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Messecongress Graz
Austria

The Five-Stage Transformation of the Austrian Housing Stock towards Net Zero and beyond

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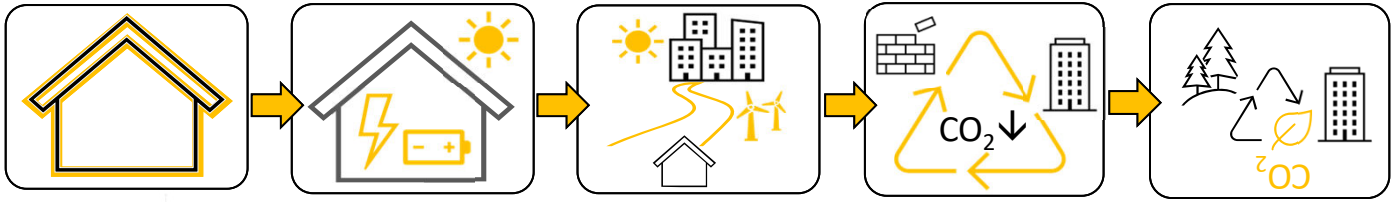
Structure

0. Introduction: A great transformation ahead. What is the role of the building sector?

1.-5. The five stages of the transformation of the (Austrian) housing stock

⇨ *Focus on the limited-profit housing (LPH) stock*



6. Conclusions

⇨ Discussing decarbonisation strategies by findings from statistical data, scientific literature and political / legal documents

Introduction (1) - A great transformation ahead

DIE GEMEINNÜTZIGEN

The Green Deal – Europe the first continent to become climate-neutral by 2050

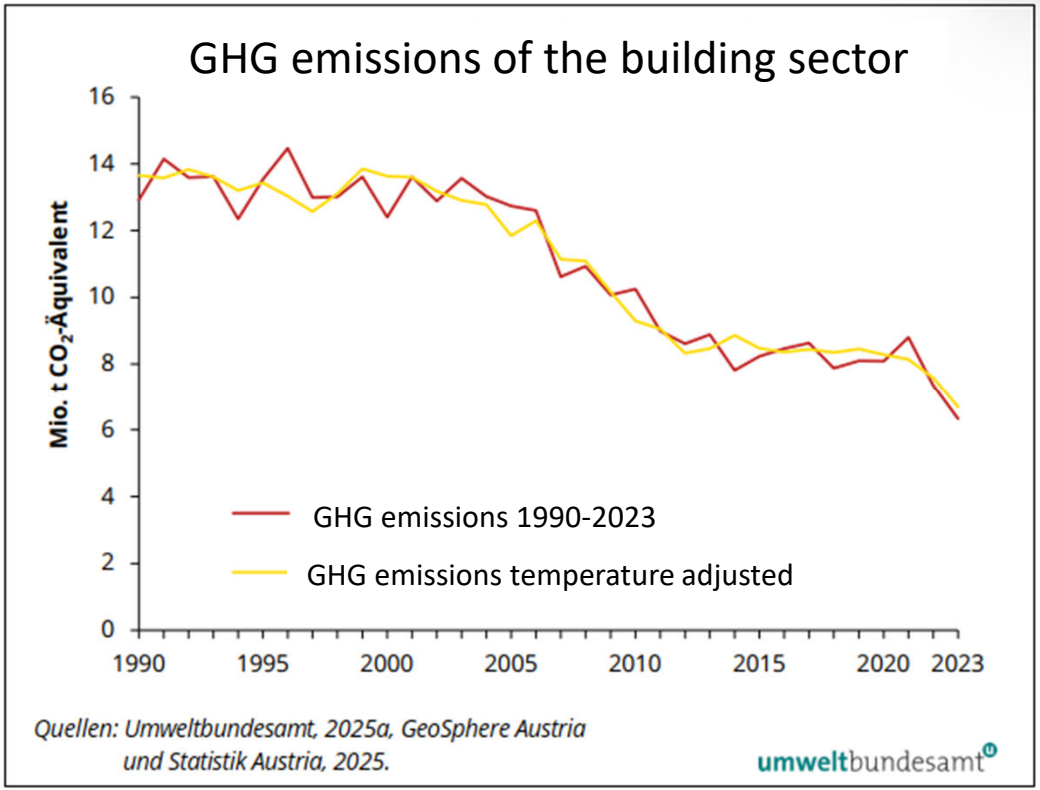
"*Above all, the European Green Deal sets a path for a transition that is just and socially fair. It is designed in such a way as to leave no individual or region behind in the* ***great transformation*** *ahead.*" (EC, 11 Dec. 2019)

⇨ Climate Law, Fit for 55, EPBD, ETS 2…

Ursula von der Leyen, President of EU-Commission

Austria: Government declared 2020 the target to become climate-neutral by 2040

Introduction (2) – building sector on track?



S: Umweltbundesamt, Klimaschutzbericht 2025

GHG in building sector according to national inventory (2023):

- 6.3 Mt CO2-eq in total
- 9.2 % of total GHG emissions
- Reduction by 51% since 1990

! only operational emissions without district heating and electricity for heat pumps!

1st stage: Improving energy efficiency by insulation of the building's envelope

- Mainly „improve“ approach in the A.S.I concept
- „Insulation boom“ from 1995-2012
- In the strongest years >70,000 thermal refurbishments p.a.
- Thermal refurbishment rate ~1.7% p.a. (> 2% in nonprofit housing), lowest in condominiums (~1%)

2nd stage: Decarbonisation of heat systems

- Replacement of heat systems based on oil, gas and coal by environmentally friendly systems (district heating, heat pumps, pellets)
- Peaked around 2010 and 2022-2024 (generous subsidies)
- Main challenge: Decentral gas boilers in multi-family houses
- Focus today: Combination with on-site production of renewable energy + demand side management systems

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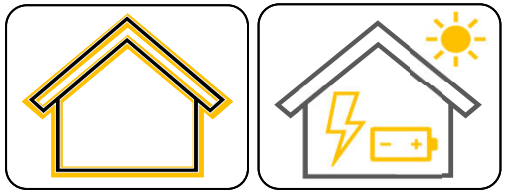


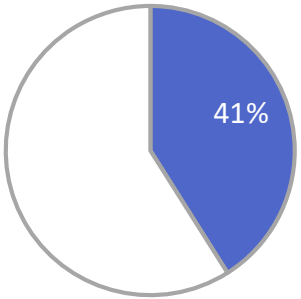
Progress in stage 1 and 2

DIE GEMEINNÜTZIGEN

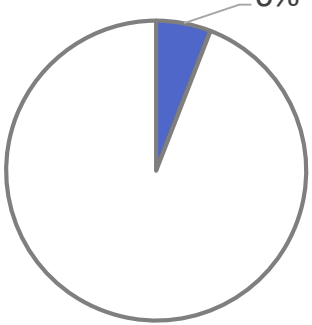
1st stage

Share of energy-inefficient housing units in Austria (built before 1991, not yet refurbished)

All main residences



LPHA rent

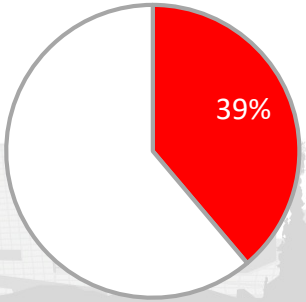


„almost done“ (at least in first renovation cycle)

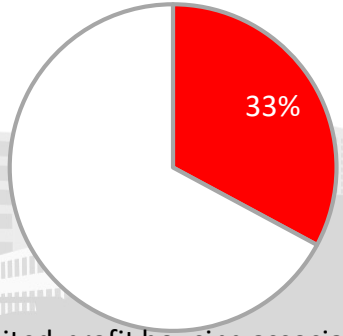
2nd stage

Share of dwellings with fossil heating system

All main residences



LPHA rent



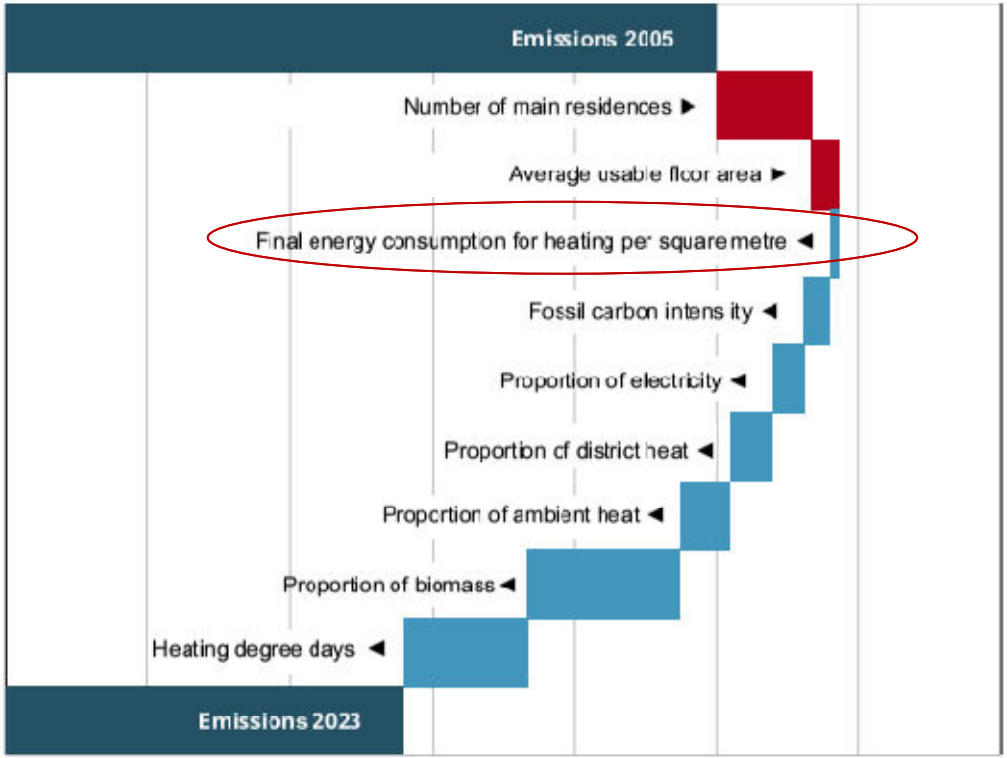
„still a way to go“

Q: GBV based on data by Statistik Austria, IIBW, GBV

LPHA: Limited-profit housing associations

CO_2 emissions of the building sector (operating phase), devt 2005-2023

DIE GEMEINNÜTZIGEN



S: Umweltbundesamt, Klimaschutzbericht 2025

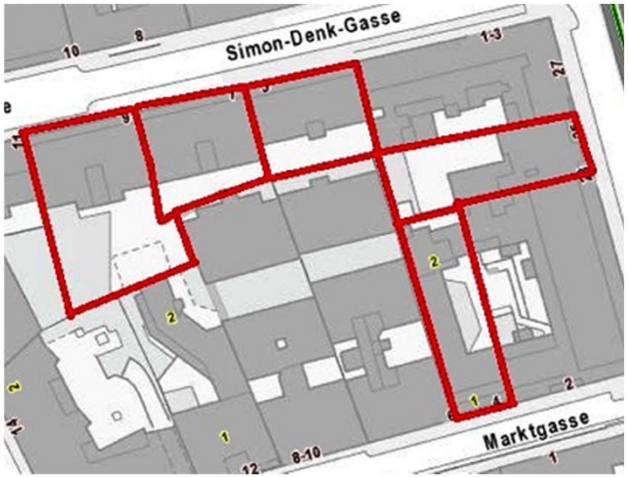
In the last 18 years hardly any reduction of CO_2-emissions by energy efficiency measures!

Since 2005 climate change itself (fewer heating degree days) and the decarbonsation of heating systems were the drivers of GHG emission reduction

3rd stage: Expansion from the property level to the neighbourhood level “District approach”

Avoid / improve / shift

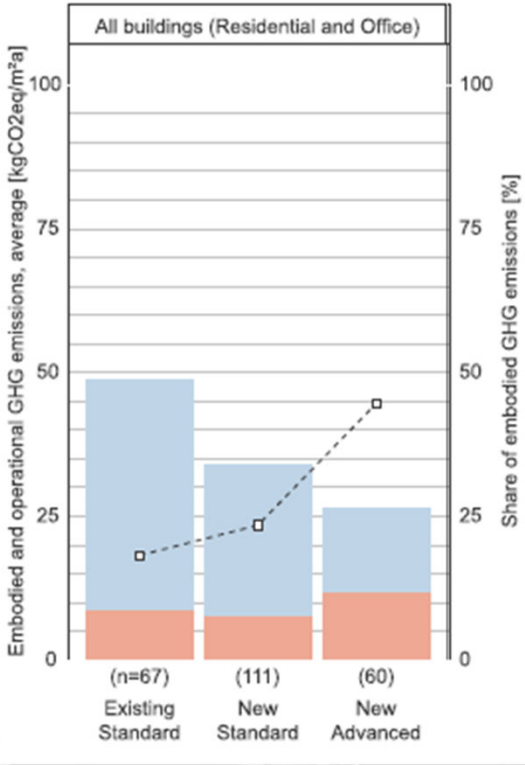
Urban densification / better use of existing structures



Local energy communities

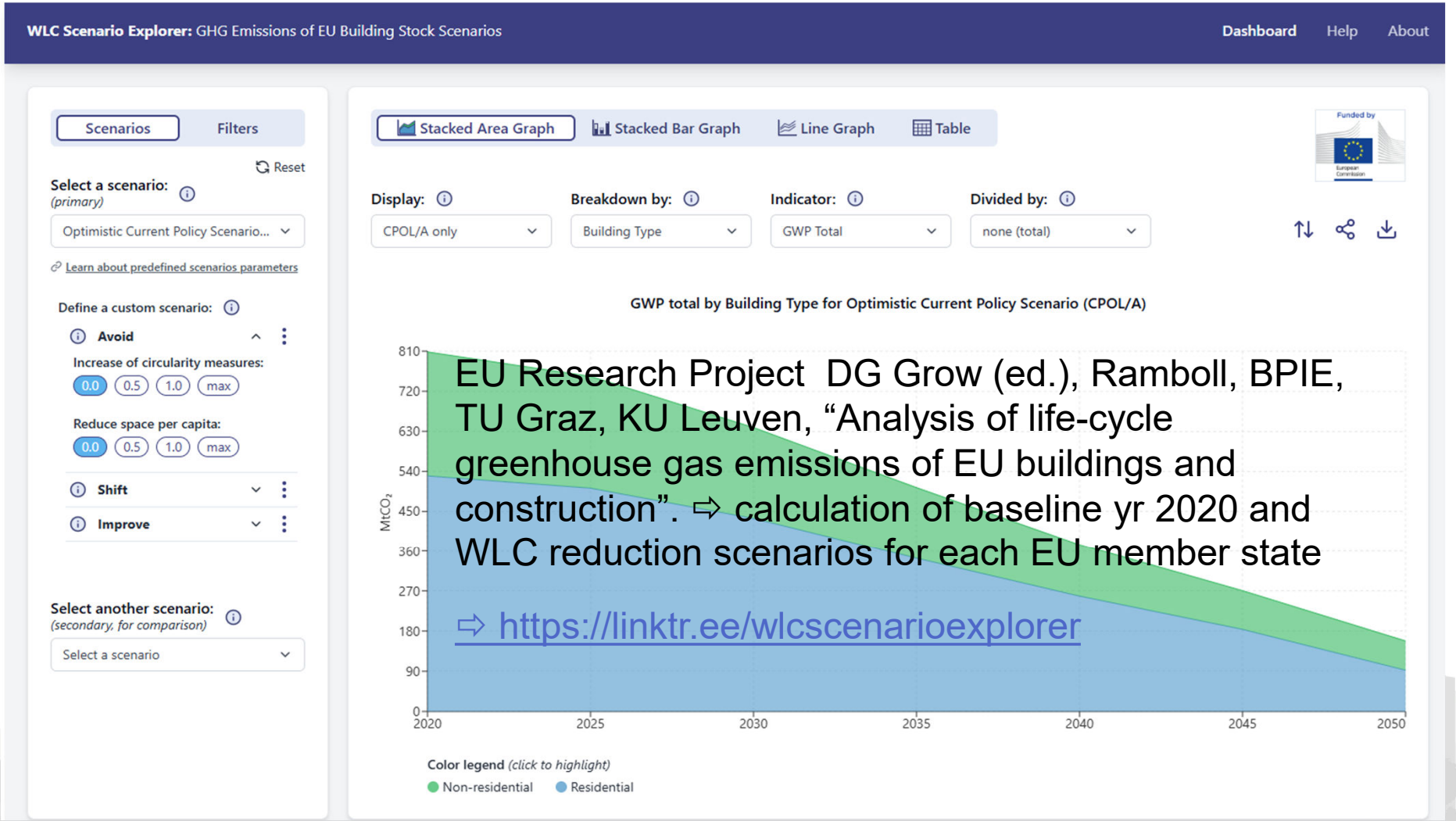
Positive energy districts

4th stage: Decarbonisation in the whole life cycle with a focus on grey emissions and circularity



Source: Röck et al. (2020), 6 (Fig. 3)

- Embodied carbon (by production and processing of building material) makes up ~20% of WLC emissions in existing, but 45%+ in new buildings
- How to reduce WLC emissions?
  - Compact settlement structures
  - Longevity and adaptability of buildings (avoid/improve)
  - Better choice of building materials (improve/shift)
  - Circularity
- EPBD: Calculation of WLC emissions compulsory by 2030 ⇨ reduction roadmap
- AT: OIB guideline 7 will address LCA
- Limited-profit housing in Austria is role model in terms of compact structures and longevity, but only in the first part of the journey concerning materials and circularity


WLC Scenario Explorer: GHG Emissions of EU Building Stock Scenarios
Dashboard
Help
About
Scenarios
Filters
Reset
Select a scenario:
(primary)
Optimistic Current Policy Scenario...
Learn about predefined scenarios parameters
Define a custom scenario:
Avoid
Increase of circularity measures:
0.0
0.5
1.0
max
Reduce space per capita:
0.0
0.5
1.0
max
Shift
Improve
Select another scenario:
(secondary, for comparison)
Select a scenario
Stacked Area Graph
Stacked Bar Graph
Line Graph
Table
Funded by
Display:
CPOL/A only
Breakdown by:
Building Type
Indicator:
GWP Total
Divided by:
none (total)
GWP total by Building Type for Optimistic Current Policy Scenario (CPOL/A)
MtCO2
810
720
630
540
450
360
270
180
90
0
2020
2025
2030
2035
2040
2045
2050
EU Research Project DG Grow (ed.), Ramboll, BPIE, TU Graz, KU Leuven, “Analysis of life-cycle greenhouse gas emissions of EU buildings and construction”. ⇨ calculation of baseline yr 2020 and WLC reduction scenarios for each EU member state
⇨ https://linktr.ee/wlcscenarioexplorer
Color legend (click to highlight)
Non-residential
Residential

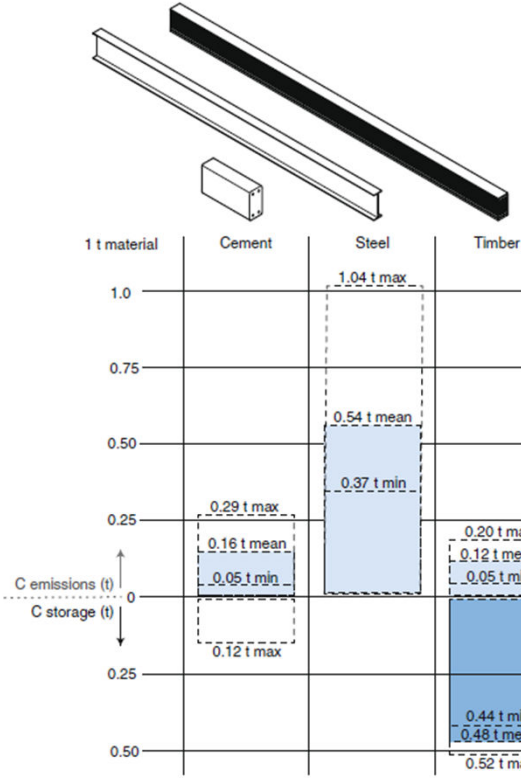
5th stage: Transforming the built environment from a carbon emitter to a carbon sink

DIE GEMEINNÜTZIGEN

Go beyond net zero and „repair“ the climate through negative emissions

“[Negative emissions] can be realized at appropriate scale and reasonable cost if we ***reforest the planet and retimber the city***”
Schellnhuber 2023

- ⇨ *Biobased architecture in combination with sustainable forest management*
- ⇨ *Timber and other biobased materials can store carbon and replace CO_2-intense materials (concrete, steel)*
- ⇨ *A significant shift in the construction practice would be necessary (timber market share in multifamily buildings in AT ~ 3%)*
- ⇨ *estimations in literature vary regarding the realistic carbon removal potential of biobased architecture (in EC/Ramboll 2025 study: 10% of total building-related CO_2-reduction potential from 2020-2050 in main scenario)*



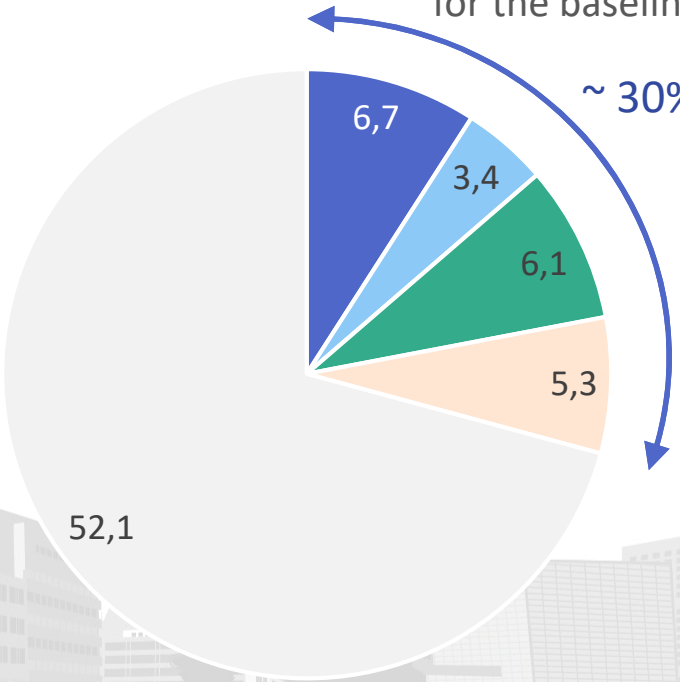
Source: Churkina et al, 2020

Wohnbau Max-Mell-Allee, Graz, Austria
Architecture: Nussmüller Architekten
Contractor/owner: LPHA Siedlungsgenossenschaft Ennstal
Photo ©pierer.net

Wohnbau Holzgraf, Obergrafendorf
Architecture: MAGK Architekten
Developer: Alpenland Gemeinnützige Bau-, Wohn- u. Siedlungsgenossenschaft
Photo © Josef Herfert

Conclusions (1)

Estimation of building-related GHG emissions in Austria and their proportion of the total GHG emissions (merging national GHG inventory and WLC studies, for the baseline year 2020, Mt CO_2eq)



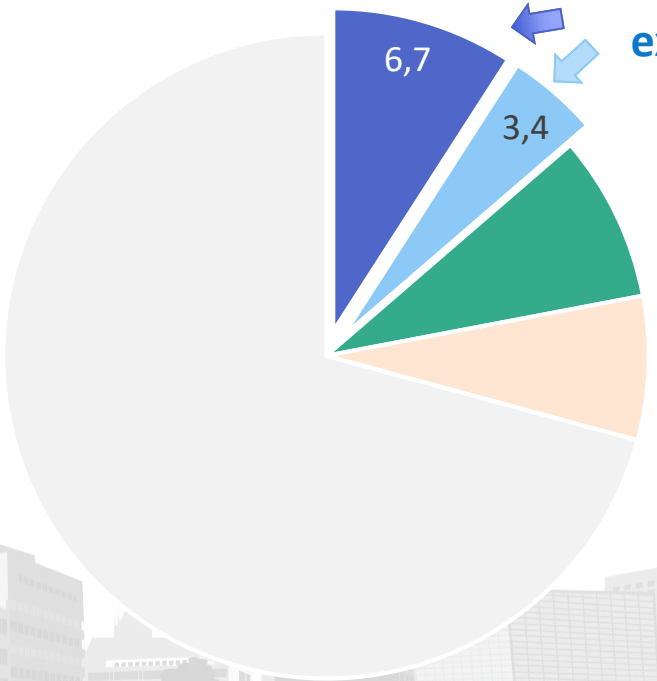
~ 30% (22 Mt CO_2eq)

- Emissions attributed to residential buildings (private households) in the national inventory
- Other operational emissions in residential buildings (district heat, electricity for heat pumps)
- Embodied emissions in residential buildings
- Emissions related with non-residential buildings (operational and embodied)
- Emissions of other sectors

Own representation based on data from the national GHG inventory and from Röck et al, 2025 for the WLC emissions of buildings (https://linktr.ee/wlcscenarioexplorer)

Conclusions (1)

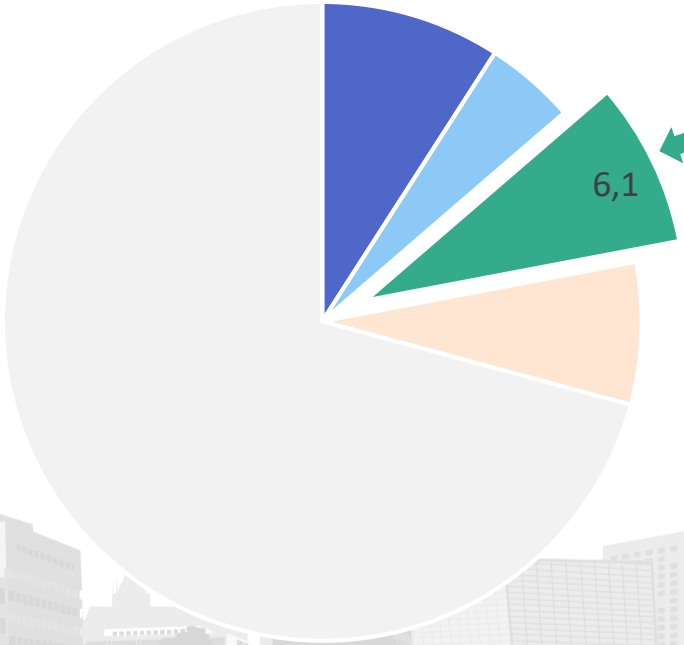
DIE GEMEINNÜTZIGEN



Decarbonising **operational emissions** in the **existing housing stock** (emissions, stages 1-3)

Own representation based on data from the national GHG inventory and from Röck et al, 2025 for the WLC emissions of buildings (https://linktr.ee/wlcscenarioexplorer)

Conclusions (1)

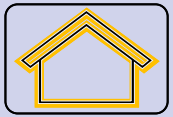
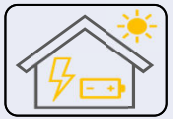
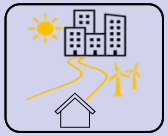
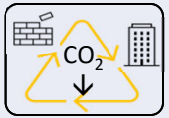


Embodied emissions: Focus on **decarbonising new developments** and **redevelopments (stages 4-5)**

Own representation based on data from the national GHG inventory and from Röck et al, 2025 for the WLC emissions of buildings (https://linktr.ee/wlcscenarioexplorer)

Conclusions (2): Progress and potential of the five stages

DIE GEMEINNÜTZIGEN

Stage of transformation		ASI approach	Progress in Austrian housing sector	CO_2-reduction potential until 2040/50
	1) Energy efficiency / building envelope	Improve	Depending on subsector, very advanced in LPH	Depending on subsector. In total effects have passed their peak. Important to boost 2)
	2) Decarbonisation of heat systems	Shift	~ 35-40% of dwellings still on oil or gas heating	**Very high in existing stock ⇨ need for scaling up and speeding up**
	3) District approach	Avoid / improve / shift	Not much advanced yet; depending on region, settlement structure and measure	Medium to high – boosts 1) 2) and 4)
	4) Reduce WLC and increase circularity	Shift / improve	Very low. No WLC regulation in place yet	**High for (re-)developments ⇨ incentives + regulation needed**
	5] Achieve negative emissions by biobased architecture	Shift	very low, esp. in multifamily housing. Poor market uptake.	Medium to high in new construction

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