

University of Geneva

## Moving towards cost-optimal and nearly zero energy renovation. Policies and practices in the EU

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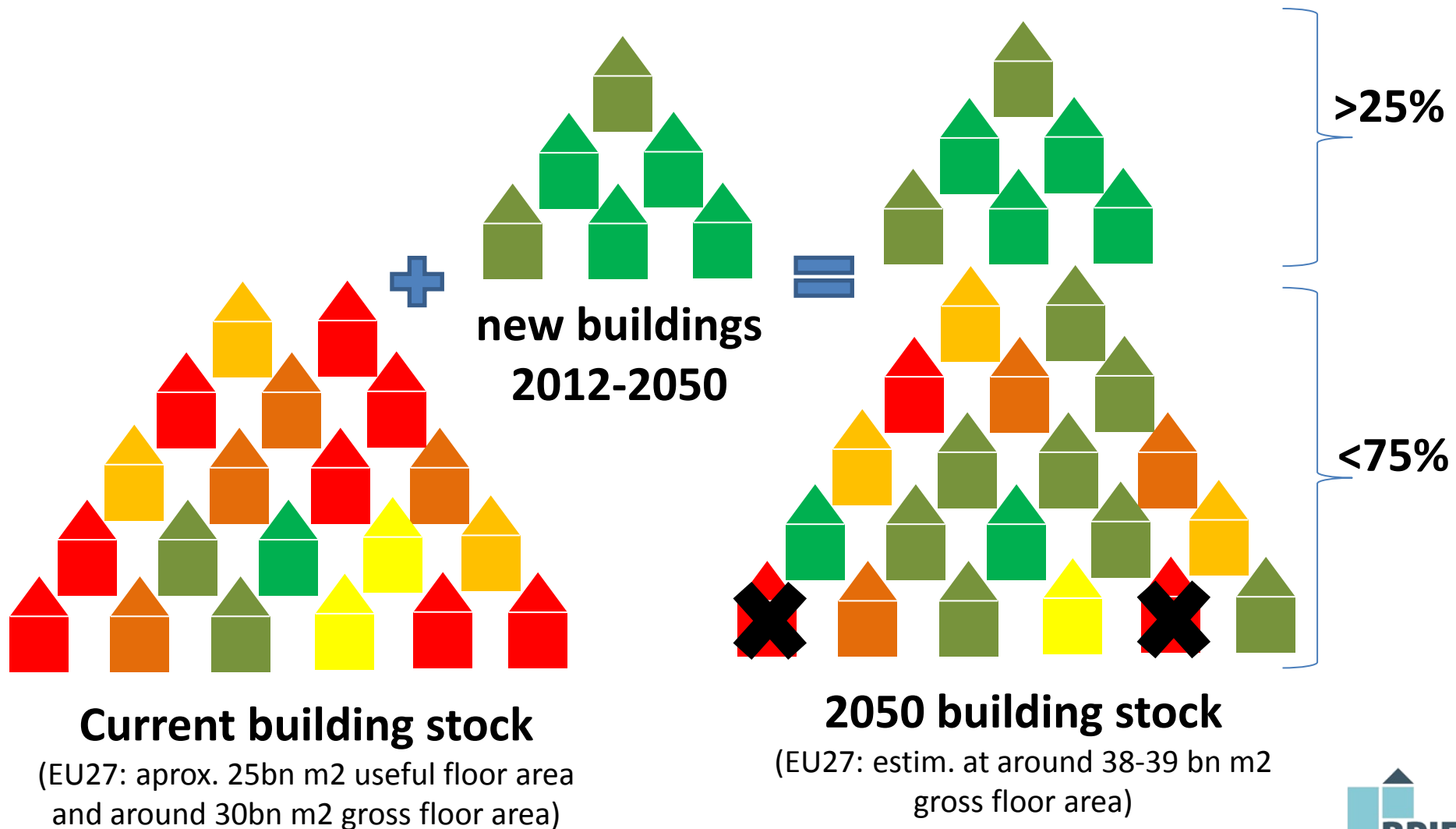
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# A strong interest in the building sector

- ▶ Buildings' (residential + commercial) share in Europe's energy end-use consumption is about 42 %
- ▶ 35% of EU CO2 emissions
- ▶ 9% of EU GDP
- ▶ 7-8 % of EU employment
- ▶ Important cultural, historic, and economic value
  - 501 million inhabitants living in ~ 170 million homes
  - Once built, buildings last for decades
  - Architectural protection of historic buildings
  - Large market for the construction sector, appliances and equipment covered by EU minimum efficiency requirements, performance labels and other standards
  - Business opportunities, especially for SMEs

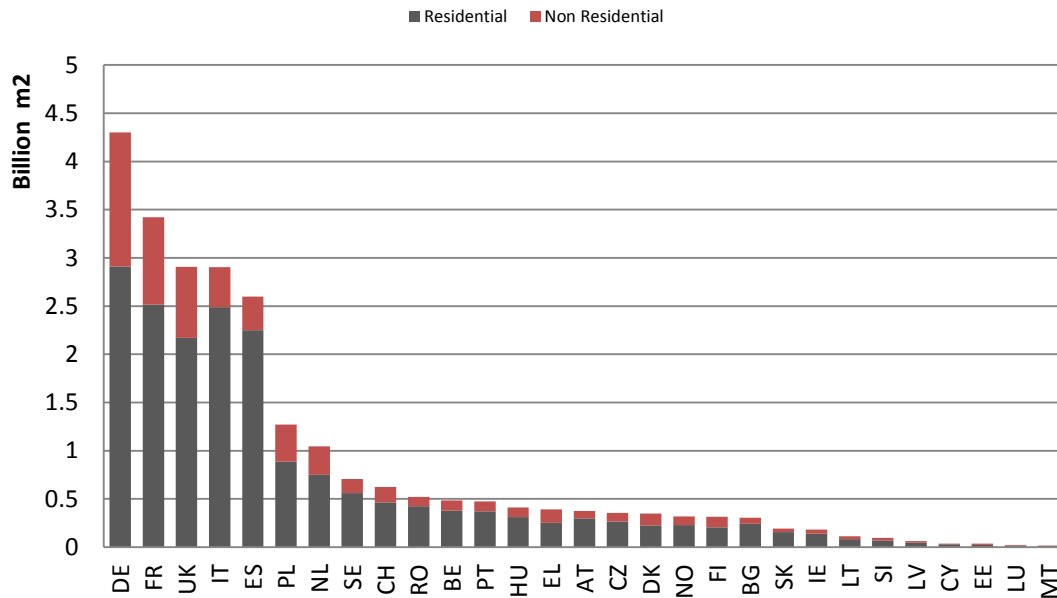


...a big challenge by 2050 for both existing and new buildings

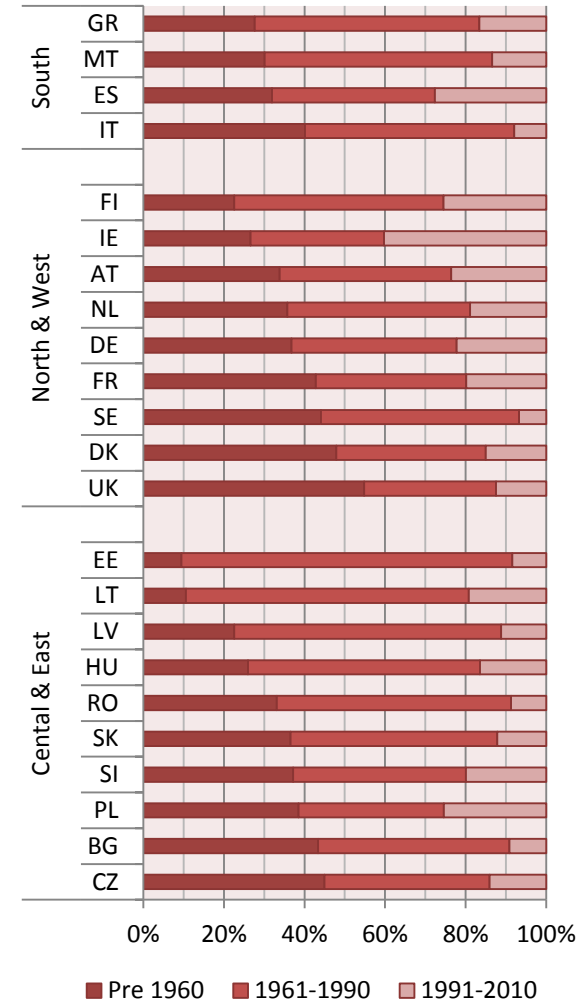


# Building stock 2010

## Floor Space per country



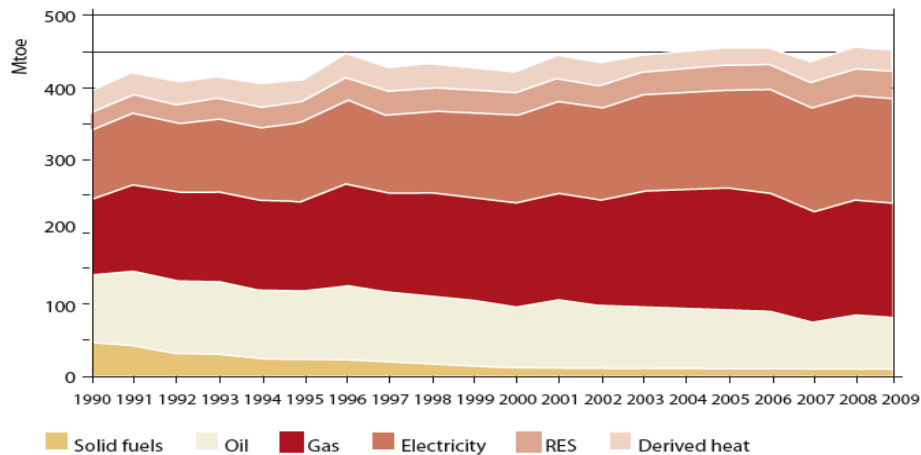
## Age profile of residential floor space



EE: Data only from 1951 onwards.  
 IT: Data excludes heritage buildings before 1950.  
 LT: Data only from 1941 onwards.  
 ES: Data excludes secondary houses  
 SE: Data only from 1921

## Final energy consumption in the building sector for the EU27, Ch, No

Source: Eurostat database



# Complex EU energy, climate and sustainable development strategies

## EUROPE 2020 - the EU Comm. Strategy for Growth

7 flagship initiatives:

- **A resource-efficient Europe.**

- Long-term framework for actions in many policy areas:
  - 2011: Low-carbon Economy 2050 Roadmap
  - 2011: Roadmap for a resource-efficient Europe 2050
  - 2011: Energy 2050 Roadmap
  - 2011: European Energy Efficiency Plan 2020

SUSTAINABLE

- An Industrial Policy for the Globalisation Era

- Innovation Union
- Digital Agenda for Europe
- Youth on the Move

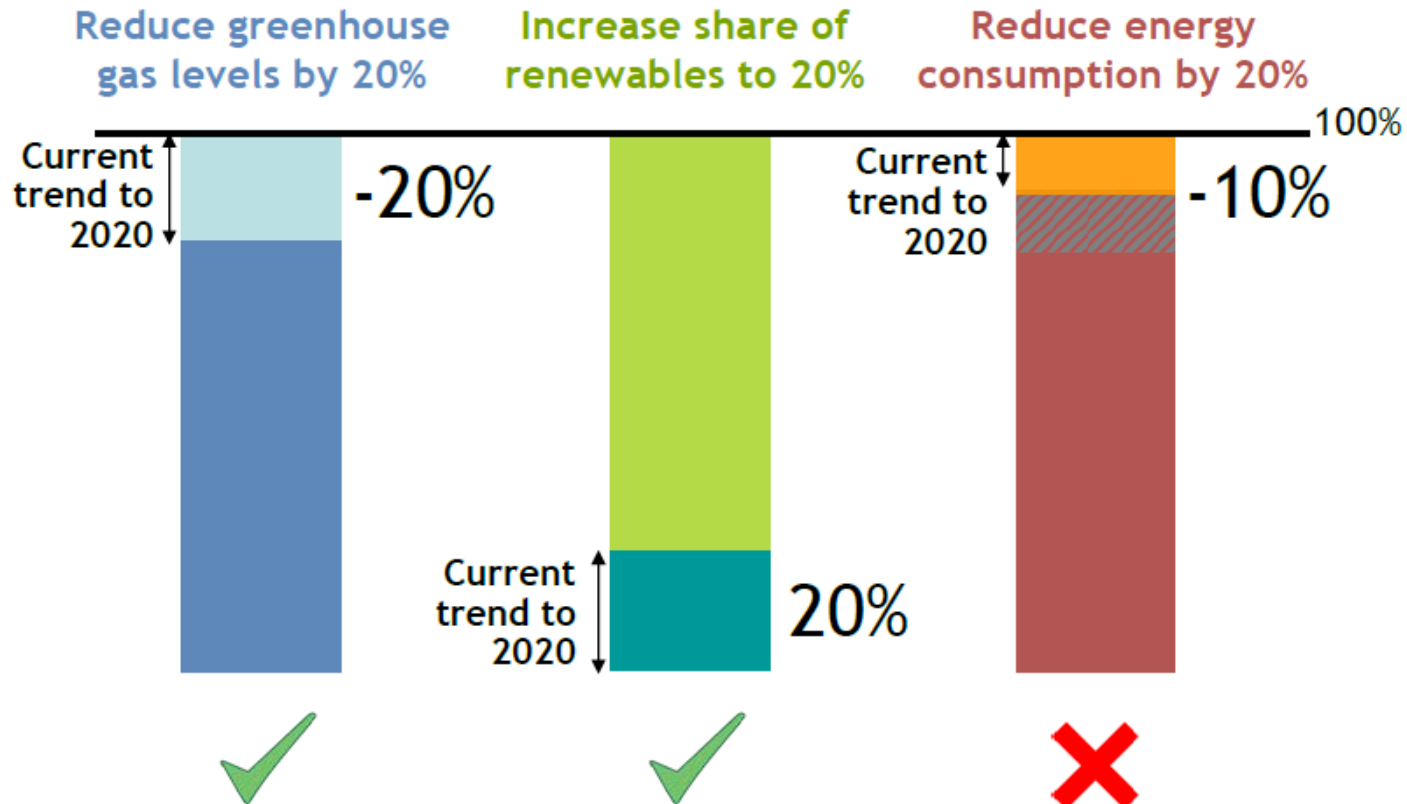
SMART

- An Agenda for New Skills and Jobs
- European Platform Against Poverty

INCLUSIVE



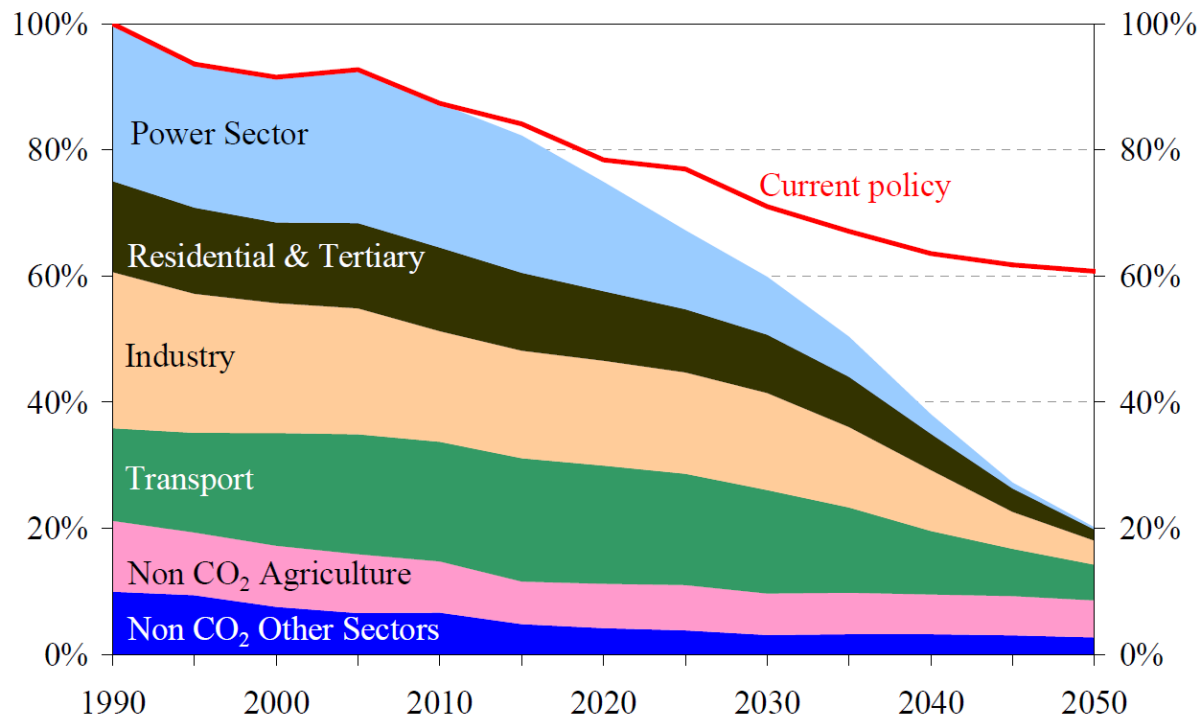
# Climate and Energy medium-term targets



Source: Presentation of J.M. Barroso to the European Council, 4 February 2011

# Ambitious long-term goals to reach

## Roadmap for moving to a competitive low-carbon economy in 2050



...with very high sectorial targets

GHG reduction vs. 1990	2030	2050
<b>Total</b>	-40 to -44%	-79 to -82%
<b>Power</b>	-54 to -68%	-93 to -99%
<b>Industry</b>	-34 to -40%	-83 to -87%
<b>Transport</b>	+20 to -9%	-54 to -67%
<b>Residential and services</b>	-37 to -53%	-88 to -91%
<b>Agriculture</b>	-36 to -37%	-42 to -49%
<b>Other non-GHG emissions</b>	-72 to -73%	-70 to -78%

*Source: Roadmap for moving to a competitive low-carbon economy in 2050*



## ...in a resource efficient manner

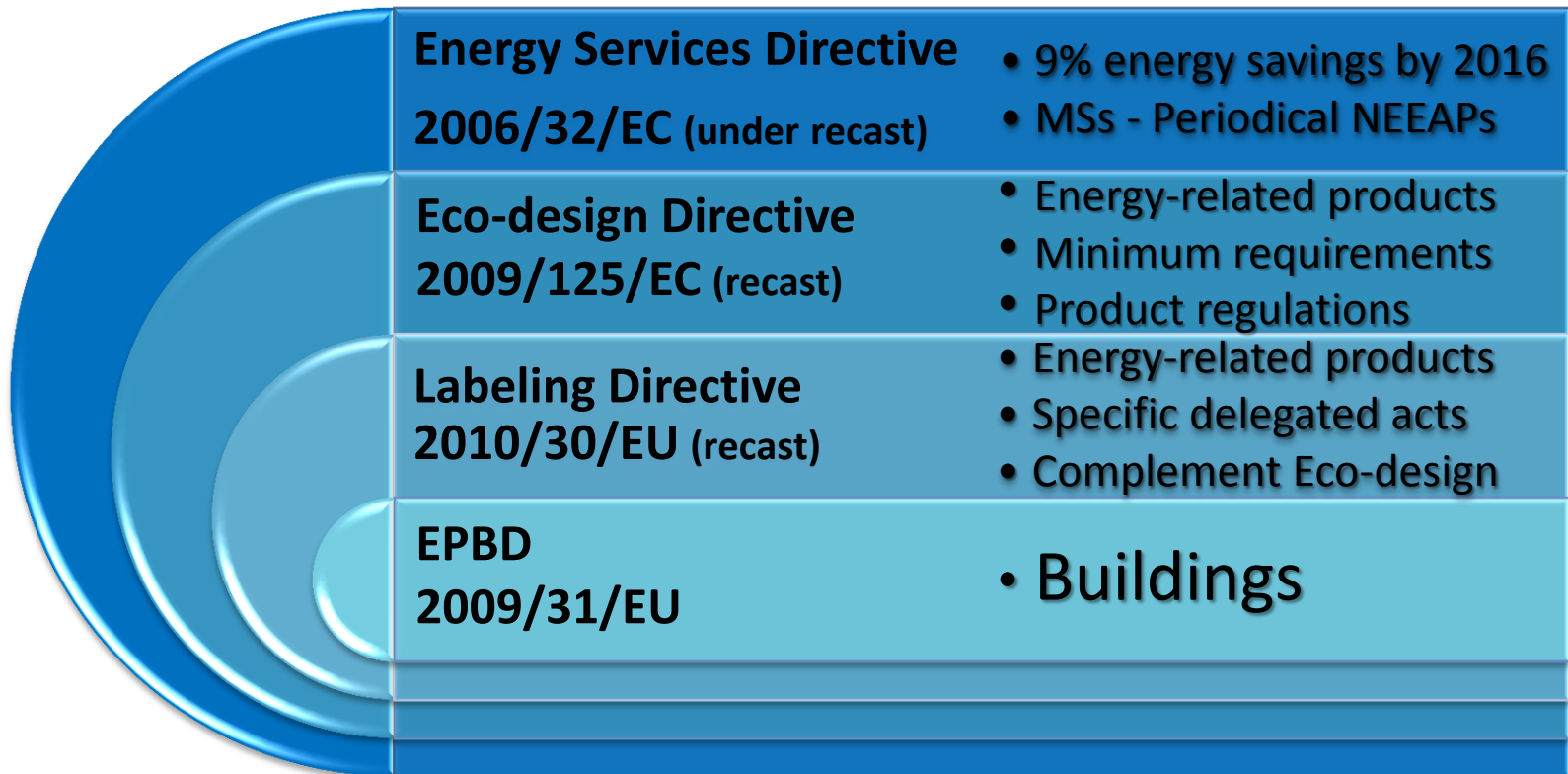
### **EU Resource Efficiency Roadmap 2050**

- **Buildings one of key sectors (together with food and mobility)**

By 2020:

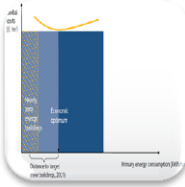
- renovation and construction of buildings at high resource efficiency levels.
- Life-cycle approach will be widely applied;
- Reduce Fossil fuels use via Energy Efficiency and RES
- Reduce GHG emissions
- All new buildings will be nZEB and highly material efficient,
- policies for renovating the existing building stock will be in place so that it is cost-efficiently
- refurbished at a rate of 2% per year
- 70% of non-hazardous construction and demolition waste will be recycled.

# A complex EU end-use energy efficiency legislation



To be transposed by 9 July 2012

# Energy Performance of Buildings Directive



## Energy performance & Cost optimality

- MSs: Minimum energy performance requirements
- Cost-optimal methodology (common framework)
- Requirements for technical building systems



## Existing Buildings

- All the buildings undergo major renovation should implement energy efficiency measures
- Minimum requirements for buildings and components



## New Buildings



## Nearly Zero Energy Buildings

- By 31 Dec. 2018 public admin. Bdgs
- By 31 Dec. 2020 all buildings
- National plans for nZEB



## Energy performance certification

- Implement EPC schemes
- Recommendation for cost-optimal improvements
- Independent control systems



## HVAC inspection

- Regular inspections (heating > 20kW, AC>12kW)
- Independent control systems



## Financial incentives & Market barriers

- MSs: to prepare lists of measures and instruments
- Take into account cost-optim. for these measures

# Cost-optimal methodology

## (Article 5, EPBD)

- Published by the EU Commission in March 2012 (Delegated Act) + Implementation guidelines in April 2012. (Significant delay vs EPBD timeline: June 2011)
- MSs: national methodologies based on framework by 30 July 2012

To be implemented by 9 Jan 2013 for public buildings and by 9 July 2013 for all

# Cost-optimality

***For the first time, the EPBD provides a common framework methodology to the MSs on how to set energy performance requirements, also by considering the economic aspects as a driver for improving technical building codes***

- **Rationale:**

Equivalent level of ambition in all MS, but no harmonised requirements


- **Aims:**

- Shift focus from upfront investment costs to global life cycle costs (including energy costs)

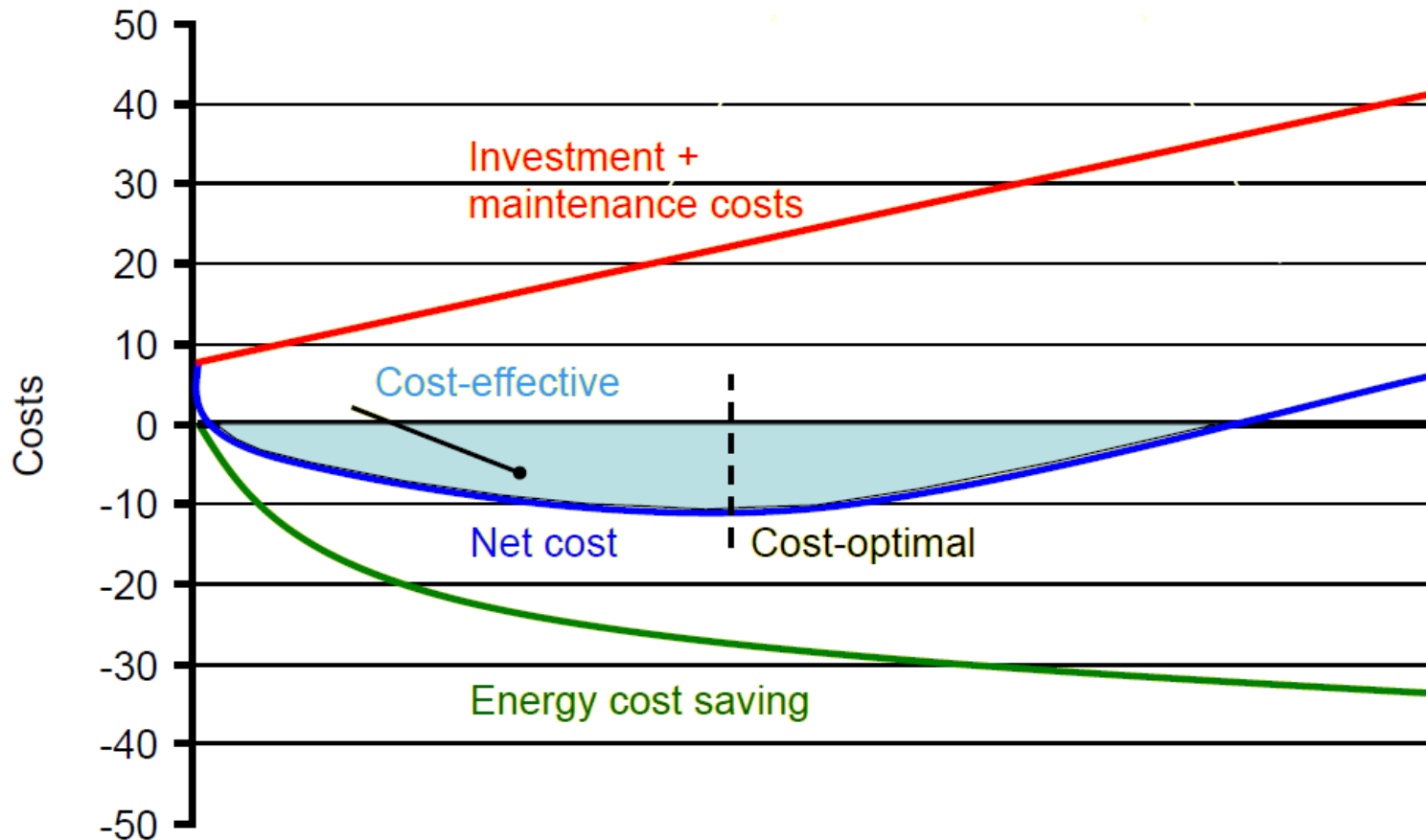
- Tightening the building codes for new buildings and renovation of the existing buildings

- Cost-optimality: will become reference point for EU Funding!**

## Steps of cost-optimality

1. **Select** reference buildings/systems
  2. **Establish** sets of energy efficiency measures
  3. **Calculate** the energy performance
  4. **Calculate** the life cycle costs using net present valuation  
 Cost optimal set of measures for optimising energy performance of a reference building in a given MS, in kWh/(m<sup>2</sup>/a)
  5. **Report** to Commission on calculations and input data used
  6. **Compare** results with current building codes and if necessary **adjust them!**
- Cost optimum for micro or macro level (the latter including carbon costs)
  - RES options to be considered

# Cost-optimality



BPIE study available here: [http://www.bpie.eu/cost\\_optimality.html](http://www.bpie.eu/cost_optimality.html)



# Flexibility that can lead to sub-optimal results

- The application of national calculation procedures is allowed as an alternative to using CEN standards;
- Some efficiency measures may be excluded from the calculation upfront if previous cost analysis have shown that these are “far from cost optimal” (‘previous’ but how long ago?)
- A number of variables where MS are free to chose values:
  - estimated economic lifecycle
  - discount rate (societal including the carbon costs or private)
  - the costs for energy carriers, products, systems, maintenance cost, operational costs and labour costs;
  - primary energy factors
  - energy price development; alternatively to those recommended, MS are free to use own national projections.

# Nearly zero-energy buildings

## (Article 9 EPBD)

‘nearly zero-energy building’ [...] has a **very high energy performance**. The **nearly zero or very low amount of energy required** should be covered to **a very significant extent by energy from renewable sources, including on-site or nearby RES**. (EPBD)

**Scope:** energy need for heating, cooling, hot water, ventilation and lighting (the last only for non-residential buildings)

nZEB will not be a technical standard itself, nor a single definition/approach, but a policy requirement leading to tightening buildings' codes requirements.

to be implemented by 9 January 2013

Article 6 for public authorities buildings: by 9 January 2013

# Main Requirements

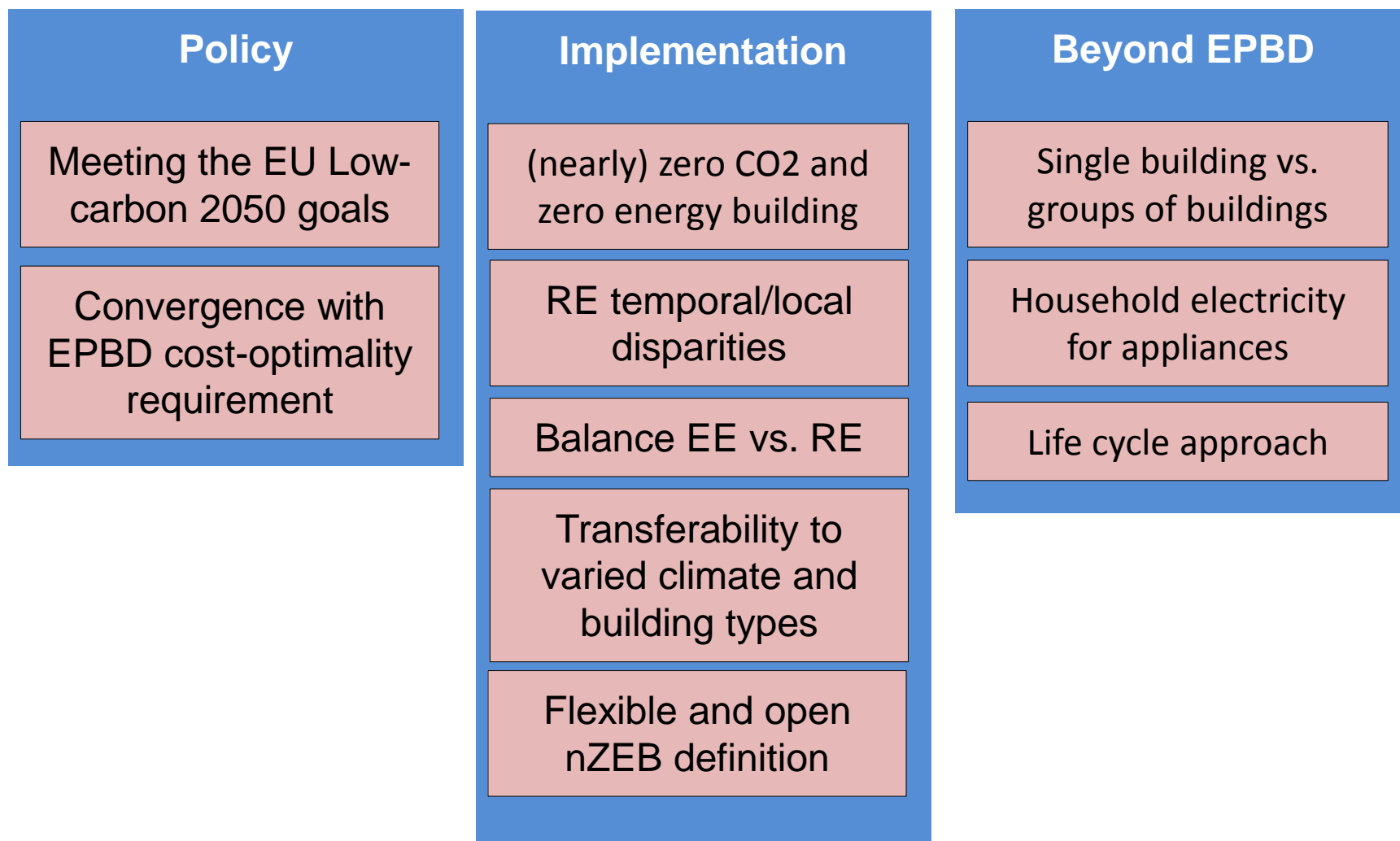
- **Art. 9: Nearly Zero-Energy Buildings (nZEB)**
  - by 31 December 2020, all new buildings are nZEB
  - after 31 December 2018, new buildings occupied and owned by public authorities are nZEB
  - national plans for nZEB
    - 2015 interim target
    - national definition for nZEB
    - show the financial instruments and measures
  - public sector leading example: policies and measures for stimulating the buildings refurbishment into nearly zero-energy buildings

# Plans, strategies and proposals towards nZEB

Country/year	Existing	2010-11	2012-13	2014-15	2016	2020
<b>Belgium</b>	119-136 kWh/m <sup>2</sup> /year (primary energy)	-25 %				
<b>Denmark</b>	2010: 52.5-60 kWh/m <sup>2</sup> /year (primary energy)	-25 %		-50 %		-75 %
<b>Finland</b>	65 kWh/m <sup>2</sup> /year (heating demand)	-15-30 %	- 20 %	Passive house for public		
<b>France</b>	Until 2012: Fossil fuels: 80-130 kWh/m <sup>2</sup> /year Electricity 130-250 kWh/m <sup>2</sup> /year (primary energy)		LEB Effinergie 50 kWh/m <sup>2</sup> /year			Positive E+
<b>Germany</b>	2009: 70 kWh/m <sup>2</sup> /year (primary energy)		-30%			Climate neutral buildings not using fossil fuels
<b>Ireland</b>	2011: 64 kWh/m <sup>2</sup> /year (primary energy)	-60 %	CO <sub>2</sub> neutral			
<b>Netherlands</b>	Regulated through EPC factor 2008: ~100-130 kWh/m <sup>2</sup> /year (primary energy)	-25 %	Climate neutral public building	- 50 %		Energy neutral buildings
<b>Sweden</b>	2009:110-150 kWh/m <sup>2</sup> /year (delivered energy)	-20 %		25 % of all new is ZEB		ZEB
<b>United Kingdom</b>	Regulated through CO <sub>2</sub> demands 2010: ~100 kWh/m <sup>2</sup> /year (primary energy)	-25 %	-44 %	-	Zero Carbon	

(Source: BPIE's study on 'Principles for nearly zero energy buildings quoting Erhvervs og Byggestyrelsen,2011)

# 10 challenges for a robust and sustainable nZEB definition



Comprehensive BPIE report on 'Principles for nZEB' available at: [www.bpie.eu](http://www.bpie.eu)

# nZEB Principles

**Boundaries** in the energy flow related to the operation of the building (with clear guidance on how to assess):

## Thresholds:

...that defines the energy quality of the energy demand

Threshold for the maximum allowable energy need (*proposal: fix threshold in a corridor between C-O and BAT*)

energy demand

...where the share of renewable energy is calculated or measured

Threshold for the minimum share of renewables demand (*proposal: 50%<>90%*)

RES share

... where the overarching primary energy demand and CO<sub>2</sub> emissions are calculated

Threshold for the overarching primary energy demand and CO<sub>2</sub> emissions (*proposal: <3kgCO<sub>2</sub>/m<sup>2</sup>/yr*)

primary energy & CO<sub>2</sub>

# Checking the nZEB principles: simulation on reference buildings

**Aim:** Maximum coverage with a straightforward set of variants

## **Two reference buildings:**

1. Detached single family house (129 m<sup>2</sup>) 2. Four-level office block (1600 m<sup>2</sup>)

## **...in three European climate zones:**

1. Cold (Copenhagen) 2. Moderate (Stuttgart) 3. Warm (Madrid)

## **...considering seven heat supply systems:**

1. Air heat pump 2. Brine heat pump 3. Biomass boiler 4. Gas boiler 5. District heating 6. Gas- Micro-CHP 7. Biogas- Micro-CHP

## **...plus additional compensation with on-site PV or green grid electricity**

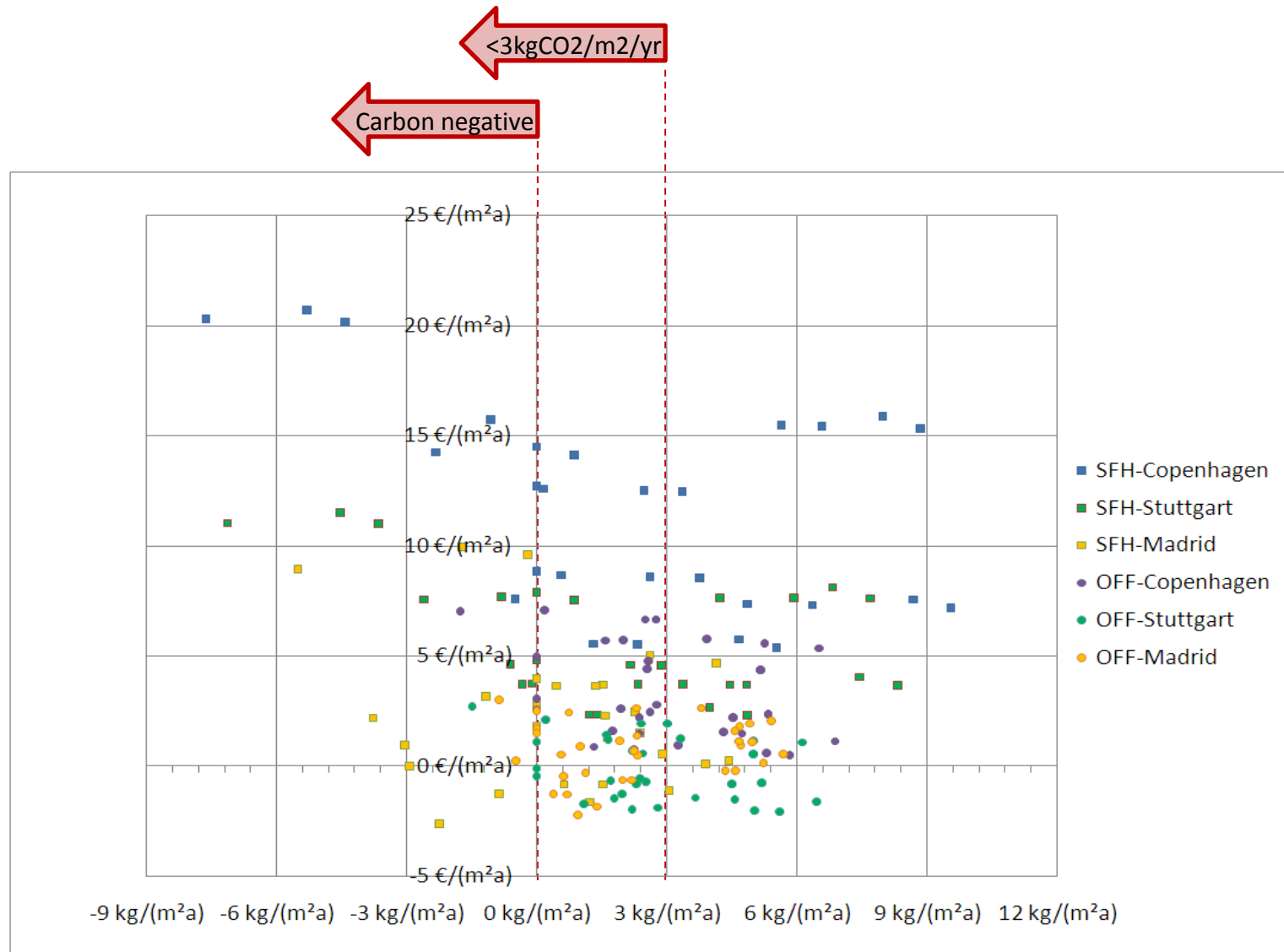
## **...with or without appliances consideration in the energy demand**

## **....with good thermal building quality:**

Well-sealed and insulated building shell with highly efficient ventilation systems (below 50kWh/m<sup>2</sup>/yr)



# Specific additional capital costs of the examined nZEB solutions vs. specific CO<sub>2</sub>-emissions



## **Existing buildings**

(Article 7, EPBD)

## **Technical buildings systems**

(Article 8, EPBD)

**Art 7,8 to be implemented by:**

**-9 January 2013 for public authorities' buildings**

**-9 July 2013 for all buildings**

# Main Requirements

- **Art.7: MSs shall take the necessary measures to ensure that when buildings undergo major renovation, the building or the renovated part thereof is upgraded in order to meet minimum energy performance requirements.**
- **Art. 7: MSs shall encourage, in relation to buildings undergoing major renovation, the consideration and taking into account of high-efficiency alternative systems (i.e. RES, CHP, DH, heat pumps).**
- **Art. 8: MSs shall set requirements for technical building systems from existing buildings in respect of the overall energy performance, the proper installation, and the appropriate dimensioning, adjustment and control.**

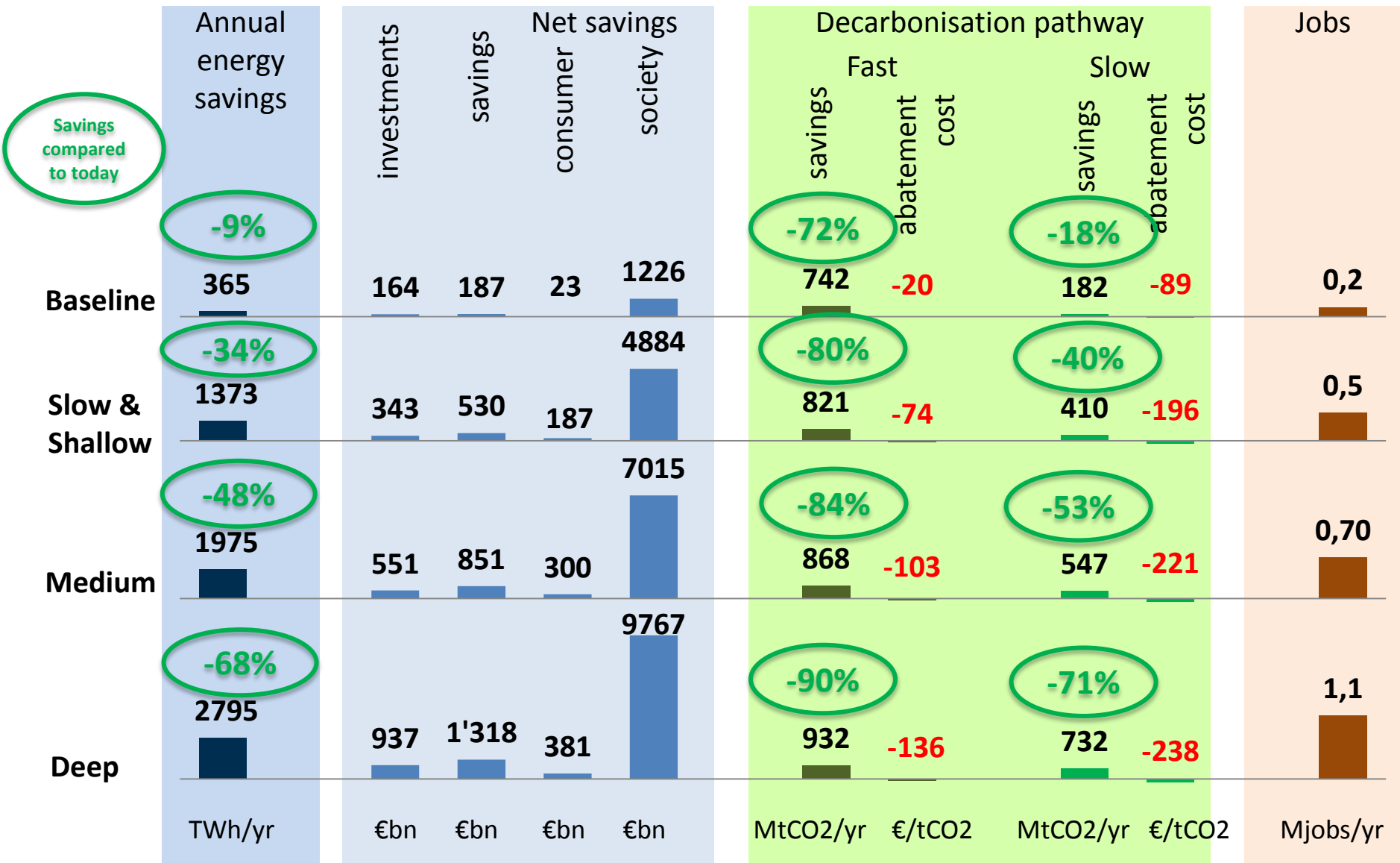
# Building Codes in the EU

		AT	BE-W	BE-Br	BE-F	BG	CH	CY	CZ	DE	DK	EE	EL	ES	FI	FR	HU	IE	IT	LT	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
Building codes	New																													
	Renovation														P															
Energy Performance	New																													
	Renovation														P															
Prescriptive/Element-based criteria	Thermal insulation																													
	Air permeability																													
	Ventilation																													
	Boiler/AC efficiency																													
	Lighting efficiency																													
	Additional specific requirements, different from country to country: summer comfort, overall thermal coef, thermal bridges, humidity, air velocity & exchange rate, RES share, orientation, windows size, glazing, solar gain, cooling, CO2 concentration, indoor temperature																													

# EPBD requirements in the light of long-term 2050 aims

- Need to:
  - renovate the entire building stock at high standards
  - decarbonise the power sectorand
  - improve data collection on buildings energy consumption and characteristics
  - develop ambitious renovation programmes and requirementsand moreover
  - To realise the significant macro-economic benefits in terms of jobs, reduce the energy import dependency, social welfare etc.

# Renovation depth and speed make a big difference



BPIE's study 'Europe's Countries under the microscope', available at [www.bpie.eu](http://www.bpie.eu)

# Financial incentives and market barriers

## (Article 10 EPBD)

MSs shall consider the most relevant financing and other instruments such to catalyse the energy performance of buildings and the transition to nearly zero- energy buildings

### Main requirements

- by 30 June 2011: MSs to draw up a list of existing and proposed measures and instruments including those of a financial nature
  - update this list every three years
  - to be communicated to the EU Comm.; option for including it in the NEEAPs
- MSs shall take account of the cost-optimal levels of energy performance when providing incentives for the construction or major renovation of buildings



# Main challenges for effective financing

- Longer payback, high transaction costs
- Impact of the economic crisis
- Public authorities have limited budget
- Not well tailored and not enough ambitious programs
- Split incentive issue

and

- Technical challenges: quality of renovations, lack of experience and skills, less ambitious building codes

and

Social challenges: awareness, occupancy impact on real performance of buildings

**BPIE Round table on financing en. eff. in EU buildings (Nov 2010):**

[http://www.bpie.eu/event\\_proceedings\\_brussels.html](http://www.bpie.eu/event_proceedings_brussels.html)

**BPIE Taskforce in Romania:** [http://www.bpie.eu/past\\_events.html](http://www.bpie.eu/past_events.html)

# Instruments for Energy Efficiency in buildings in the EU

- Energy tax (at EU and national level)
  - Taxation (reduced VAT, accelerated depreciation, tax deductions);
  - Incentives and financing for energy efficiency investments (national)
  - Public procurement;
  - White certificates/Energy savings obligations (national level);
  - Promotion of energy services (ESCOs) (national action, but not enough!)
  - Energy Audits (at national level)
  - Demand side management (not many, at national/regional)
  - Minimum Efficiency Requirements-MEPS (at EU level)
  - Buildings Codes/standards (at national level but also driven by EPBD)
  - Buildings certification and equipment labelling (national and EU level)
  - Voluntary programmes (mainly in the industrial sector at national level and for equipment at EU level, but also for buildings in few cases)
  - Information/awareness (mainly national)
- 
- Most of the schemes:  
Grants, subsidies , Preferential loans, Tax incentives and levies

# EU and carbon financing for energy efficiency in buildings

## EU Financing

### Structural Funds

2007-2013  
€ 347bn. out of  
which:

€ 9,4bn en.  
eff.&RES

€ 86bn R&D,  
€ 27,4bn SMEs,  
€ 105,3bn  
environment,  
€ 48,1bn climate  
change

### EIB-EIF instruments

European Local ENergy  
Assistance - ELENA  
-technical assistance facility  
-min leverage factor: 25

JESSICA: Sustainable development  
for urban areas

JEREMIE: Improved access to  
finance for micro business and  
SMEs in the EU regions

#### European Energy Efficiency Fund (EEE-F)

- 3,7% of the EEPR/ € 275 mn in total
- -DB (De), EIP, CDP (It)

## Carbon financing

### AAU trade under Kyoto and GIS schemes

– some countries use it for  
financing EE in buildings

### EU ETS Phase 3 (2013-2020)

– up to € 300mn allowances  
for demo CCS and RES but  
there are initiatives for  
including also EE

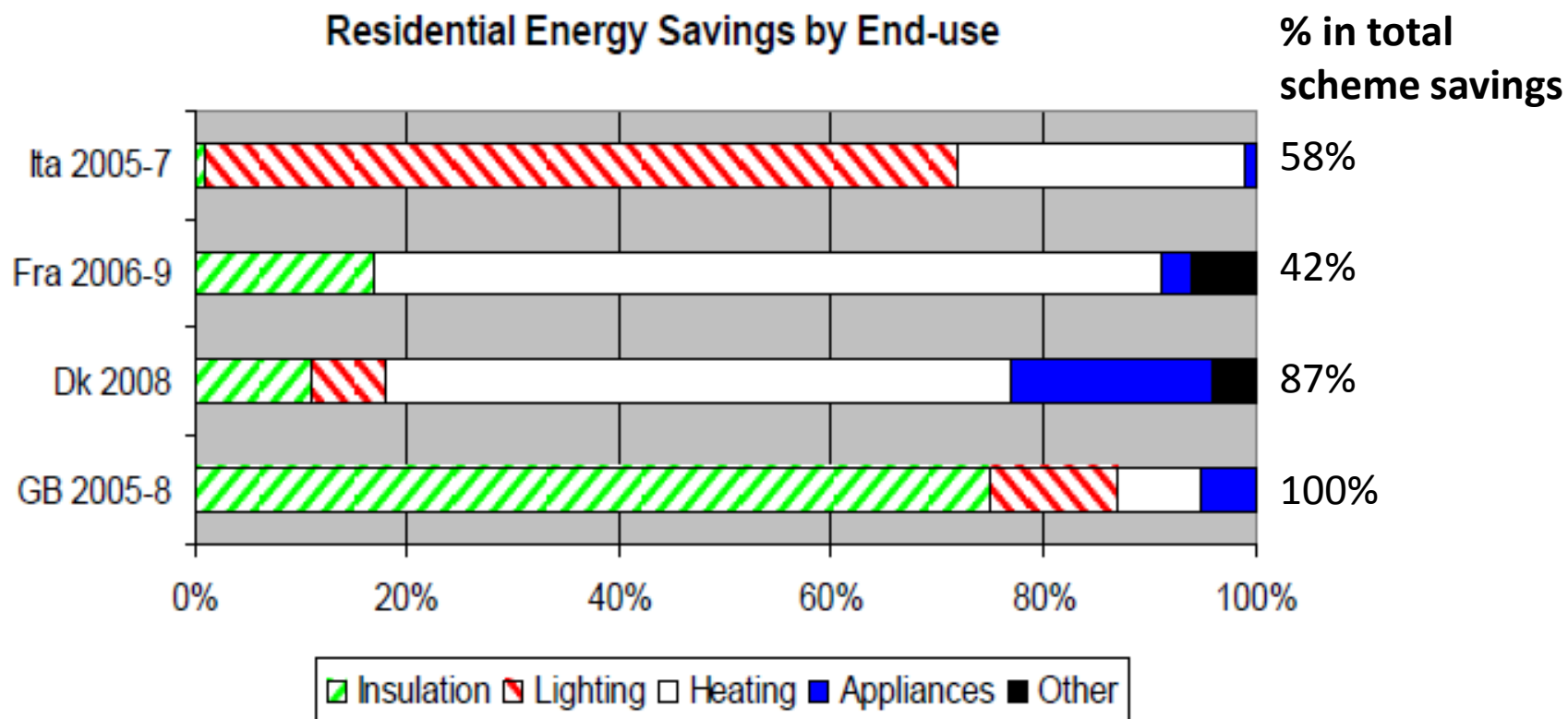
Few examples of national financing schemes for energy efficiency in buildings in the EU

## Ex. 1: White certificates / Energy savings obligations (1)

Country	Obligation for	Eligible customers	Current size of obligation	Estimated annual expenditure (euro/capita)
Be (Fl)	Electricity distributors	residential and non energy intensive industry and service	0,6TWh annual	26 mn Euro (4)
Fr	All energy suppliers	All (including transport) except EU ETS	54 TWh over 3 yrs	180 mn Euro (3)
It	Electricity&gas distributors	All including transport	2,2 Mtoe in 2008	190 mn Euro (3)
UK	Electricity&gas suppliers	Residential only	185 MtCO2 3 yrs to 2011	900 mn Euro (15)
Dk	Electricity,gas & heat distributors	All except transport or covered by EU ETS	0,82TWh annual	25 mn Euro (5)

Source: Eoin Lees, eceee: 'Experience of EU Energy Efficiency Obligations – Diverse but Delivering', 30 Sept 2011, Bucharest Forum

## Ex. 1: White certificates / Energy savings obligations (2)



Source: Eoin Lees, eceee: 'Experience of EU Energy Efficiency Obligations – Diverse but Delivering', 30 Sept 2011, Bucharest Forum

## Ex 2: Germany's KfW loans

- Promotional loans for both for new and existing buildings

New buildings	Existing buildings
max. 50.000 EUR per housing unit	max. 75.000 EUR per housing unit
<b>KfW-Efficiency House standards</b> KfW115; KfW-100-94-55kWh/m <sup>2</sup> /yr -100% of EnEv; KfW85; KfW70; KfW55; KfW40-40% of EnEv)	
partial debt relief possible	
-three promotional stages	-grants as an alternative for owners of single and two family houses -additional special support available
<b>Higher energy efficiency means better conditions</b>	

### Results:

Subsidies for aprox. 3,1 mn homes

Reduction of 3,9 mn t CO<sub>2</sub>/yr.

Aprox. 200.000 jobs/year

Cumulative savings (heating costs): 950 mn euros

2009: 10,6 bn Euro en eff and 6,3 bn Euro RES

Investments triggered: aprox 51 bn Euro



### Lesson learned:

Open to all investor groups

Focus on long term loans

A brand for energy efficiency

Higher energy efficiency is rewarded

Distributional network and Funding



## Ex 3: Lithuania – JESSICA holding fund

- A tool to support the implementation of Programme for the Modernisation of Multi-Apartment Houses:
  - to modernise by 2020 at least 70 % of 24.000 multi-apartment houses before 1993 saving at least 30% of the heating energy and fuel expenses as comparing to 2004
- Budget: EUR 227 mn. (EUR 100 mn National + EUR127 mn. ERDF)
- Financing scheme:
  - Fixed interest rate at **3% p.a.**
  - Maturity up to **20 years**
  - **2 years** grace period (during construction)
  - No collateral or guarantees required;
  - **15% JESSICA loan write-off** if certain energy efficiency level achieved (upon completion) 110-145 kWh/m<sup>2</sup> (Class “D”)
  - **100% grant** for preparation of renovation documentation reimbursed (paid from national funds)
  - **100% of reimbursement of installments** to low income families;
  - **15 %** additional support from Climate Change Special programme for energy efficiency measures implementation JESSICA loan **write-off** if not less than 40 % energy savings are achieved
- **Results March 2012: more than EUR14mn credits and EUR22,4mn planned investments, energy savings of around 50%**

## Ex 4: Czech Republic - Green Savings Programme (GIS)

- Financed from the trade of the Assigned Amount Units (AAU) under Kyoto ETS.
- Aprox € 800 mn, by 30 June 2012
- By 2010: 72000 applications for subsidies (of which 6000 housing blocks/168000 flats)

Measure	Subsidy
<b>A.1 Complex insulation (decrease of the need of energy for heating by - at least - 40%)</b>	
<b>Complex insulation (specific heat requirement) &lt;30 kWh.m<sup>-2</sup>a<sup>-1</sup>)</b>	<b>58 EUR /per m<sup>2</sup></b>
<b>Complex insulation (specific heat requirement) &lt;55 kWh.m<sup>-2</sup>a<sup>-1</sup>)</b>	<b>40 EUR /per m<sup>2</sup></b>
<b>A.2 Partial thermal insulation</b>	
Partial thermal insulation– (decrease of the need of energy for heating by - at least 30%)	23 EUR /per m <sup>2</sup>
Partial thermal insulation- (decrease of the need of energy for heating by - at least - 20%)	17 EUR /per m <sup>2</sup>
<b>B Construction in the passive energy standard</b>	
<b>Block of flats <u>in the passive energy standard</u></b>	<b>5770 EUR / per unit</b>
<b>C Use of renewable energy sources for heating and hot water preparation</b>	
Sources of biomass	Max. 960 EUR / per unit
Installation of low-emission biomass-fired sources and efficient heat pumps in new buildings	Max. 770 EUR / per unit
Installation of solar-thermal collectors for the preparation of hot water	Max. 960 EUR / per unit

Source: Vit Vanicek, CECODHAS: 'Green Savings Programme. Using ETS (AAU in Czech Republic) funds for building renovation, BPIE Roundtable, March 2011, Bucharest

## Conclusion 1: Lesson learned

- Varied financing instruments and policies among the EU MSs for renovating the building stock
- Ambition level of buildings policies and measures are imposed by country's specific conditions such as:
  - Perceived importance of energy efficiency
  - Country's economic potential (purchase power, existence of related industry)
  - Ability to address and integrate the existing financing opportunities
  - Ability to integrate the macro-economic benefits (job creation, tax rebates, indirect benefits of en eff. etc.)
  - Ability to introduce tailored policies and measures (on building and people categories)
  - Maturity of energy efficiency market (ESCOs, willingness of banks, accompanied measures such as training for professionals, awareness and information among all stakeholders etc)

## Conclusion 2: We have to do more

- The actual efforts are far behind the savings potential. The EU is likely to fall short on 2020 target of 20% energy savings (est. indicate up to 10%)!
- Reaching the EU 2050 climate and energy goals implies:
  - To perform deep renovation of the existing building stock
  - To build at very high energy performance standards
- Need to reduce/eliminate the actual market barriers
- Need for more and innovative financing for bridging the market gap for new and more efficient technologies
- Need for more holistic policies with tailored measures & financing, awareness and information, training and education of professionals, RTD support
- Implementation is a key issue!

## Conclusion 3: Key recommendations

At the EU level:

- Renovation roadmap with binding milestones and measures
- EU Renovation Fund (EIB)
- Minimum requirements for allocation the EU Funds on buildings
- Guidance to the MSs for setting policies and financing
- Training and education roadmaps
- RTD support for new technologies

At MSs level:

- Predictable policies and measures (national roadmaps)
- Gradual tightening of building codes and standards by 2020
- Better enforcement and compliance
- Better financing and market conditions
- Increase awareness and confidence of consumers and investors
- Involvement of all stakeholders in developing policies
- Training and education
- RTD support

## **Buildings Performance Institute Europe**

- Started to operate in February 2010
- Non-profit association based in Brussels
- Founding partners: European Climate Foundation, ClimateWorks (US) and eceee
- Focus on energy efficiency in buildings throughout Europe
- Centre of technical expertise in buildings
- European Partner of Global Building Performance Network
- Targeted research, policy analysis & evaluation, support policy implementation, dissemination of information

**Thank you!**

[www.bpie.eu](http://www.bpie.eu)