

Building-Retrofit-Policies

Overview on Policies and Implementation in Austria and Czech Republic Effects of Refurbishment Actions



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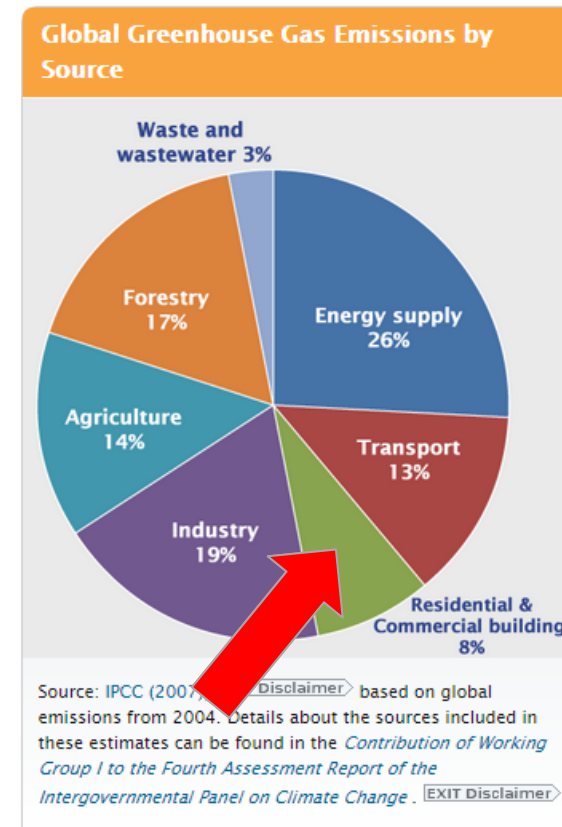
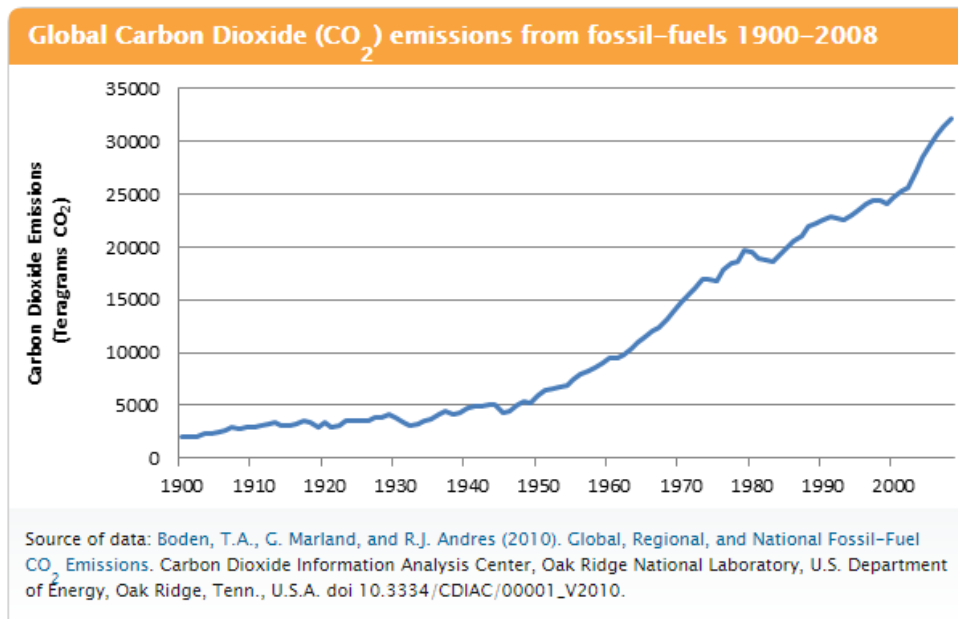
- Problem & Motivation
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 - Potential and Effects of Building Refurbishments
 - Building-Retrofit-Policies
- Conclusions



The Problem in broader Sense

NEARLY ALL ACTIVITIES OF HUMANS ARE RELATED TO ENERGY CONSUMPTION!

CO₂ – EMISSIONS: ONE OF THE WORLD'S MOST EXISTING CHALLENGES TO-BE SOLVED

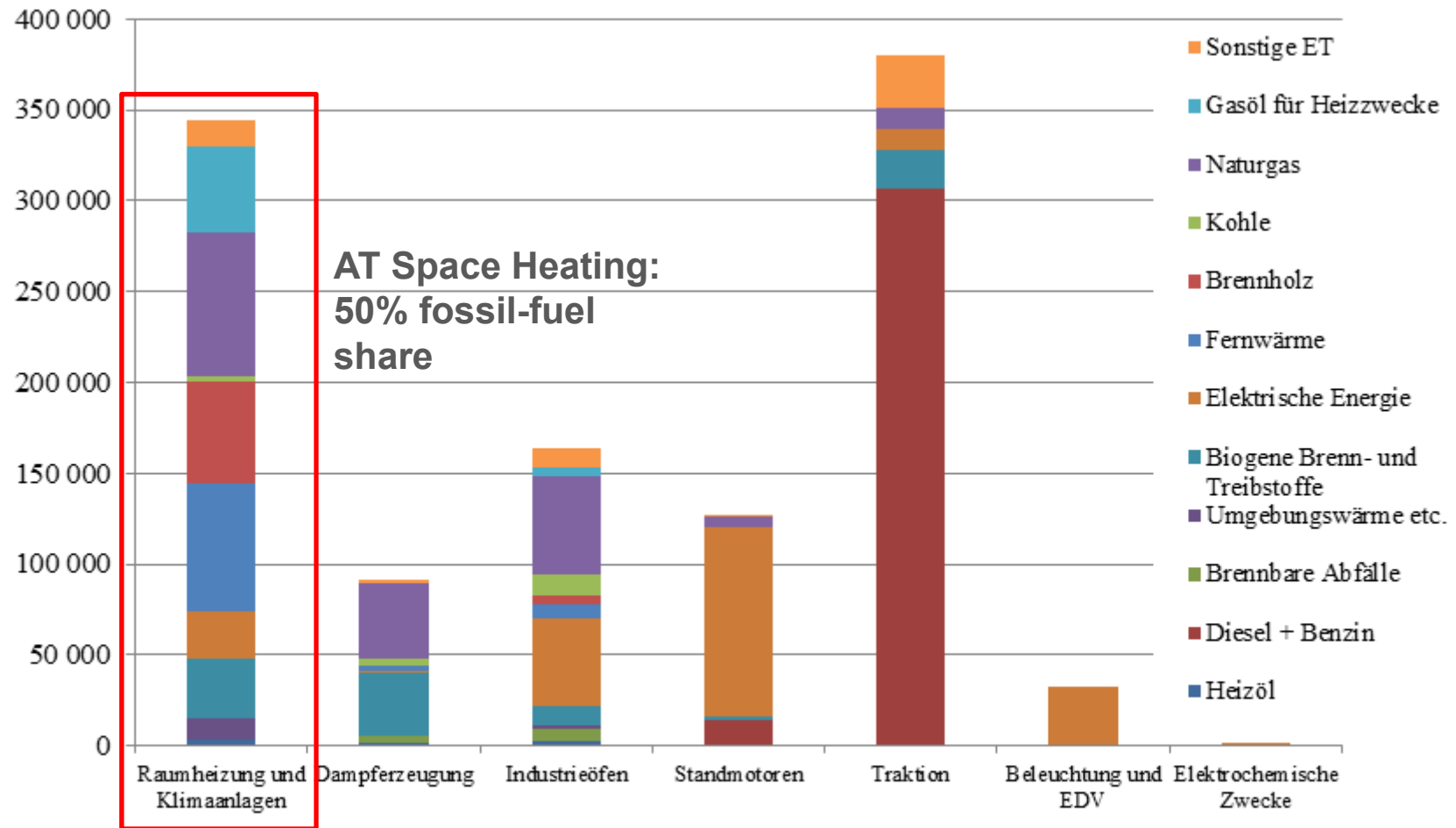


Sources: IPCC 2007, Climate Change 2007: Mitigation of Climate Change; NRC 2010, Advancing the Science of Climate Change; Houghton 2008, Carbon Flux to the Atmosphere from Land-Use Changes: 1850-2005



Final Energy Consumption AT 2013 (TJ/a)

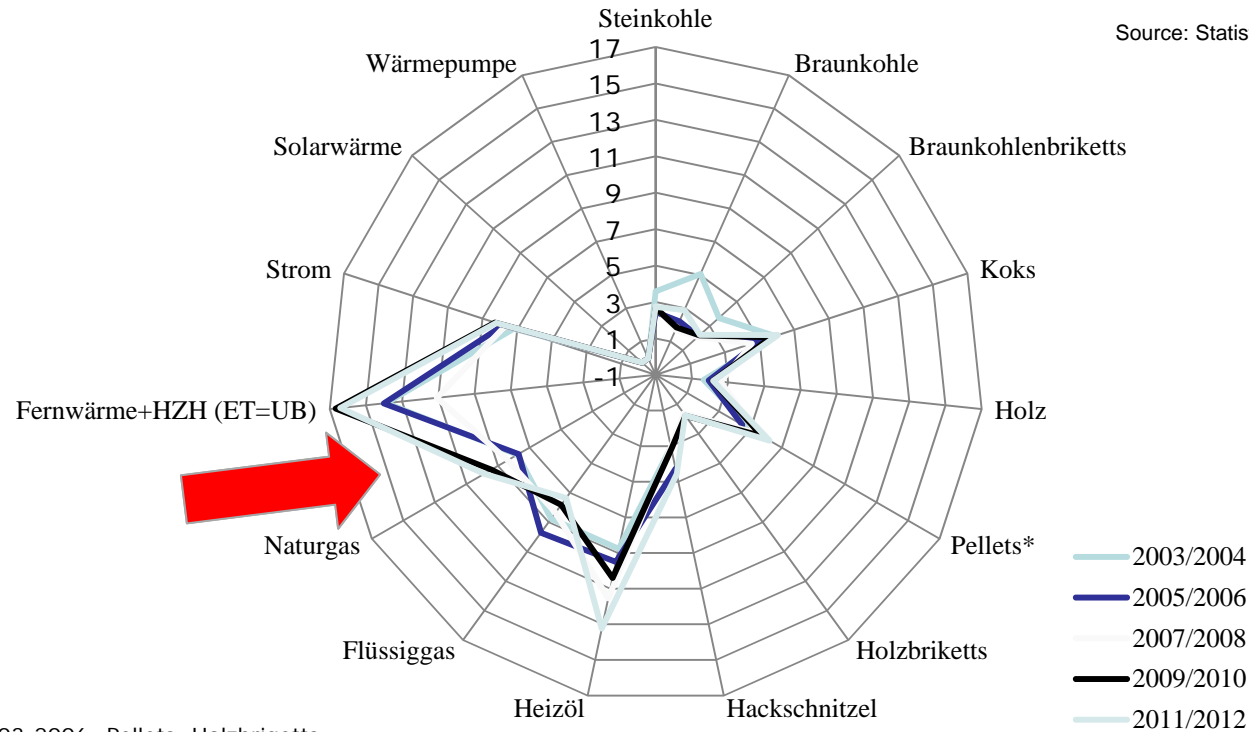
AT: Space heating and cooling – 40% share in total energy consumption



Source: [Statistik Austria](#), 2015



Expenses for Heating AT (Euro/m²)



*2003-2006: Pellets, Holzbricketts
 Physikalische Mengeneinheiten: Naturgas = m³, Strom und Fernwärme = kWh, alle anderen Energieträger = kg

- Expenses households for energy consumption: **3.6 mio. households spend 2,840 Euro per year (ca. 10 billion Euro)**
- **32% for space heating**
- Energy prices for fossil fuels are increasing steadily
- Small expenses for RES (0 – 5 Euro/m²)
- **High expenses for fossil-fuels (7 - 13 Euro/m²)**



Motivation

- Building sector represents **40%** of the EU's total energy consumption
- Inefficiencies in building stock
- High (fossil-fuel) energy consumption & increasing heating costs
- High energy-(cost)-saving potential & more energy-efficiency possible
- No need for new buildings, resources and energy
- Technology available & competitive (affordable) on markets
- Economic as well as ecological benefits (CO2-reduction)
- Chance to meet future energy and climate goals
- Increase of comfort and property value
- Creating jobs, money “stays” in country
- Coupling effects (additional costs of a thermal insulation: 30-40%)

NEED FOR THERMAL-ENERGETIC BUILDING MODERNIZATION!



Approach

- **What are the effects of building refurbishments in AT and CZ regarding?**
 - Avoided energy demand for heating (energy saving potential)
 - Avoided heating costs (saved money)
 - Avoided CO2 emissions (GHG potential)

- **What policies for building refurbishment are available to improve energy efficiency and how are they implemented?**
 - EU level
 - Austria (national and regional level)
 - Czech Republic (national level)

- Literature research on building-retrofit-policies
- Quantitative analyses on building refurbishment actions: (1)project TABULA (2) real cases: Sanierungsscheck)

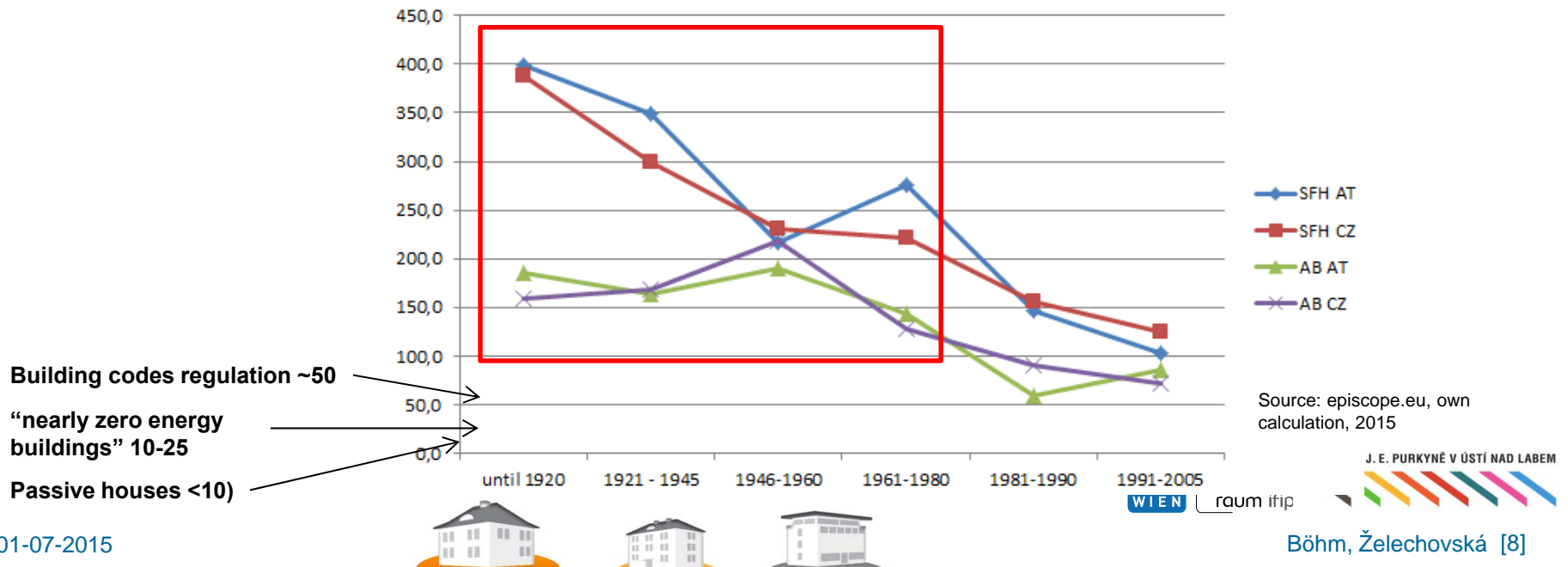


Potential for Refurbishment Actions

- 50% of buildings have a high energy saving potential
(Study: "Thermische Sanierung in Österreich", Donau Universität Krems, 2012)

	vor 1919	1919 - 1944	1945 - 1960	1961 - 1970	1971 - 1980	1981 - 1990	1991 - 2000	ab 2001	total
EFH	7,9% : 5,3% 1,49	4,9% : 3,1% 1,58	9,3% : 5,1% 1,82	8,7% : 5,9% 1,47	6,4% : 7,7% 0,83	4,9% : 6,8% 0,72	3,9% : 7,7% 0,51	1,6% : 4,9% 0,33	47,5% : 46,4% 1,02
ZFH	3,0% : 2,0% 1,50	1,5% : 1,0% 1,50	3,9% : 2,2% 1,77	4,3% : 2,9% 1,48	2,3% : 2,8% 0,82	1,2% : 1,6% 0,75	0,6% : 1,3% 0,46	0,2% : 0,6% 0,33	17,2% : 14,3% 1,20
MFH	3,4% : 2,6% 1,31	1,9% : 1,4% 1,36	2,9% : 1,9% 1,53	2,7% : 2,1% 1,29	1,0% : 1,8% 0,56	0,8% : 1,8% 0,44	0,9% : 2,8% 0,32	0,5% : 1,7% 0,29	14,2% : 16,0% 0,89
WHA	3,0% : 2,3% 1,30	1,3% : 1,0% 1,30	1,5% : 1,0% 1,50	2,8% : 2,1% 1,33	1,0% : 1,8% 0,56	0,6% : 1,4% 0,43	0,5% : 1,6% 0,31	0,3% : 1,0% 0,30	11,1% : 12,1% 0,92
GWB	3,3% : 2,5% 1,32	0,8% : 0,6% 1,33	1,2% : 0,8% 1,50	2,5% : 1,8% 1,39	1,2% : 2,2% 0,55	0,5% : 1,1% 0,45	0,4% : 1,3% 0,31	0,3% : 0,9% 0,33	10,1% : 11,1% 0,91
total	20,6% : 14,5% 1,42	10,4% : 7,1% 1,46	18,8% : 10,9% 1,72	21,1% : 14,8% 1,43	11,9% : 16,2% 0,73	8,0% : 12,8% 0,63	6,4% : 14,7% 0,44	2,8% : 9,1% 0,31	100,0% : 100,0% 1,00

- Energy Demand for Heating kWh/m²a (Tabula – episcopo.eu) - Selection



Results: Effects of Refurbishment Actions - Setting

■ **Tabula/Episcope:**

- 4 building types, 6 time periods;
- Calculated Scenarios: usual, advanced refurbishment
- Avoided Heating Demand
- Avoided Heating Costs
- Avoided CO2 Emissions

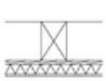




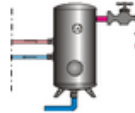

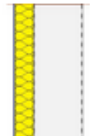


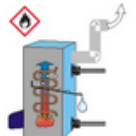
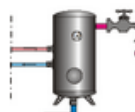

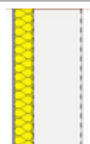




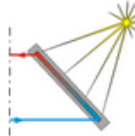
■ **Real Experienced Cases: Sanierungsscheck**

- 86,000 cases; 2009-2014
- Avoided Heating Demand / Costs



Results: TABULA – Refurbishment Actions

- Example: Multi-Family House, Built: 1960-1980

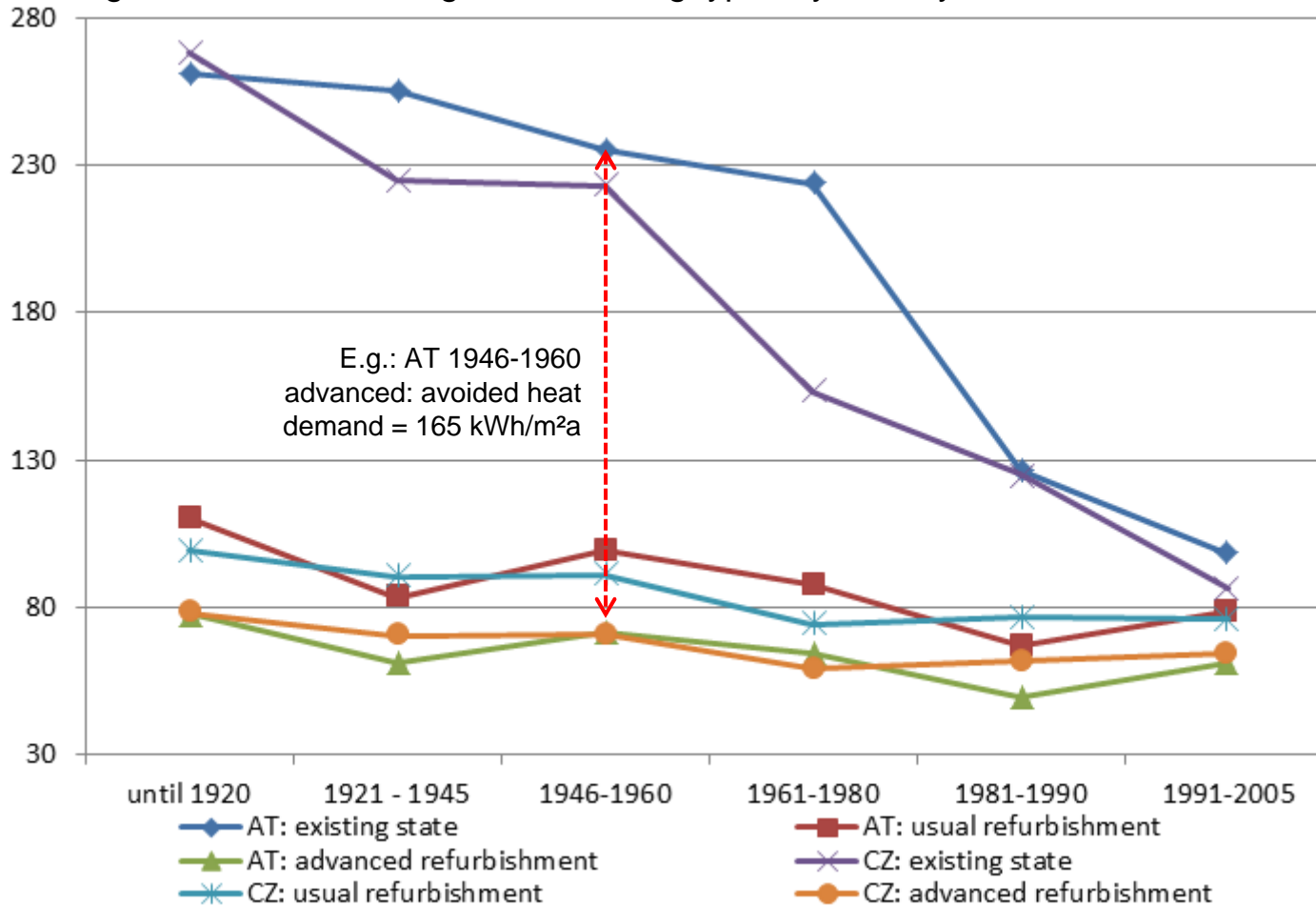
	Thermal Envelope				Heat Supply System		
	Roof	Wall	Window	Floor	Heating System	Ventilation System	DHW System
Existing State							
	$U = 0.58$ W/(m ² K)	$U = 1.8$ W/(m ² K)	$U = 1.5$ W/(m ² K)	$U = 1.1$ W/(m ² K)	$e_{p,h} = 1.89$		$e_{p,w} = 9.17$
Usual	Thermal Envelope				Heat Supply System		
	Roof	Wall	Window	Floor	Heating System	Ventilation System	DHW System
							
	$U = 0.13$ W/(m ² K)	$U = 0.22$ W/(m ² K)	$U = 1.4$ W/(m ² K)	$U = 0.2$ W/(m ² K)	$e_{p,h} = 1.62$		$e_{p,w} = 2.25$
Advanced	Thermal Envelope				Heat Supply System		
	Roof	Wall	Window	Floor	Heating System	Ventilation System	DHW System
							
	$U = 0.11$ W/(m ² K)	$U = 0.15$ W/(m ² K)	$U = 1.3$ W/(m ² K)	$U = 0.17$ W/(m ² K)	$e_{p,h} = 0.91$		$e_{p,w} = 1.48$

Source: episcopo.eu, 2015



Results: TABULA – Demand for Heating (kWh/m²a)

Average demand for heating for all building types by country

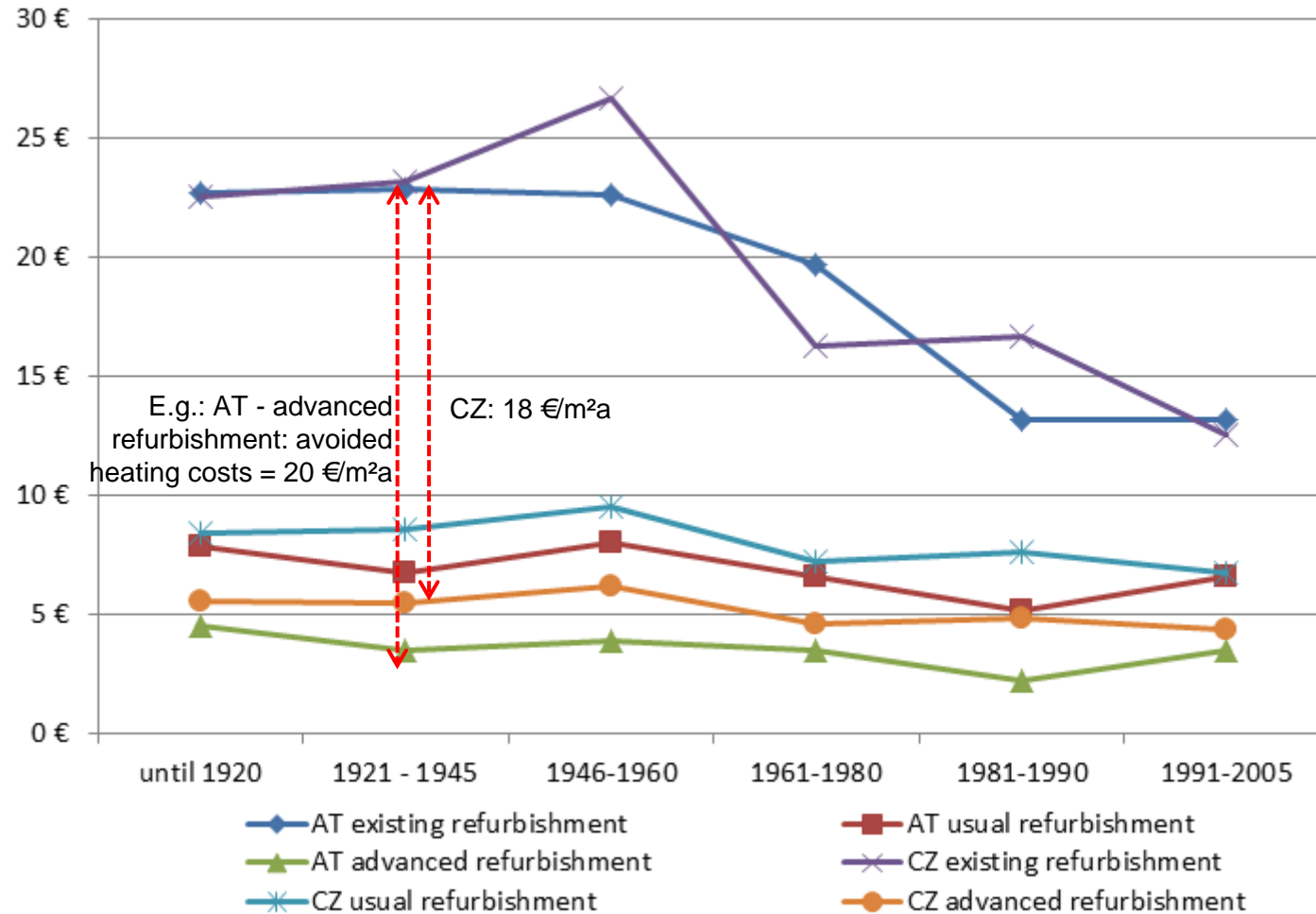


Source: <http://episcopo.eu>; own calculations, 2015

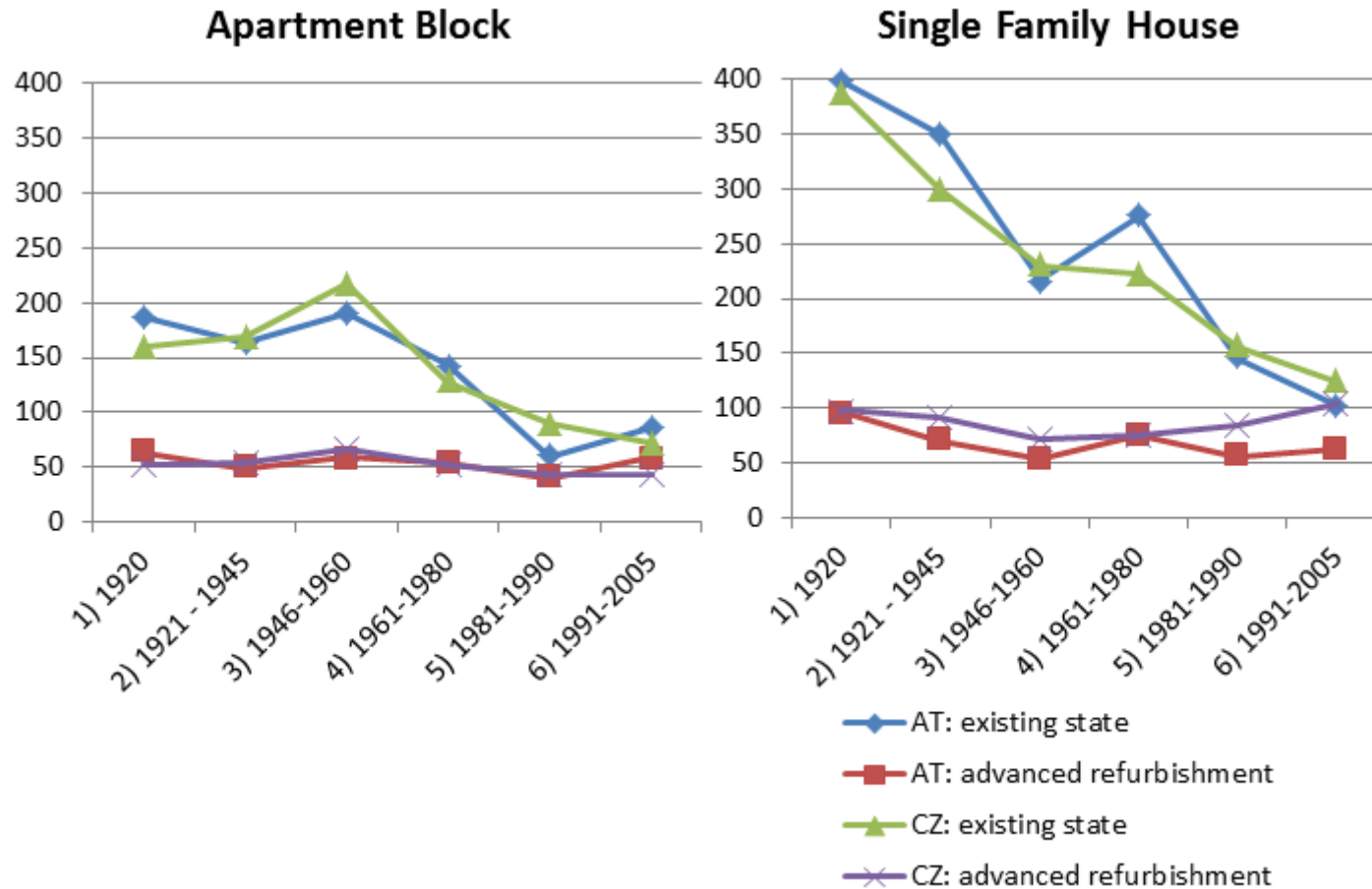


Results: TABULA – Heating Costs (Euro/m²a)

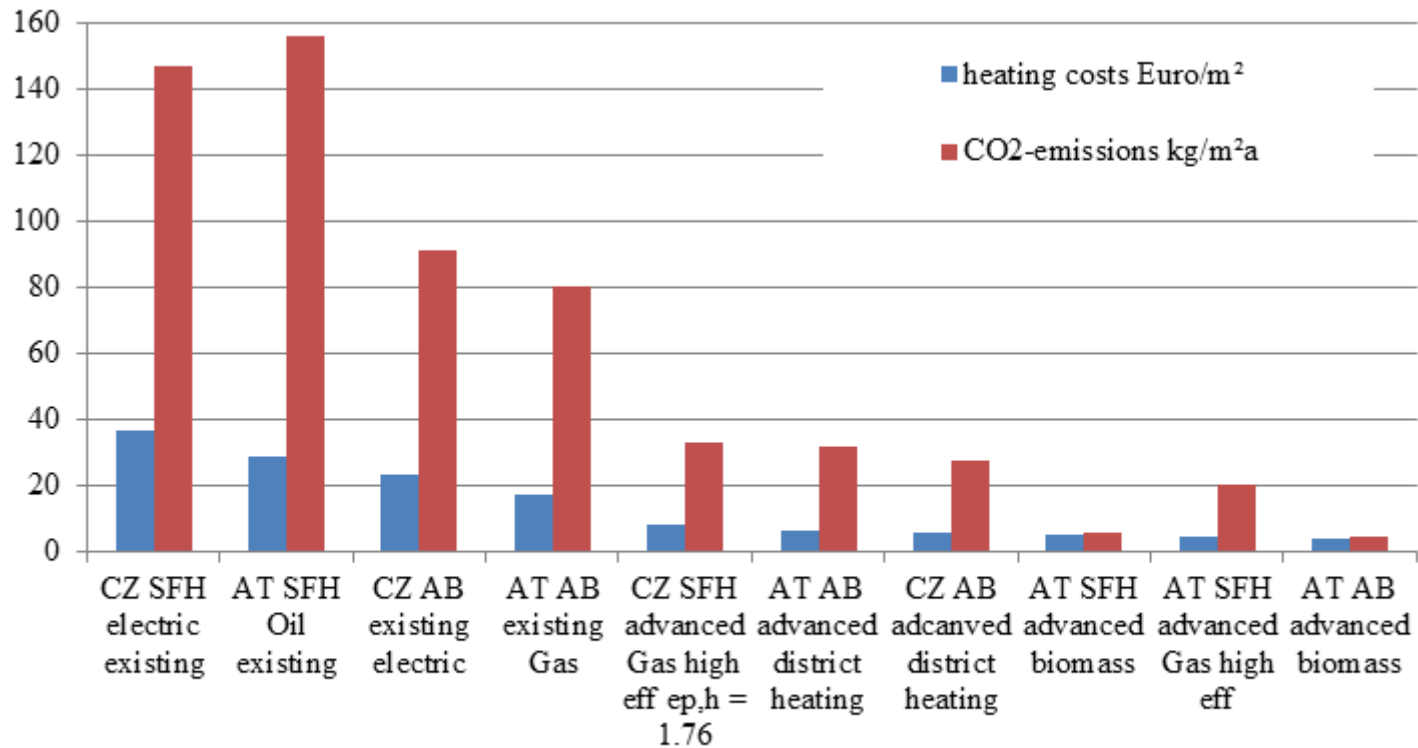
Average heating costs for all building types by country



Results: TABULA – Demand for Heating (kWh/m²a)



Results: TABULA – Heating Costs (Euro/m²a) and CO₂ Emissions (kg/m²a)

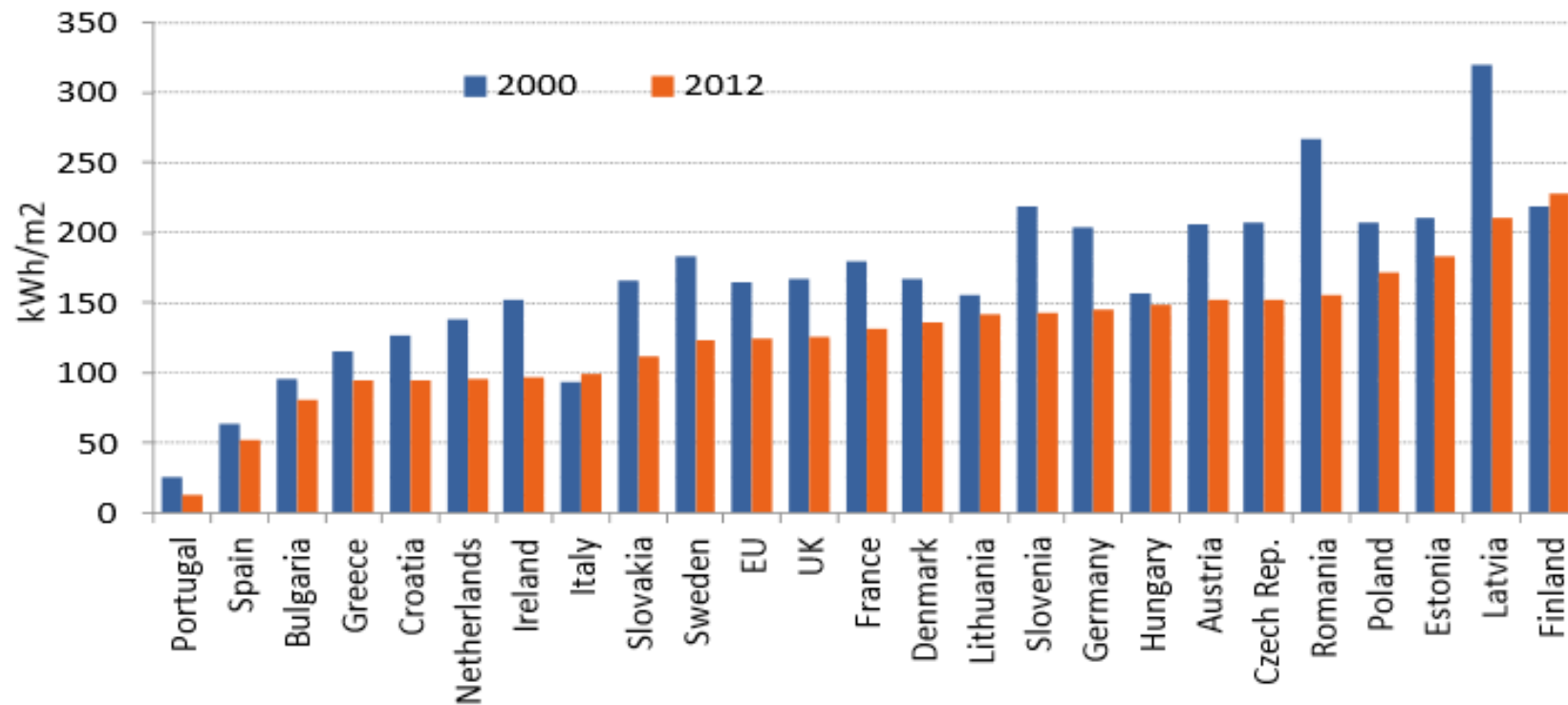


Source: <http://episcope.eu>; own calculations, 2015]



Energy Use for Space Heating in EU /m²

Figure 14: Energy use for space heating per m²

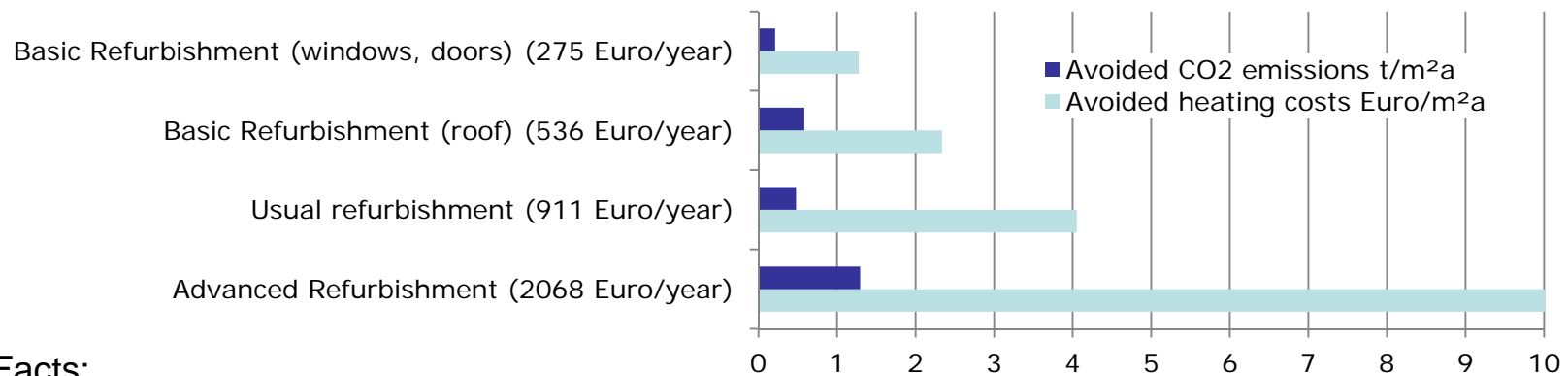


Source: ODYSSEE



Results: Experienced Cases

	spez. HWB vor Sanierung kWh/m ² a	spez. HWB nach Sanierung kWh/m ² a	HWB Reduktion %	Spez. eingesparte Heizkosten/ m ² a
Einzelmaßnahme Fenster/Türen	140,26	127,39	-9,17%	1,05 €
Einzelmaßnahme Oberste Geschoßdecke	127,81	106,63	-16,56%	1,74 €
Teilsanierung 10	148,58	110,64	-25,10%	3,53 €
Teilsanierung 20	154,70	104,20	-31,35%	4,12 €
Umfassende Sanierung	148,94	48,48	-62,02%	8,22 €
Gesamtergebnis	151,39	71,86	-47,53%	6,50 €



Facts:

2009 – 2014: 2.9 billion invested in thermal-energetic refurbishments

Avoided heating costs per year: 98.3 Mio. Euro

→ 1,133 Euro/a/Case

→ 8 Euro/m²

→ 12 Euro for every inhabitant in Austria

→ Modernization rate of 0.9%

Average investment cost per case: 33,073 Euro; average subsidy per case: 4,178 Euro



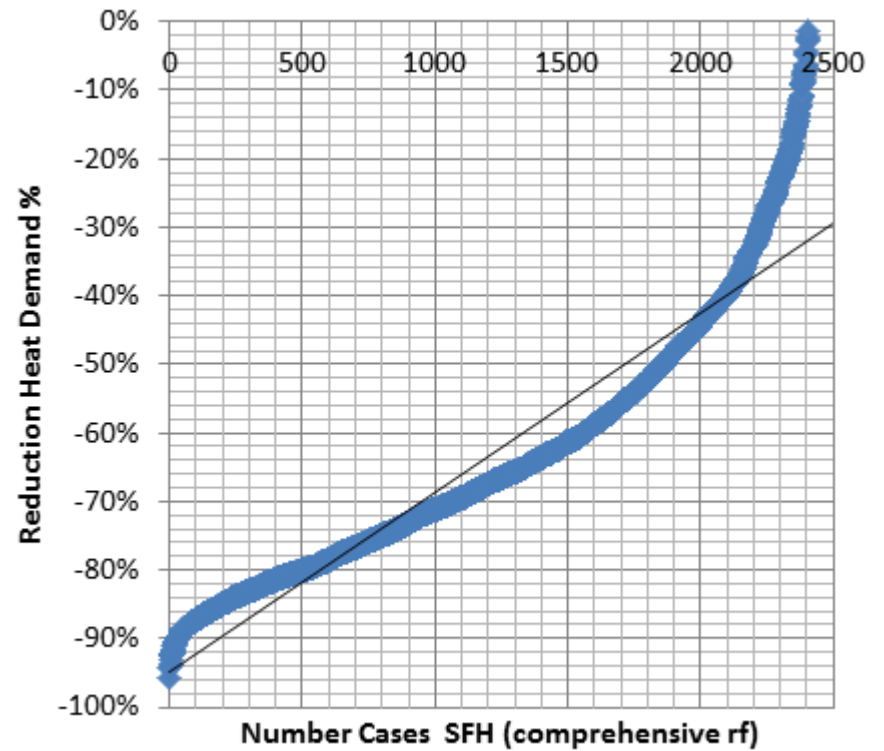
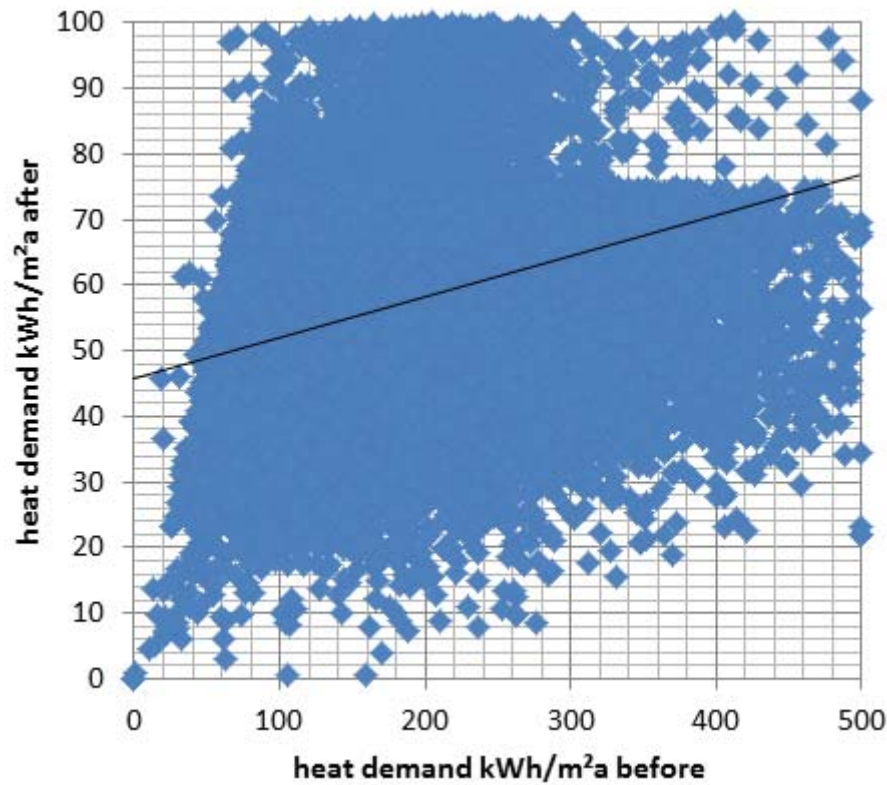
Results: Comparison Model – Real Cases

Apartment Block		AT	CZ	Average AT-CZ
energy need (kWh/m ² a)	existing state	163,10	154,99	159,05
	usual refurbishment	74,27	72,06	73,16
	advanced refurbishment	58,24	58,33	58,29
heating costs (Euro/m ² a) gas central heating	existing state	19,04	19,64	19,34
	usual refurbishment	6,83	8,02	7,42
	advanced refurbishment	3,51	5,15	4,33
CO ₂ -emissions (kg/m ² a) gas central heating	existing state	87,60	89,40	88,50
	usual refurbishment	31,28	35,33	33,30
	advanced refurbishment	14,93	21,78	18,35
saved heating costs (Euro/m ² a) (TABULA)	usual refurbishment	12,22	11,63	11,92
	advanced refurbishment	15,53	14,49	15,01
saved heating costs (Euro/m ² a) (real experience) Sanierungsscheck 2015	usual refurbishment (Teil 20, Teil 30)	4 - 7		
	advanced refurbishment (klima:aktiv)	8,2 - 10		



Results: Experienced Cases

- Comprehensive Refurbishment, Single-Family House 2014



Results: Experienced Cases – Comprehensive RF

Zusätzliche durchschnittliche mögliche Heizkosteneinsparung (EUR/Jahr) bei doch angewandter umfassender thermisch-energetischer Sanierung (statt nur Einzelbaumaßnahme)
Zeitraum: 2009-2014

Absolutwerte je Gemeinde: Mittelwert über alle Fälle, die in Gemeinde saniert haben

bis 500 €/a (min. 10)

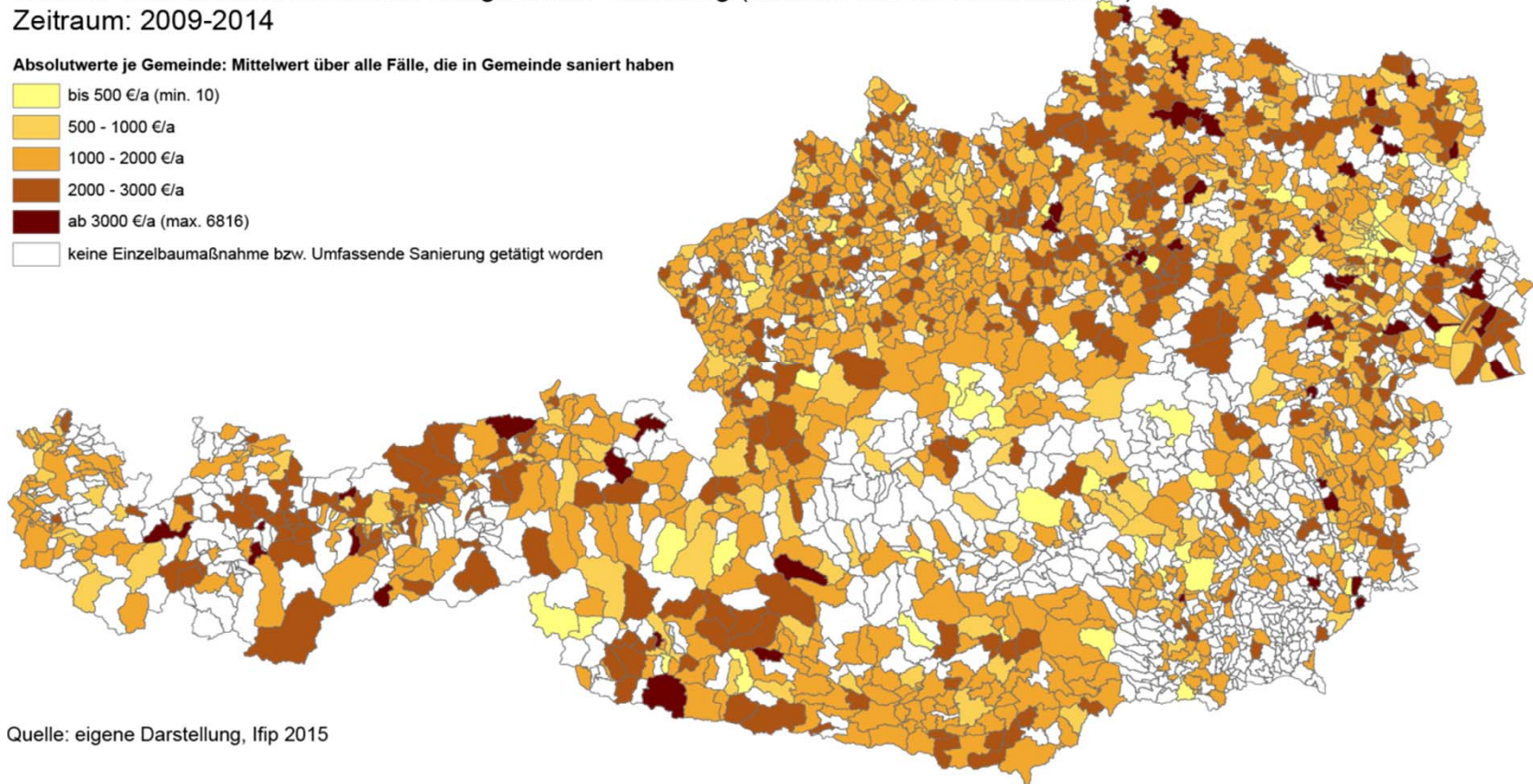
500 - 1000 €/a

1000 - 2000 €/a

2000 - 3000 €/a

ab 3000 €/a (max. 6816)

keine Einzelbaumaßnahme bzw. Umfassende Sanierung getätigt worden



Quelle: eigene Darstellung, Ifip 2015

Additionally 2.3 million Euro per year of heating costs could have been saved in Austria since 2009 (heating cost saving of about 1,600 Euro/year per case).

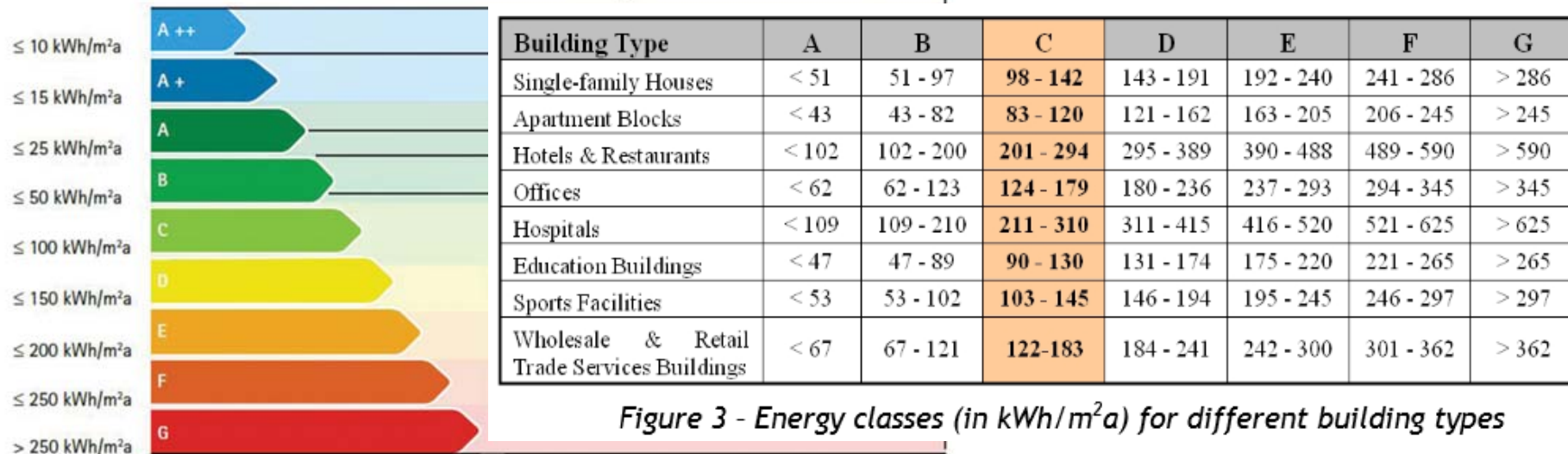


Building-Retrofit-Policies

- Energy Certificate according to “Energy Performance of Buildings directive” EPBD (2010/31/EU)

Energetische Qualität¹ in [kWh/m²a]

große Gebäude³



¹⁾ Die tatsächlichen Grenzwerte für die Gebäudetypen ergeben sich in Abhängigkeit des Verhältnisses von Gebäudeoberfläche zu Gebäudevolumen und liegen zwischen den Werten kleiner und großer Gebäude.

³⁾ große Gebäude: z.B: mehrgeschoßiger Wohnbau

⁴⁾ Zielwert für Neubauförderung



Building-Retrofit-Policies

- Comparison: Energy Certificate Regulations AT-CZ (Residential Buildings)

	Limits/Thresholds Heating Demand (kWh/m ² a)	
	Austria (OIB 6)	Czech Republic (? No. 318/2012 Coll.)
New Residential Building	66,5 or 19 * (1+ 2,5/lc*) from 2010	
	54,4 or 16 * (1+ 3/lc) until 2017	
	47,6 or 14 * (1+ 3/lc) from 2017)	
Comprehensive Refurbishment	87,5 or 25 * (1+ 2,5/lc*) from 2010	
	23 * (1+ 2,5/lc) until 2017	
	21 * (1+ 2,5/lc) from 2017	

*Lc (characteristical length: dimension for geometry of building):

$$l_c = V_B / A_B$$

V_B...Heated gross-volume

A_B...Area of thermal envelope („Surface“)

Sources: http://www.oib.or.at/sites/default/files/richtlinie_6_26.03.15.pdf
http://www.epbd-ca.org/Medias/Pdf/country_reports_14-04-2011/Czech_Republic.pdf



Conclusions

- Refurbishment Actions have a high energy saving potential
 - energy efficiency in hh is improving (1,5%/yr EU since 2000)
 - SFH have the best saving potential + highest share
 - Transportation sector NOT!
- Efficiency of hh for space heating improves since 2000 by 2.3%/yr EU
 - More new and efficient buildings
 - Change to sustainable heating system also important
- Policy framework well implemented in both countries and major driver
 - Energy Perf. Certificate as major promotion tool in EU (more promotion and restrictions (measured values, not calculated))
 - Need for better visibility, databases & consumer trust increased
 - EU: More regulations between landlords and tenants
- Building sector alone can't solve our climate problem





Thank you for your attention!

