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# Quantifying impact of policies on energy efficiency improvements in buildings

Application of policy MESC curves in Bulgaria

PMR Workshop, 25<sup>th</sup> September 2014, World Bank

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Source: Ongoing ESW on Energy Efficiency in EU5 countries; Project partners:

- **Buildings Performance Institute Europe:**
- **Technical University of Vienna, Energy Economics Group**
- **Infraproject Consult Ltd (Bulgaria)**

# Policy rationale

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- Bulgaria retains strict political control of retail power prices at the level by far the lowest in the EU, depressing not only the ability of the power sector to invest in reliable supply, but also lowering returns to demand side measures. District heat prices are heavily distorted as well.
- EU energy efficiency (among others) targets require gradual deep thermal retrofit of existing building stock
- Bulgaria has received large volumes of EU grants prioritized for energy efficiency but experienced very low disbursement and investment rate.
- Is the solution to keep increasing grant intensity?

# Issues relevant to NDCs

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- How to define energy efficiency (and emissions) baseline scenario for buildings in a country with distorted policy environment?
- What policies and measures (policy scenarios) could trigger uptake of EE investments and what will be their impact on energy savings (and emissions)?

# The scope of the study

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- Thermal retrofit of existing old buildings (built before 2000)
  
- Buildings covered:
  - Health service
  - Education
  - Offices (public and private)
  - Single family homes
  - Multifamily homes
  
- Tool: TUV Invert/EE-Lab model modified to generate marginal Energy Saving Cost Curves
  
- Data collected:
  - Building stock, including energy performance
  - Energy consumption
  - HVAC systems (stock and sales)
  - Ownership & Tenure

# Renovation packages for modelling purposes

- **Expert judgments for each building category**
  - baseline level of building retrofit
  - menu of incremental energy saving measures
  - incremental energy saving potential and incremental lifetime cost for these energy saving measures
  - Value of comfort and convenience improvement (40% of the value of energy savings)

	Roof	Wall	Floor	Windows	Heat recovery
	Thermal Insulation Thickness				
<b>Residential</b>					
Baseline	-	-	-	Double glazing - GLASS $U_g= 1,7 \text{ W/m}^2\text{K}$ ; FRAME $U_f=1,4 \text{ W/m}^2\text{K}$	no
R1	5 cm	-	-	Double glazing - GLASS $U_g= 1,7 \text{ W/m}^2\text{K}$ ; FRAME $U_f=1,4 \text{ W/m}^2\text{K}$	no
R2	15 cm	15 cm	10 cm	Double glazing - GLASS $U_g= 1,7 \text{ W/m}^2\text{K}$ ; FRAME $U_f=1,4 \text{ W/m}^2\text{K}$	no
R3	30 cm	20 cm	15 cm	Triple glazing - GLASS $U_g= 1,0 \text{ W/m}^2\text{K}$ ; FRAME $U_f=1,0 \text{ W/m}^2\text{K}$	yes

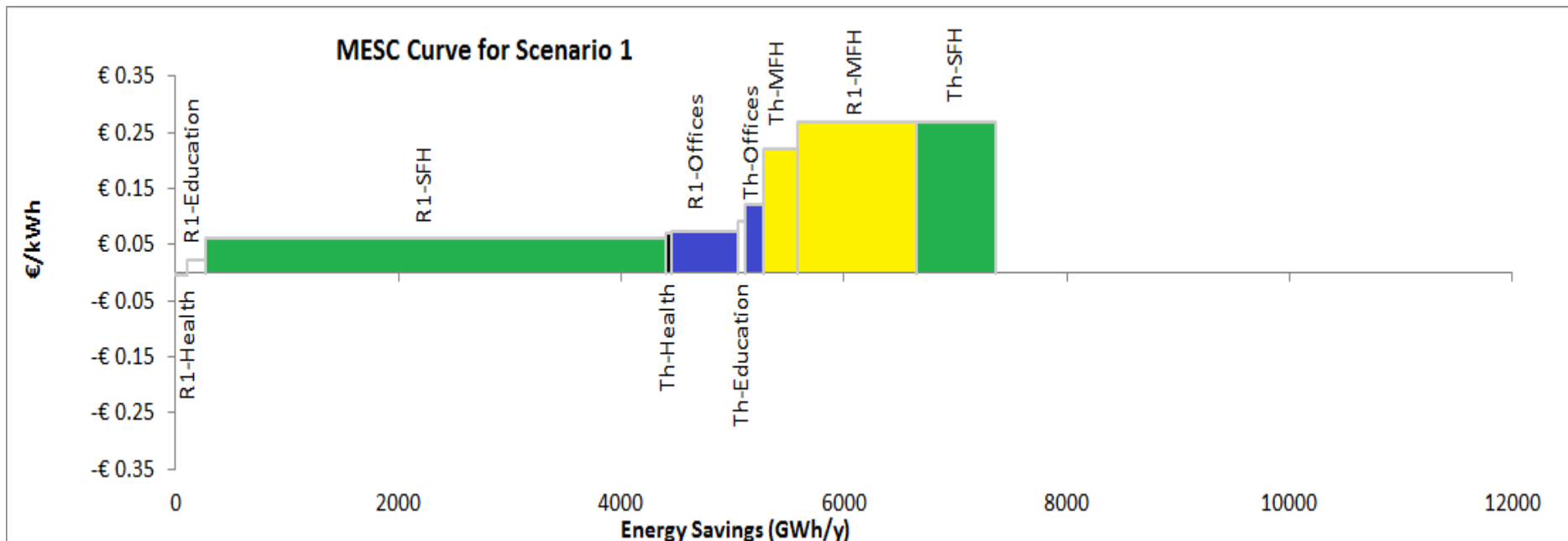
<b>Non-residential</b>					
Baseline	-	-	-	Double glazing - GLASS $U_g= 1,7 \text{ W/m}^2\text{K}$ ; FRAME $U_f=1,4 \text{ W/m}^2\text{K}$	no
R1	5 cm	-	-	Double glazing - GLASS $U_g= 1,7 \text{ W/m}^2\text{K}$ ; FRAME $U_f=1,4 \text{ W/m}^2\text{K}$	no
R2	15 cm	10 cm	10 cm	Double glazing - GLASS $U_g= 1,7 \text{ W/m}^2\text{K}$ ; FRAME $U_f=1,4 \text{ W/m}^2\text{K}$	no
R3	30 cm	25 cm	15 cm	Triple glazing - GLASS $U_g= 1,0 \text{ W/m}^2\text{K}$ ; FRAME $U_f=1,0 \text{ W/m}^2\text{K}$	yes

# Policy variables

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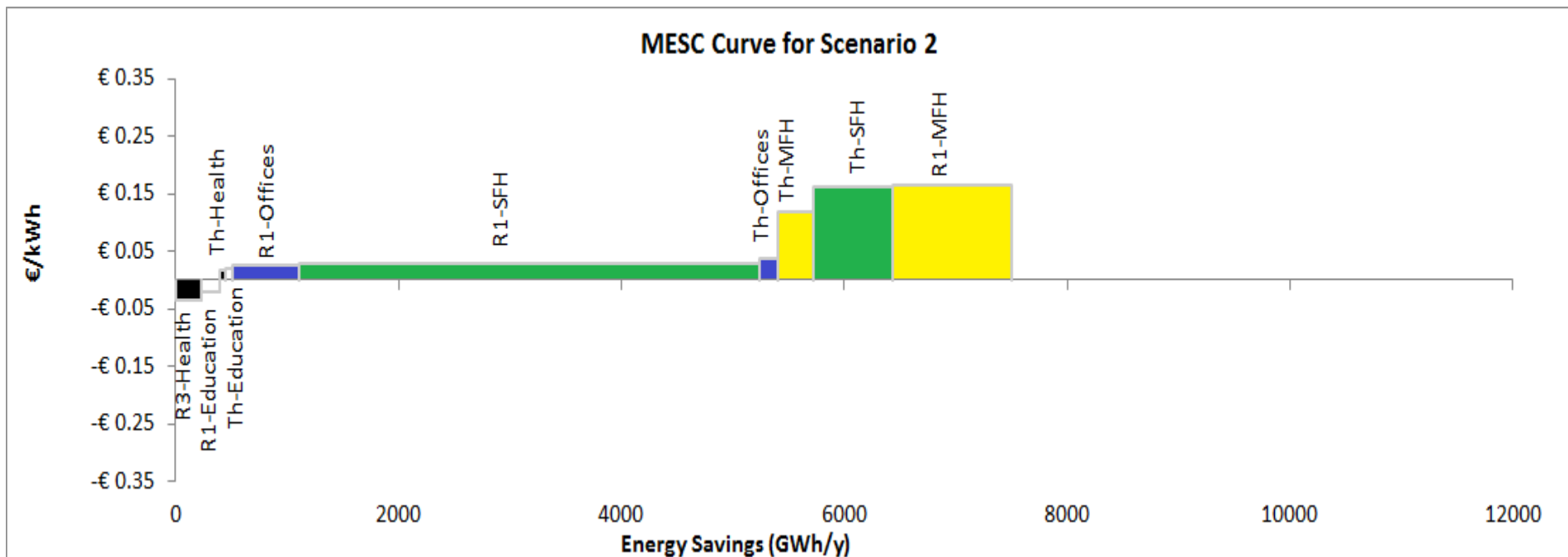
- Energy price subsidies/taxes, for each fuel, heat and electricity prices/tariffs
- Discount rates reflecting different risks profile of retrofitting different building types under different regulatory environment
- Project subsidies: capex grants, opex subsidies
- Innovation (steeper learning curves)
- Revenue enhancing instruments (e.g. feed-in tariffs, carbon prices, white certificates)
- Transaction costs
  - project transaction costs
  - Policy transaction costs activated only with a particular policy intervention

# Scenario: Baseline without grants



Building Category	MESC €/kWh	Annualised cost €M (area under curve)	Total savings (GWh/y)	Cost effective savings (GWh/y)	POLICY APPLICATION	
R1-Health	-0.56	-0.54	96	96	grants (standard)	NO
R1-Education	2.23	3.79	170		utility benefit	NO
R1-SFH	6.13	253.29	4,135		grants (higher)	NO
Th-Health	7.12	3.17	45		reduced discount rate	NO
R1-Offices	7.48	44.94	600		increased learning curve	NO
Th-Education	9.08	6.11	67		reduced transaction costs	NO
Th-Offices	12.15	19.48	160		energy price reform	NO
Th-MFH	22.07	68.98	313			
R1-MFH	26.96	286.57	1,063			
Th-SFH	26.96	193.47	718			
<b>AVERAGE</b>	<b>11.94</b>	<b>€ 879</b>	<b>7,367</b>	<b>96</b>		

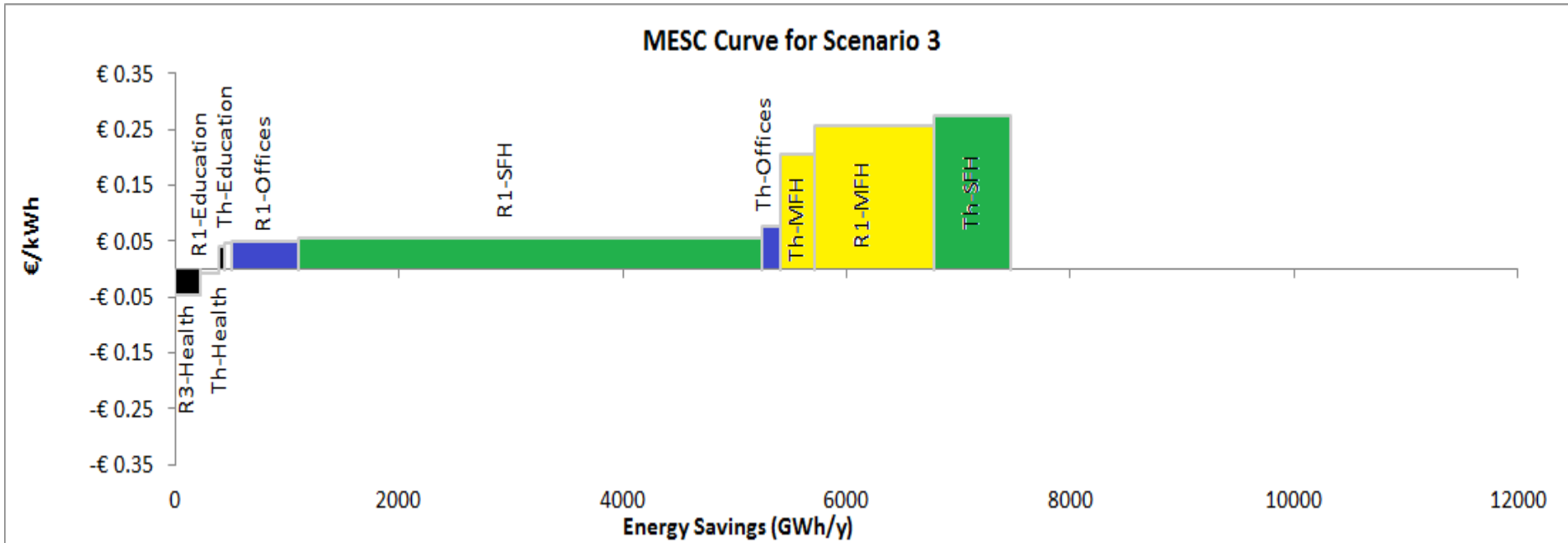
# Scenario. Baseline with 25% grants



Building Category	MESC €/kWh	Annualised cost €M (area under curve)	Total savings (GWh/y)	Cost effective savings (GWh/y)	POLICY APPLICATION	
R3-Health	-3.40	-7.64	224	224	grants (standard)	YES
R1-Education	-2.00	-3.41	170	170	utility benefit	NO
Th-Health	1.81	0.81	45		grants (higher)	NO
Th-Education	1.91	1.29	67		reduced discount rate	NO
R1-Offices	2.55	15.28	600		increased learning curve	NO
R1-SFH	2.85	117.96	4,135		reduced transaction costs	NO
Th-Offices	3.70	5.93	160		energy price reform	NO
Th-MFH	11.79	36.87	313			
Th-SFH	16.19	116.18	718			
R1-MFH	16.45	174.81	1,063			
<b>AVERAGE</b>	<b>6.11</b>	<b>TOTAL</b>	<b>€ 458</b>	<b>7,495</b>	<b>395</b>	

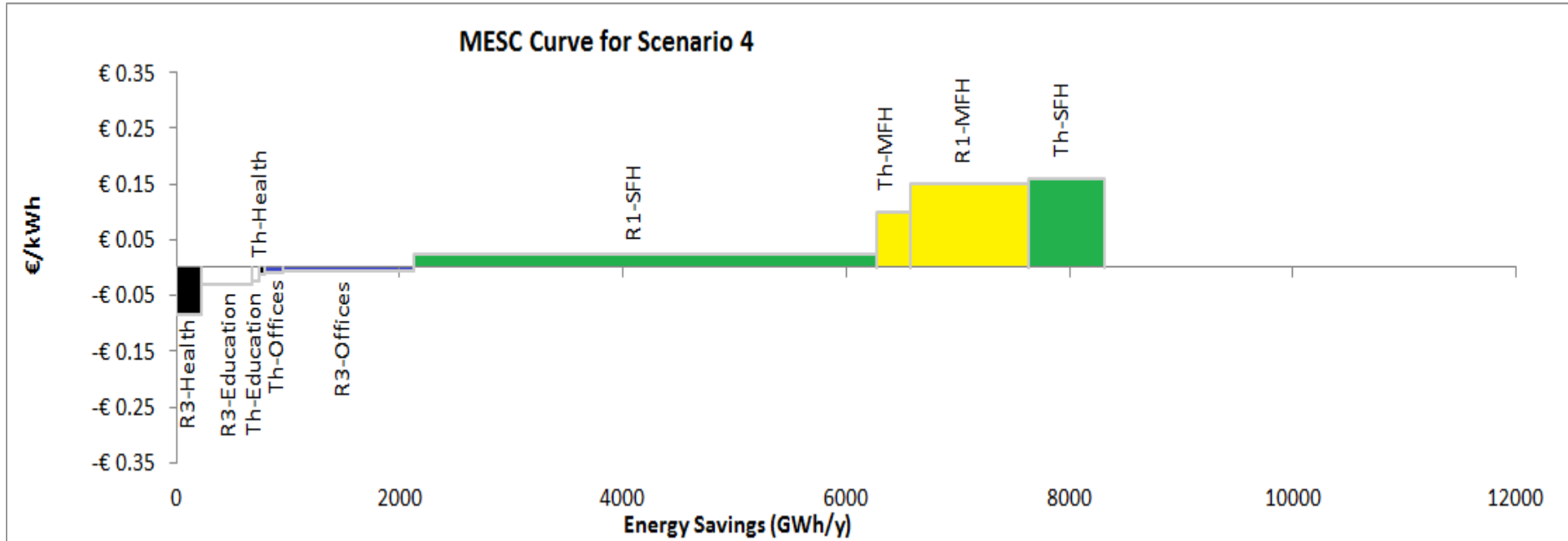


# Scenario: Baseline with comfort and convenience valued



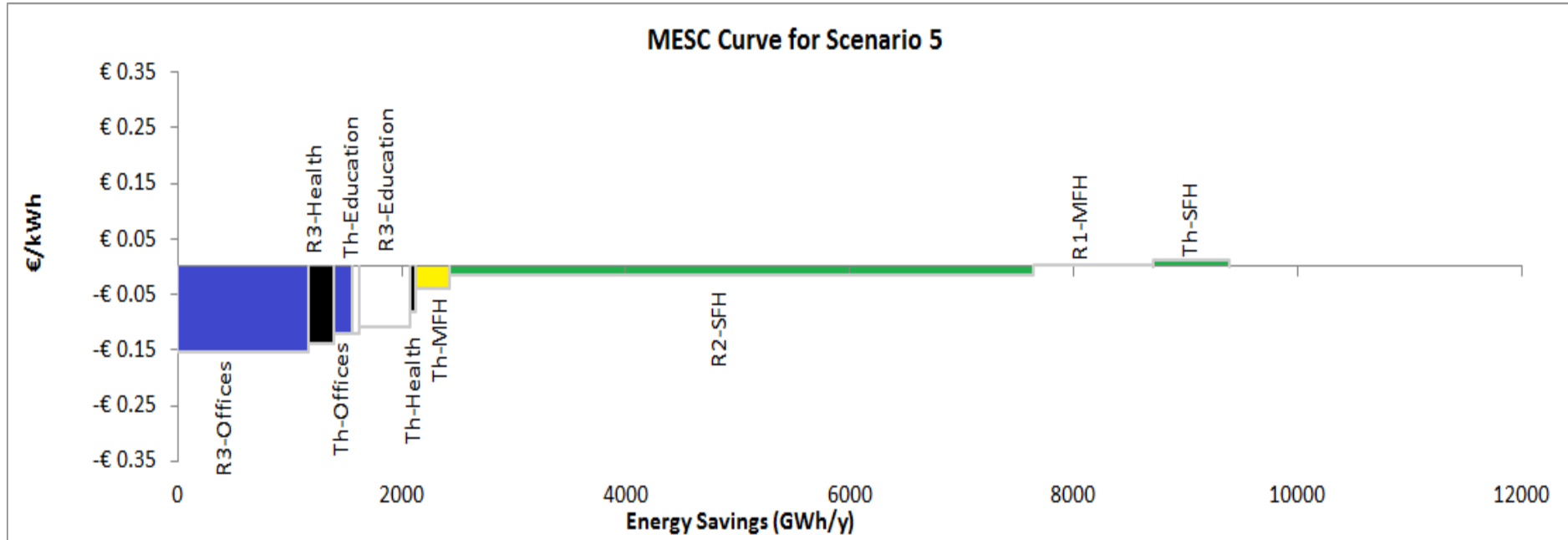
Building Category	MESC €/kWh	Annualised cost €M (area under curve)	Total savings (GWh/y)	Cost effective savings (GWh/y)	<b>POLICY APPLICATION</b>	
R3-Health	-4.76	-10.68	224	224	grants (standard)	NO
R1-Education	-0.74	-1.26	170	170	utility benefit	YES
Th-Health	4.06	1.81	45		grants (higher)	NO
Th-Education	4.74	3.19	67		reduced discount rate	NO
R1-Offices	4.96	29.76	600		increased learning curve	NO
R1-SFH	5.69	235.84	4,143		reduced transaction costs	NO
Th-Offices	7.60	12.19	160		energy price reform	NO
Th-MFH	20.70	62.56	302			
R1-MFH	25.64	273.03	1,065			
Th-SFH	27.37	187.42	685			
<b>AVERAGE</b>	<b>10.64</b>	<b>TOTAL</b>	<b>€ 794</b>	<b>7,462</b>	<b>395</b>	

# Scenario: Baseline with comfort and 25% grants



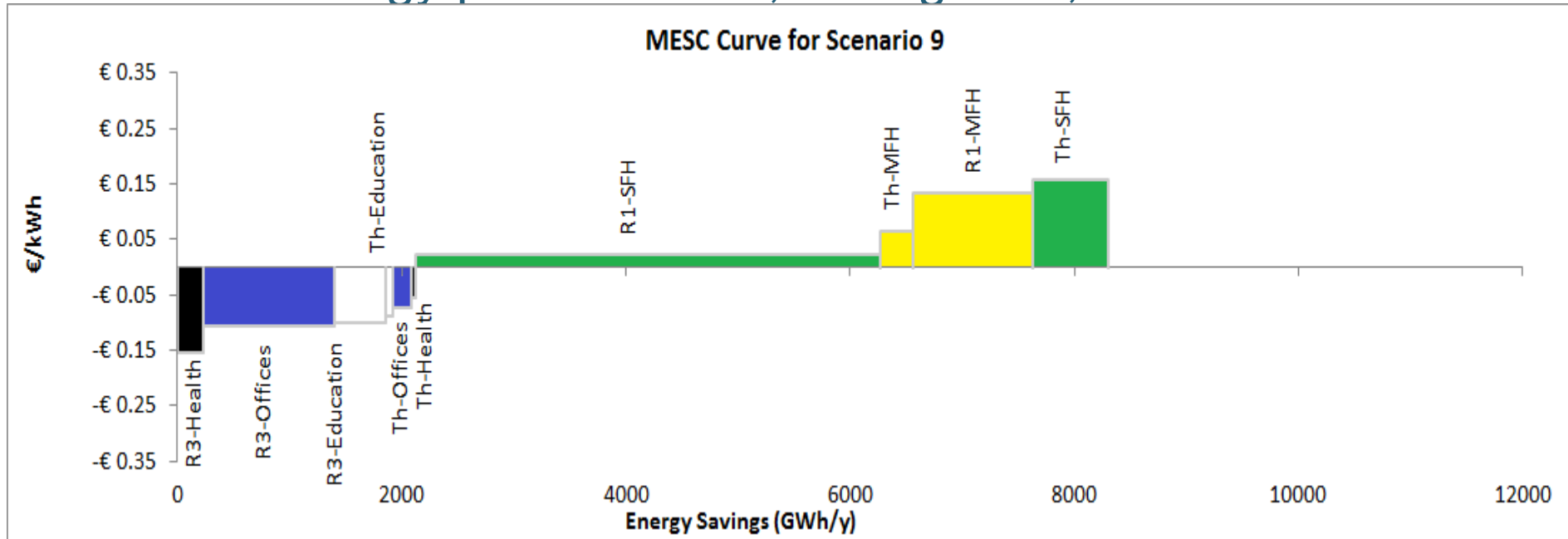
Building Category	MESC €/kWh	Annualised cost €M (area under curve)	Total savings (GWh/y)	Cost effective savings (GWh/y)	POLICY APPLICATION	
R3-Health	-8.56	-19.21	224	224	grants (standard)	YES
R3-Education	-3.02	-13.73	455	455	utility benefit	YES
Th-Education	-2.44	-1.64	67	67	grants (higher)	NO
Th-Health	-1.25	-0.56	45	45	reduced discount rate	NO
Th-Offices	-0.85	-1.36	160	160	increased learning curve	NO
R3-Offices	-0.50	-5.82	1,172	1172	reduced transaction costs	NO
R1-SFH	2.42	100.46	4,143		energy price reform	NO
Th-MFH	10.05	30.37	302			
R1-MFH	15.14	161.27	1,065			
Th-SFH	16.06	109.97	685			
<b>AVERAGE</b>	<b>4.32</b>	<b>€ 360</b>	<b>8,319</b>	<b>2,124</b>		

# Scenario: 50% grants, comfort valued



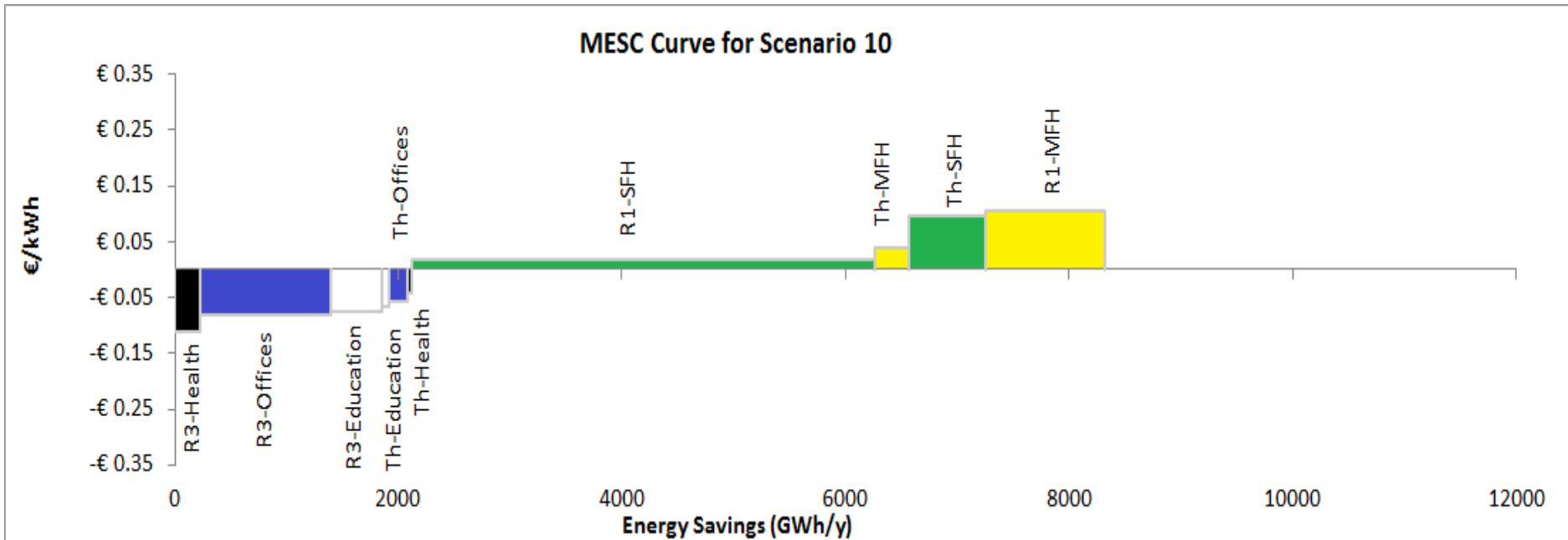
Building Category	MESC €/kWh	Annualised cost €M (area under curve)	Total savings (GWh/y)	Cost effective savings (GWh/y)	<b>POLICY APPLICATION</b>	
R3-Offices	-15.28	-179.20	1,172	1172	grants (standard)	NO
R3-Health	-13.89	-31.16	224	224	utility benefit	YES
Th-Offices	-12.04	-19.30	160	160	grants (higher)	YES
Th-Education	-11.93	-8.03	67	67	reduced discount rate	NO
R3-Education	-10.75	-48.93	455	455	increased learning curve	NO
Th-Health	-8.28	-3.69	45	45	reduced transaction costs	NO
Th-MFH	-4.05	-12.24	302	302	energy price reform	NO
R2-SFH	-1.55	-80.65	5,213	5213		
R1-MFH	0.45	4.79	1,065			
Th-SFH	1.09	7.48	685			
<b>AVERAGE</b>	<b>-3.95</b>	<b>-€ 371</b>	<b>9,388</b>	<b>7,639</b>		

# Scenario: Energy price reforms, 25% grants, comfort valued



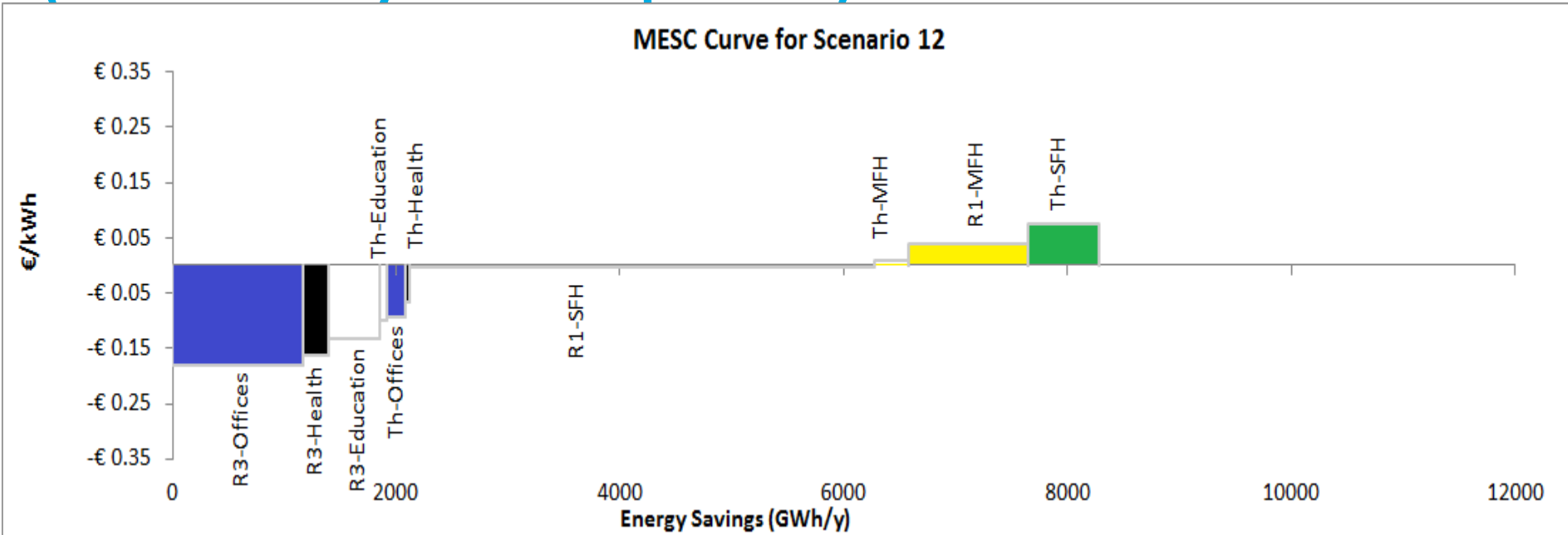
Building Category	MESC €/kWh	Annualised cost €M (area under curve)	Total savings (GWh/y)	Cost effective savings (GWh/y)	<b>POLICY APPLICATION</b>	
R3-Health	-15.36	-34.46	224	224	grants (standard)	YES
R3-Offices	-10.79	-126.51	1,172	1172	utility benefit	YES
R3-Education	-9.91	-45.09	455	455	grants (higher)	NO
Th-Education	-8.71	-5.86	67	67	reduced discount rate	NO
Th-Offices	-7.44	-11.93	160	160	increased learning curve	NO
Th-Health	-5.57	-2.48	45	45	reduced transaction costs	NO
R1-SFH	2.16	89.40	4,146		energy price reform	YES
Th-MFH	6.52	19.11	293			
R1-MFH	13.26	141.52	1,068			
Th-SFH	15.68	105.75	674			
<b>AVERAGE</b>	<b>1.56</b>	<b>€ 129</b>	<b>8,305</b>	<b>2,124</b>		

# Scenario: Soft policy measures, no price reform



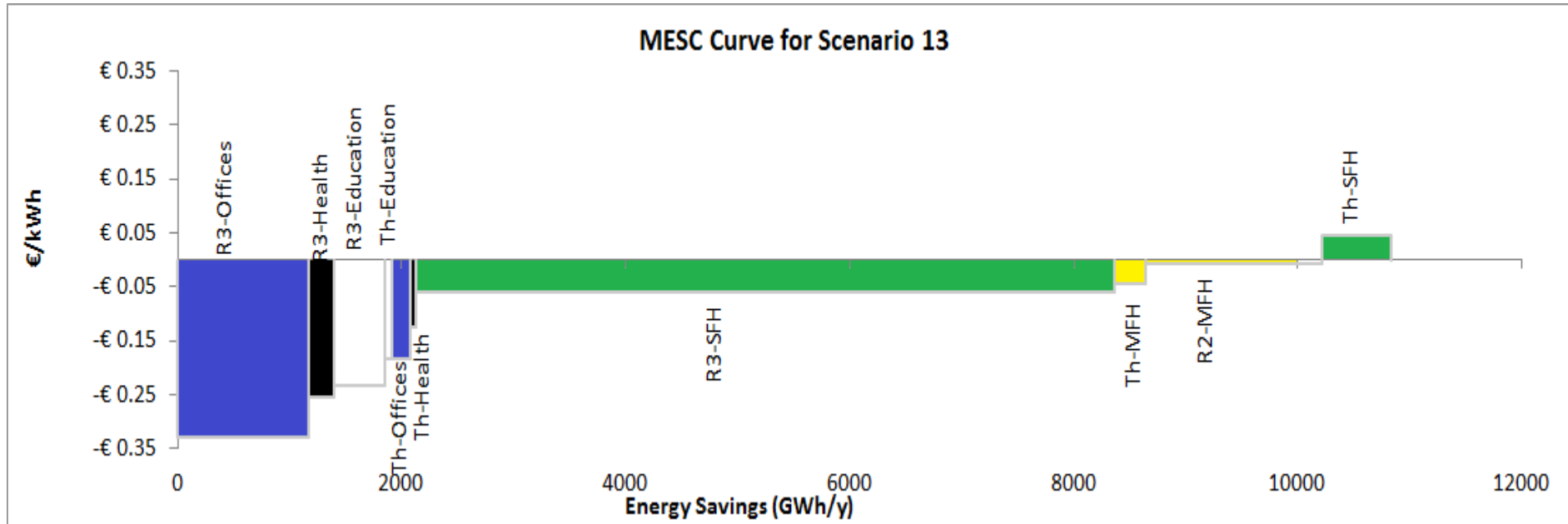
Building Category	MESC €/kWh	Annualised cost €M (area under curve)	Total savings (GWh/y)	Cost effective savings (GWh/y)	POLICY APPLICATION	
R3-Health	-11.25	-25.25	224	224	grants (standard)	NO
R3-Offices	-8.00	-93.77	1,172	1172	utility benefit	YES
R3-Education	-7.51	-34.17	455	455	grants (higher)	NO
Th-Education	-6.56	-4.41	67	67	reduced discount rate	YES
Th-Offices	-5.71	-9.15	160	160	increased learning curve	YES
Th-Health	-4.30	-1.92	45	45	reduced transaction costs	YES
R1-SFH	1.93	79.93	4,143		energy price reform	NO
Th-MFH	3.93	11.87	302			
Th-SFH	9.57	65.49	685			
R1-MFH	10.54	112.22	1,065			
<b>AVERAGE</b>	<b>1.21</b>	<b>TOTAL</b>	<b>€ 101</b>	<b>8,319</b>	<b>2,124</b>	

# Scenario: Market based combined policy boost (economically efficient policies)



Building Category	MESC €/kWh	Annualised cost €M (area under curve)	Total savings (GWh/y)	Cost effective savings (GWh/y)	<b>POLICY APPLICATION</b>	
R3-Offices	-17.94	-210.27	1,172	1172	grants (standard)	NO
R3-Health	-16.15	-36.25	224	224	utility benefit	YES
R3-Education	-13.35	-60.74	455	455	grants (higher)	NO
Th-Education	-9.97	-6.70	67	67	reduced discount rate	YES
Th-Offices	-9.37	-15.03	160	160	increased learning curve	YES
Th-Health	-6.68	-2.98	45	45	reduced transaction costs	YES
R1-SFH	-0.21	-8.56	4,154	4154	energy price reform	YES
Th-MFH	0.96	2.83	296			
R1-MFH	4.05	43.16	1,067			
Th-SFH	7.59	48.82	643			
<b>AVERAGE</b>	<b>-2.97</b>	<b>-€ 246</b>	<b>8,284</b>	<b>6,278</b>		

# Scenario: Market based combined policy boost +25 grants



Building Category	MESC €/kWh	Annualised cost €M (area under curve)	Total savings (GWh/y)	Cost effective savings (GWh/y)	POLICY APPLICATION	
R3-Offices	-33.09	-388.00	1,172	1172	grants (standard)	YES
R3-Health	-25.57	-57.37	224	224	utility benefit	YES
R3-Education	-23.20	-105.55	455	455	grants (higher)	NO
Th-Education	-18.31	-12.32	67	67	reduced discount rate	YES
Th-Offices	-18.24	-29.24	160	160	increased learning curve	YES
Th-Health	-12.57	-5.61	45	45	reduced transaction costs	NO
R3-SFH	-5.95	-371.27	6,237	6237	energy price reform	YES
Th-MFH	-4.59	-13.13	286	286		
R2-MFH	-0.70	-11.05	1,569	1569		
Th-SFH	4.58	28.11	613			
<b>AVERAGE</b>	<b>-8.91</b>	<b>TOTAL</b>	<b>-€ 965</b>	<b>10,830</b>	<b>10,217</b>	

# Questions for discussion

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- **Baseline scenario**

- With or without current policies (e.g. 25% grants?)
- With or without co-benefits (e.g. comfort and convenience?)
- with or without market reforms (in own interest)

- **Policy scenarios**

- What level of ambition for thermal retrofit (only economically efficient or also beyond)?
- Grants expected with or without market reforms





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Thank you