CO_2 mitigation potential from space and water heating in the Hungarian public buildings

Center for Climate Change and Sustainable Energy Policy

Central European University

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Környezetvédelmi és Vízügyi Minisztérium

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Overview

- Background – CO_2 emissions and energy consumption
- Methodology
- Preliminary findings
- Conclusions and recommendations

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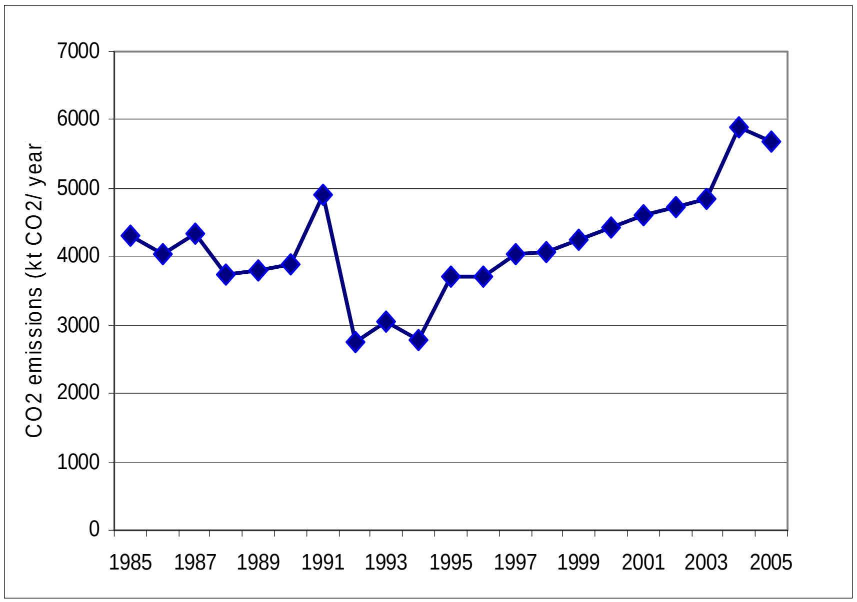
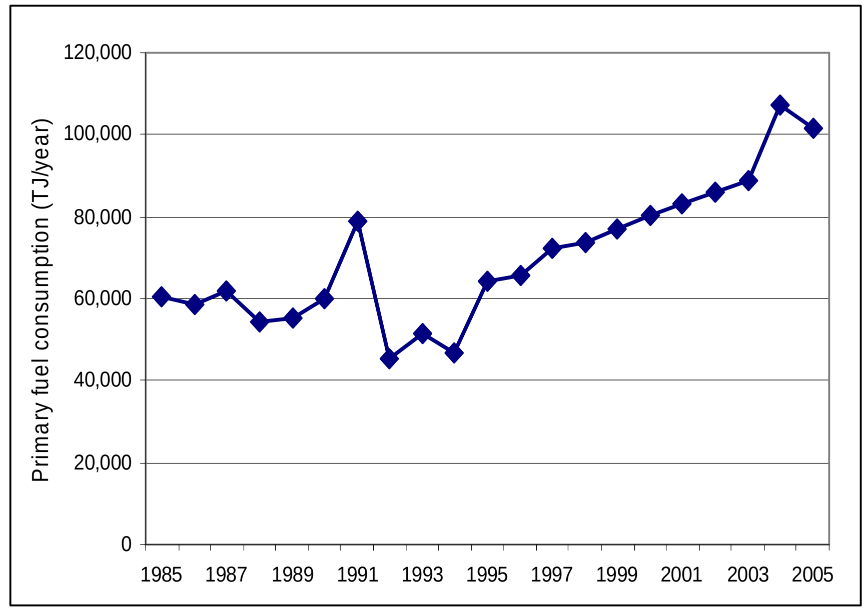
CO_2 emissions & use of primary energy in the Hungarian tertiary sector

Source: NIR 1985-2005 from 2007 submission, vs. 2.1





- In the period 1985-2005 the CO_2 emissions as well as primary fuel consumption increased in total by cca. 30%

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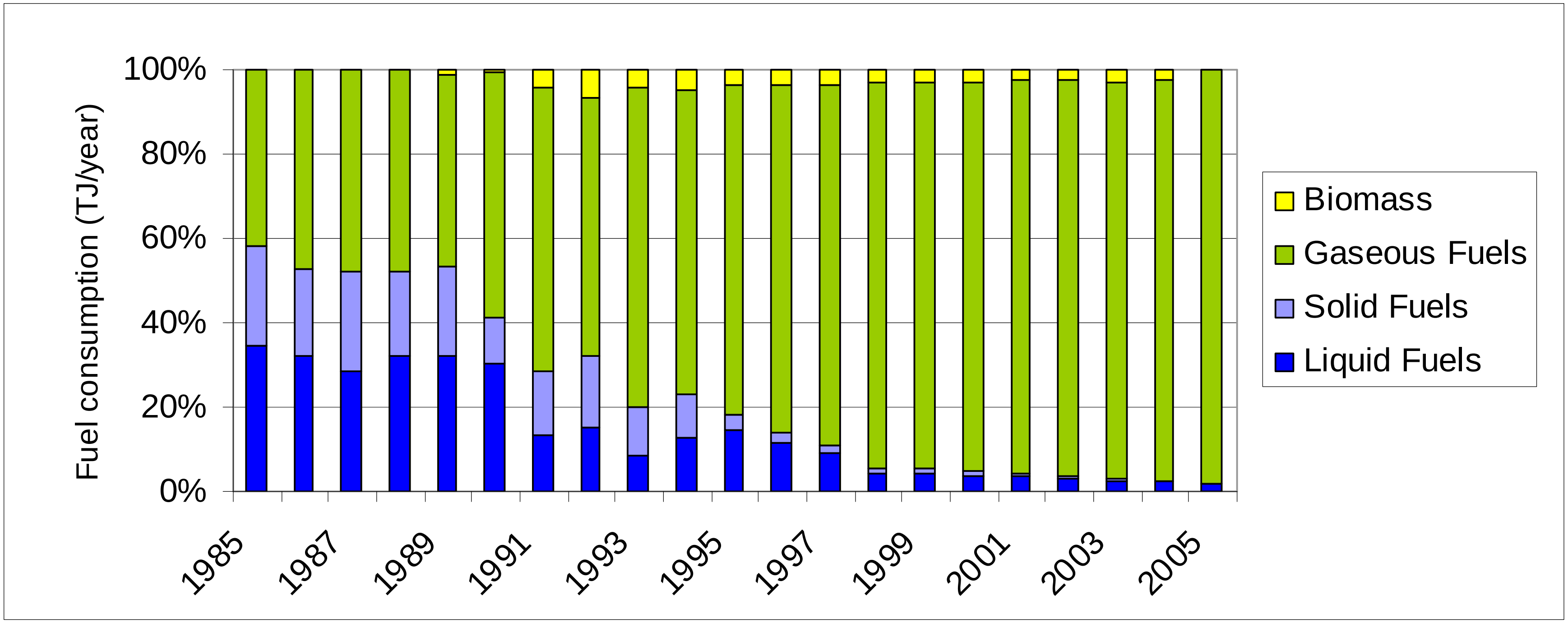
Trends in energy use in the Hungarian tertiary sector



Source:
NIR 1985-2005 from 2007 submission, vs. 2.1

- While share of the natural gas increased by one third (1985-2005), share of non-gas primary fuels decreased substantially in the same period.

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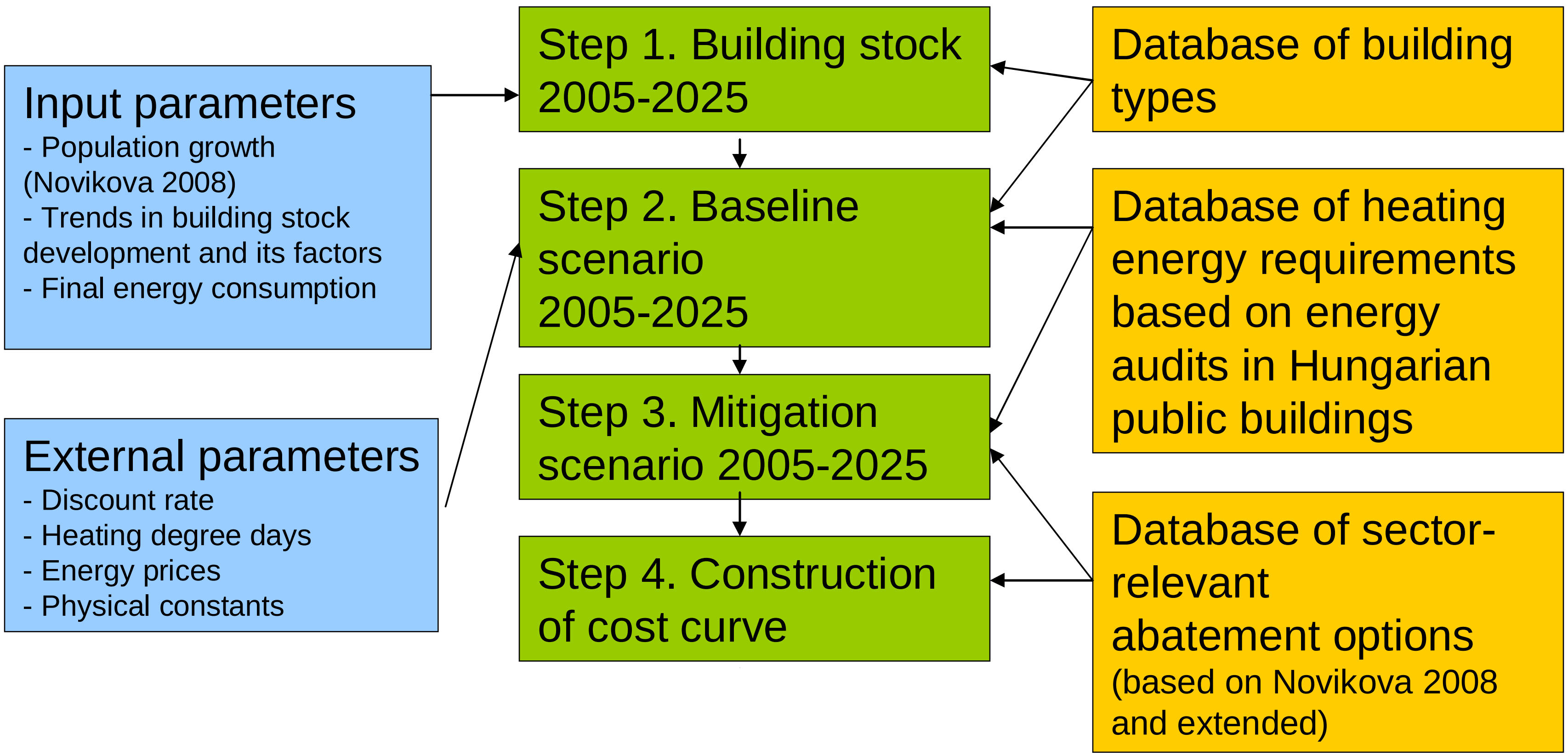
Methodology

- Bottom-up technology-based model
- Modeling framework based on residential model of Novikova (2008) with all input data and assumptions adjusted to public buildings
- Mitigation potential is estimated through the 'cost curve' method
- In the study are considered the most cost-efficient abatement options and options with the largest mitigation potential based on the database of Novikova (2008) adjusted and extended for the needs of public sector
- Options for existing buildings:
  - temperature management, hot water demand reduction, high-performance building envelope, boilers with increased efficiency
- Options for new construction:
  - Passive house standard

Methodological steps



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Data sources

- Building stock projections: KSH (2000-2005)
- Building typologies: Ürge-Vorsatz *et al* (2000) and energy audits (below)
- Average heating energy requirements: based on set of audits:
  - UNDP/GEF Hungary Public Sector Energy Efficiency Project,
  - Display campaign (2008),
  - Csoknyai (2008)

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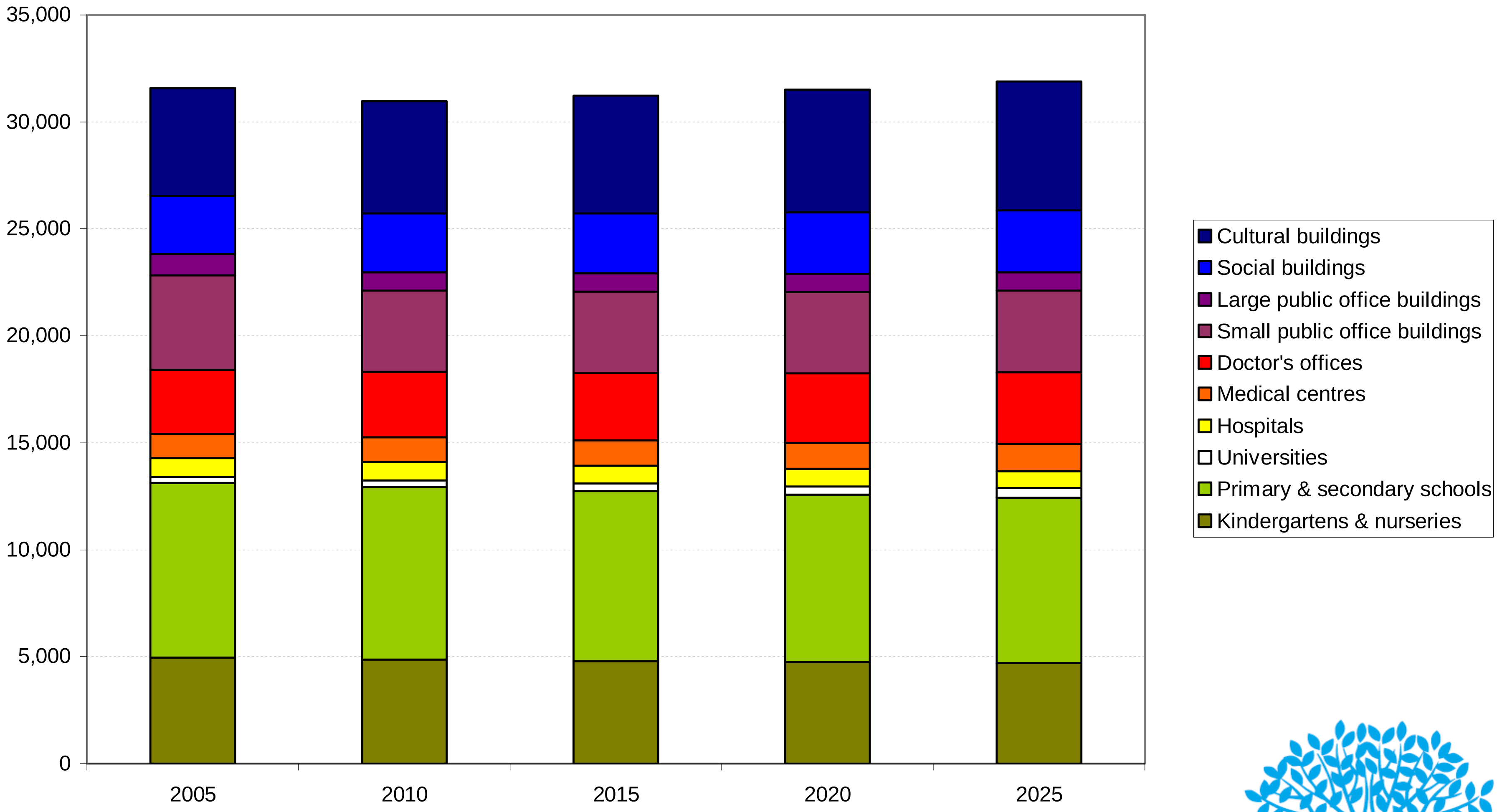
First results: Hungarian public buildings

Classification of public buildings in 2005

2005	Number of buildings	Number of buildings	Floor area (m2)	Floor area (%)
Educational	**13,409**	**24%**	**15,193**	**29%**
Kindergartens & nurseries	4,963	9%	2,485	5%
Primary and secondary schools	8,160	15%	11,137	22%
Universities	286	1%	1,572	3%
Health	**5,005**	**9%**	**11,650**	**23%**
Hospitals & Buildings for confined to bed	881	2%	4,228	8%
Doctor's offices & ambulance stations	2,988	5%	1,970	4%
Medical centres	1,136	2%	5,453	11%
Public Administration offices	**5,403**	**10%**	**5,077**	**10%**
Small public office buildings	4,407	8%	2,297	4%
Large public office buildings	995	2%	2,781	5%
Social buildings	**2,735**	**5%**	**1,747**	**3%**
Cultural buildings	**5,021**	**9%**	**10,825**	**21%**
Other (assumed non-heated)	23,691	43%	7,107	14%
Total	**55,264**		**51,601**	

Note: the floor area of Other is an estimate due to lack of data.

Building stock of the Hungarian public buildings 2005-2025



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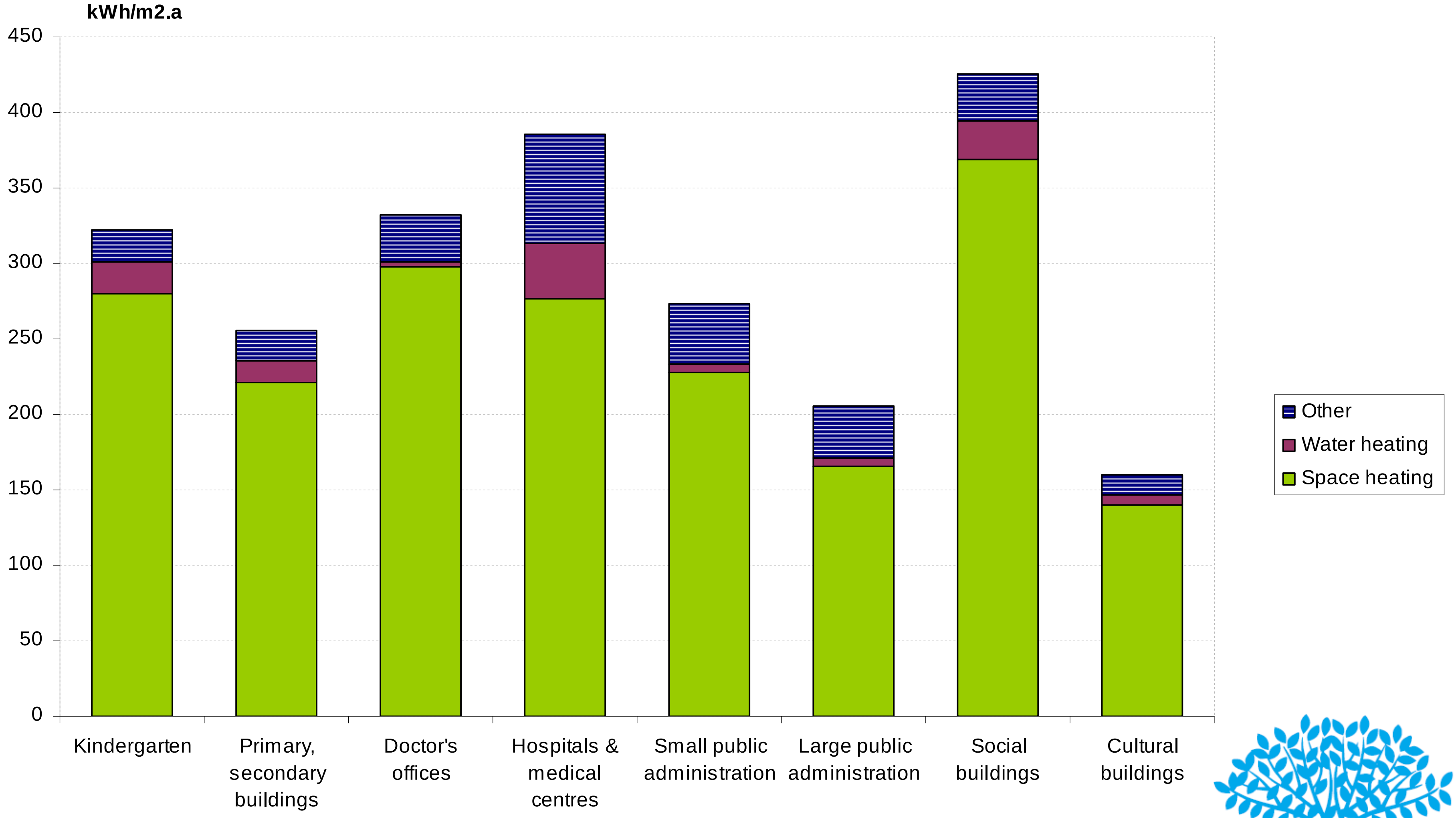
Average heating energy requirements per building type



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CO_2 mitigation potential in 2025, cumulative investments and saved energy costs

Total mitigation potential: 761 kt CO2 (37% of the SWH baseline CO2 emissions)
Total energy savings: 3.8 TWh

	CO2 savings in 2025	Cumulative CO2 savings in 2025	Cost of mitigated CO2 in 2025	Energy savings in 2025	Cumulative energy savings in 2025	CCE in 2025	Cumulative invest-ments 2008-2025	Cumulative saved energy costs 2008-2025
Measure	kt CO2	kt CO2	EUR/tCO2	GWh/yr.	GWh/yr.	EUR/ kWh	million EUR	million EUR
Switching off DHW recirculation at night	7	7	-253	35	35	0.0003	0.12	16
Temperature management 2C	89	96	-220	446	481	0.01	38	223
Insulation of wall in large industrialized buildings	65	161	-106	325	806	0.03	171	369
Insulation of wall in small buildings	30	191	-79	147	953	0.03	249	433
Exchange of windows	140	331	-56	695	1648	0.04	627	769
Insulation of roof	53	384	29	264	1912	0.06	832	891
Insulation of basement	29	413	49	146	2058	0.06	953	958
Passive building standard	273	686	219	1374	3432	0.09	3114	1629
Condensing boiler	75	761	236	369	3801	0.1	3530	1859

Note: the table shows aggregated results for technical options in all examined buildings.

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Mitigation potential by cost categories

CO_2 mitigation potential in cost categories	**CO_2 abatement potential in 2025** Cumulative		By cost category		Total cumulative investments 2008-2025	Cumulative energy cost savings 2008-2025
	% baseline of modeled end-uses	1000 tCO_2/yr.	% baseline of modeled end-uses	1000 tCO_2/yr.	million Euro	million Euro
< 0 EURO	18.1%	367	18%	367	742	836
0 - 20 EURO*	18.4%	374	0.3%	7	770	853
20-100 EURO*	22.6%	459	4%	85	1171	1070
100 - 300 EURO*	35.0%	711	12%	252	2980	1703
>300 EURO*	37.4%	761	2%	50	3530	1859

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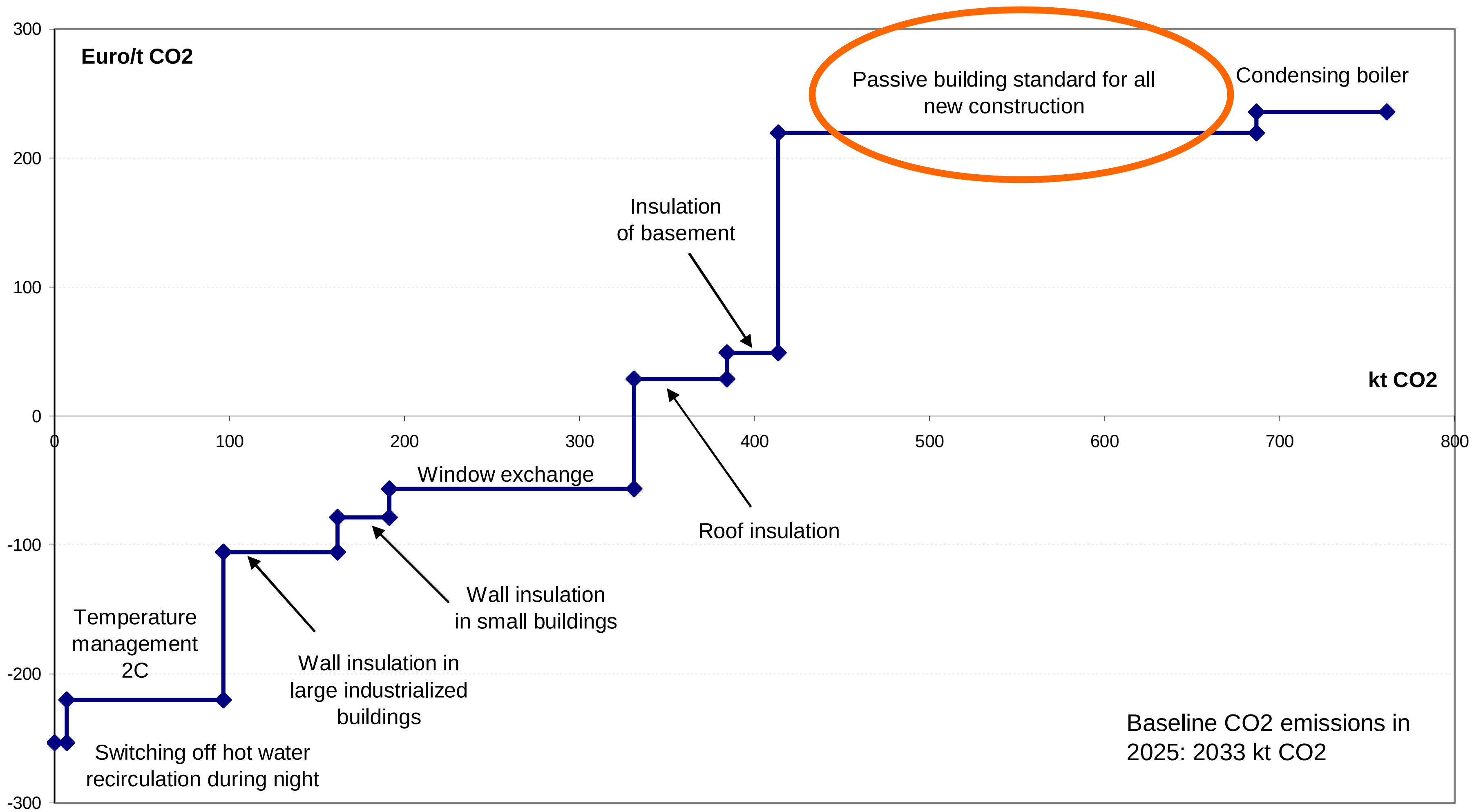
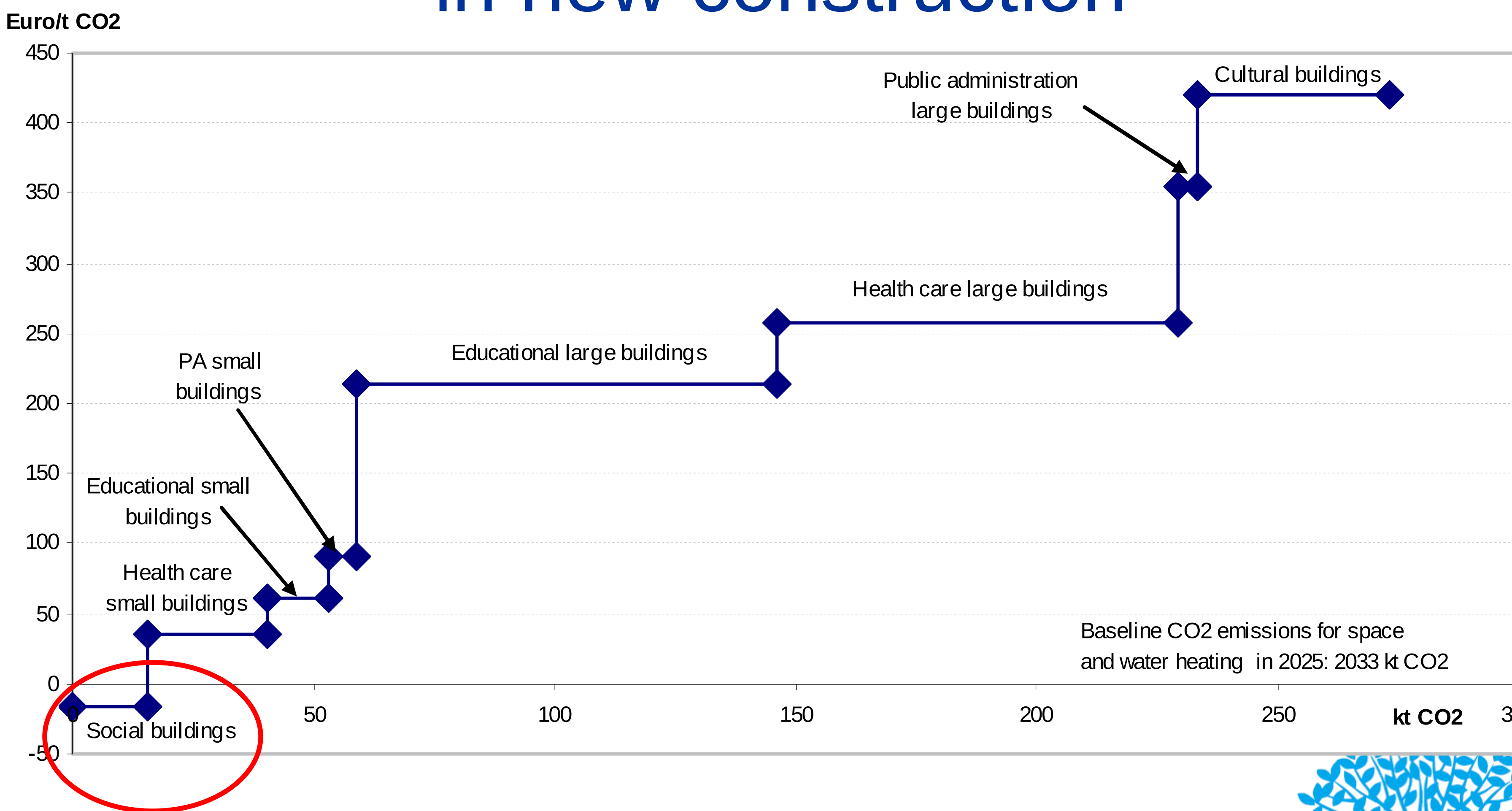
Aggregated cost curve for Hungarian public buildings



Mitigation cost curves for application of passive house standard in new construction



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Conclusions & recommendations (1)

- Public buildings offer significant share of cost-effective mitigation potential

- Processing of energy audits in the Hungarian public buildings shows large specific heating energy consumption in Hungarian public buildings and implies possible savings

- The most cost-effective options are:
  - Temperature management
  - Reduction of energy for water heating through switching off hot water recirculation during night
  - External wall insulation & windows replacement
  - Insulation of other building components (basement & roof)
  - Passive house application for new construction
  - Installation of condensing boiler

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Conclusions & recommendations (2)

- Nevertheless, the buildings have to be retrofitted holistically, not only via implementing low-cost options.
- Only thorough, complex retrofit, *“including the simultaneous insulation of walls, exchange of windows and renovation of heating systems provide better thermal performance and less risk of fabric damages“* (Zöld and Csoknyai, 2007).
- Retrofit of the existing buildings to the lowest possible levels should be promoted right from the beginning and thus not leaving room for energy inefficiency trapped in sub-optimal retrofits.
- There are first examples of both passive new construction and passive retrofit in the Hungarian public buildings (e.g. retrofit of the REC centre, plan for “green” governmental district, retrofit of Pecs museum).
- To lower additional costs of passive construction in Hungary, one should support the conditions for passive construction businesses.
- To ensure that low-energy & passive buildings function as designed, commissioning, an overall check of the installed equipment, should be performed both in major retrofits and new constructions.

Acknowledgements

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Thank you for your attention!

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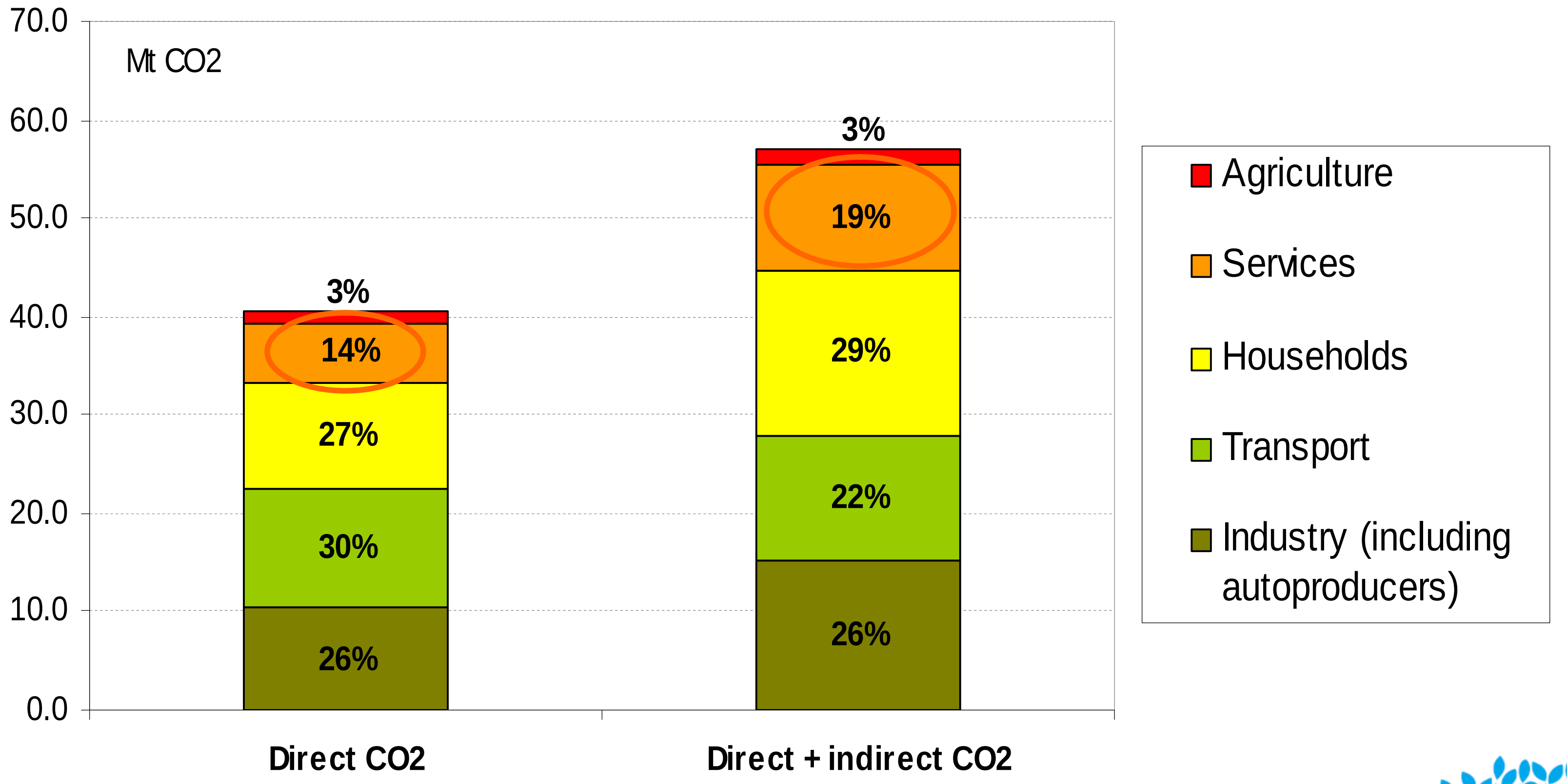
Background slides

CO_2 emissions in Hungarian tertiary sector



Source: ODYSSEE 2009. URL: http://odyssee.enerdata.eu

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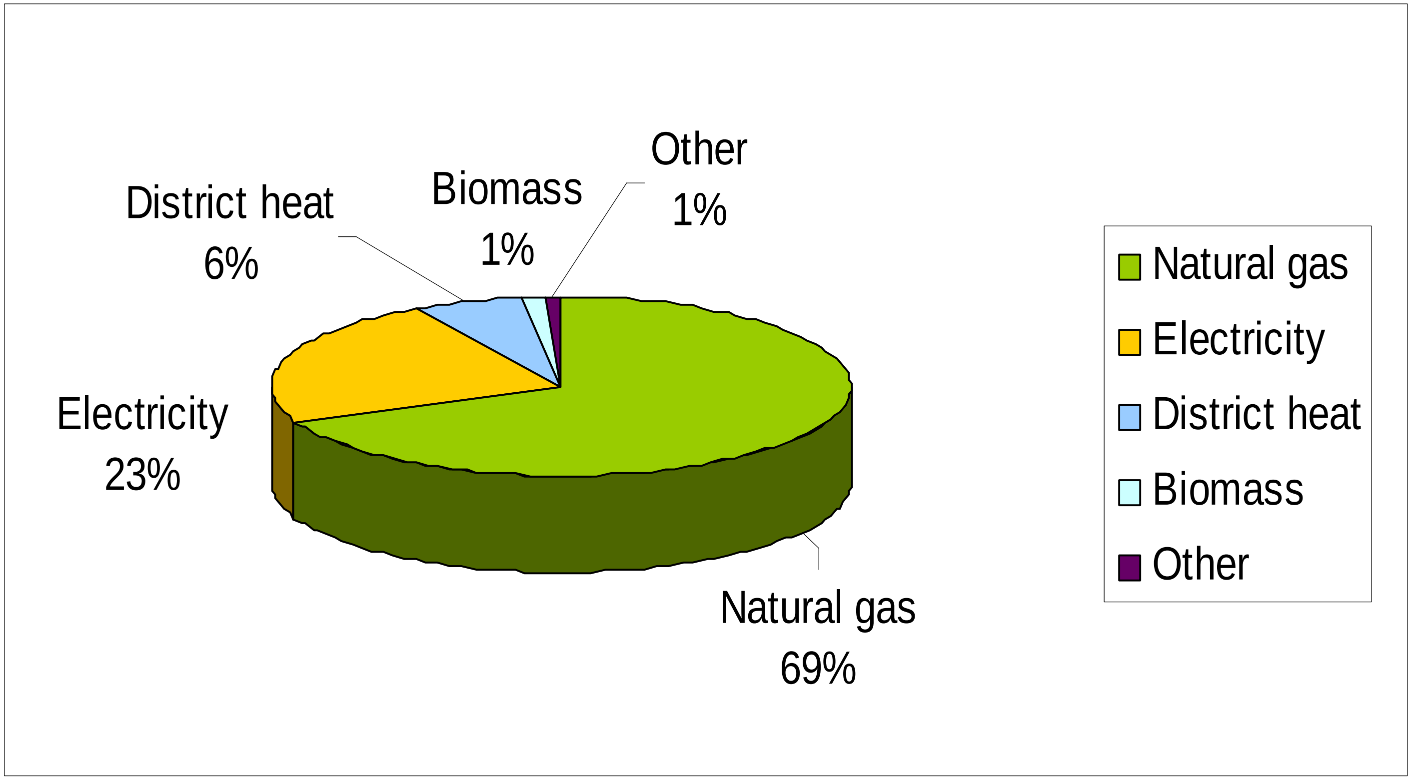
Final energy by fuel (2005)



Source: IEA, 2008. Energy Statistics of the OECD countries

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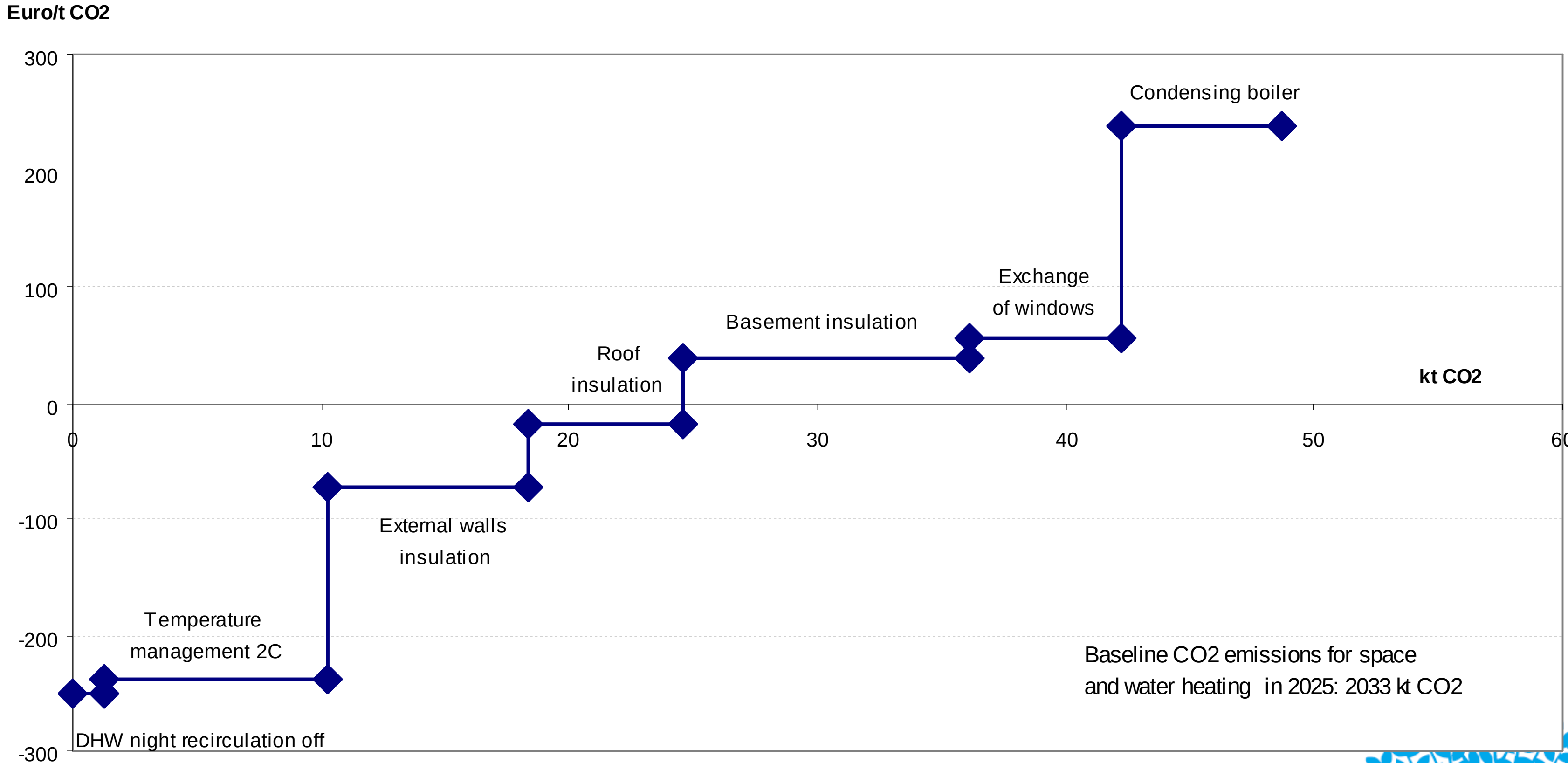
Mitigation cost curves for small educational buildings



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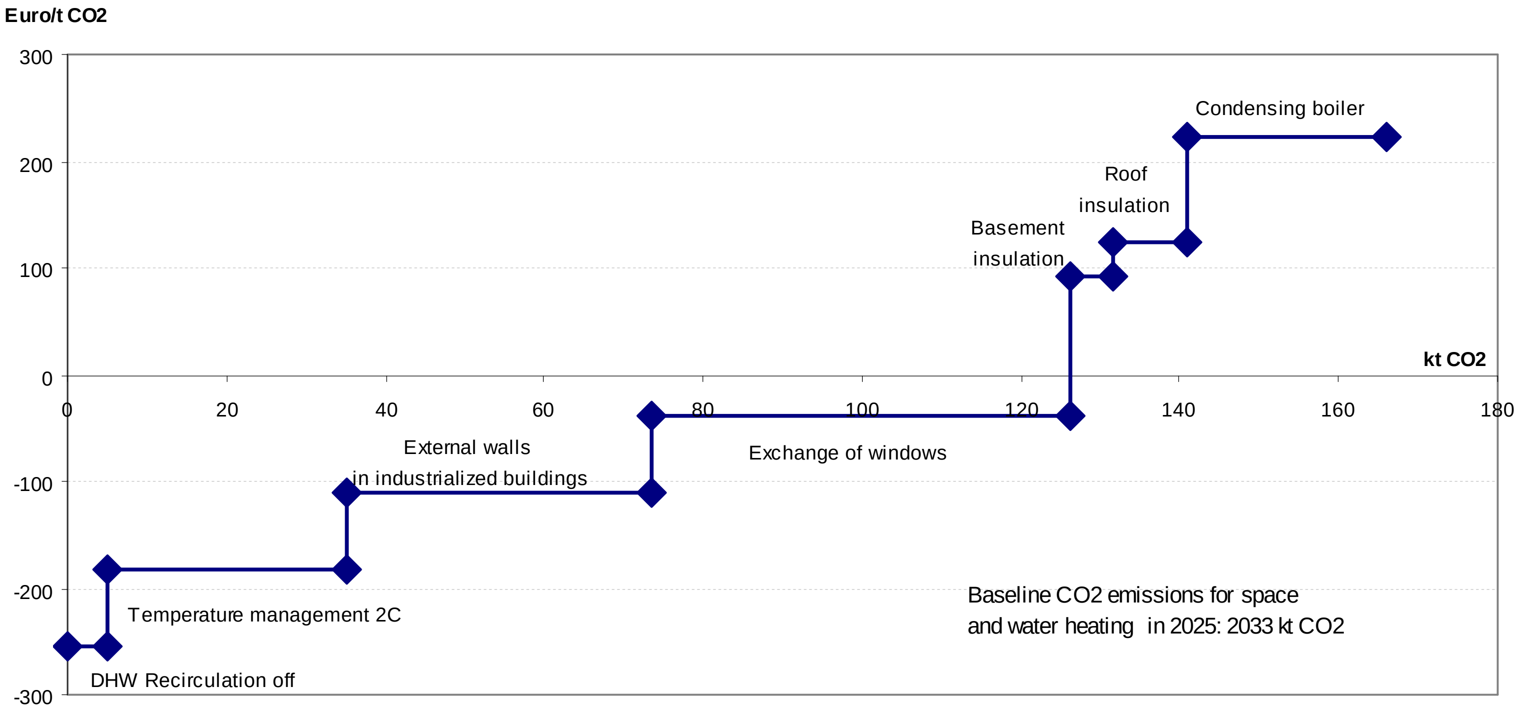
Mitigation cost curves for large educational buildings



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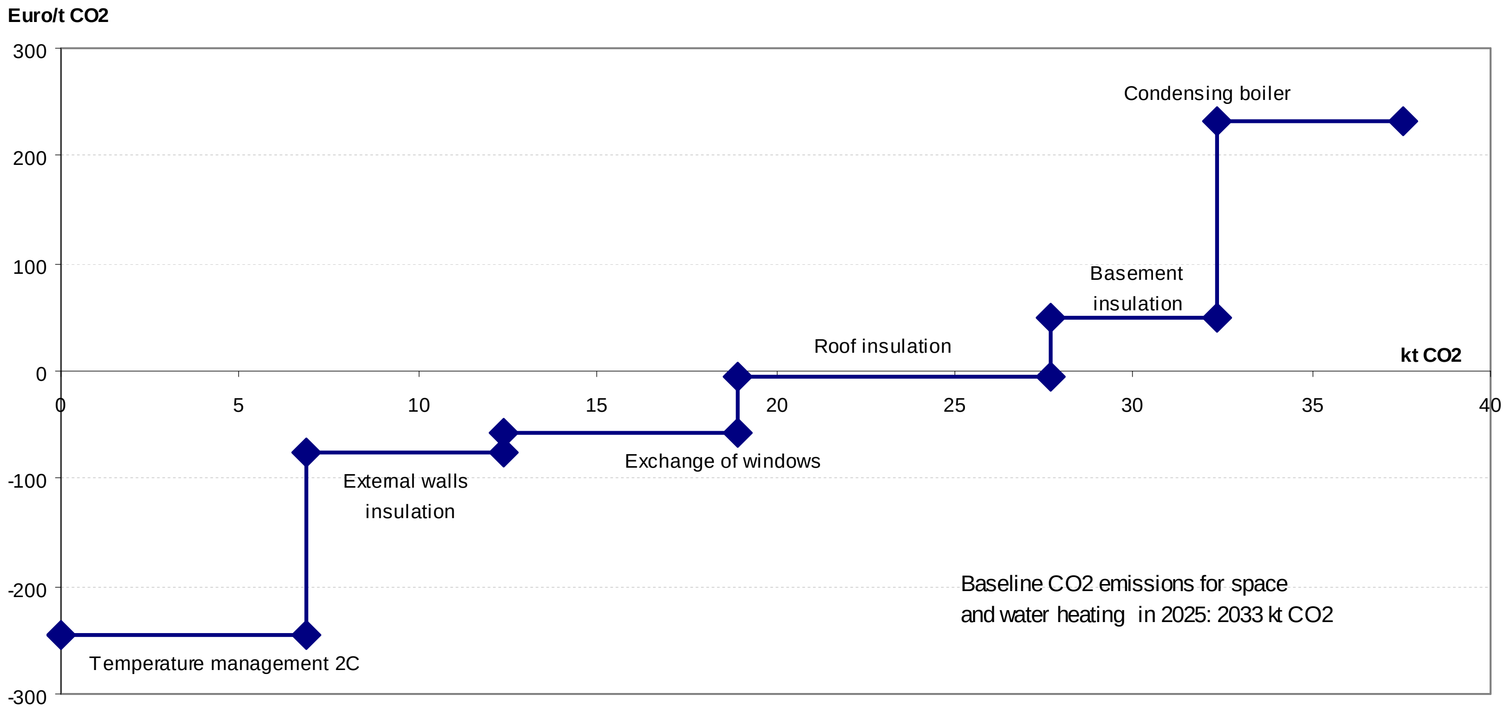
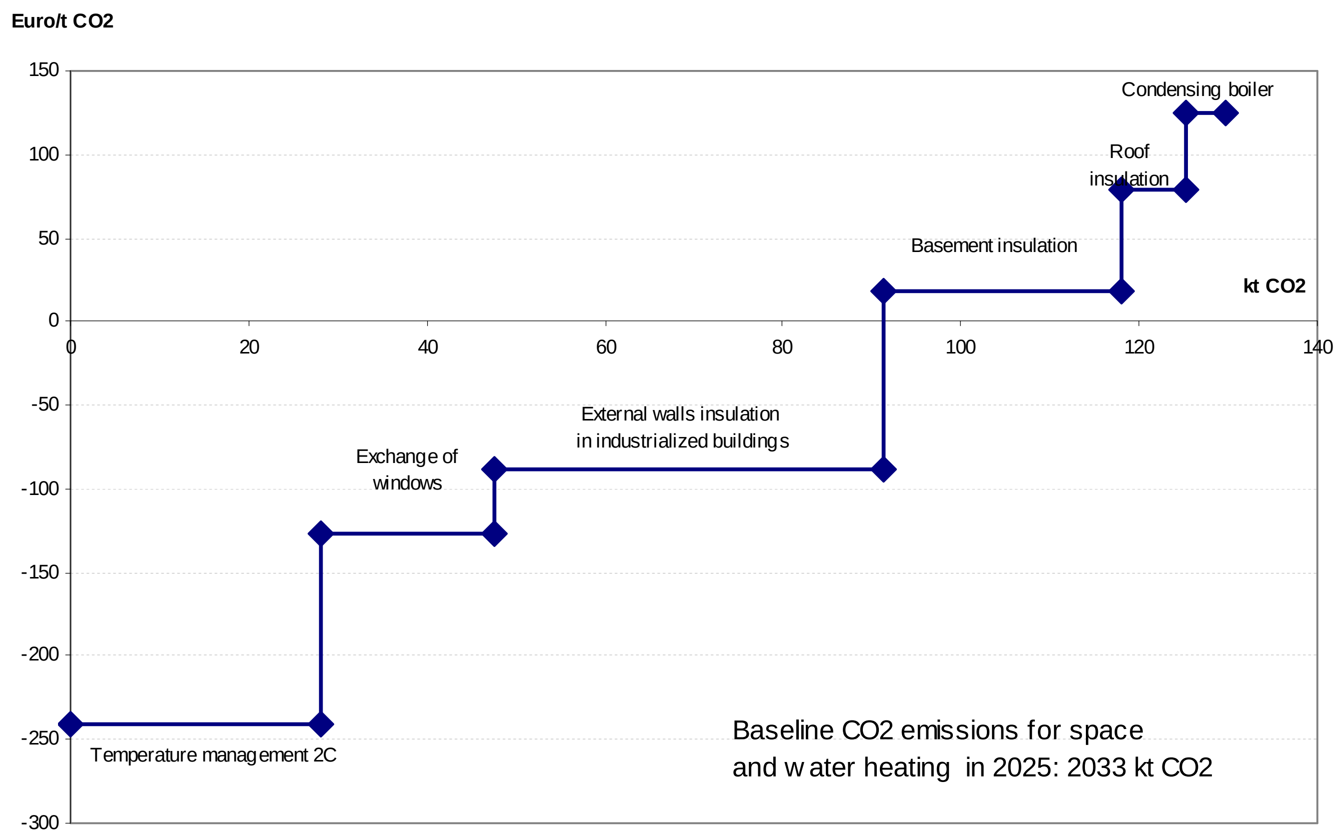
Mitigation cost curves for small health care buildings



Mitigation cost curves for large health care buildings



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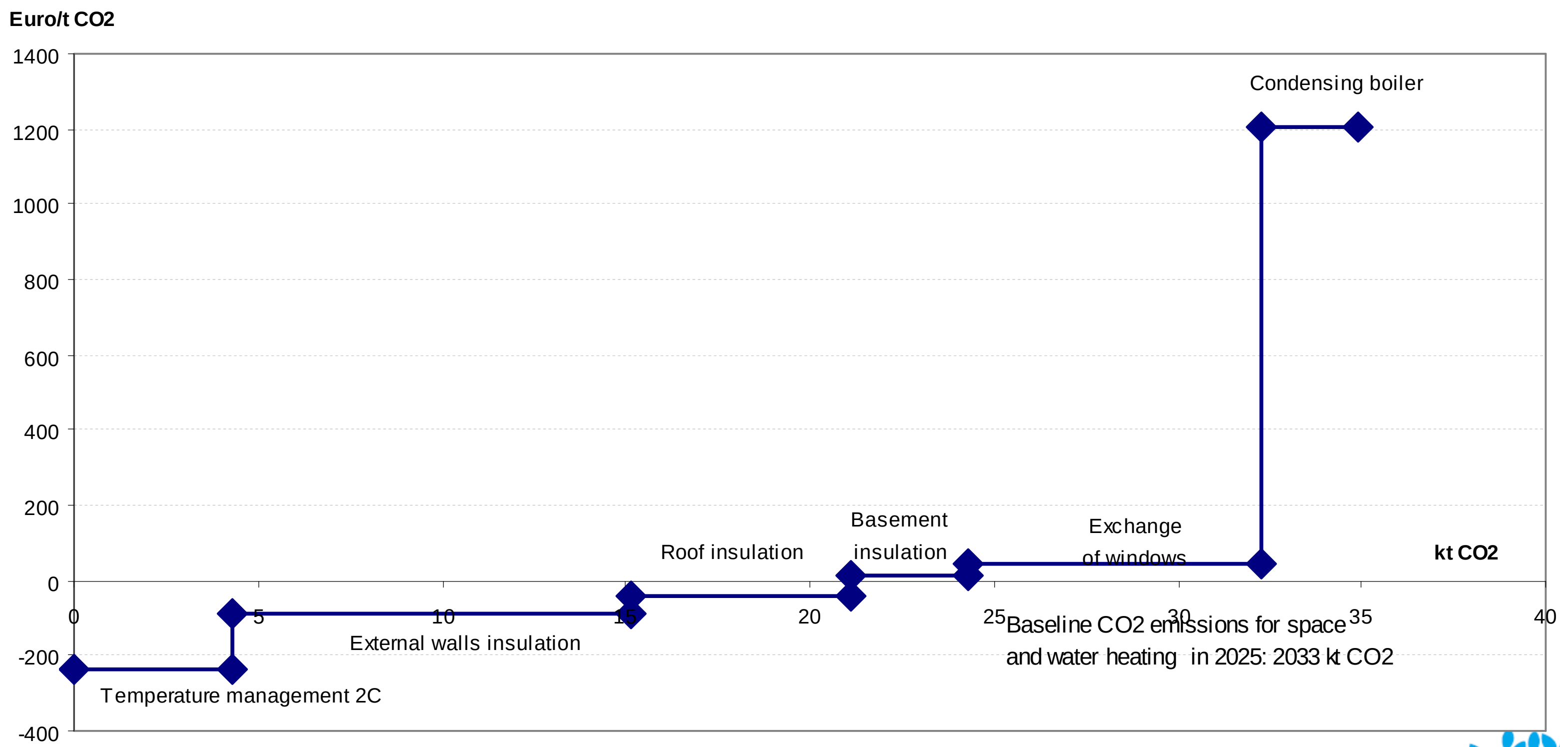
Mitigation cost curves for small public administration buildings



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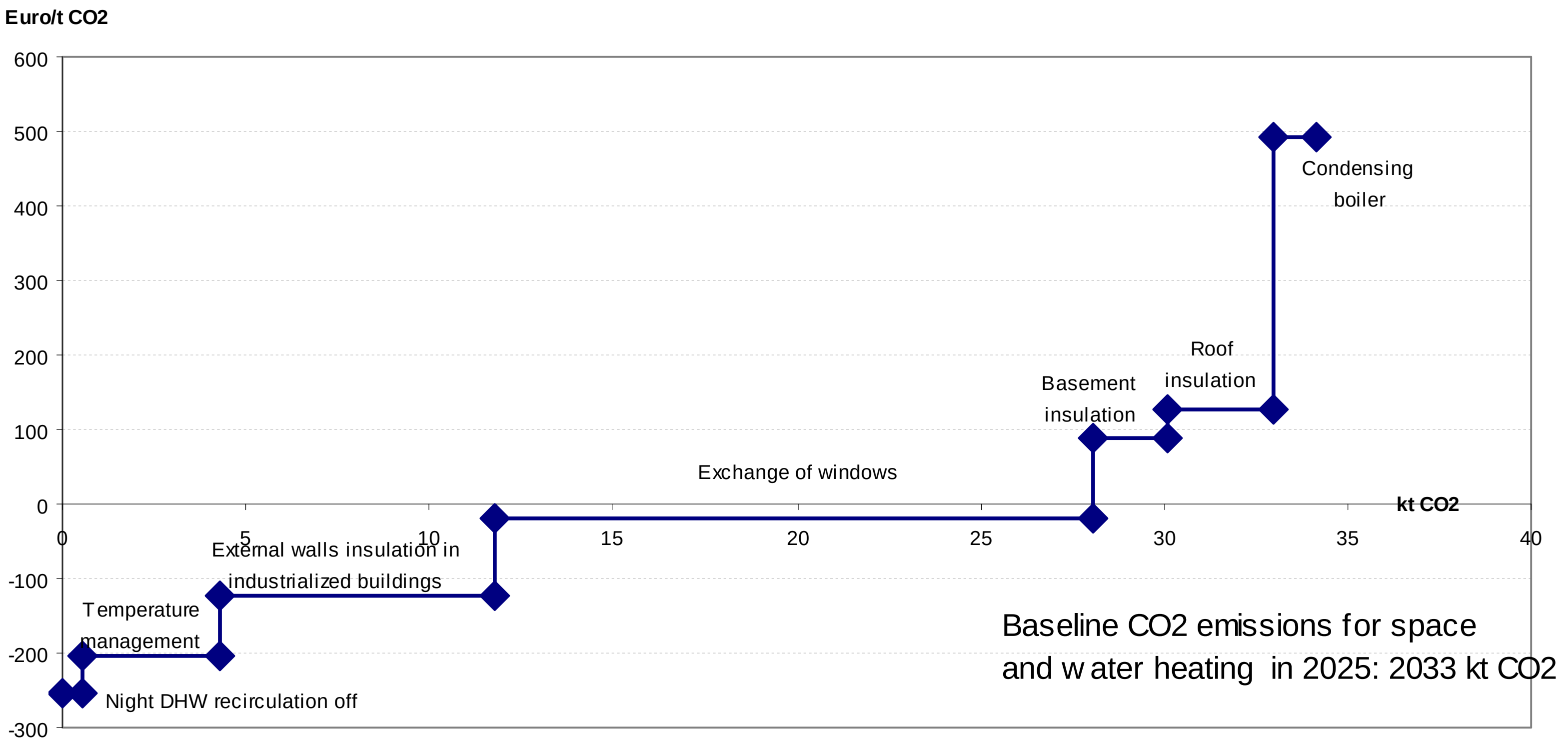
Mitigation cost curves for large public administration buildings



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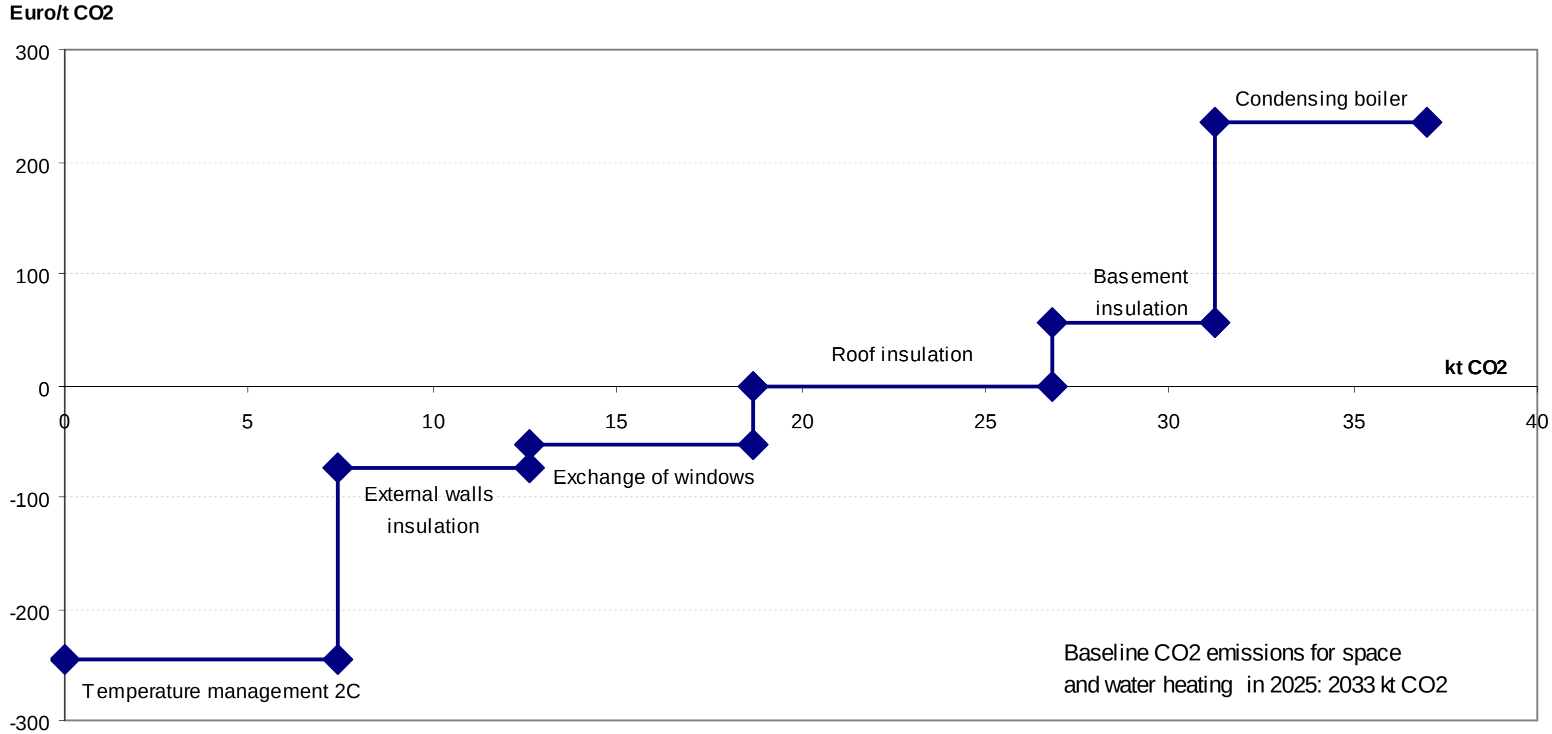
Mitigation cost curves for social buildings



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