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Scenarios for the improvement of energy efficiency in the building sector of South East Europe

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Why to support energy efficiency policies for the buildings of Albania, Serbia, and Montenegro?

Objectives

- To assist the design of energy efficiency and decarbonization policies in the building sector of Albania, Serbia, and Montenegro with the information on:
  - What are the present energy consumption and CO_2 emissions as well as what are their future trends? What are the key influencing factors? What are the priority sector segments for policy-making?
  - What kind of policy packages and what level of policy efforts are required to make buildings low energy/carbon in the future? What are the associated costs? How high are possible energy savings and CO_2 emission reduction?
- Our aim was not only to supply ready results, but also to increase the capacity of policy-makers and experts to conduct their own assessment.

Tasks

- For the residential sector of Albania, Serbia, Montenegro
  - To design a bottom-up simulation model to assess the impact of decarbonization policy packages
- For the public sector of Albania
  - To conduct a country-wide analysis of costs and benefits of thermal efficiency retrofits
- The work was performed in co-operation with policy-makers
  - On the design and assumptions of the models
  - On the preliminary results
- The models were also provided to national policy-makers and experts for their further use and modification.

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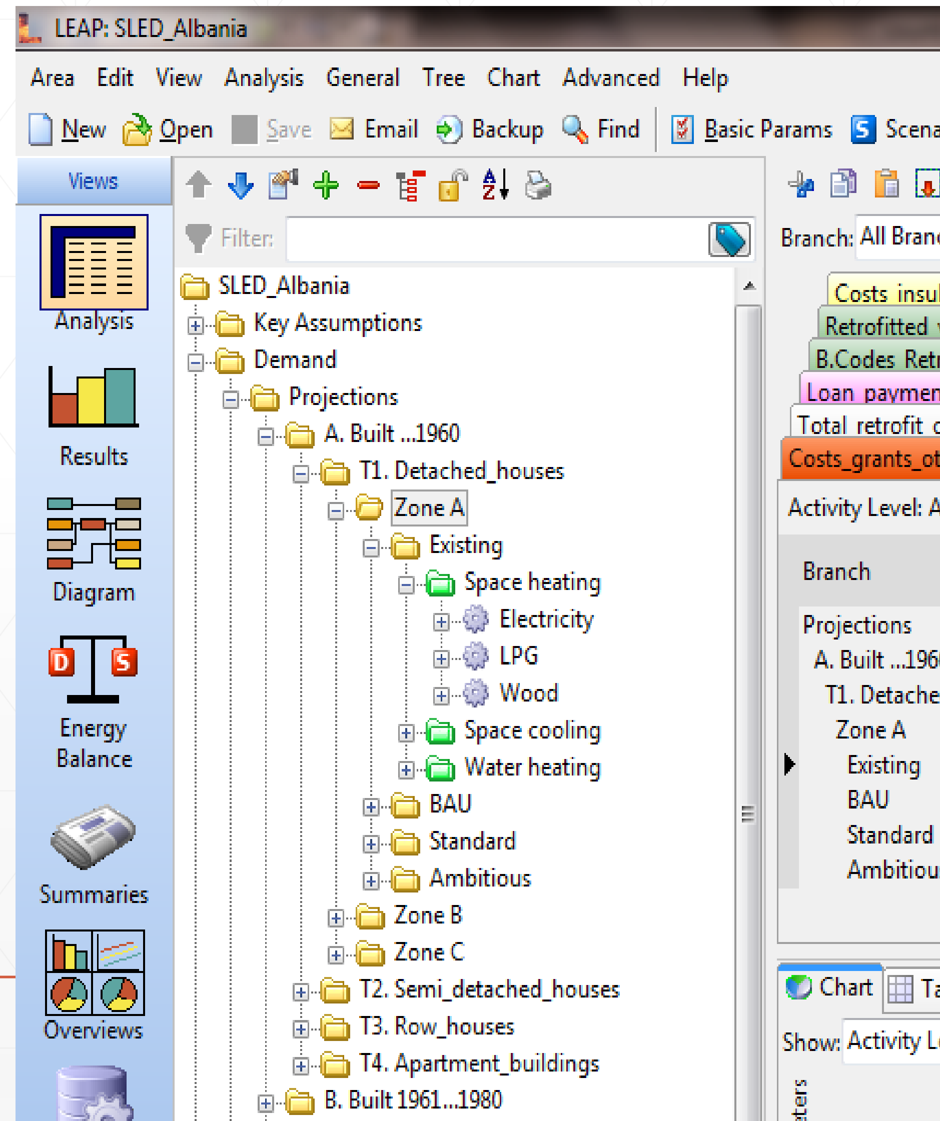
The residential sector:
Albania, Montenegro, Serbia

Methodology and boundaries

- The bottom-up approach aggregating energy information on the levels of
  - Building age and type
  - Climate zone
  - Performance level
  - Energy end-use and source
- The models consider
  - Illegal buildings, non-inhabited dwellings
  - Space heating, space cooling, water heating
  - Only CO_2 emissions (direct and indirect)
- The models do not consider
  - Other appliances, lighting and cooking

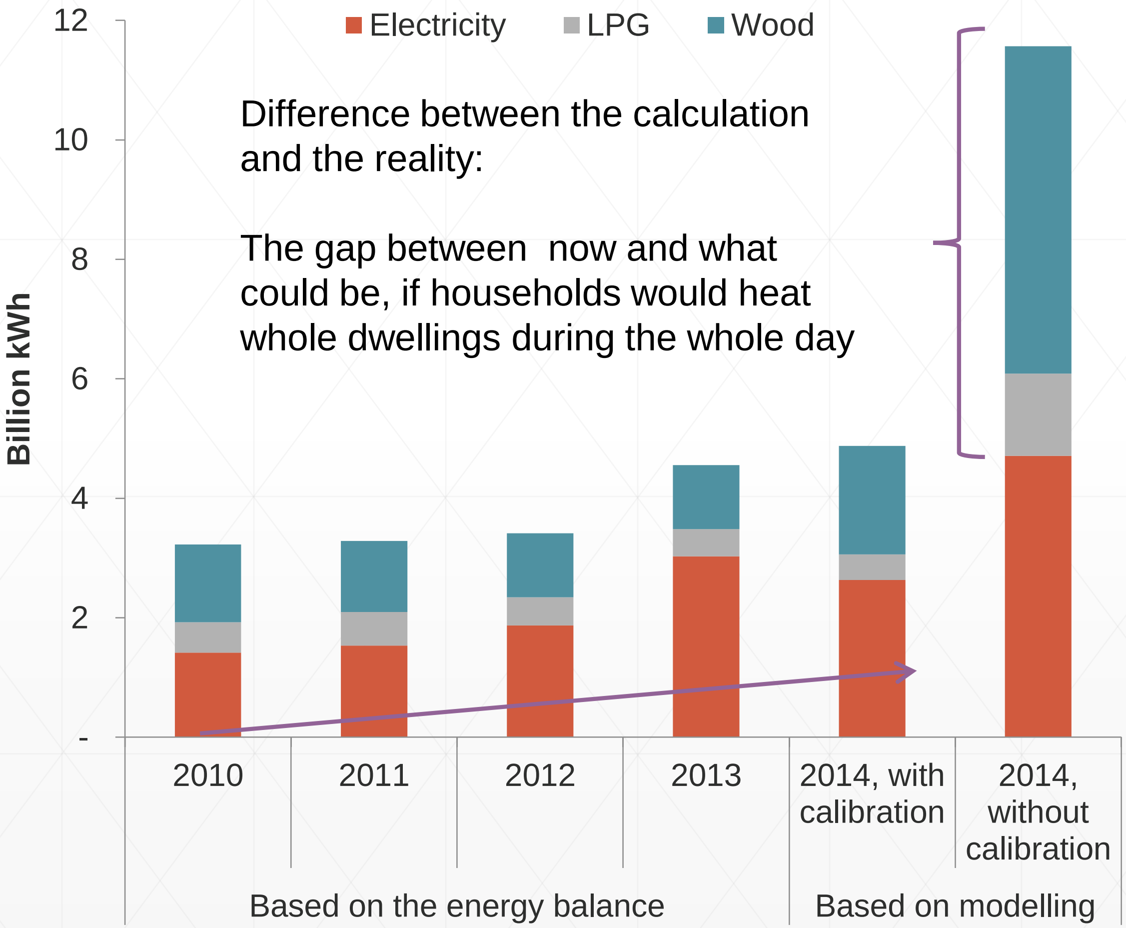


Results: uncertainty in building or energy statistics

- The calculated final energy demand appeared to be different from the official sector energy balances because
  - Dwellings are heated and cooled partially for a few hours a day
  - Censuses provide misleading information on breakdowns by energy source
  - Energy balances provide misleading information for wood consumption

Calibration for Albania: correction for thermal comfort

Final energy consumption for space heating/cooling and water heating



Calibration for thermal comfort

- Floor area heated
  - Zone A – 50%
  - Zone B – 60%
  - Zone C – 80%
- Duration of space heating
  - Electricity heating - 8 hours
  - Wood and LPG heating – 6 hours
- Floor area cooled
  - 60%
- Duration of space cooling
  - 12 hours

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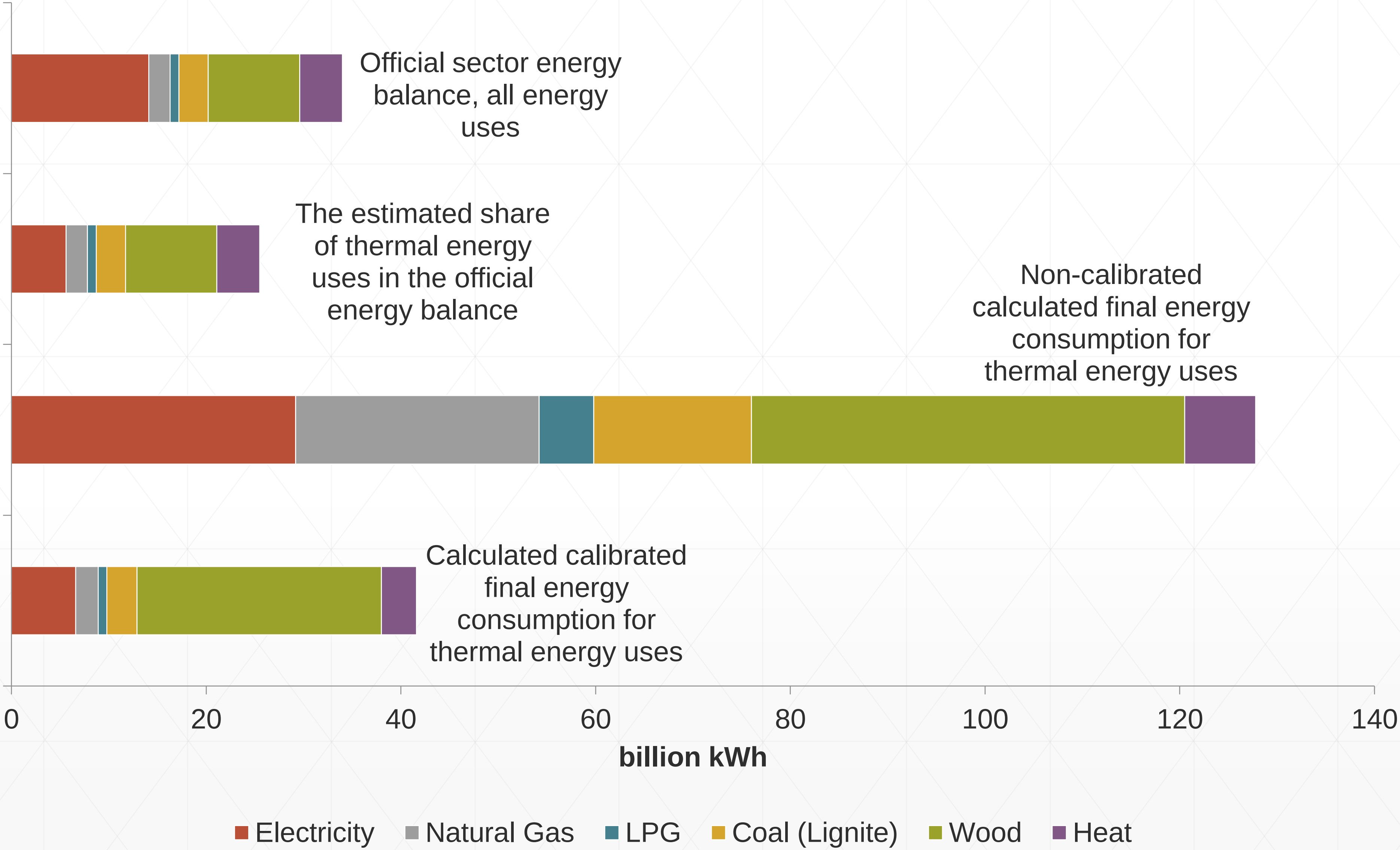
Calibration for Serbia, 2013:
Correction for thermal comfort and the wood share in the balance



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Results: uncertainty in building or energy statistics

- The calculated final energy demand appeared to be different from the official sector energy balances because
  - Dwellings are heated and cooled partially for a few hours a day
  - Censuses provide misleading information on breakdowns by energy source
  - Energy balances provide misleading information for wood consumption
- We recommend
  - To gather information about both primary and secondary technical systems
  - To gather information about partial and intermittent heating and cooling
  - To re-examine biomass consumption in the building sector
  - To revise the structure of the building sector energy consumption (MNO)

Formulated scenarios

- The reference scenario
  - Business-as-usual technological, policy, and market changes
- The moderate scenario
  - The energy performance of all new and existing buildings correspond to that after the standard improvement in Albania by 2050, and in Montenegro and Serbia by 2070.
- The ambitious scenario
  - The largest part of the new and existing buildings of all three countries will achieve the level of ambitious improvement by 2050

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Moderate scenario

New buildings	▪ comply with the building codes recently adopted or to be adopted ▪ the performance under the codes corresponds to the “standard” improvement.
Existing buildings	▪ will be retrofitted by 2050 in Albania and by 2070 in Serbia and Montenegro to the standard level and their owners will receive financial support for that. Grants will be provided to cover eligible costs for: ▪ low income households ▪ the declining over time share of retrofitted dwellings in large buildings (90% of the retrofitted dwellings in 2016 vs 10% of them by the target year) Low interest loans will be provided to cover eligible costs for: ▪ the rest of the households in small houses ▪ the rest of the dwellings in row houses and apartment buildings

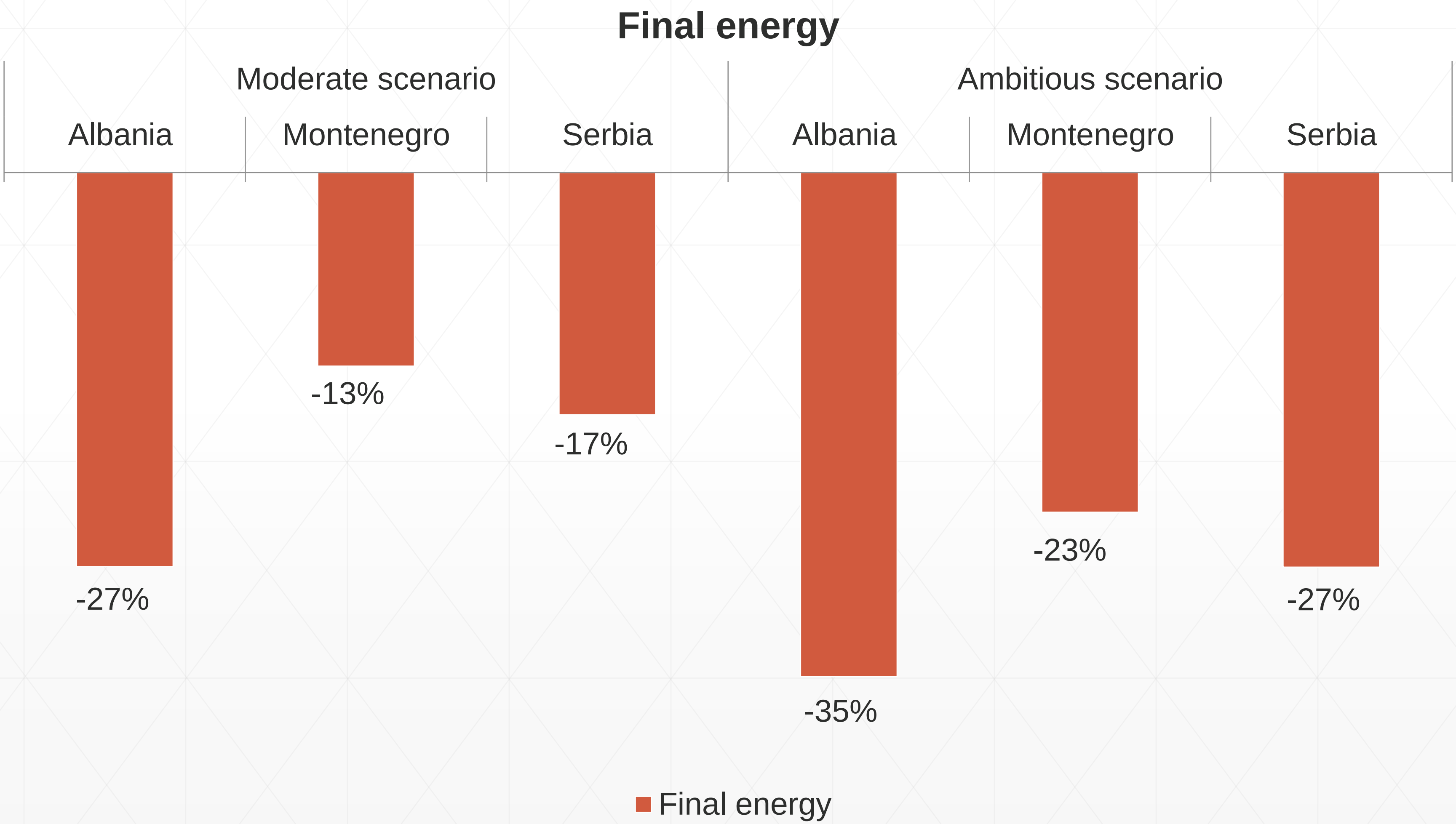
Ambitious scenario

	Additionally to the assumptions of the moderate scenario:
New buildings	▪ are eligible for low-interest loans until 2023 to cover eligible costs, if their performance achieve that according to the 2023 building code ▪ comply with the new building codes once they are introduced in 2023 ▪ the performance under the codes corresponds to the “ambitious” improvement
Existing buildings	▪ will be retrofitted by 2050 in all countries and their owners will obtain financial support for that (the same structure as in the moderate scenario) ▪ will have to comply with the standard improvement until 2022 ▪ will have to comply with the ambitious improvement after 2023

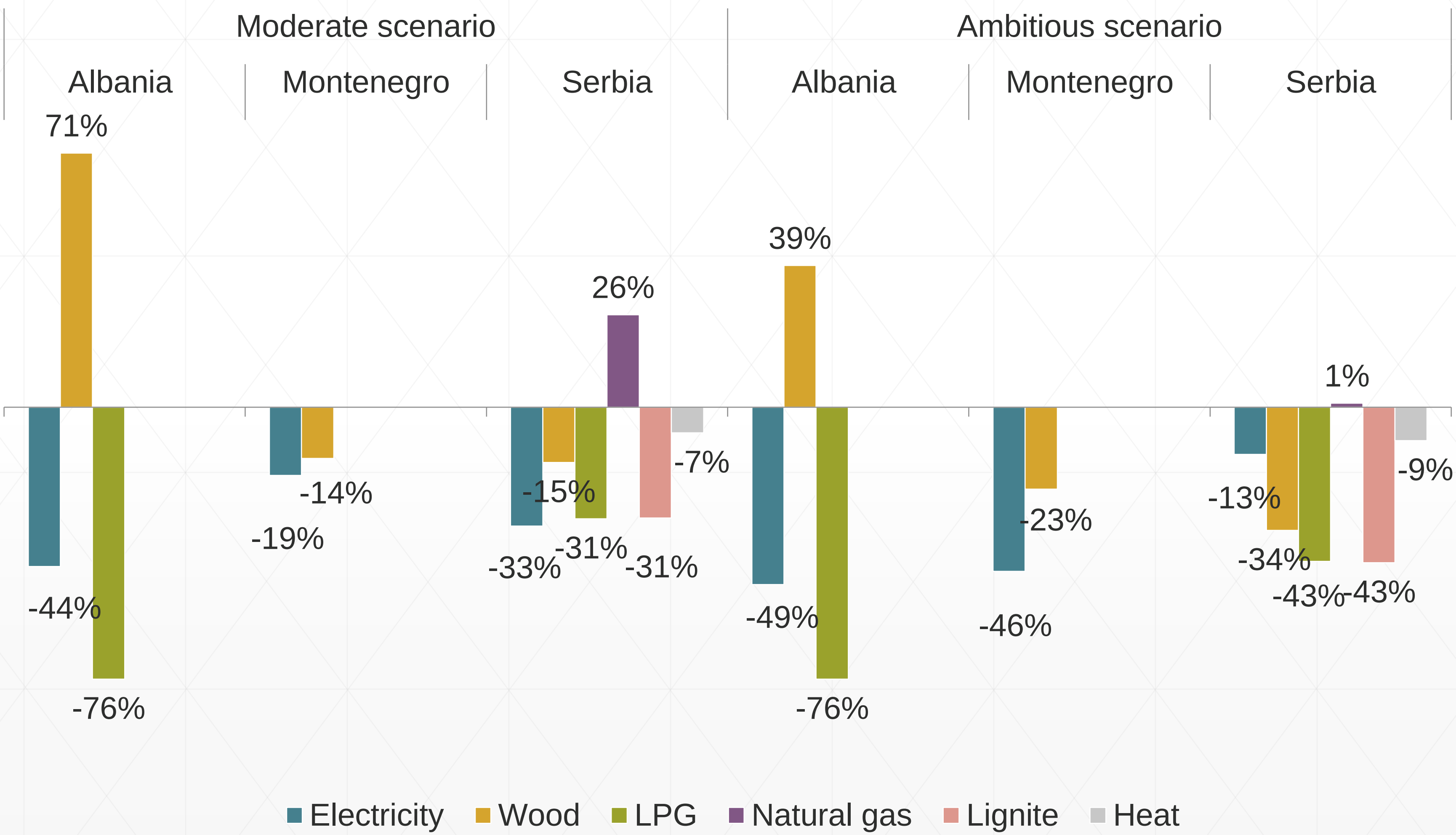
Results: savings by building segment

- In all countries, both moderate and ambitious policy scenarios may deliver significant energy savings

Results: energy savings and CO_2 reduction



Results: energy savings and CO2 reduction



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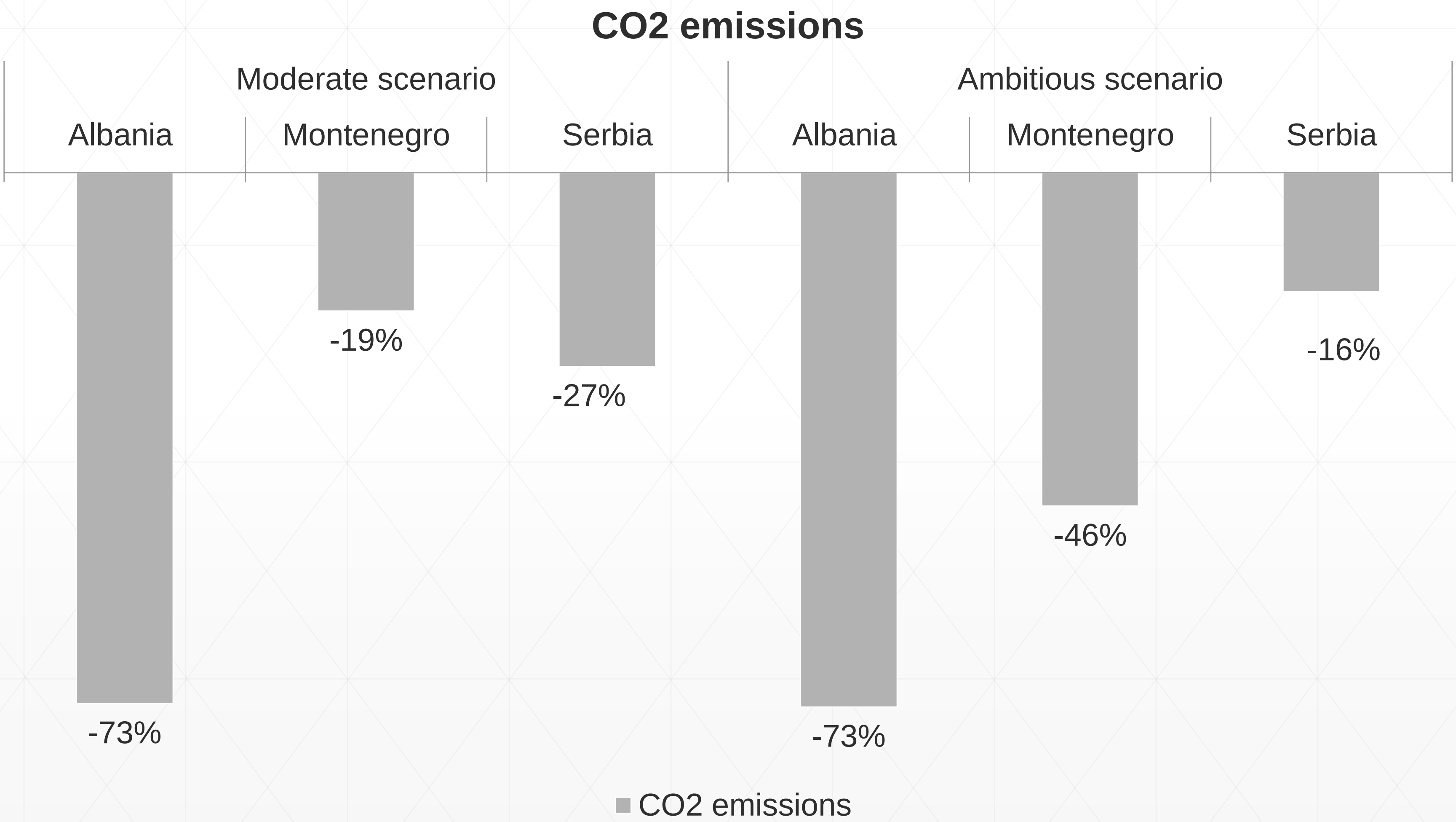
Results: energy savings and CO2 reduction

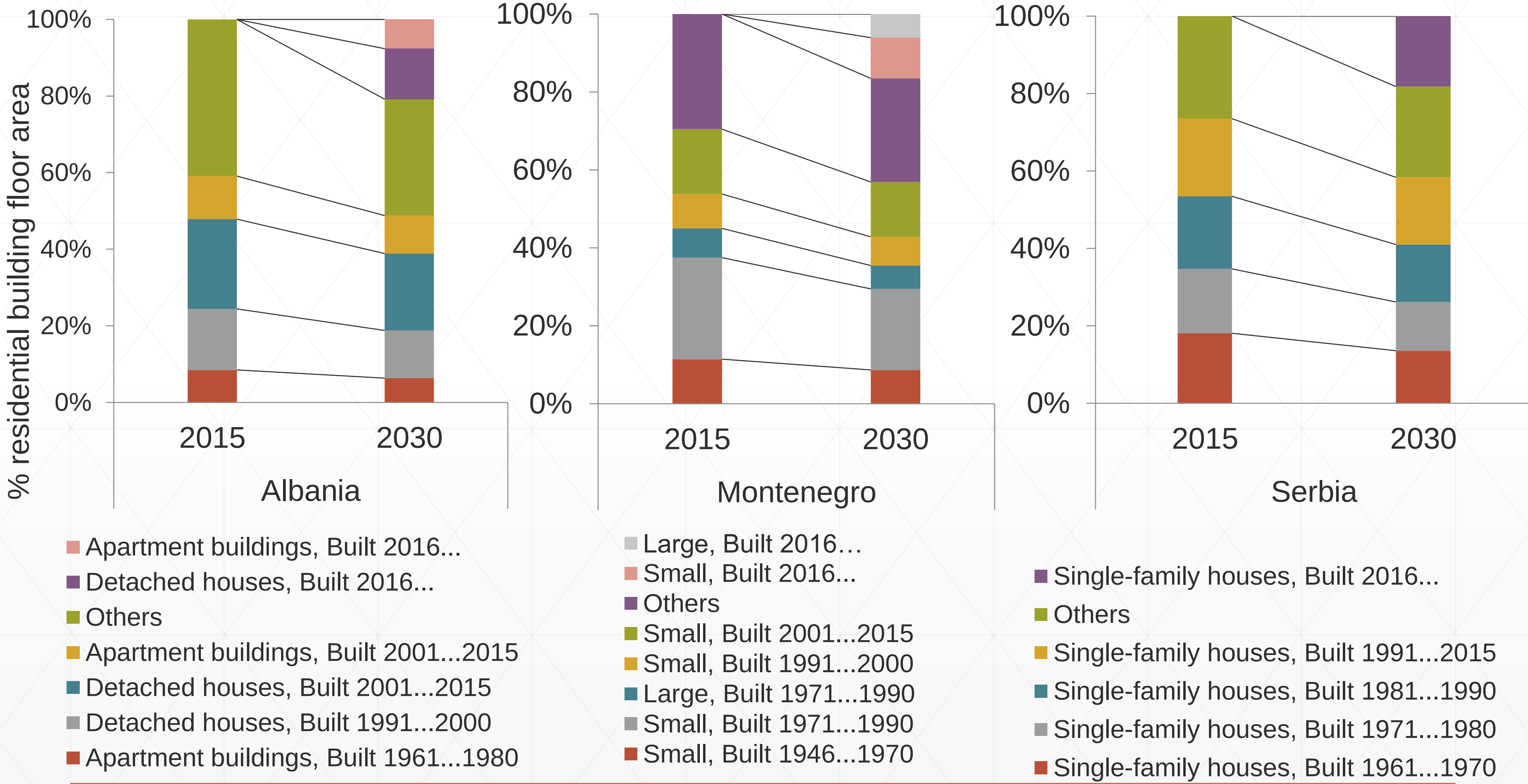


Results: savings by building segment

- In all countries, both moderate and ambitious policy scenarios may deliver significant energy savings

- However, sector priorities for policy-making are different for each country

The structure of residential building floor area by building age and type



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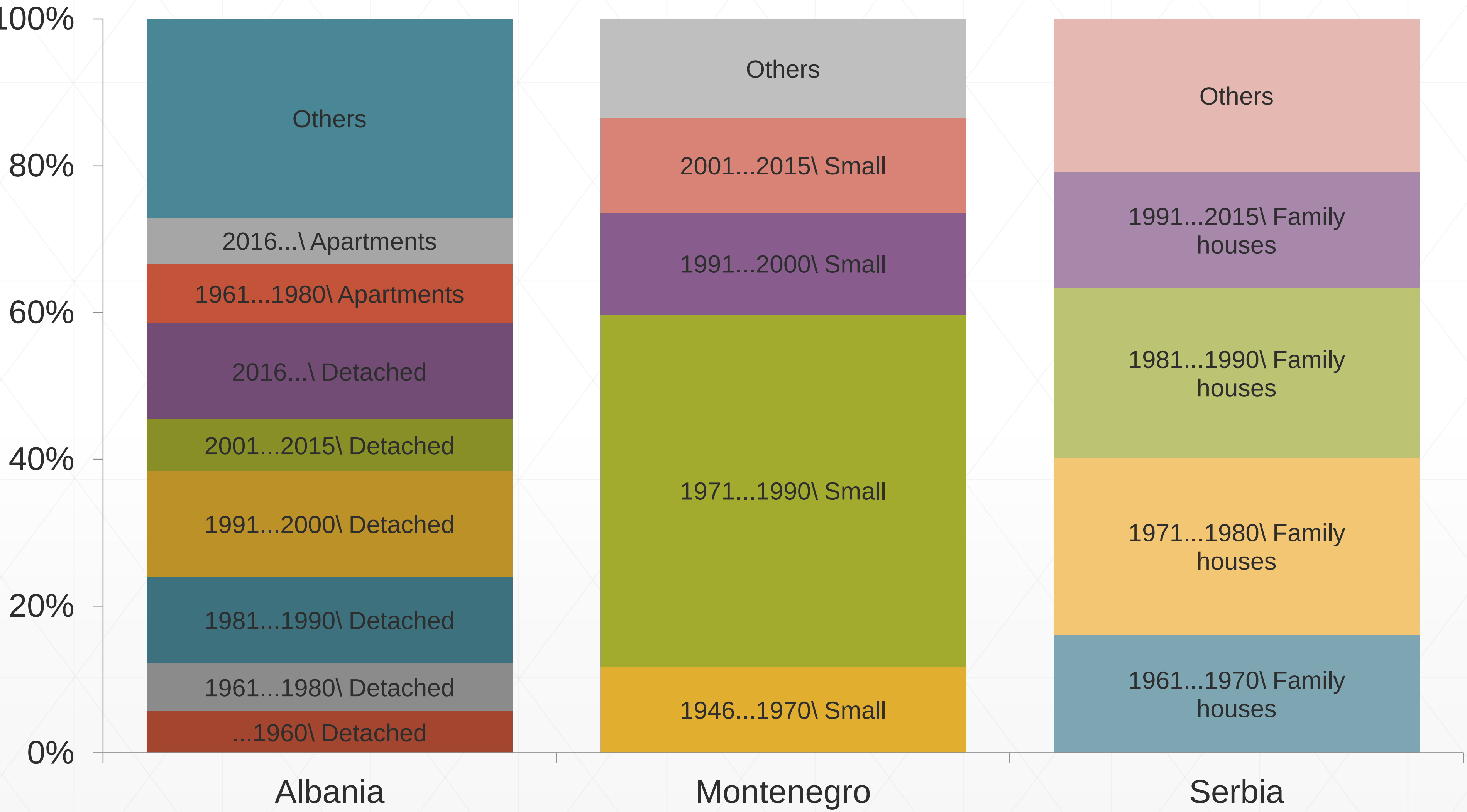
The structure of final energy savings in 2030, the moderate scenario



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Results: investment required

- The investment required are high in all three countries

Indicators		Albania		Montenegro		Serbia	
		Moderate	Ambitious	Moderate	Ambitious	Moderate	Ambitious
Floor area affected, annual average							
Floor area retrofitted	mil m2	1.7	1.7	0.31	0.43	6.6	7.0
Share of the floor area	%	2.5	2.5	1.6	2.4	2.0	2.1
New floor area affected	mil m2	1.1	1.1		0.25		5.2
Investment costs, annual average							
Total costs, retrofits	mil EUR	153	180	46	80	822	1,076
Incremental costs, retrofits	mil EUR	72	99	19	53	329	583
Incremental costs, constr.	mil EUR	40	72		15		265

Results: economic analysis

- The investment required are high in all three countries

- We recommend:
  - To couple thermal efficiency improvement of existing buildings with their business-as-usual renovation
  - To inforce retrofits at the point of sale

Results: cost-effectiveness of scenarios

Indicators (annual average)		Albania		Montenegro		Serbia	
		Moderate	Ambitious	Moderate	Ambitious	Moderate	Ambitious
Annualized incremental costs*	EUR/m2	2.3	3.5	1.9	5.4	2.9	4.2
Saved energy costs**	EUR/m2	3.8	4.1	3.6	5.5	3.8	2.7

Notes: * the discount rate is 4%; ** costs are per m2 of new and retrofitted buildings

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Results: cost-effectiveness

- The investments into all scenarios except for the Serbian ambitious scenario are cost-effective or on the border of cost-effectiveness.
  - Saved energy costs are higher than annualized investment costs as a whole on the country level, but not for all building categories in all climate zones.
- We recommend:
  - To calculate other benefits additionally to saved energy costs.

Results: evaluation of policies

- The realization of the scenarios requires
  - a careful design and massive provision of financial products for the residential energy efficiency
  - as well as the introduction and enforcement of building codes

Results: evaluated policy packages

Notes: *** for 2016-2022

Million EUR, total over 2016 - 2030	Albania		Montenegro		Serbia	
	Moderate	Ambitious	Moderate	Ambitious	Moderate	Ambitious
Private investments raised by low-interest loans						
Retrofits	548	1,103	183	481	4,692	8,457
Construction* **		612		97		1,737
Governmental costs for low-interest loans						
Retrofits	599	803	84	204	2,191	3,629
Construction		516		64		1,147
Governmental costs for grants						
Retrofits	327	451	89	179	1,008	1,756

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The public sector: Albania

Methodology

- The analysis using energy conservation supply curves
  - The potential energy savings from a set of thermal energy retrofit packages applied to different building types as a function of the cost per unit
- Traditional financial analysis
  - Investment size, simple payback period, net present value (NPV), internal rate of return (IRR), and the benefit-cost ratio taking into account saved energy costs as benefits
- Financial analysis including other benefits beyond saved energy costs
  - Thermal comfort, avoided CO_2 emissions, avoided economic effects from airborne pollutants, employment, and economic growth

Co-benefits from the state point of view

GDP increase	[EUR/EUR]	0.65
direct	[EUR/EUR]	0.30
multiplier effects	[EUR/EUR]	0.35
Labour income	[EUR/EUR]	0.30
direct	[EUR/EUR]	0.17
multiplier effects	[EUR/EUR]	0.13
Employment	[jobs/million EUR]	148
direct employment	[jobs/million EUR]	85
multiplier effects	[jobs/million EUR]	63
Monetized CO2 emissions avoided	EUR/tCO2	5
Air quality including health impacts	EUR/MWh-yr.	1.38
Improved comfort and services of buildings	[% real estate value]	2%

Source: estimated based on a study on green energy-efficient schools for Albania prepared by Arizona State University (Arizona State University 2015) and a study on the development of an investment programme for building rehabilitation of public building prepared for Romania within the JASPERS financing tool of the European Investment Bank (EXERGIA S.A. 2013).

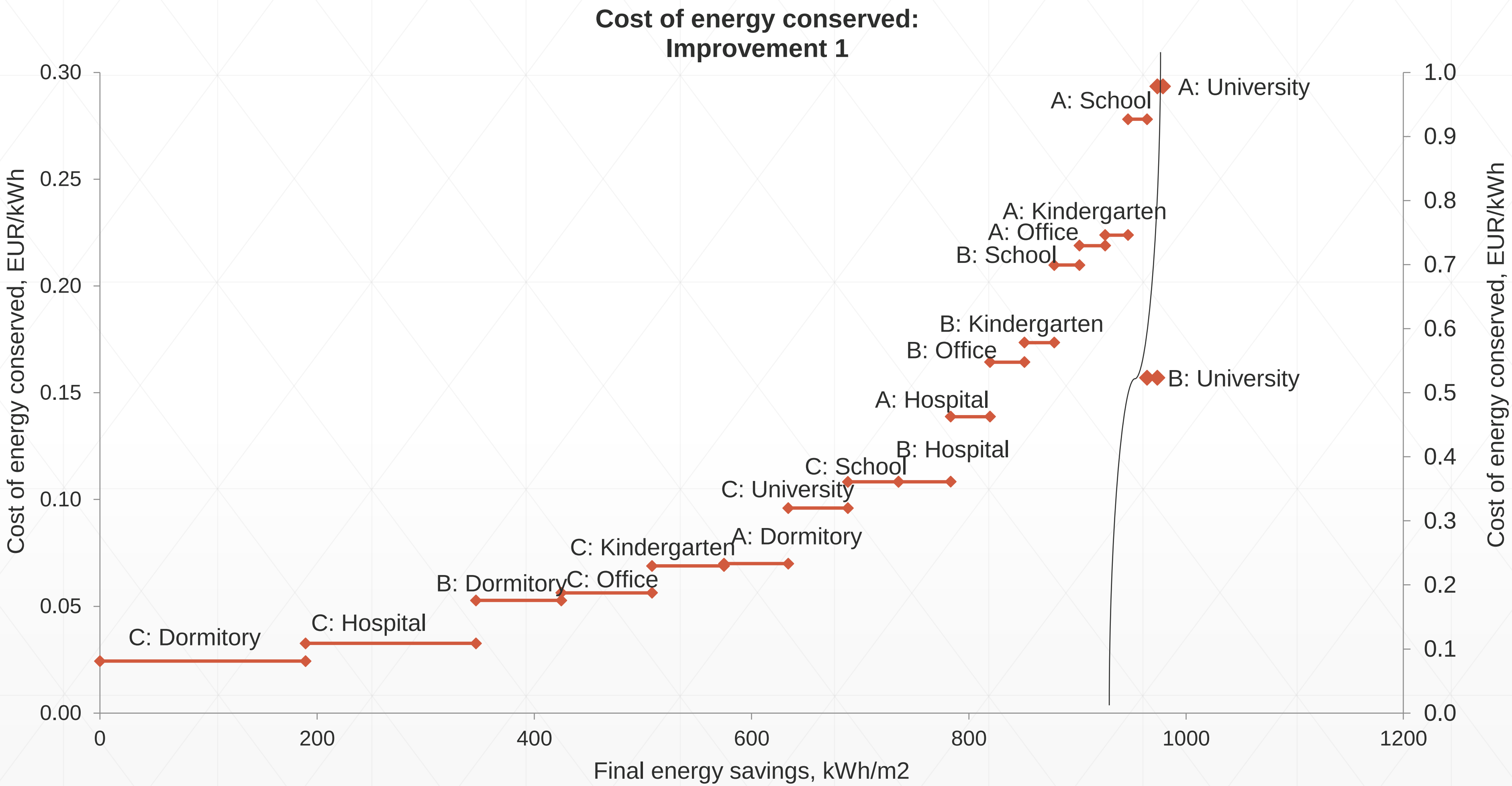
Methodology and boundaries

- The model was prepared in MS Excel
  - by m2 by climate zone for both improvements;
  - by m2 and for the whole stock for each climate zone for municipalities;
  - by m2 and the whole stock for the whole country for program administrators.

- Only thermal energy services are analyzed
  - Space heating, space cooling, and water heating

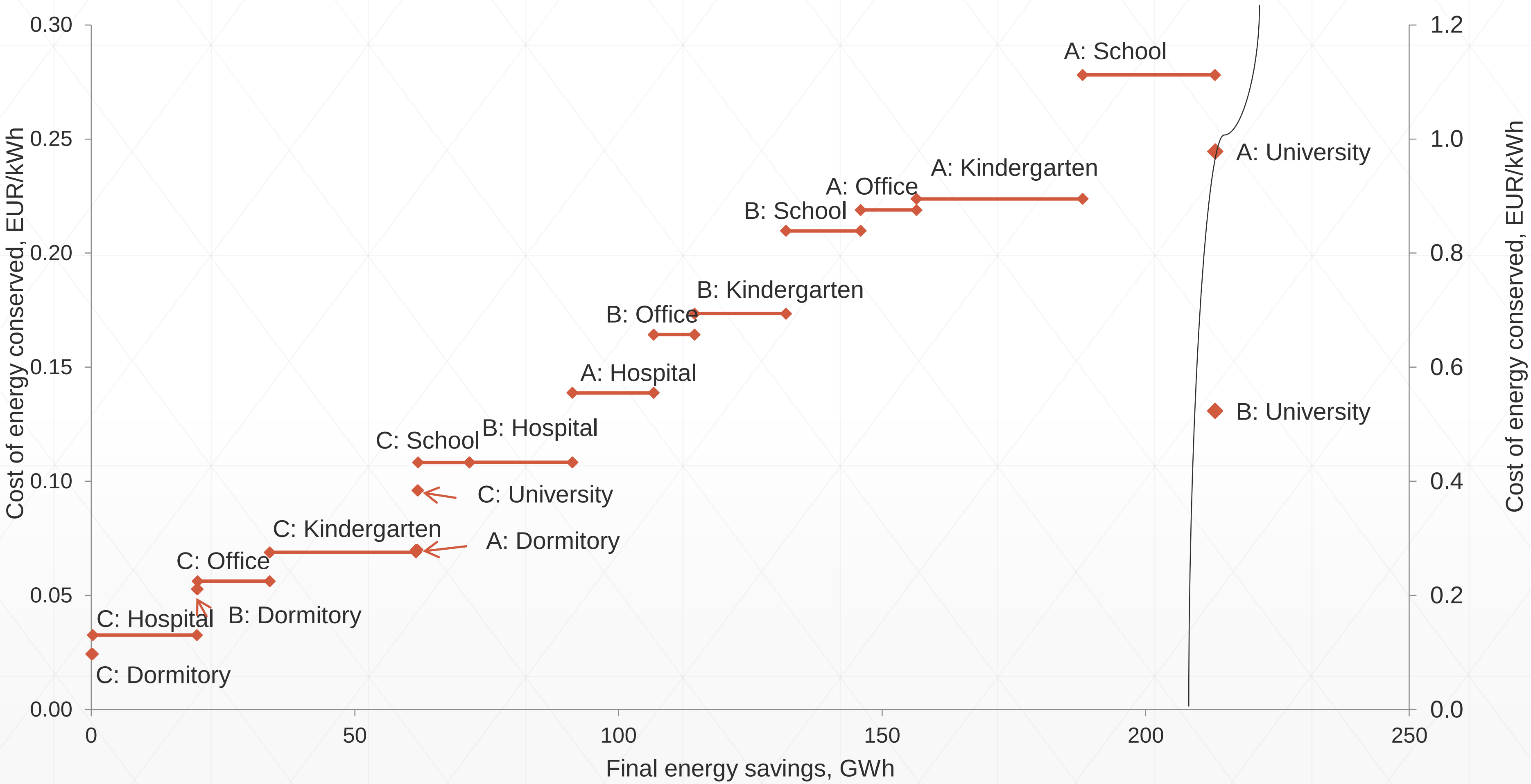
- Energy demand of public buildings was calibrated to energy bills
- In order to make the recommended advanced packages comparable the BAU renovations, the country-wide analysis is prepared according to the level of comfort suggested by these advanced retrofit packages.

Results: cost-effectiveness of improvement 1



Note: the discount rate is 4%

Results: final energy savings, improvement 1



Note: the discount rate is 4%

Results: improvement 1

- Investment need is EUR 500 million
  - The highest investment on the national scale are required by kindergartens and schools followed by offices and hospitals.
  - If classified by climate zone, the largest investment is required in zone A.

- Energy cost savings are EUR 29 million/yr. or EUR 502 million over measure lifetime.
  - Almost 45% of it is in the zone A due to its large number of buildings.
  - Saved energy costs per m2 in the climate zone C are more than twice higher than those in the zone A and 65% higher than in the zone B.
  - The highest energy cost savings per m2 are offered by dormitories and hospitals.

- If only saved energy costs are considered, only dormitories and hospitals are financially feasible for retrofits

Financial analysis	Units	Dormitory	Hospital	Kita	Office	School	Uni	Total
Simple payback	[years]	5	7	20	17	27	n/a	17
Internal rate of return	[%]	15.7%	11.1%	3.0%	4.0%	1.1%	-0.2%	3.9%
NPV	[EUR/m2]	1.3	83.2	-25.8	0.2	-63.3	-0.4	-4.8
Cost - benefit ratio		0.3	0.4	1.2	1.0	1.5	2.1	1.0

- However, other co-benefits are cumulatively comparable to saved energy costs even given that only a limited number of them is quantified.

Financial analysis	Units	Dormitory	Hospital	Kita	Office	School	Uni	Total
GDP increase	[million EUR]	0.4	39.4	123.0	44.2	121.6	0.6	329
Labour income	[million EUR]	0.2	18.1	56.4	20.3	55.8	0.3	151
CO2 avoided	[million EUR]	0.02	4.1	2.4	1.2	1.2	0.0	9
Air quality	[million EUR]	0.0	1.1	1.8	0.8	1.4	0.0	5
Improved comfort	[million EUR]	0.1	4.6	15.2	5.1	14.8	0.1	40
Total	**[mil EUR]**	**0.6**	**67**	**199**	**72**	**195**	**1**	**534**
Employment	[jobs]	85	8,963	27,969	10,048	27,652	27	74,844

Assistance to the 2nd and 3rd NEEAP

- An alternative plan, which includes the most cost-effective retrofits and the priority types from the social point of view:
  - All kindergartens and hospitals in the climate zone C
  - The level of performance defined by the improvement 1
  - The total investment required is EUR 40 million

Plan characteristics	Hospitals	Kindergartens
Floor area retrofitted, thousand m2	126	419
Costs of energy conserved, EUR/kWh	0.03	0.07
Investment cost, million EUR	10	30
CO_2 reduction, tCO_2	3,841	1,072
Primary energy demand savings, GWh (ktoe)	18 (1.5)	13 (1.1)
Final energy demand savings, GWh (ktoe)	20 (1.7)	28 (2.4)
Saved energy costs over measure lifetime , million EUR	58	34
Simple payback period, years	3	15
Internal rate of return, %	23%	5%
NPV, EUR/m2	46	5
Cost - benefit ratio	0.2	0.9
Additional monetized co-benefits, million EUR	13	32
Employment, jobs	1,490	4,383

Conclusion 1

- Addressing energy demand in the building sector without increasing its CO_2 emissions is a challenge
- Fuel poverty is a typical problem, energy consumption would be much higher if EU health and comfort standards are met
- We recommend to eliminate uncertainties in energy balances and building statistics
  - Account for both primary and secondary systems
  - Gather information on fuel poverty
  - Re-examine biomass consumption
  - Revise the energy consumption of the residential and tertiary sector in MNO

Conclusion 2

- Both scenarios may deliver energy savings in the residential sector
  - Incl. electricity savings and lignite consumption reduction (Serbia)
- Sector priorities for policy-making are different for each country
  - Albania: small buildings + those constructed after 1991
  - Serbia&Montenegro: small buildings + those constructed in 1971 – 1990
- The investment required are high ->
- We recommend to couple retrofits with their BAU renovations and other windows of opportunities
- The investment is cost-effective for all scenarios except for the ambitious in Serbia if saved energy costs are calculated as a benefit but not for all building categories +not in all climate zones
- Other benefits beyond saved energy costs should be included

Conclusion 3

- The realization of the scenarios requires
  - a careful design and massive provision of financial products
  - the introduction and enforcement of building codes
- The governments play a central role but they cannot finance alone
  - Investment of the private sector should be leveraged
  - Retrofits of low income households could be reallocated to utilities
  - International donor support for credit line is crucial

Conclusion 4

- Energy services in the public sector in Albania are inadequate
- The highest energy savings per m2 are in mountains but in the absolute numbers on the coastline
- The largest savings are in kindergartens, schools, hospitals
- Only dormitories and hospitals are financially feasible for retrofits if saved energy costs are considered as a benefit
- Other co-benefits monetized are higher than saved energy costs

Thank you!

Reports are available at: http://sled.rec.org/building.html

Models are available on request at: aleksandra.novikova@ikem.de

International experts

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