

An aerial photograph of a Swiss town, likely Unterseen, situated on a peninsula and along the shores of a large lake. The town features numerous traditional European buildings with red-tiled roofs, several churches with prominent spires, and a large stone castle or fortress on a hill. The lake is a deep blue, and the surrounding landscape is green and hilly under a partly cloudy sky.

# Comparison of nZEB ambition level in different countries

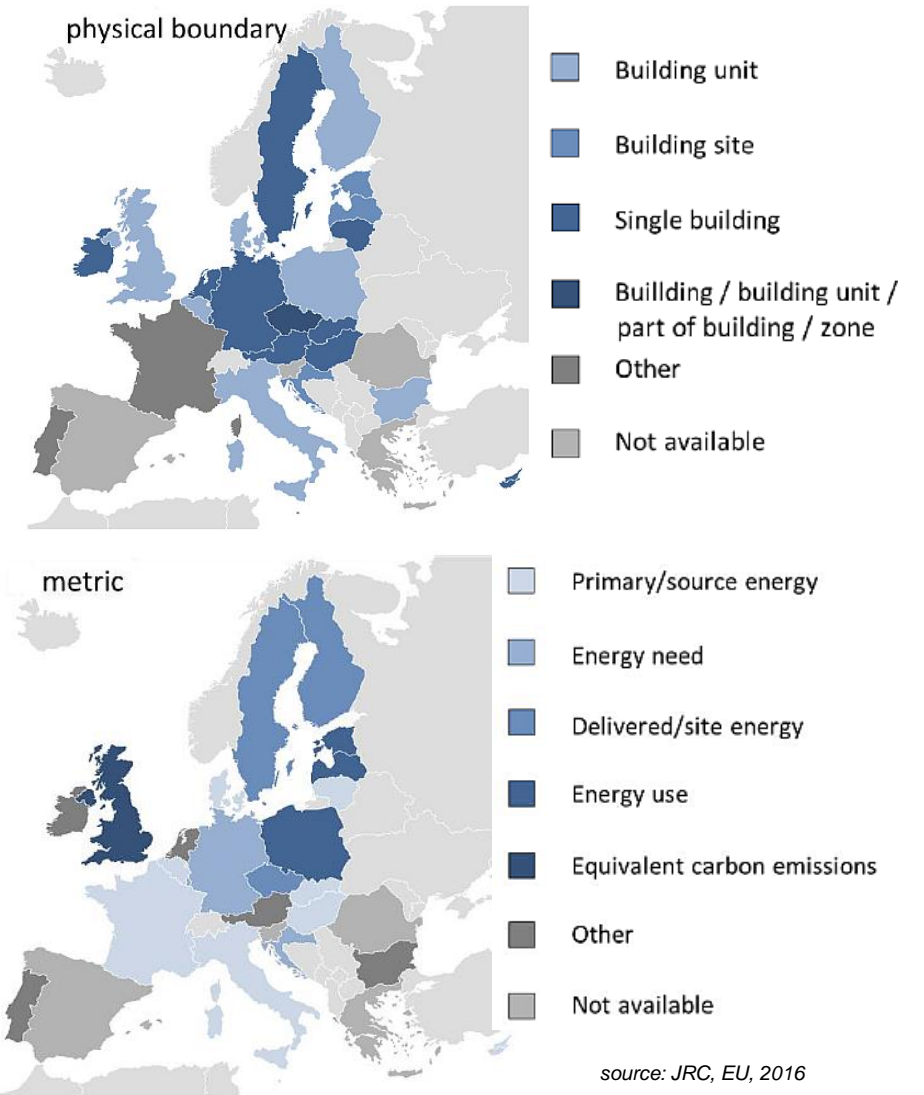
Carnot User Meeting 2022,  
UIBK, July 1, 2022



# Comparison of nZEB ambition level in different countries

## Background

- Implementation of the EPBD requires nearly Zero Energy Buildings (nZEB) for all new buildings since Jan 1, 2021
- However, nZEB implementation differs among EU member states regarding criteria, metrics and limits
- Moreover, national calculation methods, boundary conditions and climate used for nZEB rating procedures
- Thus, national ambition levels of nZEB implementations are not obvious



# Comparison of nZEB ambition level in different countries

## Motivation

- Development of a methodology to compare nZEB ambition levels among different countries by simulation
- Test for countries in different climate zones  
Germany, Austria and Switzerland for central Europe  
Sweden as Nordic climate and  
Italy of southern European climate
- Test were performed for a single family house  
in IEA HPT Annex 49
- Use of different simulation programs  
CARNOT Matlab-Simulink (2 different versions)  
& TRNSYS 17

# Comparison of nZEB ambition level in different countries

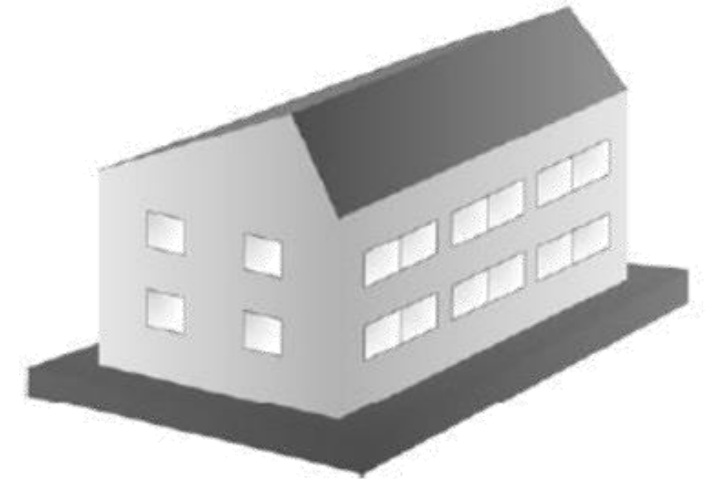
## Methodology

- Reference building and reference boundary conditions are used
- Different steps transform the national nZEB implementation to common boundary conditions
- Step 1: Calibration case
  - Calibration of the different simulation programs in use
- Step 2: Climate case
  - Evaluation of the impact of the weather data of respective sites
- Steps 3-8: National case
  - Implementation and transformation of national nZEB to common boundary conditions and simulation of nZEB energy consumption

# Comparison of nZEB ambition level in different countries

## Methodology

- The reference framework building of IEA SHC Task 44/ HPP Annex 38 is used
- Single family house with high energy performance (SFH 15 corresponding to high performance envelope)
- Modifications to an all-electric nZEB
  - Air-to-water heat pump is used as building system technology
  - PV is installed on the south-oriented roof according to national requirements
  - DHW operation is simulated in more detail



*source: IEA HPC Annex 38/SHC Task 44*

# Comparison of nZEB ambition level in different countries

## Methodology

- Steps of simplified methodology

*Table 1. Steps of the methodology to compare ambition levels*

Step	Tool	Climate	BC	Envelope	HVAC	Renewables	Remark
<b>1</b>	Simulation	Strasbourg	Framework	Framework	Framework	Framework	Calibration case
<b>2</b>	Simulation	<b>National/ Site</b>	Framework	Framework	Framework	Framework	<b>Climate case</b>
<b>7</b>	Simulation	National/ Site	Framework	National nZEB	National nZEB	National	<b>Comparison to No.2 / No. 11</b>
<b>8</b>	Simulation	<b>Strasbourg</b>	Framework	National nZEB	National nZEB	National	<b>Comparison to No.1</b>
<b>9</b>	<b>PHPP</b>	National/ Site	Framework	PH envelope	Ideal heating 20 °C	-	PHPP PH
<b>11</b>	<i>Simulation</i>	National/ Site	Framework	PH envelope	Framework	Framework	<b>National PH Comp. to No.7</b>

## Comparison of nZEB ambition level in different countries

# Comparison and Benchmarks

- Comparison among countries for building envelope/system requirements excluding/including on-site renewable production
- EU cost optimality guideline (2012)
- EU recommendations (2016) for nZEB implementation

Table 2: EU recommendations for nZEB ambition level

	Mediterranean	Oceanic	Continental	Nordic
	Office [kWh/(m <sup>2</sup> yr)]			
NEP	20-30	40-55	40-55	55-70
PE	80-90	85-100	85-100	85-100
RE	60	45	45	30
	Single family house [kWh/(m <sup>2</sup> yr)]			
NEP	0-15	15-30	20-40	40-65
PE	50-65	50-65	50-70	65-90
RE	50	35	30	25

Legend: NEP – net primary energy, PE - primary energy consumption, RE – on-site renewable primary energy

source: EU, 2016

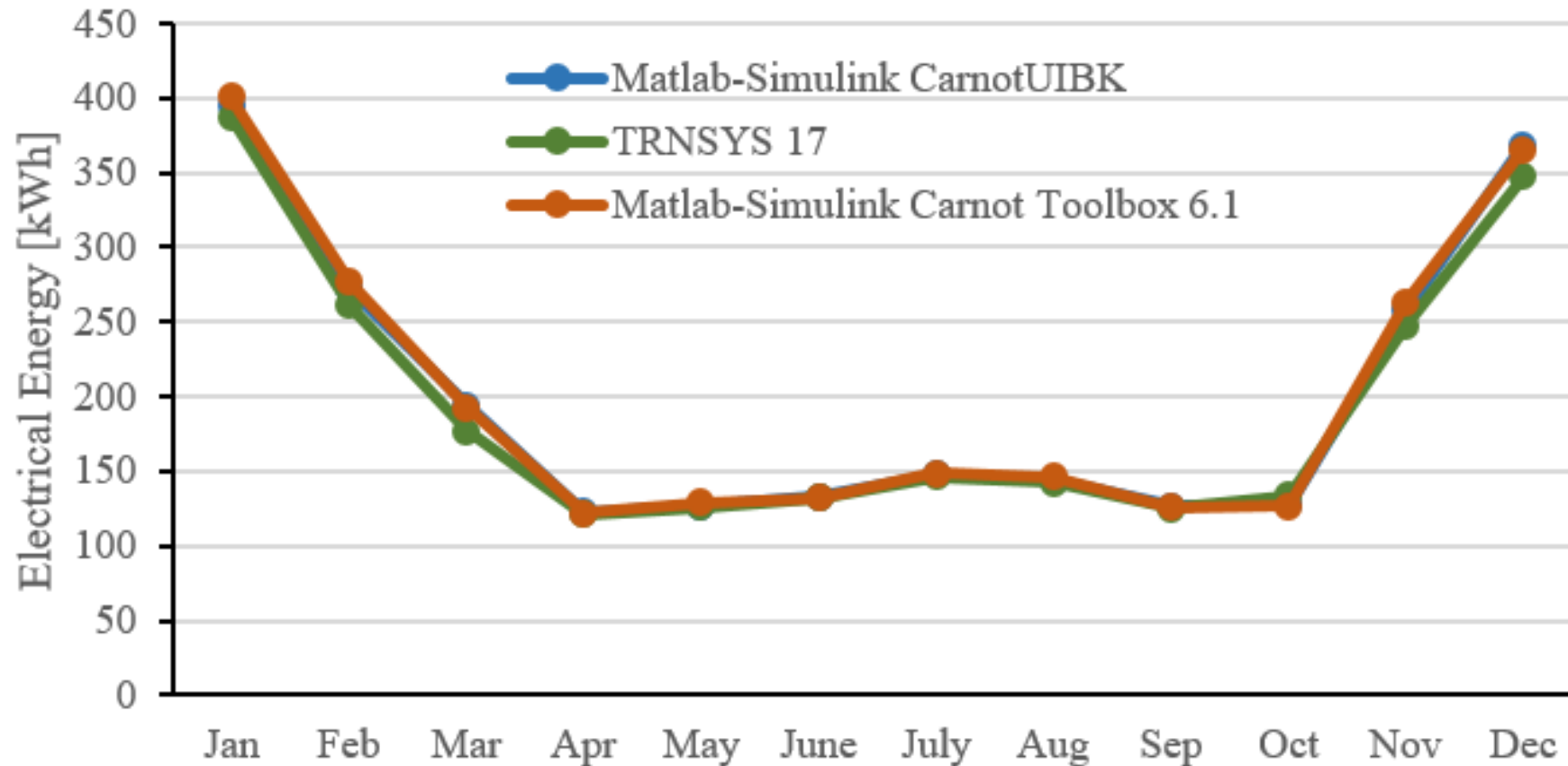
### References:

EU (2012) Commission delegated Regulation (EU) No 244/2012 of 16 January 2012 supplementing Directive 2010/31/EU of the European Parliament and of the Council on the energy performance of buildings by establishing a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements, Official Journal EU, L81/18-36

EU (2016) Commission recommendation (EU) 2016/1318 of 29 July 2016 on guidelines for nearly zero energy buildings and best practices to ensure that, by 2020, all new buildings are nearly zero energy buildings, Official Journal EU, L208/46

# Comparison of nZEB ambition level in different countries

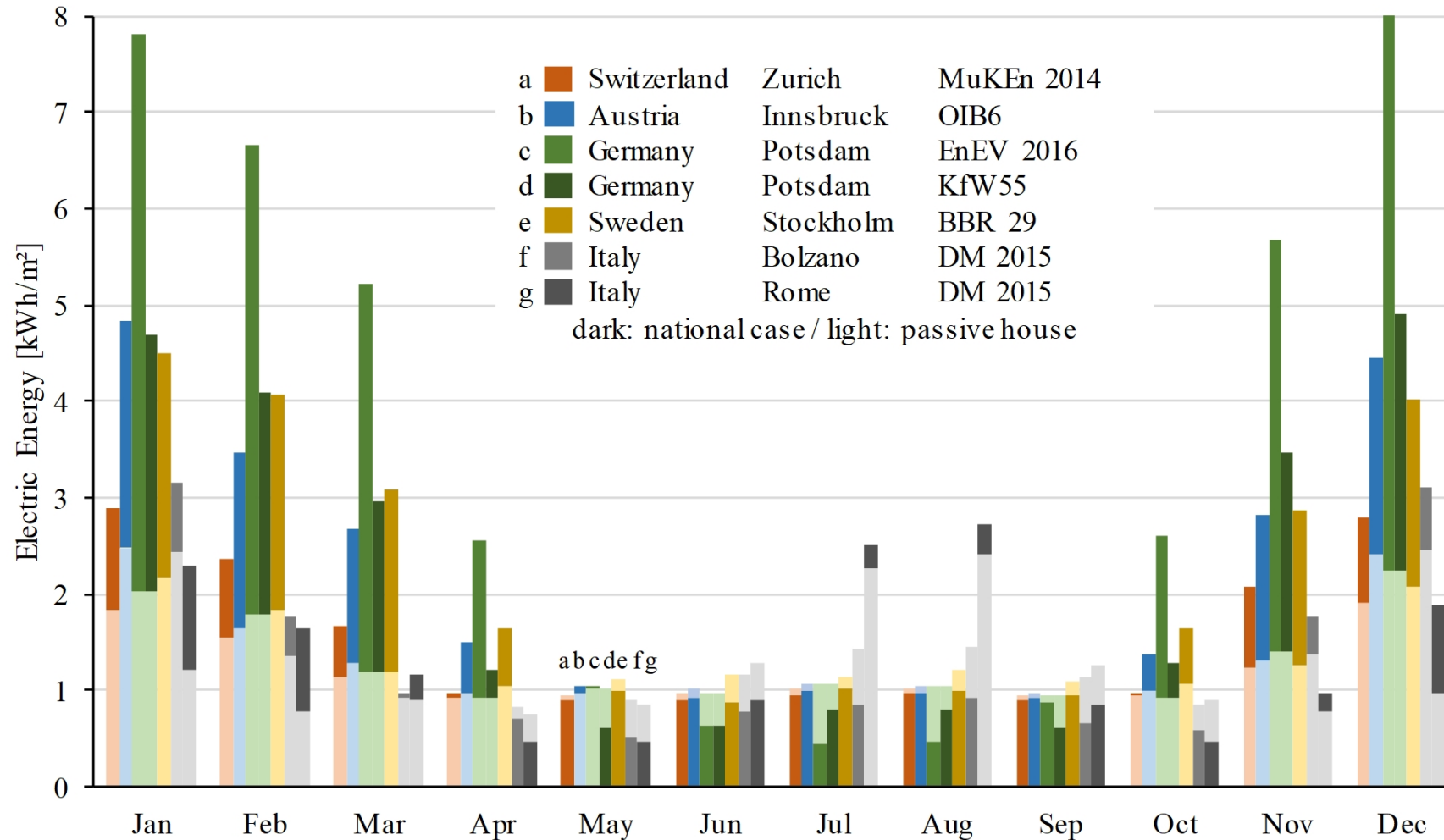
## Calibration Case





## Comparison of nZEB ambition level in different countries

# Monthly electric energy consumption



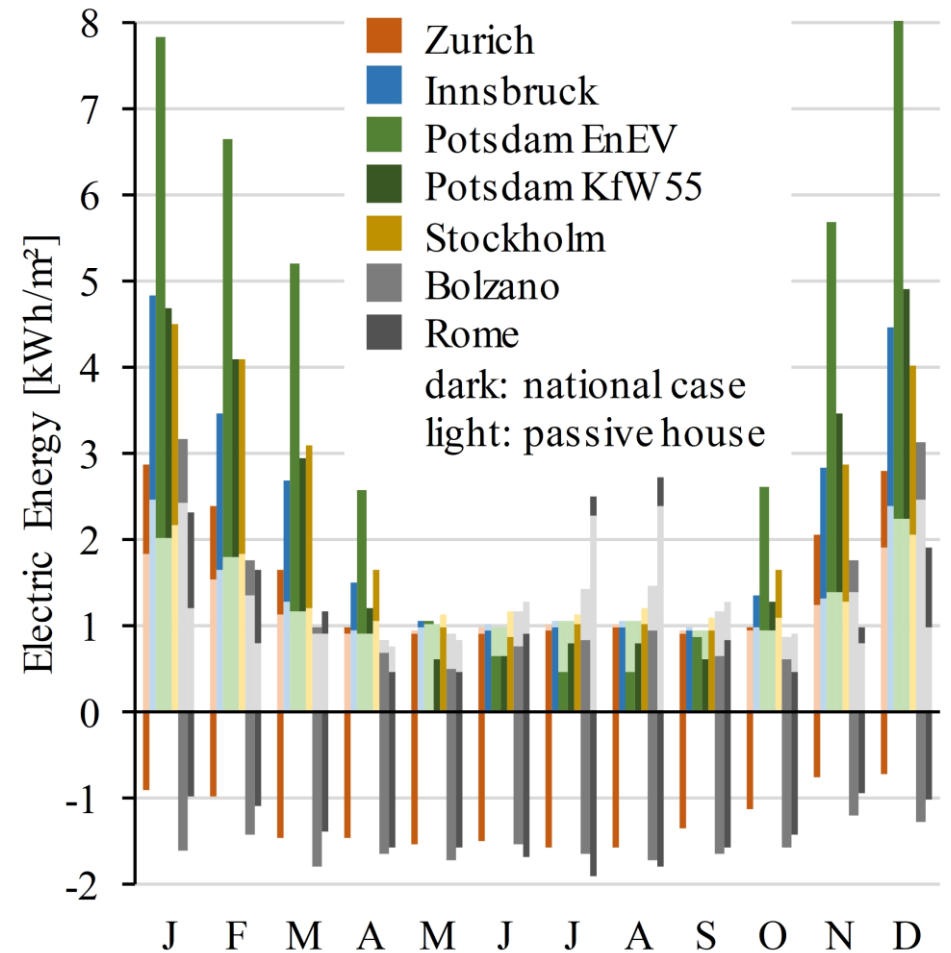
## Comparison of nZEB ambition level in different countries

# Comparison including on-site renewable production

- CH and IT have additional on-site renewable production requirement

Table 4: Comparison of annual net electrical energy of the national nZEB (step 7) including PV yield

<b>Country/ regulation</b>	<b>Energies [kWh/m<sup>2</sup>/yr]</b>	<b>National nZEB</b>	<b>On-site PV yield</b>	<b>Net balance</b>
AT OIB 6 Innsbruck		26.0	0	26.0
CH MuKE Zurich		18.3	14.9	3.4
DE EnEV Potsdam		42.0	0	42.0
DE KfW55 Potsdam		26.1	0	26.1
SE BBR Stockholm		26.7	0	26.7
IT DM 2015 Bolzano		15.8	18.8	-3.0
IT DM 2015 Rome		16.3	17.0	-0.7



## Comparison of nZEB ambition level in different countries

### Comparison to EU benchmarks

- EU benchmarks set ambitious goals

Energy use/primary energy	SFH	office
Space heating [ $\text{kWh}_{\text{th}}/\text{m}^2/\text{yr}$ ]	15-35	20-35
DHW [ $\text{kWh}_{\text{th}}/\text{m}^2/\text{yr}$ ]	15	10
Space cooling [ $\text{kWh}_{\text{th}}/\text{m}^2/\text{yr}$ ]	0	5
Sum Thermal [ $\text{kWh}_{\text{th}}/\text{m}^2/\text{yr}$ ]	30-50	35-50
Ventilation [ $\text{kWh}_{\text{el}}/\text{m}^2/\text{yr}$ ]	1	4
Lighting [ $\text{kWh}_{\text{el}}/\text{m}^2/\text{yr}$ ]	2	10
Auxiliaries [ $\text{kWh}_{\text{el}}/\text{m}^2/\text{yr}$ ]	5	7
Sum Electric [ $\text{kWh}_{\text{el}}/\text{m}^2/\text{yr}$ ]	20-28	34-40
Primary energy [ $\text{kWh}_p/\text{m}^2/\text{yr}$ ]	50-70	86-101
Primary energy EU [ $\text{kWh}_p/\text{m}^2/\text{yr}$ ]	50-70	85-100

Legend: SFH – single family house,  $\text{kWh}_{\text{th}}$  – kWh thermal,  $\text{kWh}_{\text{el}}$  – kWh electric,  $\text{kWh}_p$  – kWh primary energy

- Compliance to EU benchmark only by ambitious nZEB

Site	nZEB	EU	$\Delta$ [%]	Net	EU	$\Delta$ [%]
AT	70	57.5	122	70	22.5	311
CH	51	57.5	89	13.5	22.5	60
DE E	110	57.5	191	110	22.5	489
DE K	70	57.5	122	70	22.5	311
SE	72	77.5	93	72	52.5	137
IT B	45	60	75	-2.5	30	-108
IT R	46	57.5	80	3.2	7.5	43

Legend: DE E – DE EnEV, DE K – DE KfW55, IT B Italy Bolzano, IT R – Italy Rome,  $\Delta$  - percent deviation, nZEB – energy demand national nZEB, net – Net balance national nZEB, EU – EU recommendation benchmark

# Comparison of nZEB ambition level in different countries

## Summary of results

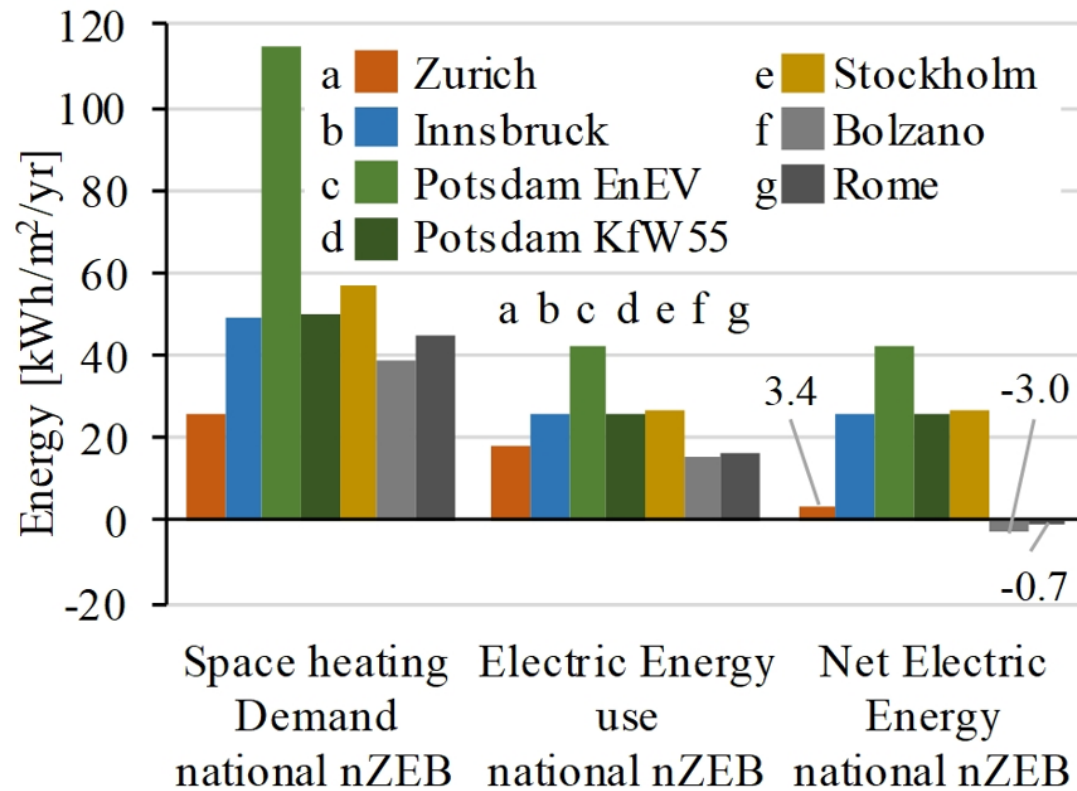


Figure 4: Yearly energy demands and net balance including on-site PV production (step 7).

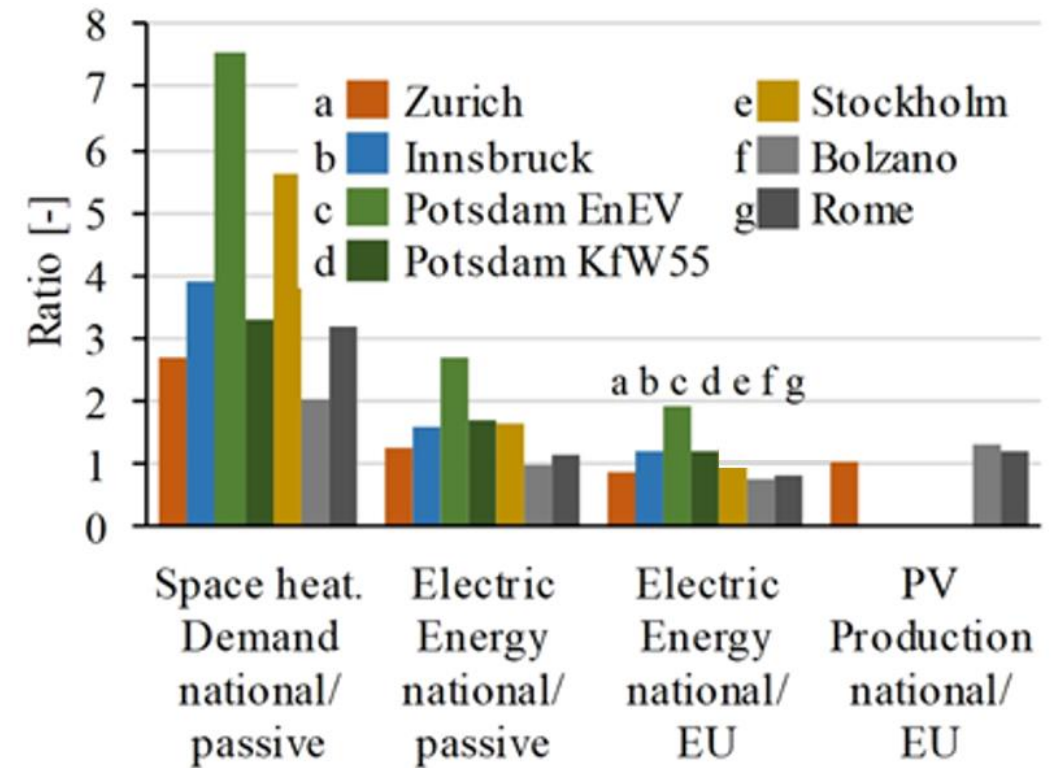


Figure 5: Ratio of national nZEB implementation to local passive house and EU recommendation benchmark



## Comparison of nZEB ambition level in different countries

### Conclusion

- Different nZEB implementations and ambition levels among EU member states, which do not all meet EU recommendations
- EU recommendation (2016) set reasonably ambitious nZEB targets for the new built sector
- Developed methodology enables a relative comparison based on building/system simulation to enhance transparency
- Results can be used by policy makers and national authorities to further develop requirements and enhance ambition levels
- Methodology should be further tested for other site/countries and other building/system types (multi-family/office or non-HP systems)

# Thank you for your attention

