havířov

34,000 dwellings

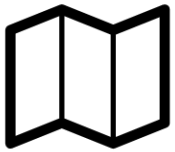


Source: Statutární město Havířov, 12/2014

Municipal Housing Stock of Havířov



7,577 flats in 225 buildings



378,100 m^2 [Conditioned Area]

17,600 tenants

District Heating

Describing the Municipal Housing Stock

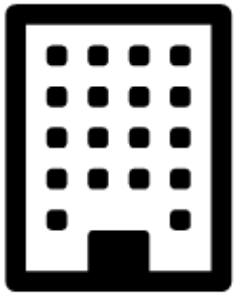
Construction year

Number of flats

Building type

Total conditioned area

Heating energy consumption



Characteristics of the thermal envelope
*Windows
*Walls
*Roof
*Floor

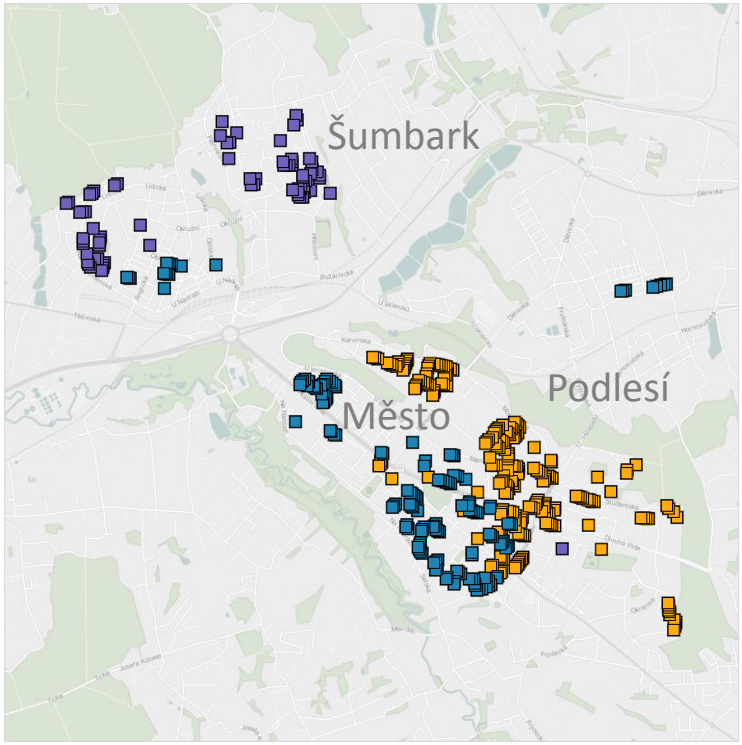
Refurbishment measures
*Thermal envelope
*Heating system
*DHW system

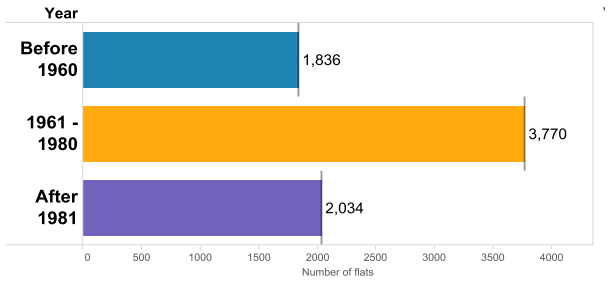
Local Building Typology

	MFH Multi-family Houses	AB Apartment Blocks
Before 1960		
1961 - 1980		
After 1981		

Municipal Housing Stock

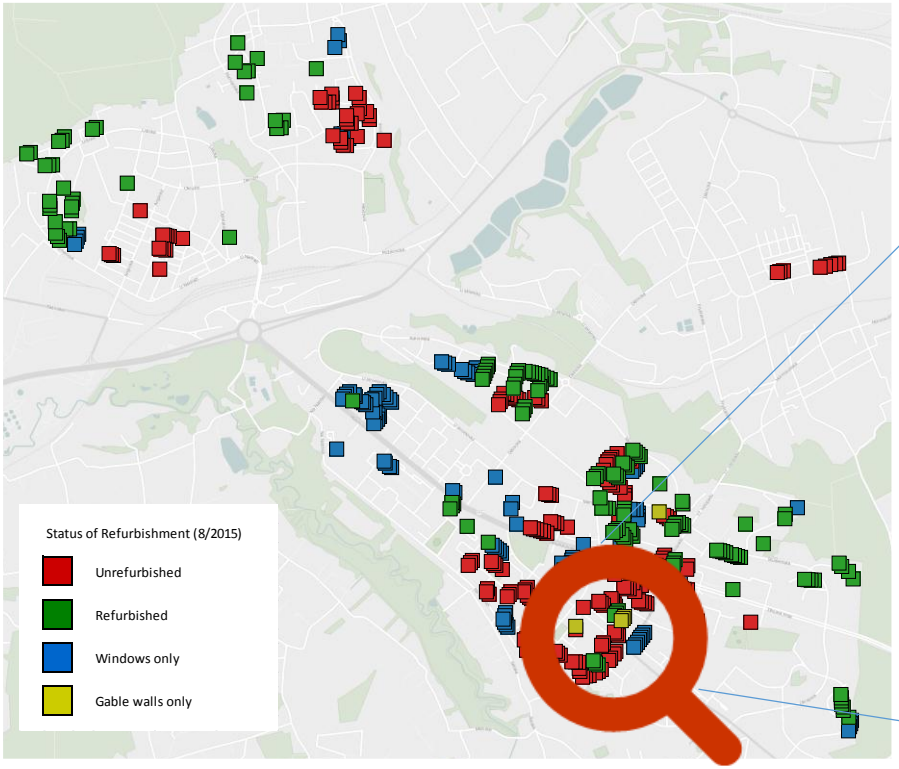
Construction Year



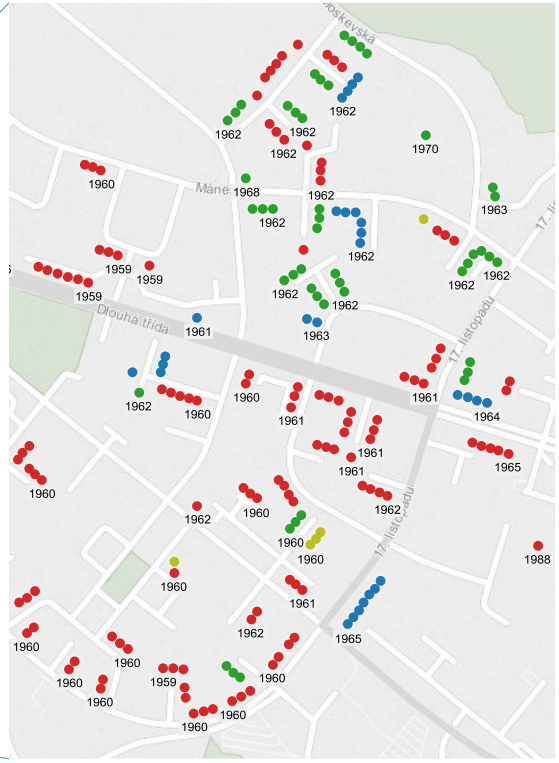


Refurbishment Progress

Refurbishment Status

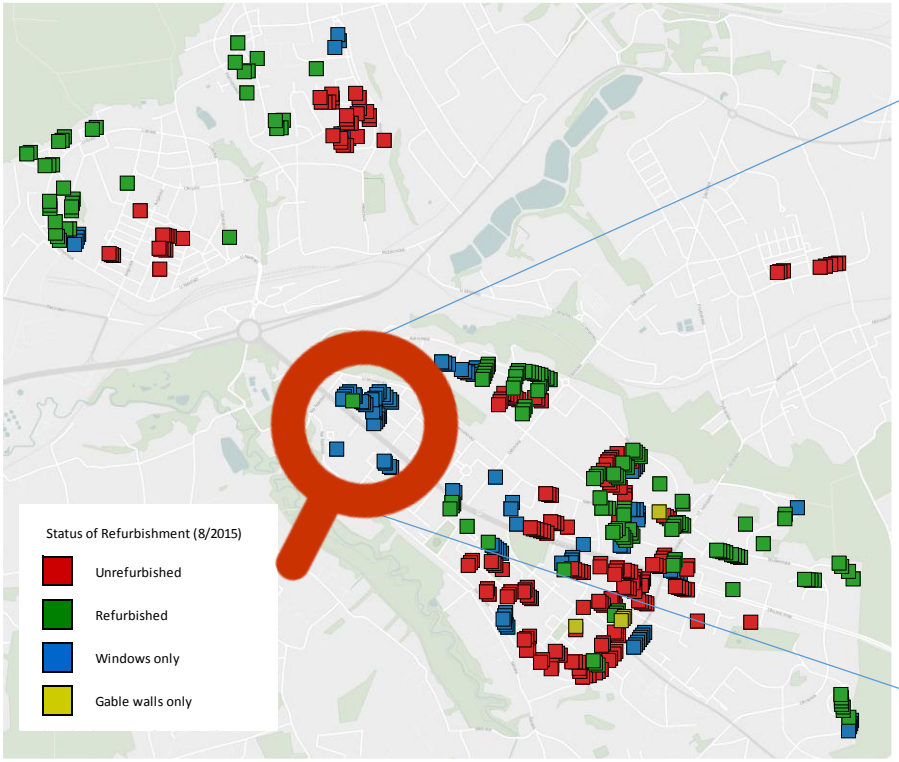


Construction Year

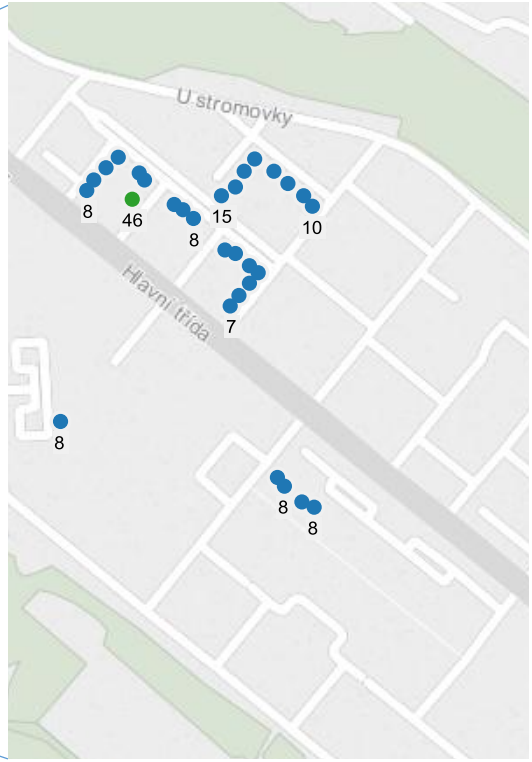


Refurbishment Progress

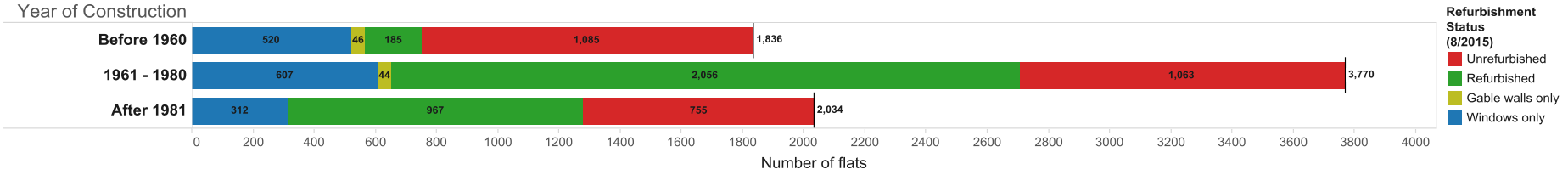
Refurbishment Status



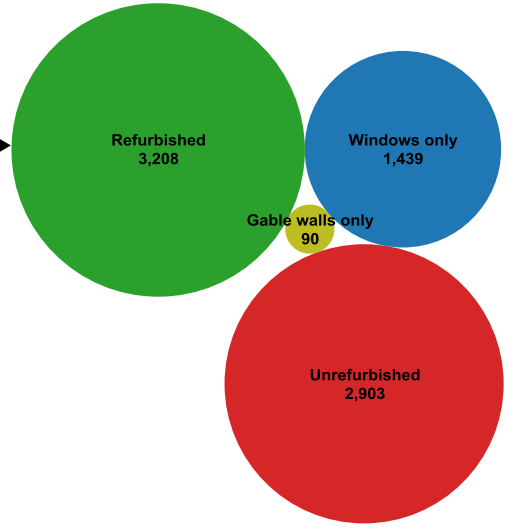
Number of flats / building



Refurbishment Progress

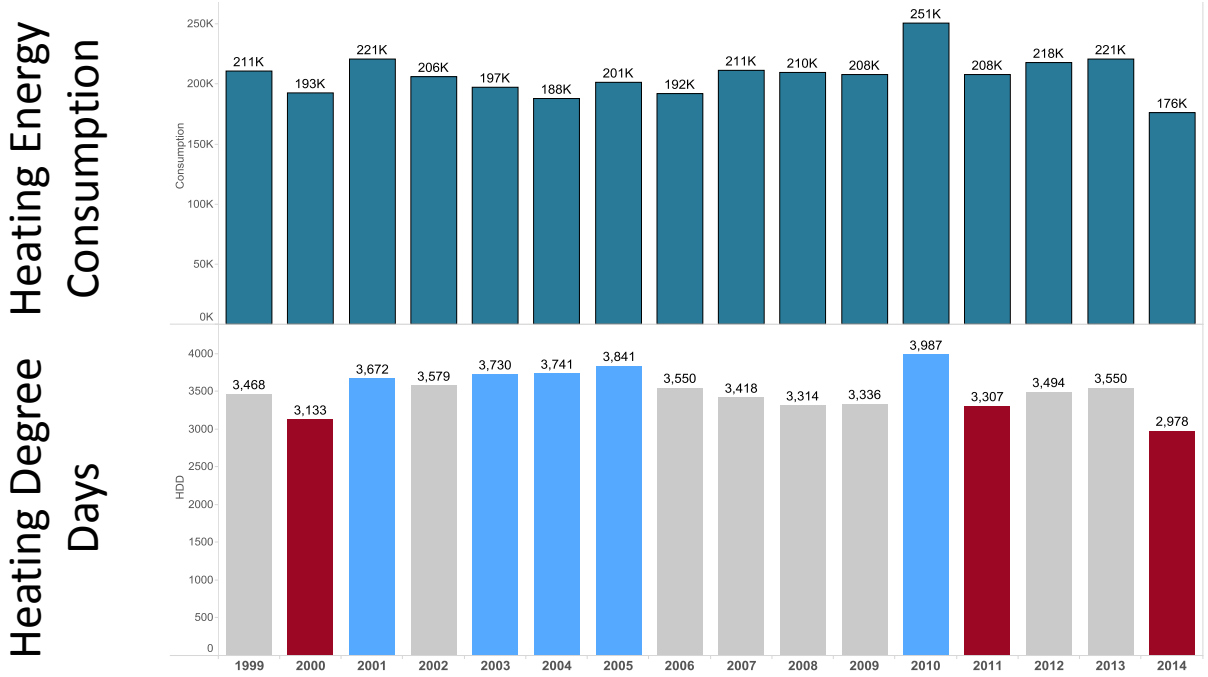


Second round of refurbishment?



@ 200 flats / year

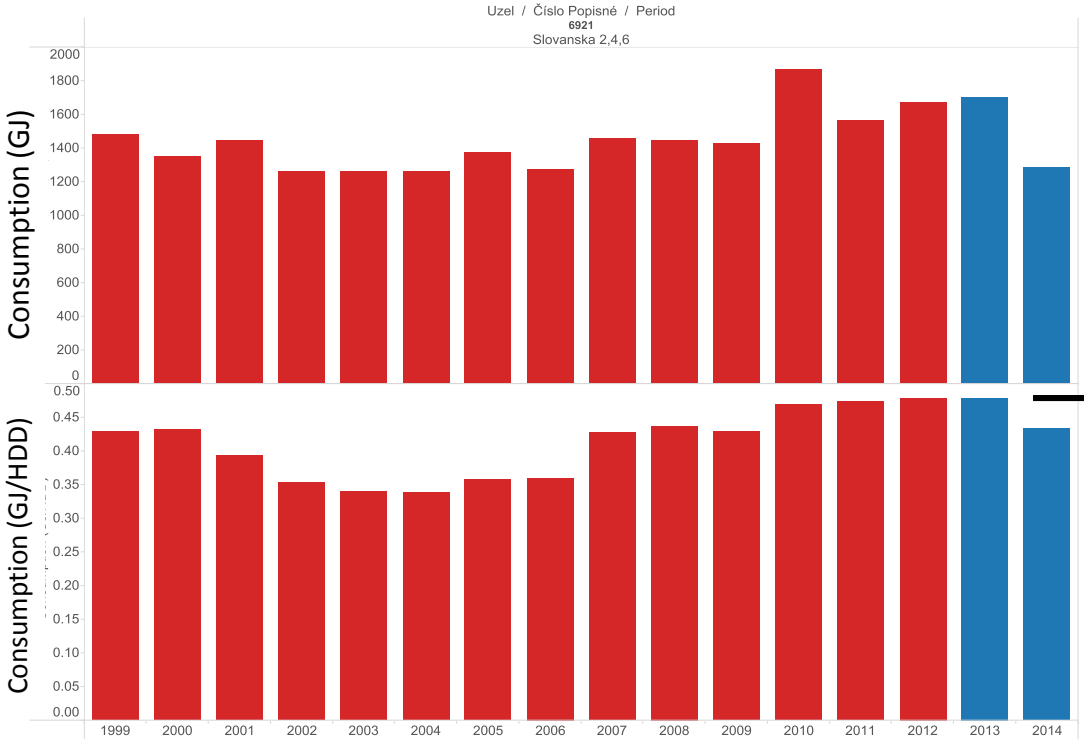
Analysis of Heating Energy Consumption



Analysis of Heating Energy Consumption

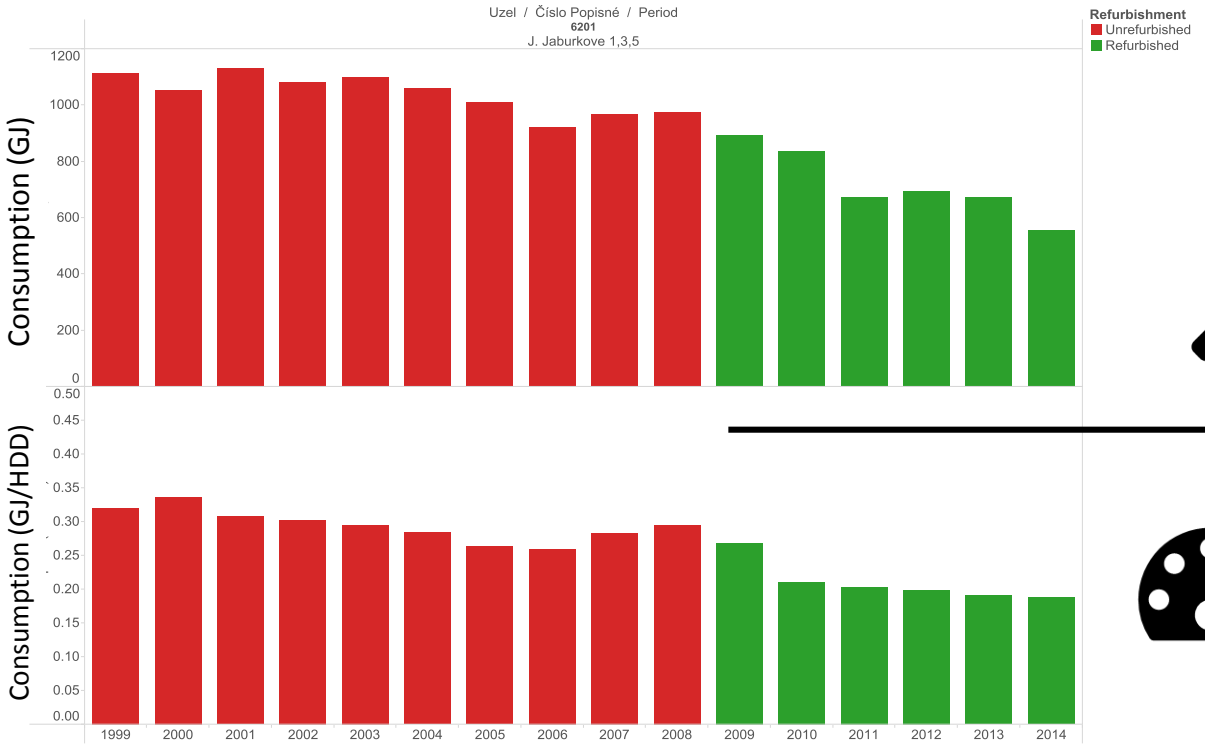
- Quality of the refurbishment
- User behaviour

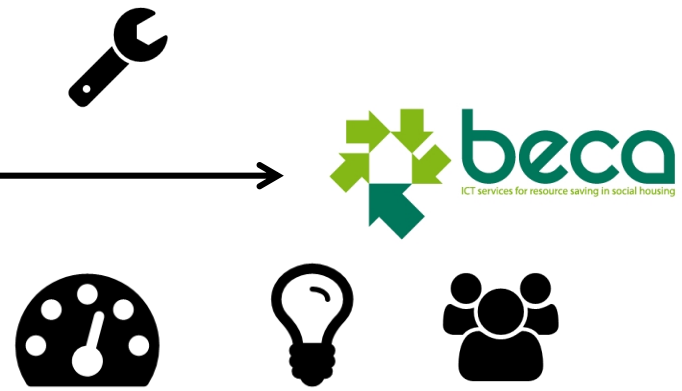
Analysis of Heating Energy Consumption



- Continuous monitoring
- Include other factors

Analysis of Heating Energy Consumption





Lessons Learnt and Recommendations

Validation of data and continuous monitoring

Deep refurbishment strategies

User behaviour; demographics

User awareness

EPISCOPE

Towards an energy efficient European housing stock

Brussels, 18 November 2015

BPIE

DATA HUB FOR THE ENERGY PERFORMANCE OF BUILDINGS

www.buildingsdata.eu

Integrating data in an open source –
The challenges ahead and reaping the benefits

Aleksandra Arcipowska
Buildings Performance Institute Europe

EPISCOPE

Co-funded by the Intelligent Energy Europe Programme of the European Union

BPIE European Buildings Data Hub: Background

2010

2011

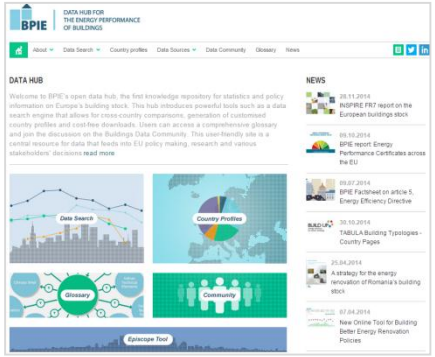
BPIE Survey 2010/2011
Report on EU Building stock *Europe's Buildings under Microscope*

2012

BPIE DATA HUB FOR THE ENERGY PERFORMANCE OF BUILDINGS

Launch of the BPIE DATA HUB
Online knowledge resource for European Building Stock

2013



Launch of the EU Buildings Data Community
Launch of the Building Glossary

2014

Integration of the results of the IEE project:

- TABULA/EPISCOPE
- ENTRANZE
- COMMONENERGY

2015

BPIE is currently working on developing the EU Building Stock Observatory for DG ENER

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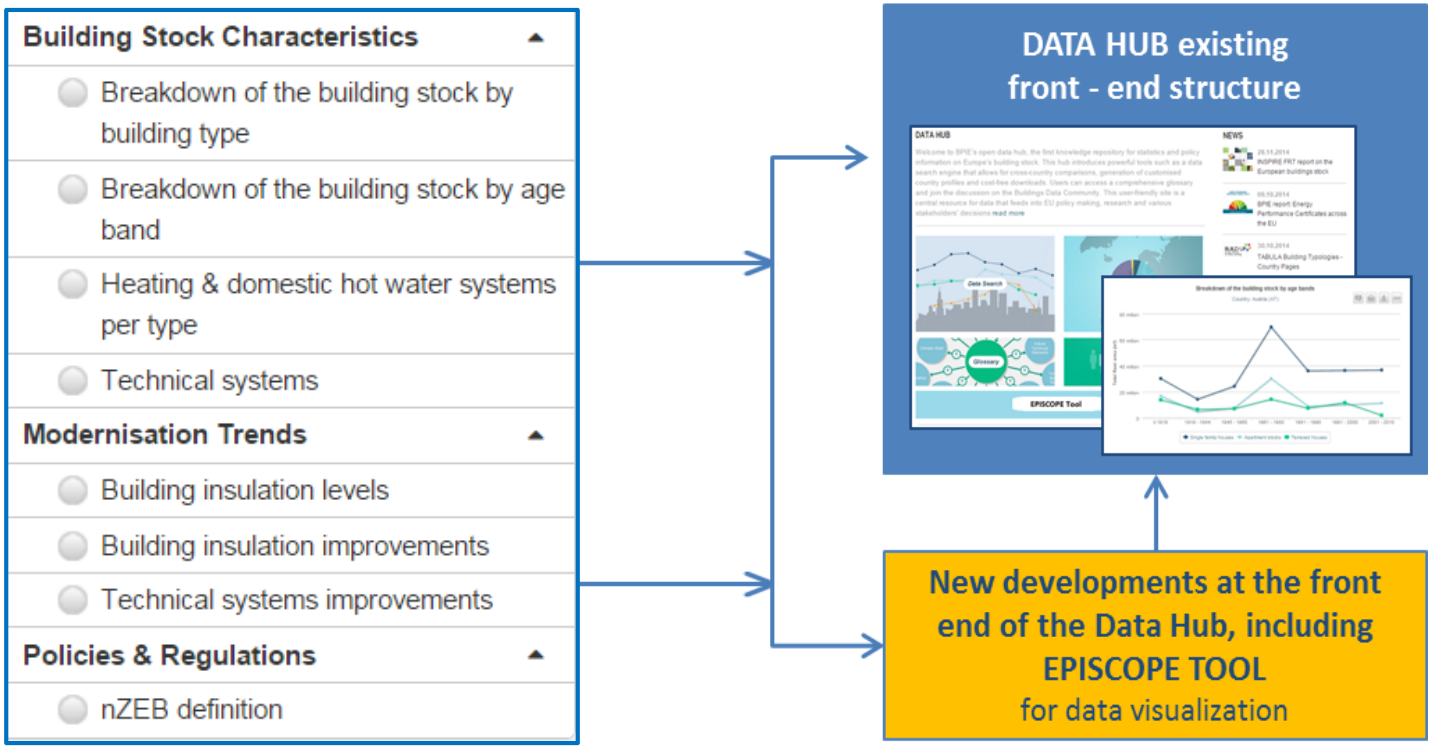
BPIE role in EPISCOPE project: Objectives

- ✓ **Full integration of the EPISOPE results in the BPIE Data Hub**
- ✓ Presentation of a new country profile for **Serbia**
- ✓ Development of **the EPISCOPE tool** for the cross country comparison of the results



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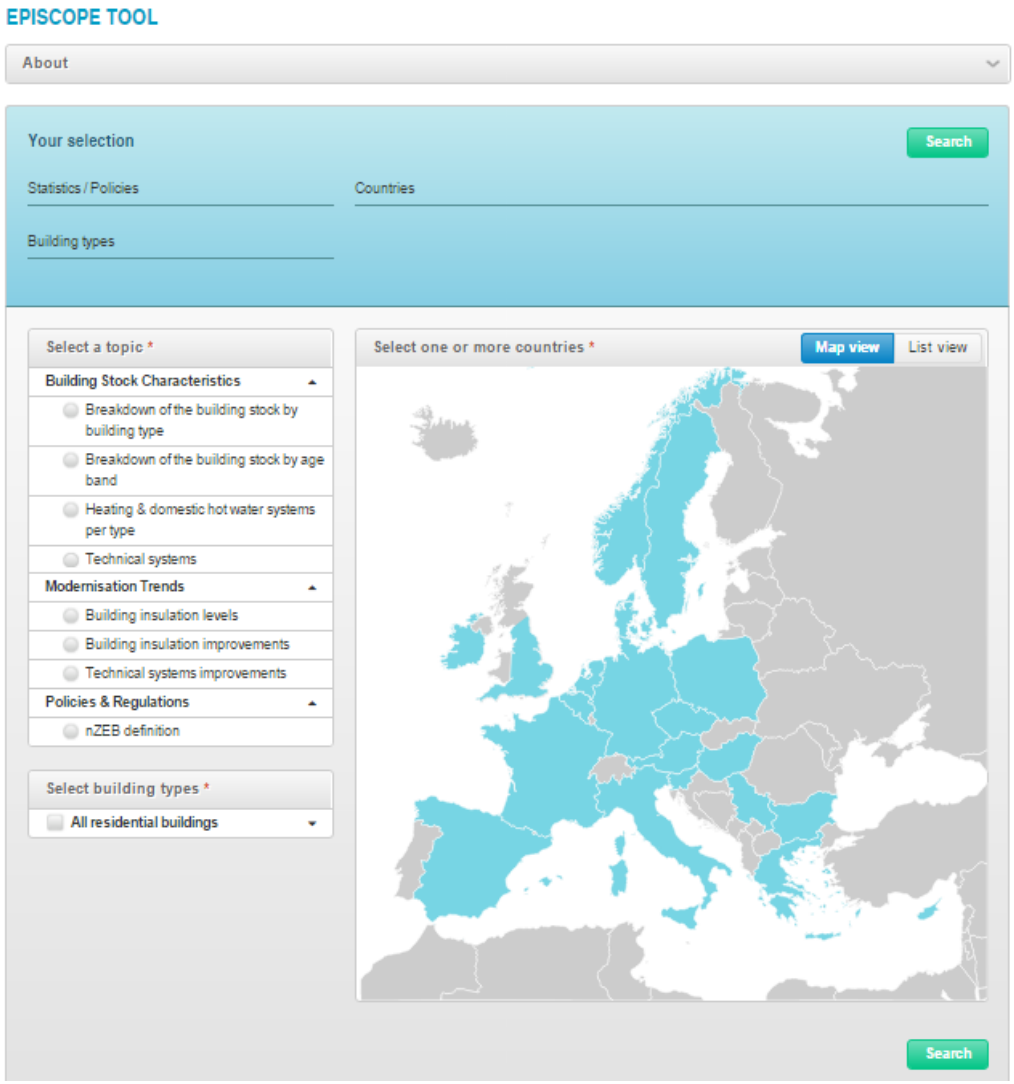
EPISCOPE tool: Intro



- **Dedicated web tool to present outcomes from the of the EPISCOPE project;**

  Presentation of the project;
  Methodology;
  Project partners;
  Data sets.

- **Data for residential building stock presented for 20 MS (EPISCOPE/TABULA)**, detailed information available for 6 MS (DE, NO, SI, GR, NL, UK-England)

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EPISCOPE tool: Example of results

EPISCOPE

Building insulation improvements

Wall | Roof | Ground Floor | Window

Complete residential building stock | Old residential building stock

CSV

Building insulation improvements – Roof (Old residential building stock)

Countries	Building insulation improvements				Notes / Sources
	Percentage of the insulation improved (from original state)	*Average thickness of improved insulation*	*Annual rate of insulation improvement (from original state)*	*Average thickness of insulation in recent modernization*	
Germany (DE)	47.0%	12,8 cm	1,50 %	16,2 cm	
Greece (GR)	21.5 %	n.d.	n.d.	n.d.	
Norway (NO)	86%	100 mm	2%	250 mm	
Slovenia (SI)	55.2%	n.d.	1.52 %	n.d.	

http://www.buildingsdata.eu/data-sources/episcope-data

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Join us at:
http://www.buildingsdata.eu

Thank you for your attention!

Aleksandra.Arcipowska@bpie.eu

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EPISCOPE

How to collect the necessary data to feed into the decision making process?

Conclusions from EPISCOPE

Nikolaus Diefenbach, Institut Wohnen und Umwelt, Darmstadt

18 November 2015

EPISCOPE Experts Workshop in Brussels, Belgium

IWU Institut Wohnen und Umwelt

Co-funded by the Intelligent Energy Europe Programme of the European Union

The Role of Monitoring in Climate Protection Strategies

EPISCOPE

Scope of EPISCOPE case studies

Building Stock Models / Building Typologies

basis for energy balance and scenario analysis in the building stock

Scenario Analysis

trends and perspectives of energy saving measures and technologies, energy consumption and CO_2 emissions

Monitoring of the Building Stock

- what could already be achieved?
- which are the current trends?

Policy Instruments for Climate Protection

- information, education
- policy law
- economic measures (taxes, funding)

„Earthing“ of the whole process:

- **Control of success**
- **Foundation of theory**

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Monitoring of Structural Data about Building Energy Efficiency

EPISCOPE

Overview of necessary structural data

Basic data of the buildings

- Building location and type (construction period, single-/multi-family house, detached/semi-detached/…)
- Additional information: wall construction type, roof type, historical monument, …

Building insulation

- Walls, roofs/upper floor ceiling, ground floor/cellar ceiling, windows
- Available insulation
- Quality of insulation (thickness, U-values)

Heat supply

- Main heating systems (gas/oil/biomass boilers, heat pumps, district heating, …)
- Additional systems (solar systems, stoves)
- Domestic hot water supply
- Insulation of heat distribution pipes
- Ventilation / climatisation systems

State indicators

Current state of the residential building stock

e.g. „How many walls have already been insulated?“

⇒ Starting point of scenarios

⇒ Success control: „What did we achieve in the past?“

Trend indicators

Current dynamics of the residential building stock

e.g. „How many walls are insulated per year?“

⇒ Trend scenario

⇒ Looking ahead: „Will we reach the future targets with that speed?“

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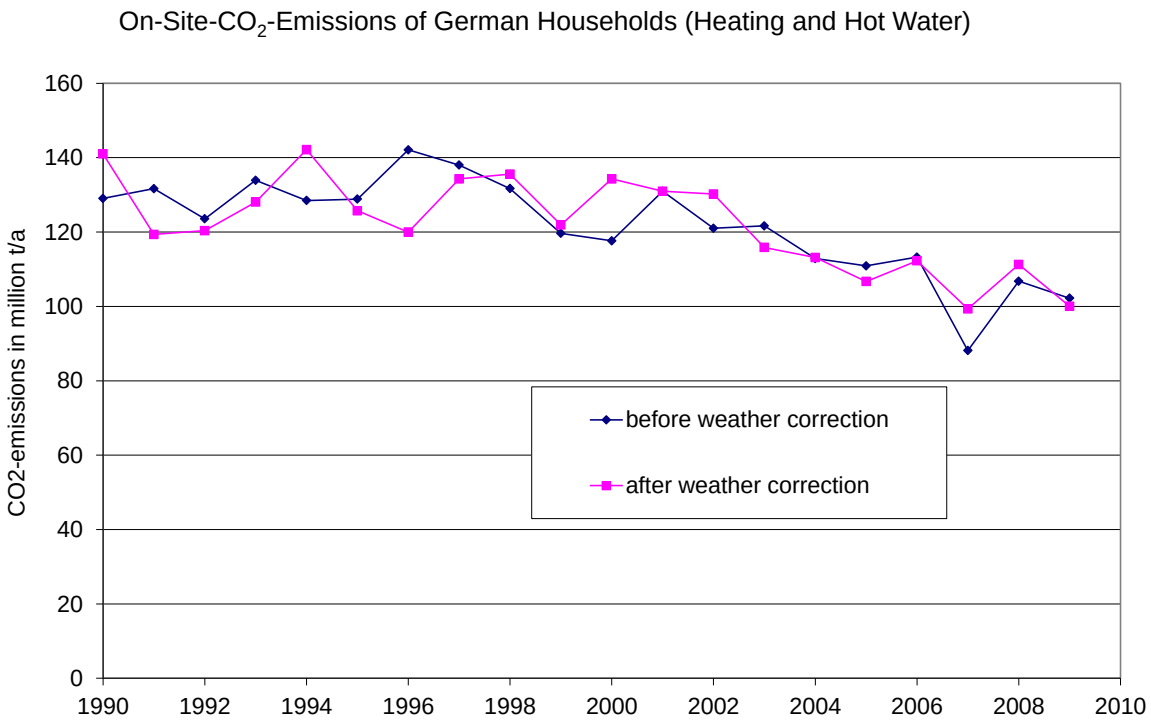
Why not only Monitoring of Energy Consumption and CO_2 Emissions?

EPISCOPE

Example: CO_2 emissions derived from the national energy balance calculations by IWU, 2013



- Uncertain weather correction -> only long term trends
- Uncertain breakdown to households / residential buildings
- **No information of reasons for the development**

Analysis of Monitoring Data in EPISCOPE

National residential building stocks
(17 countries):
Overview of available data

Presentation on the project website „typology branch“ TABULA

Presentation on the information platform BPIE data hub
BPIE DATA HUB FOR THE ENERGY PERFORMANCE OF BUILDINGS

national case studies

17 EPISCOPE Case Studies
(national/regional/local):
- Detailed analysis of available monitoring data
- some (local) projects (RS, HU, BE, CY, IE): supplementary surveys

Monitoring Indicators
(all empirically justified):
state indicators / trend indicators

Basic Case: Starting point of scenarios

Trend scenario

Further scenarios

Scenario indicators

additional assumptions

Monitoring situation is unsatisfactory in most of the building stocks:
- data gaps
- out-of-date data
- no regular update

individual concepts for introduction / improvement of monitoring

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Available Data Sources I:
Full Inventory Counts / Building Portfolios

EPISCOPE

- in principle a very convenient data source
- often not covering all data needs
- only representative if complete and up-to-date => database must be maintained
- typical on local level and/or for special stocks, e.g. from housing companies,
  in EPISCOPE case studies: FR, CZ, CY, (NL)
- National census usually not including energy efficiency data (exception: Sl)

=> In principle an ideal data source, but mostly not available

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Available Data Sources II: Energy Performance Certificate Databases

EPISCOPE

General analysis in predecessor IEE project DATAMINE (2006-2009)

DATA MINE

Obstacles of general application for building stock monitoring:

- collected EPC data often does not completely cover monitoring data needs
- EPC data bases might often be biased (not representative)

=> Applicable in individual cases and/or for individual questions (in EPISCOPE case studies: AT, IT, FR, IE, GR, RS)

=> Mostly not applicable as the general source for monitoring

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Available Data Sources III: Sample Surveys

- used in several EPISCOPE case studies :
  GB, DE, RS, NO, SI, BE, CY, HU, IE, FR, (NL)
- representative if basic statistical principles are considered (inter alia: random sampling)
- robustness depends mainly on the sample size, hardly on the sampling fraction
- coverage of data needs depends on questionnaire

=> In principle applicable for general (international / harmonised) monitoring approaches

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Sample Surveys as a generalisable approach
I: Comprehensive Surveys

Preference: „Comprehensive surveys“

- Example: English / UK Housing Surveys
- face-to-face interviews, if possible on-site inspections
- large questionnaire
  => large information base
  => e.g. analysis of correlations is possible

⇒ **further option: Collection of both structural and energy consumption data**

- Calibration of energy balance calculation models to realistic values
- Specific question of high relevance, maybe with a specific empirical approach (independent of regular monitoring)

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Sample Surveys as a generalisable approach
II: Short Surveys

EPISCOPE

Second best / lower-cost alternative: „Short surveys“

- Example: current IWU project: residential building survey (Germany / Hesse) started in 10/2015
- Questionnaires submitted to interviewees (house owners) by letter post to save costs
- short questionnaires (e.g. 4 pages only) => reducing effort of interviewees
  => increasing the return rate
- „Rule of thumb“: return of circa 10,000 questionnaires necessary to enable robust results also for thermal modernisation trends (magnitude 1 %/a)
- in principle suited for an international / (partly) harmonised approach
- difficulties (to be solved for each building stock)
  - access to the (almost) complete population of buildings from which the random sample is drawn
  - access to the interviewees (addresses of house owners)

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General Conclusions

- Monitoring of structural data about building stock energy efficiency plays a prominent role for climate protection strategies
- The current situation of available information is unsatisfactory in many European Building Stocks:
  Data is often incomplete / not reliable / out-of date
- The problem cannot be solved with the existing data sources: New and regular data collection will be necessary
- Solutions may depend on the individual situation, but sample surveys (large enough and following statistical principles) are a generalisable monitoring approach

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Questions / Discussion

EPISCOPE

BPIE

Thank you for your attendance!

Visit the EPISCOPE website at: episcope.eu

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Ms Britta Stein

b.stein@iwu.de

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