AEE INTEC

EBC
Energy in Buildings and Communities Programme

energy storage

IEA Research Cooperation
Part of open4innovation

Funded by
Federal Ministry
Republic of Austria
Climate Action, Environment, Energy, Mobility, Innovation and Technology

Workshop ISEC 2024
“Flexibility and Load Management for Energy Grids: The hidden Potential of Buildings“

Christoph Rohringer, Ingo Leusbrock


https://www.flickr.com/photos/22563225@N04/5472274938/ → swainboat

Buildings and their role in the overall energy system

Aim of this workshop

- Aim:
  - To explore the role of buildings in reshaping thermal and electric energy grids

Goals of this workshop

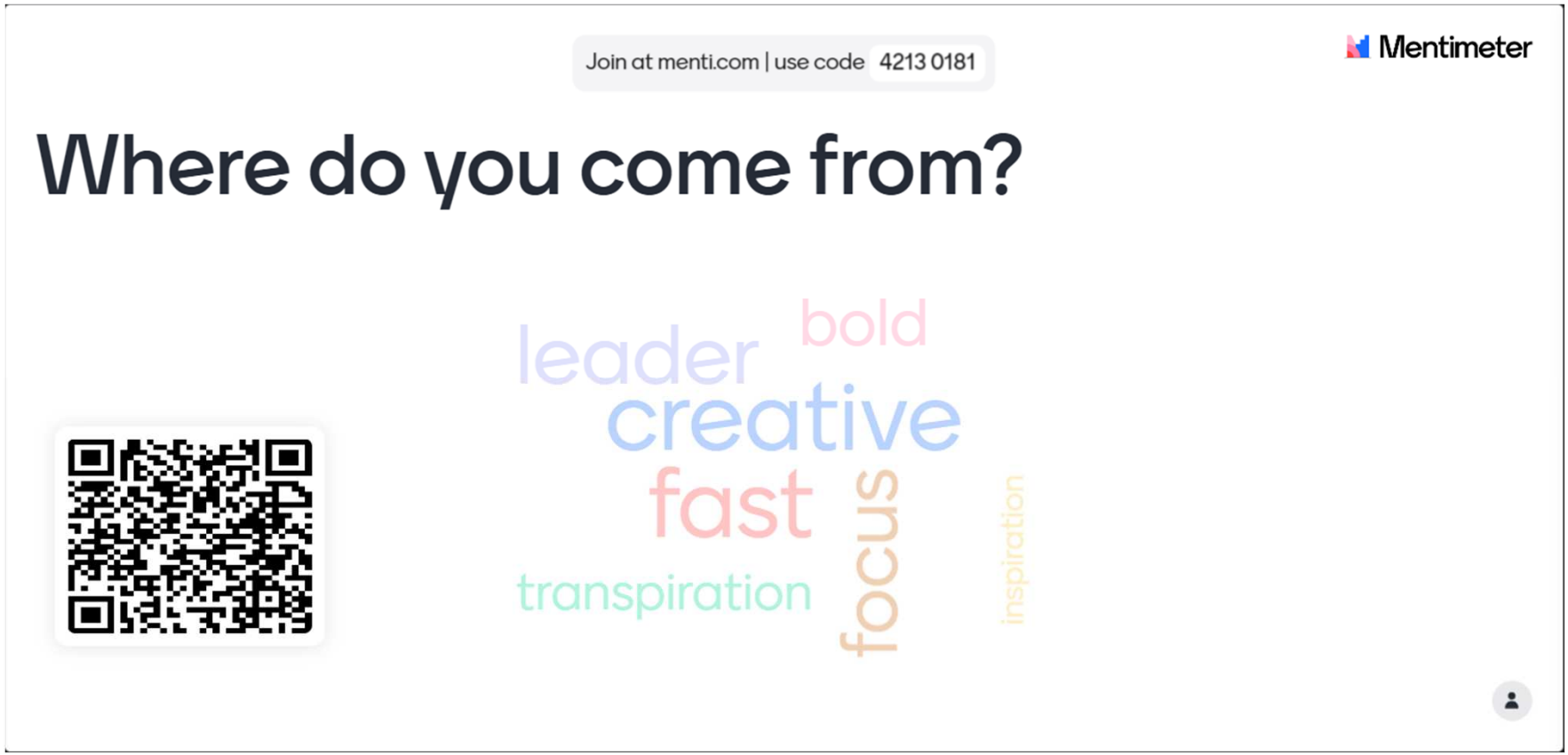
Grid flexibility	• Investigate practical approaches for enhancing grid flexibility and managing loads through building integration in energy systems
Current efforts	• Examine current research and real-world applications of utilizing buildings as active contributors within the energy ecosystem
Expert discussion	• Engage with experts to gain insights on demand response, energy storage, and decentralized energy generation utilizing building infrastructure
Boundary conditions	• Understand the capabilities and necessities of buildings to fulfill their potential in energy grid management
Business opportunities	• Explore new business models enabling buildings to transition from passive consumers to active participants in energy grid operations

Warm-up: Mentimeter questions!

- Direct link: https://www.menti.com/aljufz1y9jqy or
- www.menti.com → Code: 4213 0181

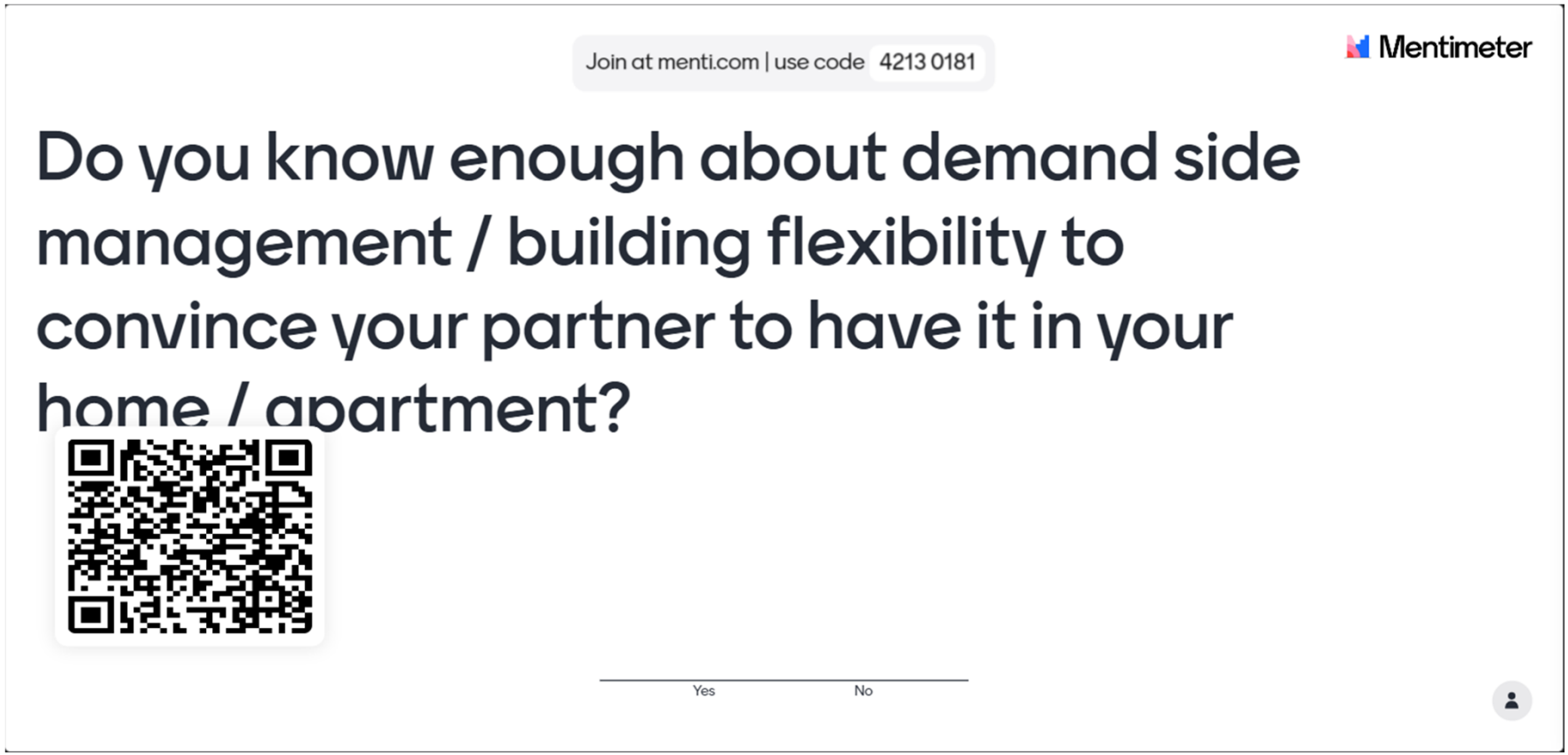
What is your background?

Where do you come from?



When you hear the term "Demand Side Management", you think it is

Do you know enough about demand side management / building flexibility to convince your partner to have it in your home / apartment?



Agenda, pt. I

- Part I: Setting the stage (45 min)
  - General intro (5 min)
  - Demand Side Management of Buildings in Thermal Networks
    - Anna Marszal-Pomianowska, Aalborg University, 15 min
  - Wind Heating 2.0
    - Matthias Kersken, Fraunhofer IBP, 10 min
  - Thermal Concrete Activation – Research and Monitoring Projects in Austria
    - Claudia Dankl, VÖZ; Christoph Rohringer, AEE INTEC, 10 min
  - Summary and transition to the interactive part (5 min)

Agenda, pt. II

- Part I: Setting the stage (45 min)
- Part II: Workshop “Ask the experts” (45 min)
  - 3 theme tables: Ask the experts (30 min)
- Table 1: Flexibility technologies on the demand side
  - Question: What do existing technologies need to be used for DSM?
- Table 2: Cooperation models
  - Question: How can cooperation models look like? What can thermal load management learn from electrical load management?
- Table 3: Grid beneficial buildings
  - Question: What do you need in your country to set up similar cooperation models?

Agenda, pt.III

- Part I: Setting the stage (45 min)
- Part II: Workshop “Ask the experts” (45 min)
- Part III: Wrap-up (15 minutes)
  - 3 minutes per topic table, 2 mentimeter questions
  - Questions from the audience

Part I: Setting the stage (45 min)

- General intro (5 min)
- Demand Side Management of Buildings in Thermal Networks
  - Anna Marszal-Pomianowska, Aalborg University, 15 min
- Wind Heating 2.0
  - Matthias Kersken, Fraunhofer IBP, 10 min
- Thermal Concrete Activation – Research and Monitoring Projects in Austria
  - Claudia Dankl, VÖZ; Christoph Rohringer, AEE INTEC, 10 min
- Summary and transition to the interactive part (5 min)

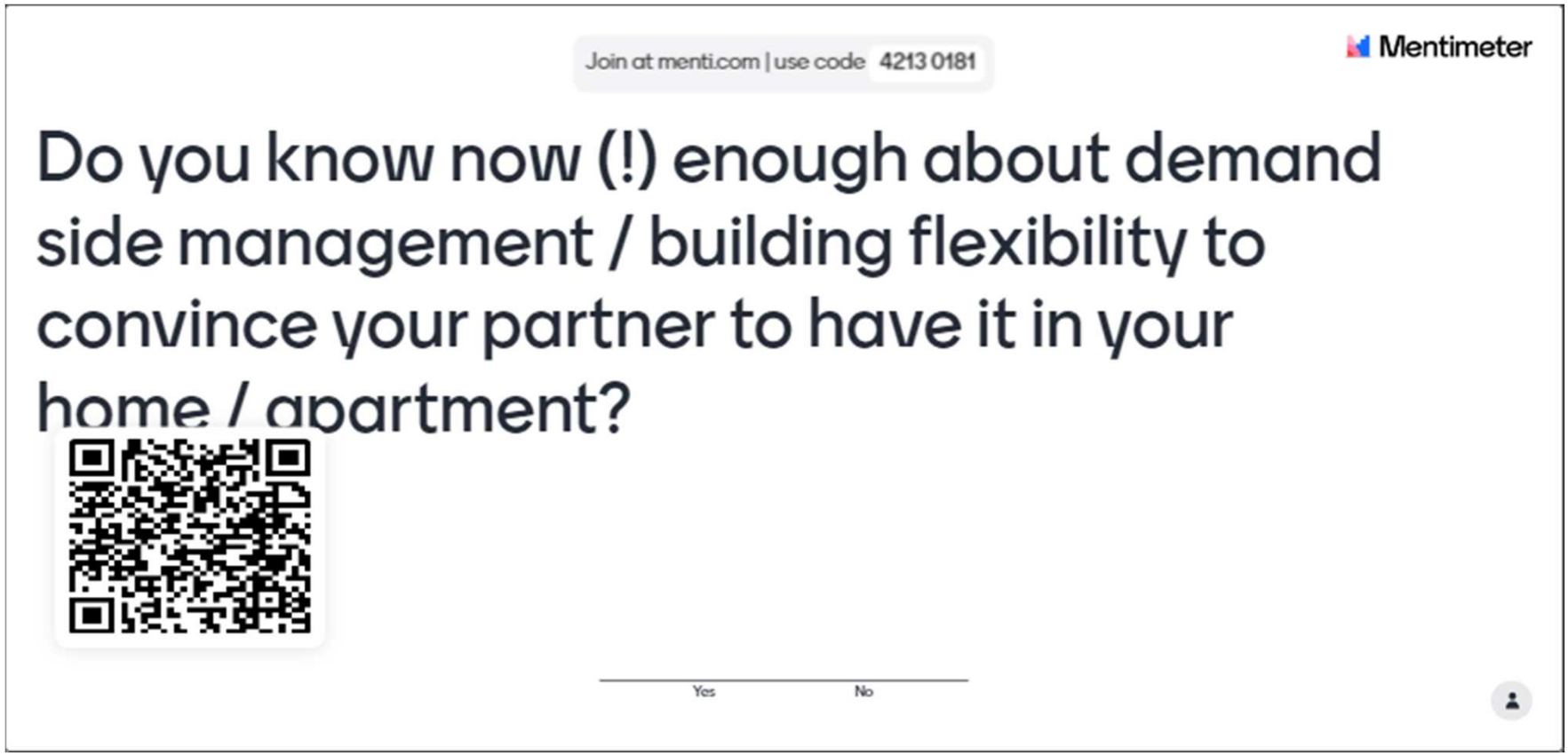
Part II: Workshop “Ask the experts” (30 min)

- 3 theme tables
- Table 1: Flexibility technologies on the demand side
  - Question: What do existing technologies need to be used for DSM?
  - Claudia Dankl + Christoph Rohringer
- Table 2: Cooperation models
  - Question: How can cooperation models look like? What can thermal load management learn from electrical load management?
  - Anna Marszal + Ingo Leusbrock
- Table 3: Grid beneficial buildings
  - Question: What do you need in your country to set up similar cooperation models?
  - Matthias Kersken
- Pick a table at the start, switch after ~15 minutes

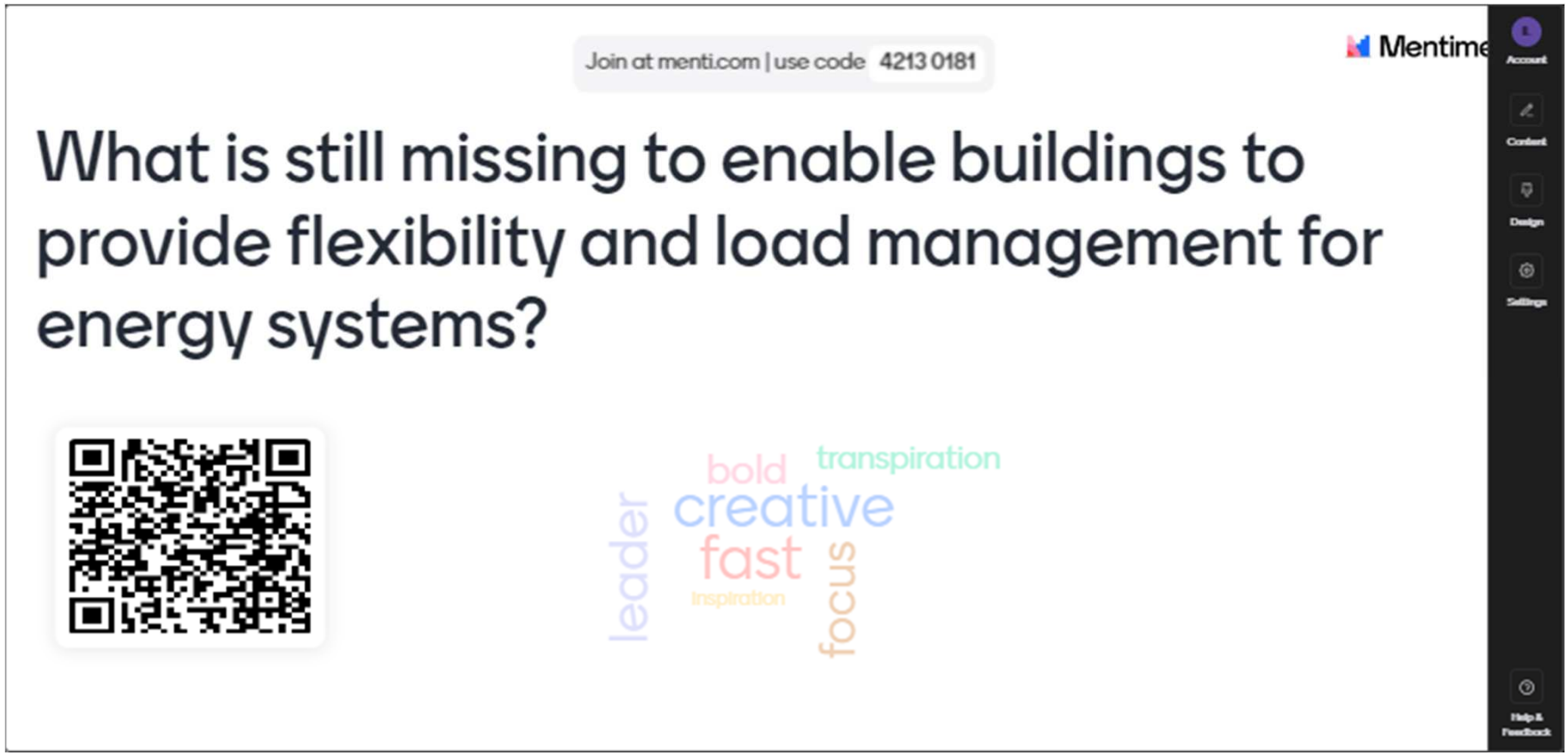
Part III: Wrap-up (15 minutes)

- Summaries of the topic tables
- Questions from the audience
- Final mentimeter round

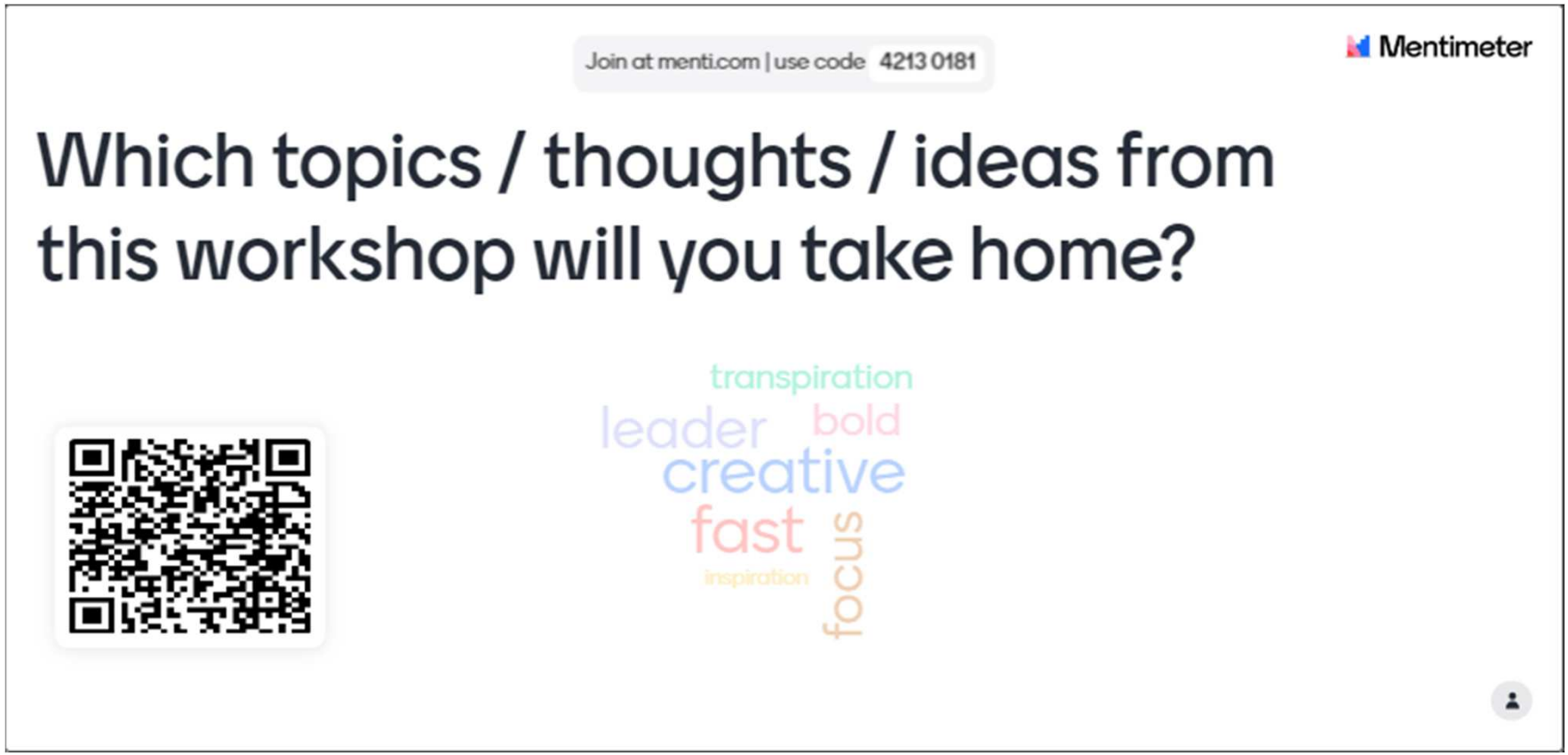
Do you know now (!) enough about demand side management / building flexibility to convince your partner to have it in your home / apartment?

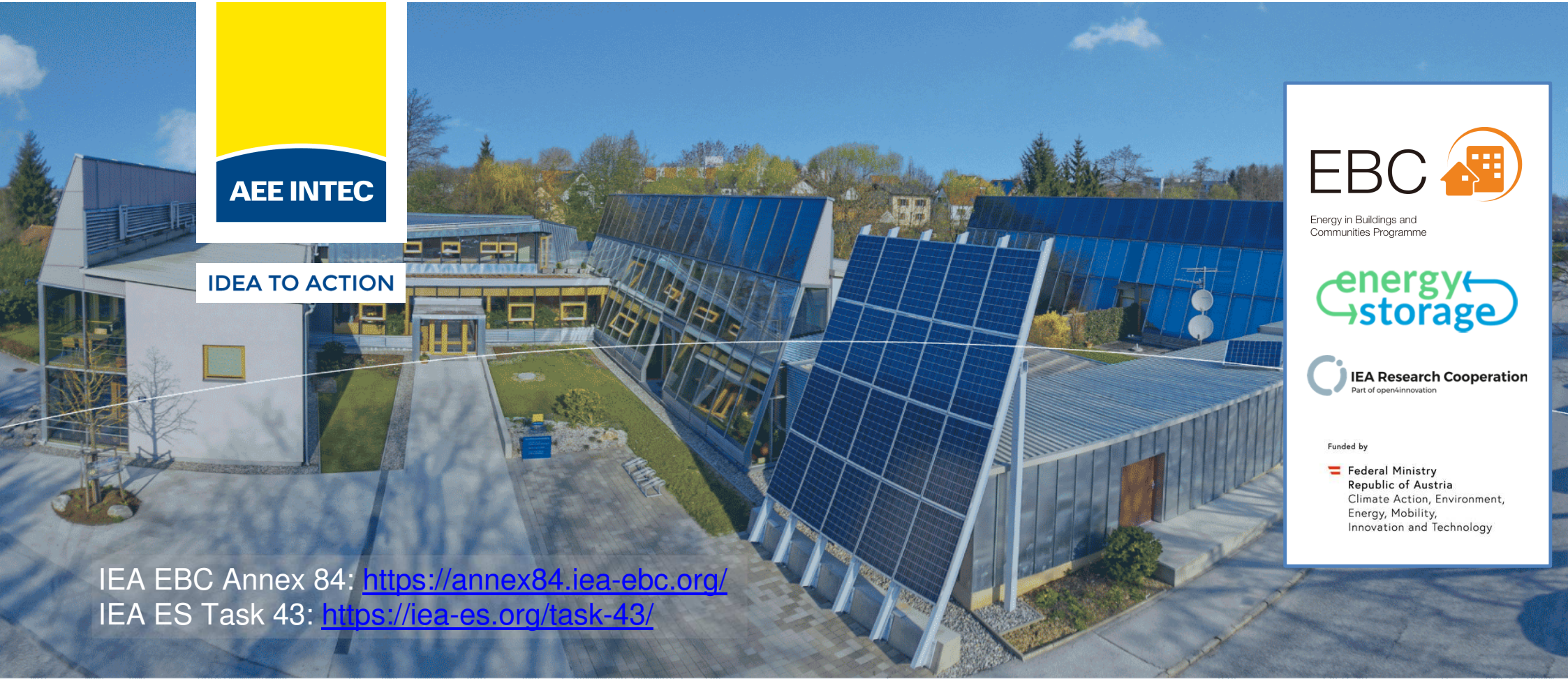


What is still missing to enable buildings to provide flexibility and load management for energy systems?



Which topics / thoughts / ideas from this workshop will you take home?





AEE – Institute for Sustainable Technologies (AEE INTEC)
8200 Gleisdorf, Feldgasse 19, Austria

Website: www.aee-intec.at
Twitter: @AEE_INTEC

Ingo Leusbrock
i.leusbrock@aee.at

Christoph Rohringer
c.rohringer@aee.at

AEE INTEC

EBC
Energy in Buildings and Communities Programme

energy storage

IEA Research Cooperation
Part of open4innovation

Funded by
Federal Ministry
Republic of Austria
Climate Action, Environment, Energy, Mobility, Innovation and Technology

Workshop ISEC 2024 “Flexibility and Load Management for Energy Grids: The hidden Potential of Buildings “

Joint workshop of IEA EBC Annex 84 & IEA ES Task 43

Christoph Rohringer, Ingo Leusbrock

Flexibility and Load Management for Energy Grids: The hidden Potential of Buildings

IEA EBC Annex 84

Demand management of buildings in thermal networks (DHC systems)

https://annex84.iea-ebc.org/

Anna Marszal-Pomianowska
Aalborg University

ISEC Conference
10-11 April, 2024 Graz

International Energy Agency

EBC
Energy in Buildings and Communities Programme

BUILD BYGGERI, BY OG MILJØ
AALBORG UNIVERSITET

Point of departure

1. **Energy use for heating in buildings**

80% of final energy consumption in the residential sector is used for space heating and water heating and global energy needs for space cooling are set to triple by 2050.

2. **DHC systems are the most sustainable way to heat up buildings.**

Share of building stock connected to DHC in Denmark 65%, Sweden 45%, Russia about 40% and China 15%.

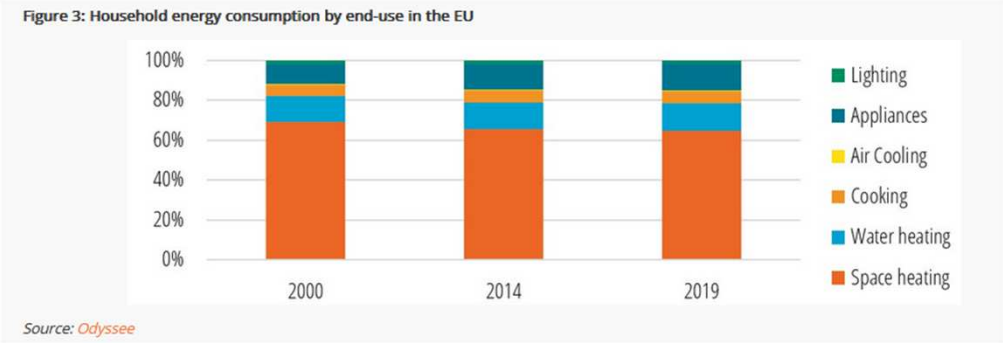
3. **Buildings' role in transition towards fossil-free society.**

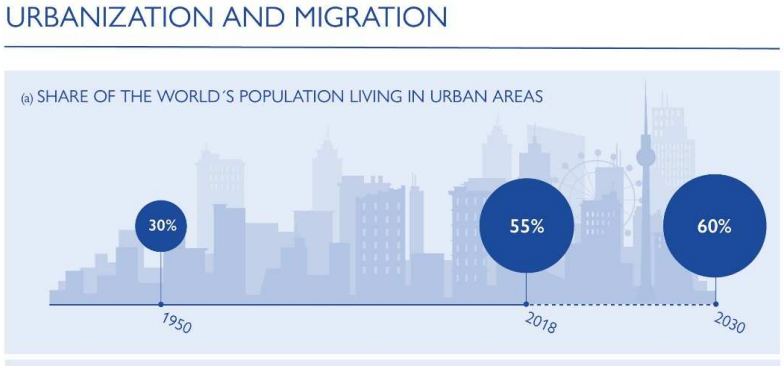
Buildings are capable of offering flexibility to the power grid by smart control of their demands. Yet, the connection point between building and utility, the impact of individual building and thereby the operational challenges of DHC systems differ from the power grids.

4. **Final users/customers engagement**

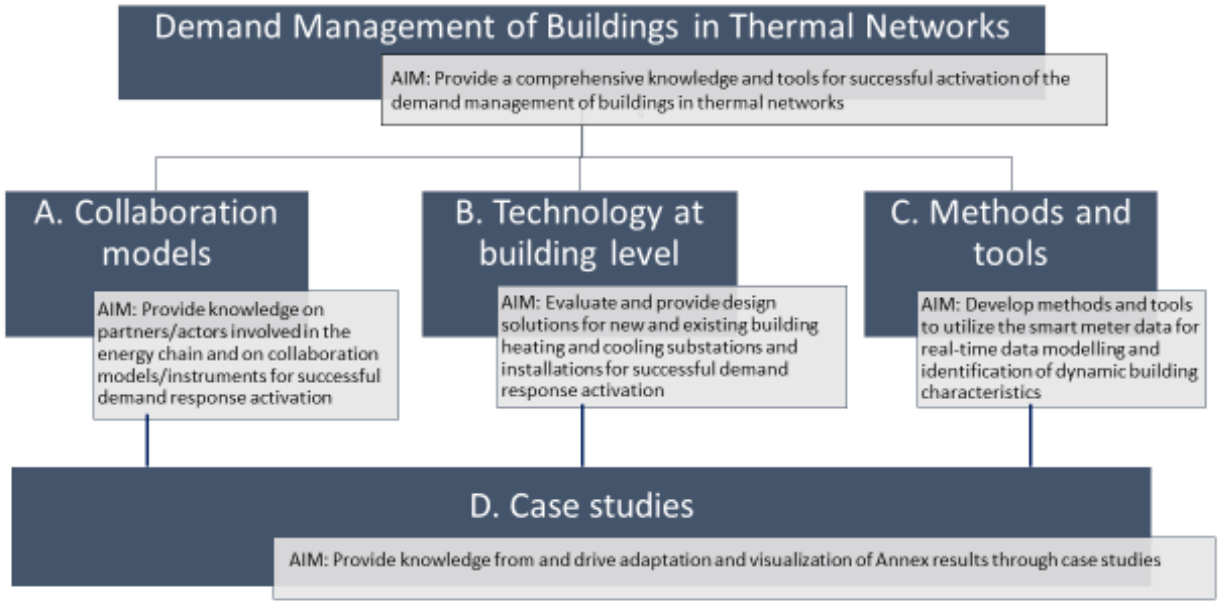
OECD or EU and emphasize that engagement of occupants, customers, users must be parallel to technology development to achieve the decarbonisation milestones

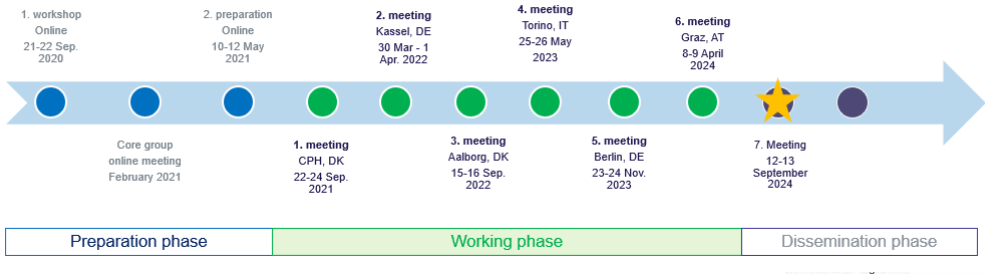
5. **Roll-out of smart heat meters and new source of knowledge about end-users (buildings) (NEW!)**





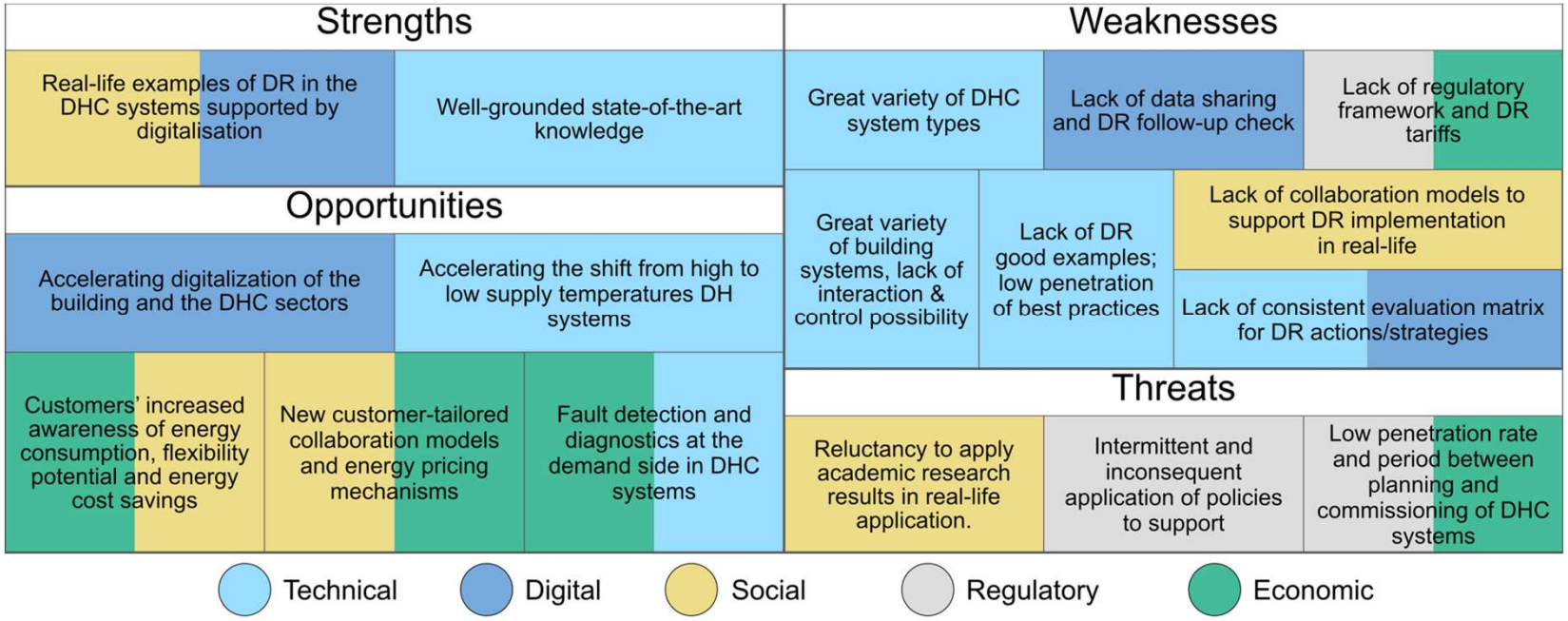
Annex84 scope & timeframe





Annex84 results

Strengths, weaknesses, opportunities and threats (SWOT) of demand response in district heating and cooling systems. From passive customers to valuable



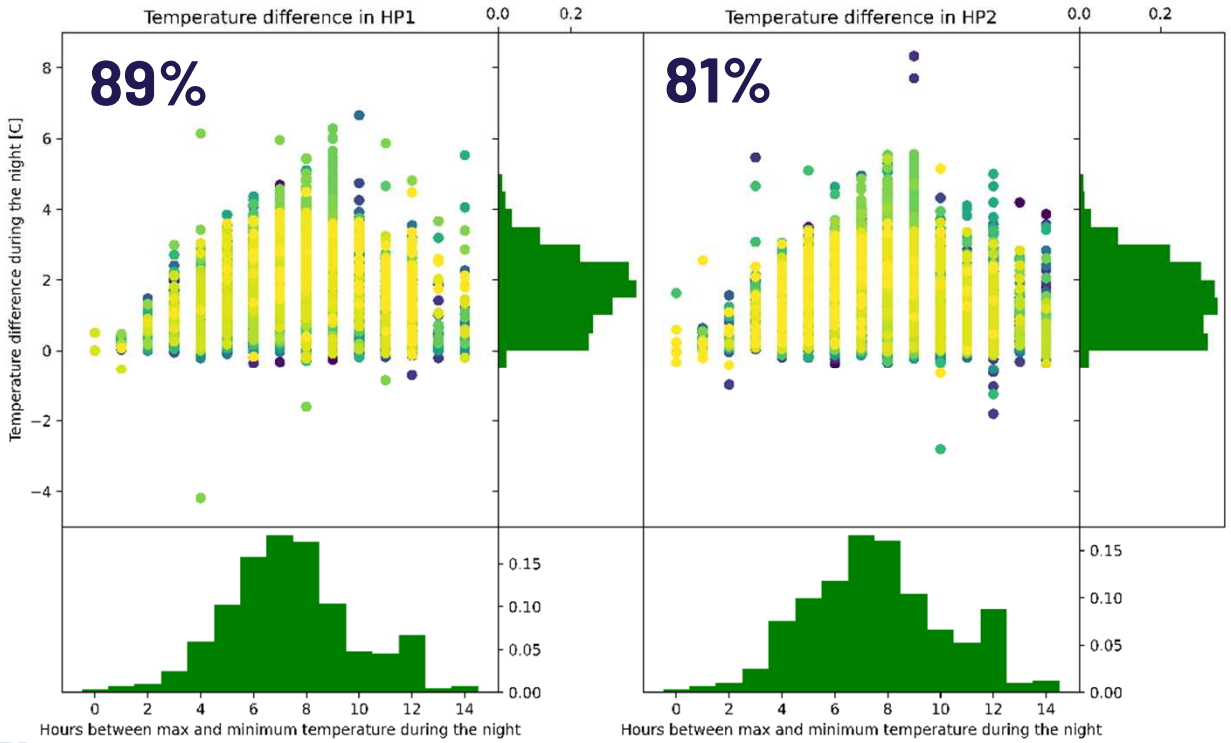

Smart Energy

Strengths, weaknesses, opportunities and threats of demand response in district heating and cooling systems. From passive customers to valuable assets

Source: Marszal-Pomianowska et al. https://doi.org/10.1016/j.segy.2024.100135

Annex84 results

Do the end-users remember to activate DR?

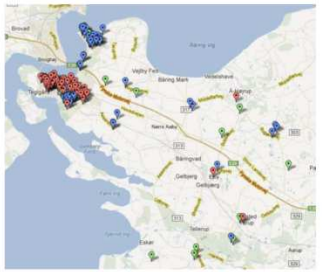


Field study

- Smart Energi I Hjemmet (SEIH) project conducted in southern Denmark in the years 2012-2015
- 72 single-family houses, privately owned and in full time occupation
- DSM strategy: night set-back
- DSM objective: energy savings for end-users
- DSM control: indirect/implicit participation of end-users via SEIH homepage
- Passive House system to control the valve at the supply of heat from the DH network + temperature sensor in the living space

Table 1. Characteristics of the 72 houses participating in the DR events.

Typology		Size of household [person]		Area [m²]		Construction year	
Detached house	47	**1**	6	**<= 90**	3	**< 1950**	33
Town house	15	**2**	31	**91-120**	23	**1951-61**	8
Row house	7	**3**	16	**121-150**	19	**1962-73**	28
Farm house	2	**4**	9	**151-180**	19	**1974-85**	3
Other	1	**5+**	10	**>=181**	8		
Total	72		72		72		72



Energy in Buildings and Communities Programme

Annex84 results

Survey on DR among DHC professionals

- 17 questions on the status on DR knowledge level / motivation forDR application /applied solutions
- Survey available in ENG, DK, FR, DE, IT, SP
- Already 60 responses in all languages
- Euroheat & Power involved

https://www.euroheat.org/resource/iea-ebc-annex-84-survey.html

EUROHEAT & POWER

About EHP | Policy | Media Centre | DHC+ Platform | Knowledge Hub | Certification

Register/Login

You are here: Euroheat & Power → Knowledge Hub → Resource Library Search → A survey on the application of Demand Response among DH utilities

EHP/DHC+ newsletter 10 May 2023

A survey on the application of Demand Response among DH utilities

Take part in the IEA EBC Annex 84 survey on "Demand Side Management status in District Heating/Cooling systems"!

The well-known and applied concept of demand side management (DSM) in the electricity system is one of the solutions that adapted to the demand side can foster the decarbonisation process and future operation of the DHC systems. The development of DHC systems actively applying the DSM requires the involvement of decision-makers and stakeholders. Therefore, the stakeholder's perception and opinion on DSM is asked during this survey.

In this survey, DSM is understood as the modification of user demand in order to meet some requirements or reach specific goals in the DHC system. Demand Side Management and Demand Response are understood as similar concepts.

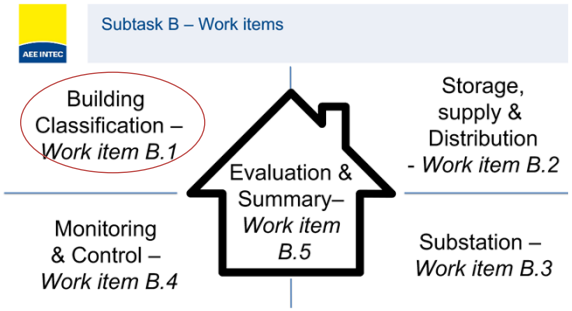
This questionnaire is anonymous, and your answers will only be used for research purposes. **The deadline to fill it in is 30 June 2023**.

Language of the survey	Link	QR Code
English	https://www.survey-xact.dk/LinkCollector?key=8GYJLW4FUJCP	

International Energy Agency

Annex84 results

STB hardware



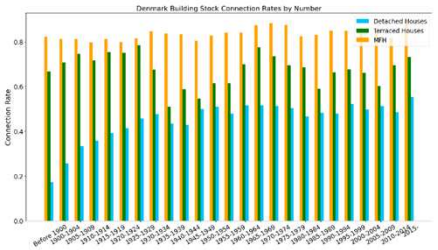
A comprehensive, in-depth overview of building stocks connected to DHC networks

3 layers of detail:

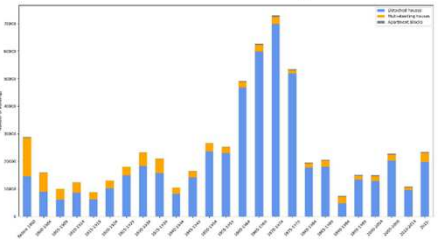
1. Country comparison of building stocks and share connected to DHC systems from country to country
2. National-level breakdown of building stock connected to DHC
3. Case studies on buildings connected to select DHC systems in given regions (additional data analysis on building load profiles etc)

Residential Building stock connected to DH Systems - Denmark

Connection Rates of Residential Buildings to DHN



Absolute number of residentialbuildings connected to DHN



- Multi-family homest (including appartment blocks) have the highest connection rate in the residential sector – approx. 80% accross all construction years.
- Largest number of residential buildings connected to DH are SFH (detached) constructed between 1960 and 1980

Country	Number of Buildings Connected: Construction Year	Number of Buildings Connected: Usage*	Connection rate to DH networks	Heated Area Connected: Construction Year	Heated Area Connected: Usage*	Average Specific Heat Demands	Source(s)
Denmark	x	x	x	x	x	x	Statistics Denmark
Germany	x	/	x	x	/		Ariadne Report, Bundesministerium für Bildung und Forschung
Sweden	x	/	x	x	/		TABULA Database
Austria	x	/	/	x	/	x	TABULA Database
Czechia	x	/	x				Czech Statistical Office, Public Database
Slovenia	x	/	x	x	/		
Norway	x	/	x	x	/		Statistics Norway
Bosnia & Herzegovena	x	/	x	x	/		TABULA Database

x – complete data collected
/ - partial/insufficient data collected (e.g. non-residential buildings missing)

Annex84 results

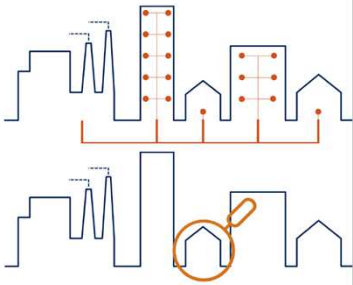
STB software

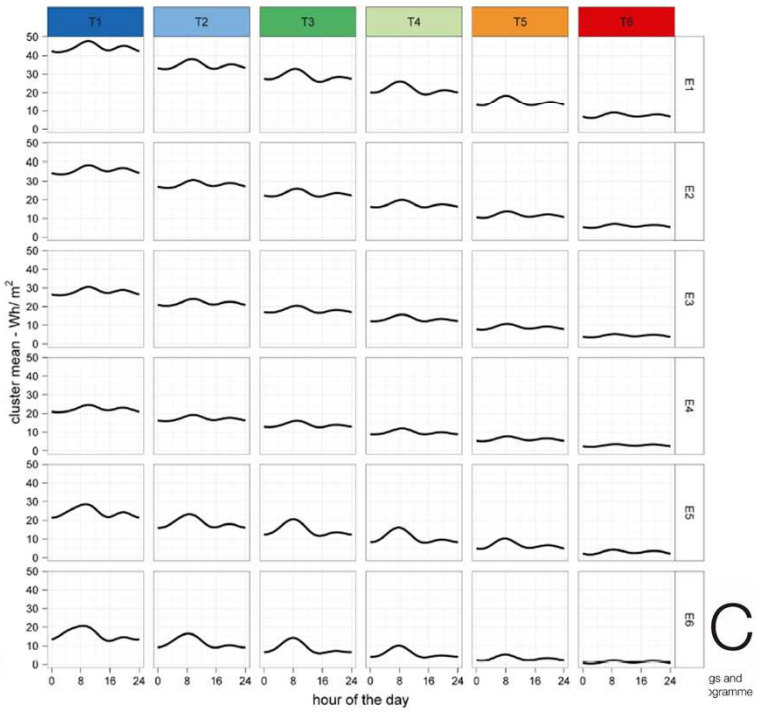
Co-clustering of end-customers in DHC systems

- Columns represent the temporal clusters
- Rows are the respective building
- –energy use clusters
- Expected seasonal variation
  - Decrease in energy with warmer external temperatures
- Peaks get less pronounced in the summer period
  - More irregular patters (holidays)
  - Decrease in DHW use with warmer temperatures
- E5 + E6 have a different shape from E1-E4

Data

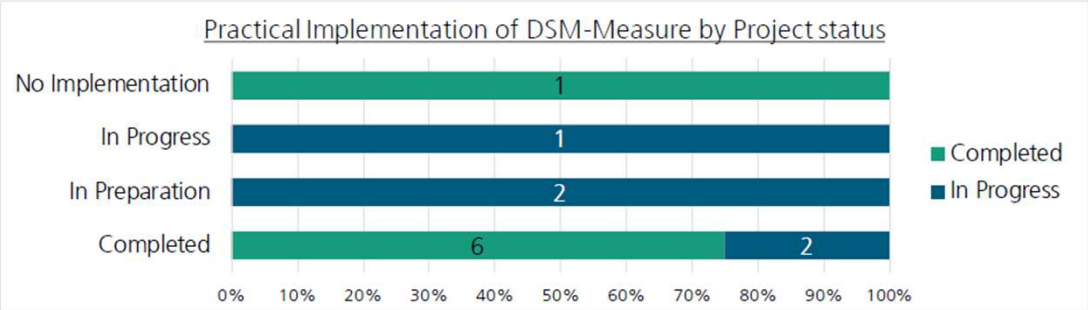
- Two years of hourly energy use data from 4500 single family houses
- Building characteristics
  - BBR: General statistical information - e.g. building area
  - EPC: detailed information - e.g. window area and characteristics
- Socio-economic information
  - 8 different variables: e.g. income, number of adults & children

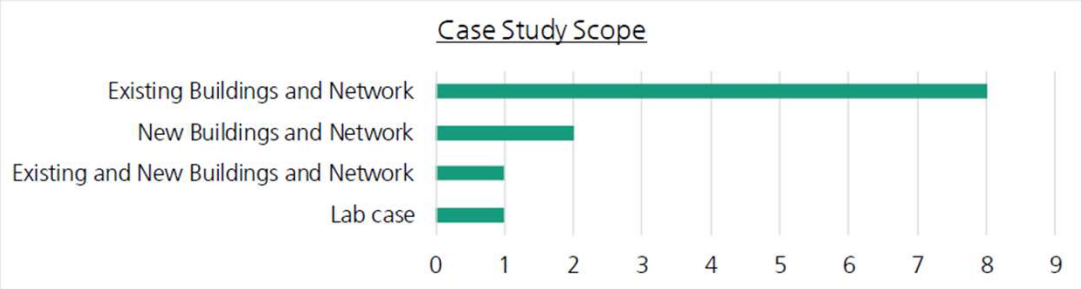


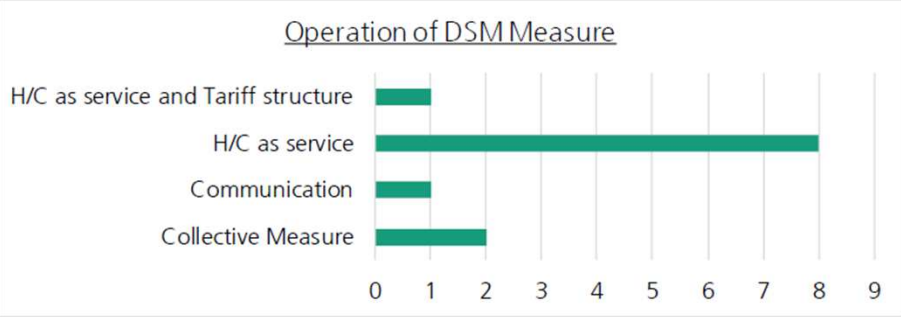


Annex84 results

Case studies





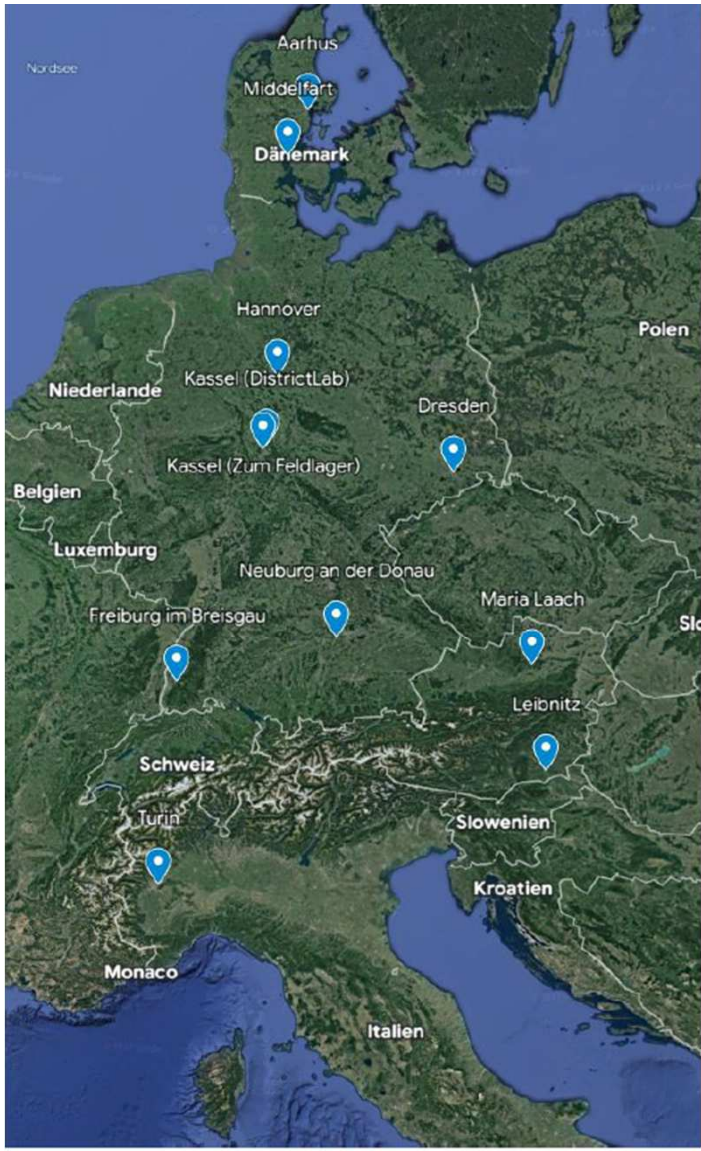


Collective measure to save energy and improve grid temperatures permanently

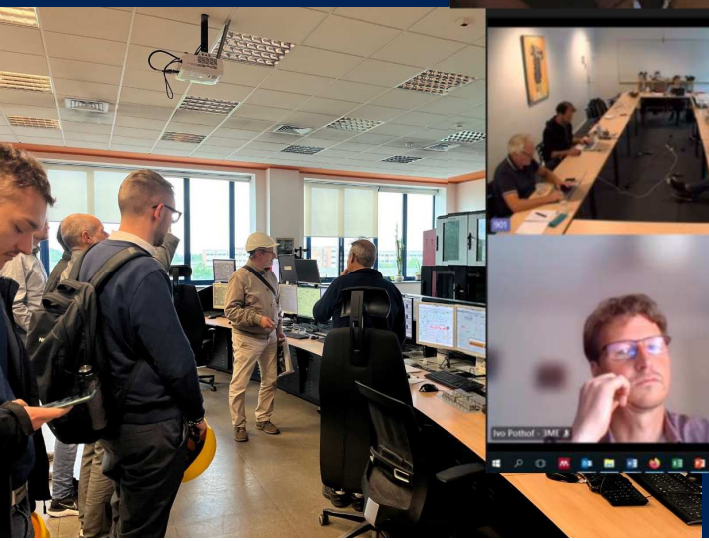
Tariff structure measures to activate demand response

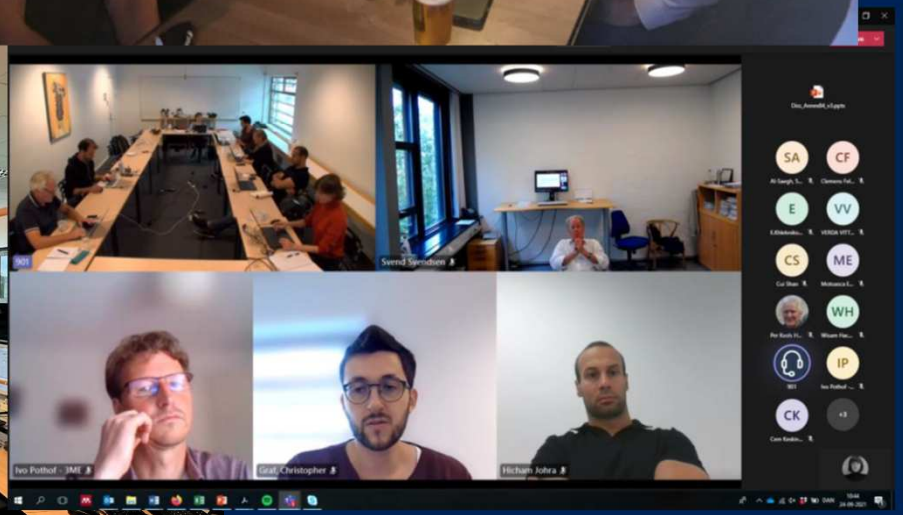
H/C as service: grid operator uses control strategies

Communication from customer is the dominant strategy to activate demand response



THIS PRESENTATION IS A JOINED EFFORT AND WORK OF ALL ANNEX84 PARTICIPANTS






THANK YOU
IEA EBC Annex 84
Demand management of buildings in thermal networks (DHC systems)
https://annex84.iea-ebc.org/

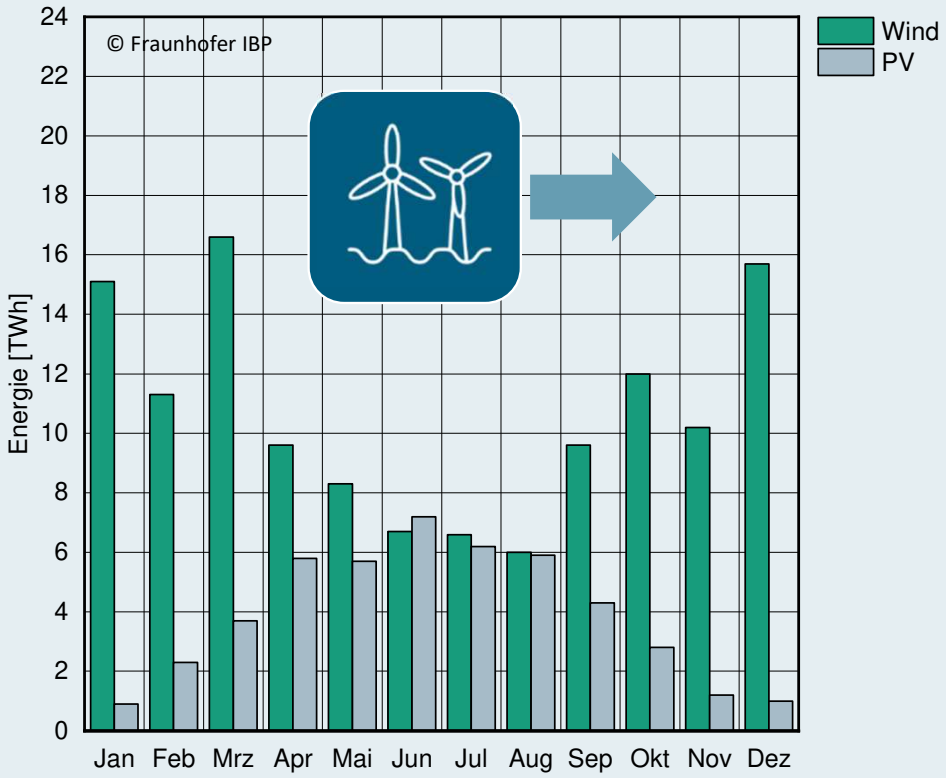
Fraunhofer IBP

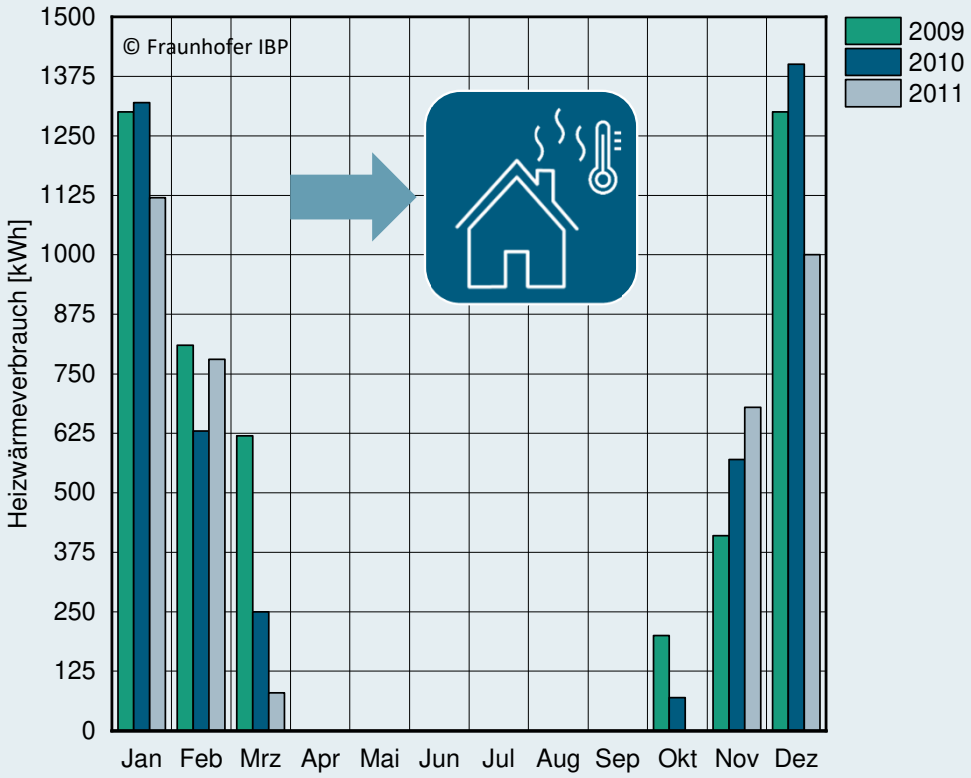
Windheizung 2.0
Wind-Heating 2.0

ISEC 2024 – Workshop: Flexibility and Load Management for Energy Grids:
The hidden Potential of Buildings
Graz, April 10th 2024

Motivation

Good correlation between heating season and high wind events

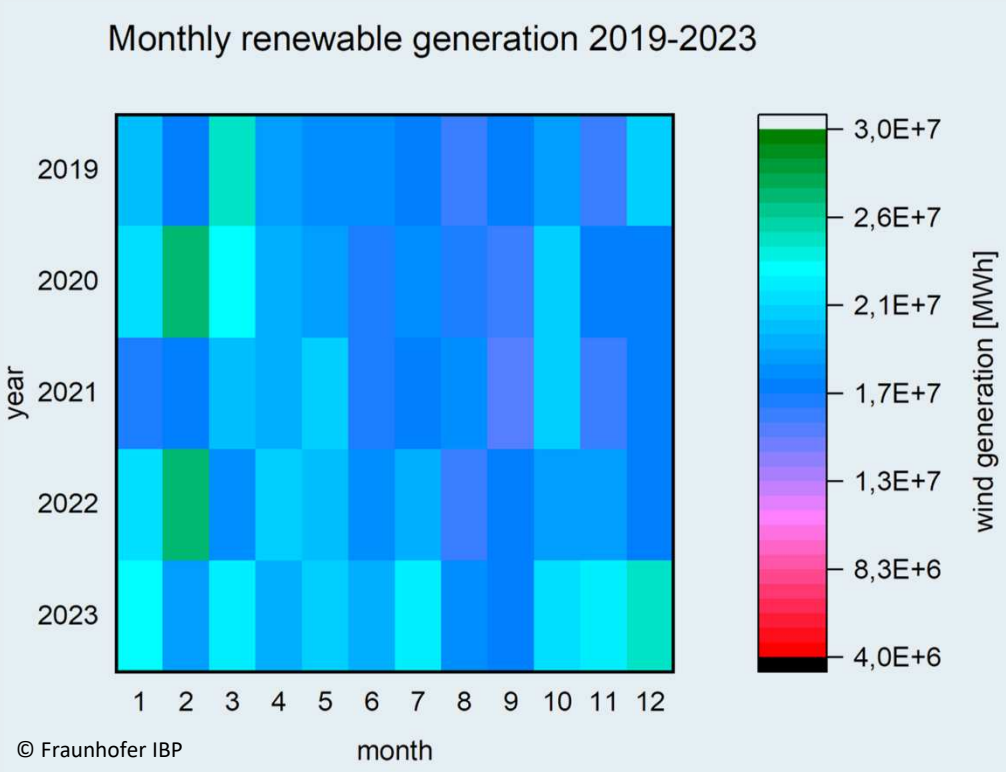


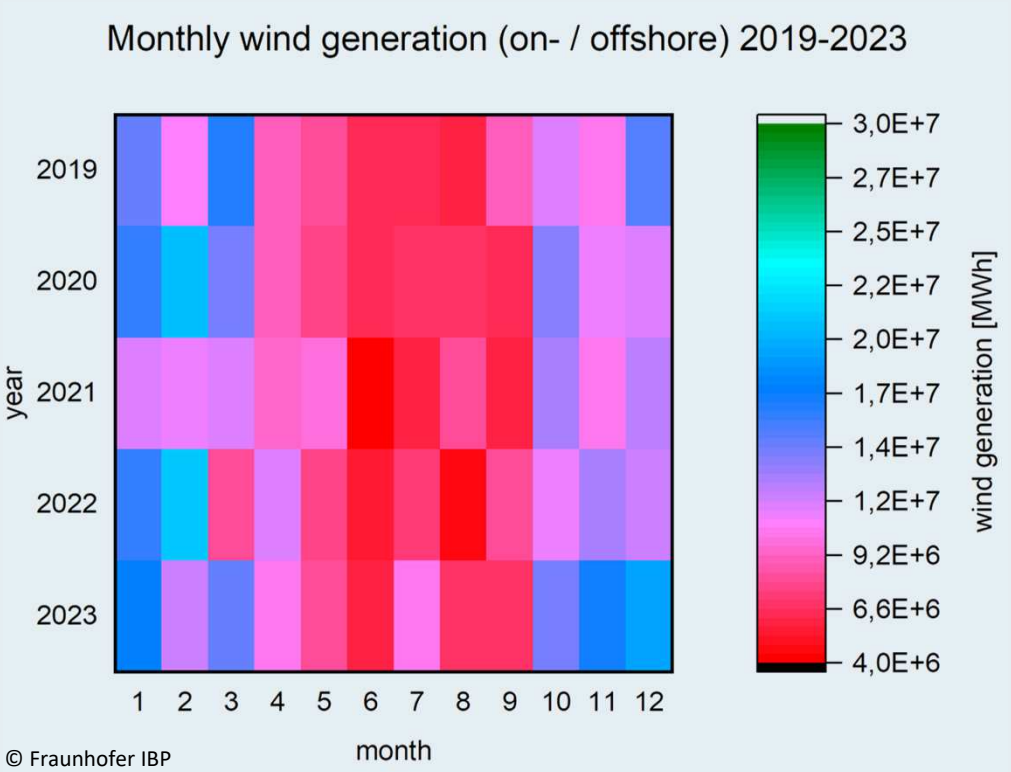


Gefördert durch:
Bundesministerium für Wirtschaft und Klimaschutz
aufgrund eines Beschlusses des Deutschen Bundestages
FKZ: 03ET1612A
FKZ: 03EN6013A

Fraunhofer IBP

Availability of renewable electricity production (Germany)





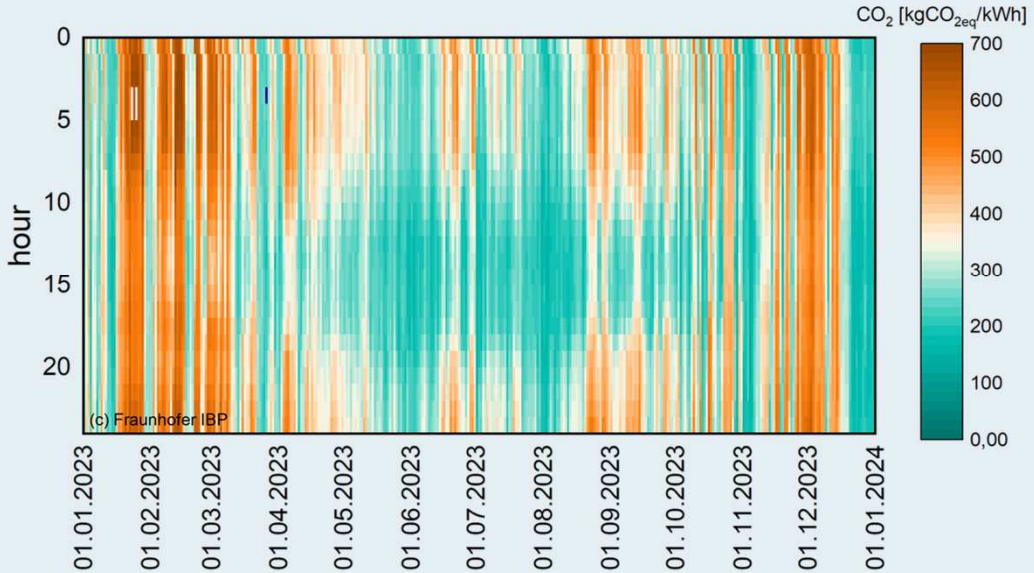
Source: SMARD market data; https://www.smard.de/home/downloadcenter/download-marktdaten/

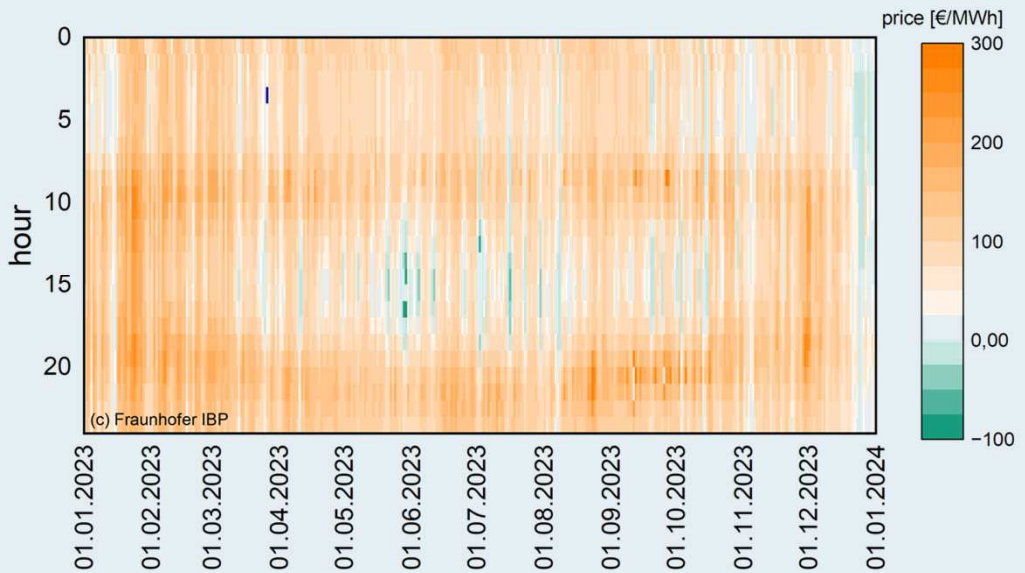
Gefördert durch:
Bundesministerium für Wirtschaft und Klimaschutz
aufgrund eines Beschlusses des Deutschen Bundestages
FKZ: 03ET1612A
FKZ: 03EN6013A

Fraunhofer IBP

Availability of renewable electricity production (Germany)

CO2 and price (2023)





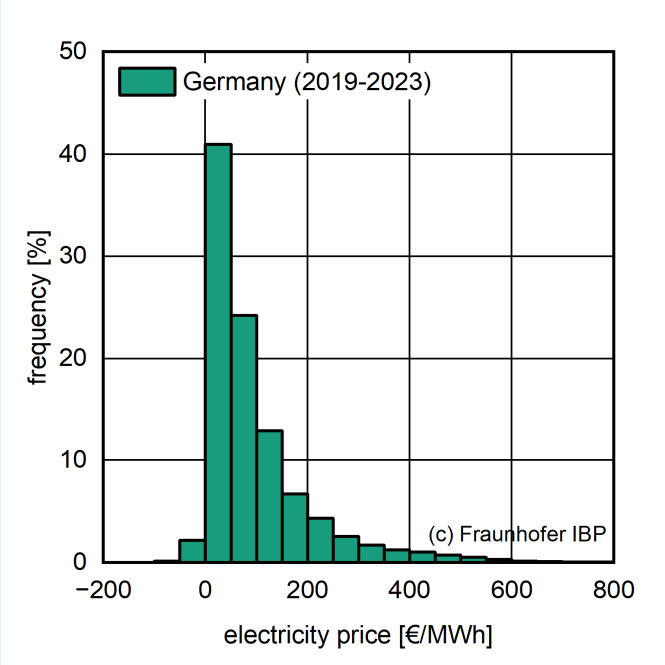
Source: SMARD market data; https://www.smard.de/home/downloadcenter/download-marktdaten/

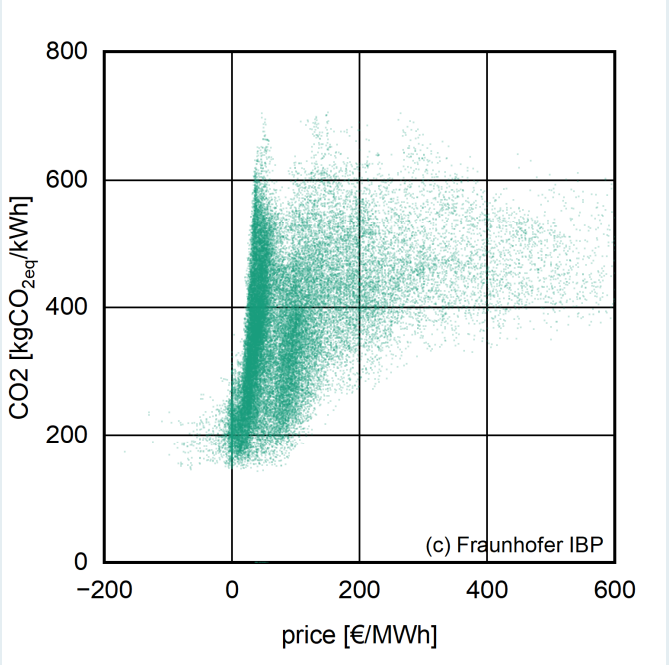
Source: Emissionsbilanz erneuerbarer Energieträger Bestimmung der vermiedenen Emissionen im Jahr 2022 Emissionsbilanz erneuerbarer Energieträger Bestimmung der vermiedenen Emissionen im Jahr 2022: https://www.umweltbundesamt.de/sites/default/files/medien/11850/publikationen/20231219_49_2023_cc_emissionsbilanz_erneuerbarer_energien_2022_bf.pdf

Gefördert durch:
Bundesministerium für Wirtschaft und Klimaschutz
aufgrund eines Beschlusses des Deutschen Bundestages
FKZ: 03ET1612A
FKZ: 03EN6013A

Availability of renewable electricity production (Germany)

CO2 and price (2019 - 2023)





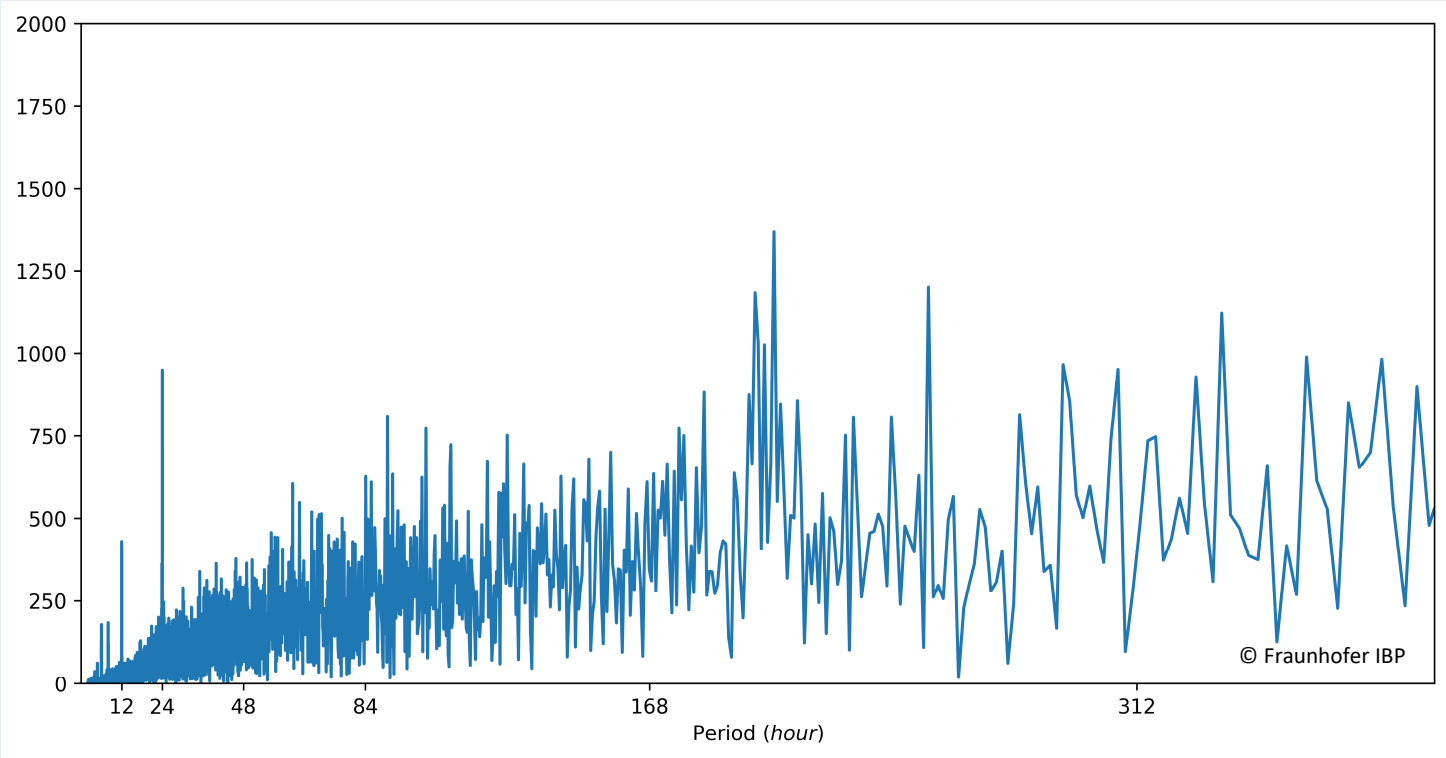
Source: SMARD market data; https://www.smard.de/home/downloadcenter/download-marktdaten/

Source: Emissionsbilanz erneuerbarer Energieträger Bestimmung der vermiedenen Emissionen im Jahr 2022 Emissionsbilanz erneuerbarer Energieträger Bestimmung der vermiedenen Emissionen im Jahr 2022: https://www.umweltbundesamt.de/sites/default/files/medien/11850/publikationen/20231219_49_2023_cc_emissionsbilanz_erneuerbarer_energien_2022_bf.pdf

Gefördert durch:
Bundesministerium für Wirtschaft und Klimaschutz
aufgrund eines Beschlusses des Deutschen Bundestages
FKZ: 03ET1612A
FKZ: 03EN6013A

Availability of renewable electricity production (Germany)

Analysis frequency domain (2019-2023) – wind power production



Source: SMARD market data; https://www.smard.de/home/downloadcenter/download-marktdaten/

Gefördert durch:
Bundesministerium für Wirtschaft und Klimaschutz
aufgrund eines Beschlusses des Deutschen Bundestages
FKZ: 03ET1612A
FKZ: 03EN6013A

Fraunhofer IBP

Requirements for grid flexible buildings

- Generation energy mix
  - Low price
  - Low carbon footprint
- Is the electricity grid „free“ between production and consumer / prosumer
  - Redispatch 2.0
- Sustainable usage of the energy
  - There will never be unlimited excess power generation
- Technical Constraints:
  - Power intake suitable for typical house power connection lines
  - …

- Results in
  - Charging periods: frequency and duration
  - Bridging periods: frequency and duration

Gefördert durch:
Bundesministerium für Wirtschaft und Klimaschutz
aufgrund eines Beschlusses des Deutschen Bundestages
FKZ: 03ET1612A
FKZ: 03EN6013A

Idea behind Windheizung 2.0

Charge the building with heat when excess wind power is available

How often
- Every 1-2 weeks
- For 5-9 hours
- (Nearly) No consumption in between

Building boundaries

- High performance building (PassiveHouse, KfW40+, …)
- Electricity supply 40 ~ 60 kW
- Fit the passive storage discharge to the building space heat demand

External boundaries / KPI

Market beneficial
- Avoid Redispatch (costs)
- Use low – negative electricity stock prices

Grid beneficial
- Consider current grid stress
- charge only when grid capacities are available
- drop load in between

tenant / economical beneficial
- lower total costs than a standard building (GEG2020) (25 a capitalized value)

ecological beneficial
- excess energy production only
- high wind power fractions
- Reduced CO2-footprint

Maintain thermal comfort

Gefördert durch:
Bundesministerium für Wirtschaft und Klimaschutz
aufgrund eines Beschlusses des Deutschen Bundestages
FKZ: 03ET1612A
FKZ: 03EN6013A

Idea behind Windheizung 2.0

Storages

Waterbased thermal storage

- *Sonnenhaus retrofits*

High Temperature Stone Storage (HTSS)

- *Stone core heated up to 1000 °C*
- *Size like a heat pump with buffer*

Insulated TABS

- ~ 45 °C
- insulation / increased ceiling thickness
- active discharge system (panel heating)
- transitory period: 1 – 1.5 weeks

Control

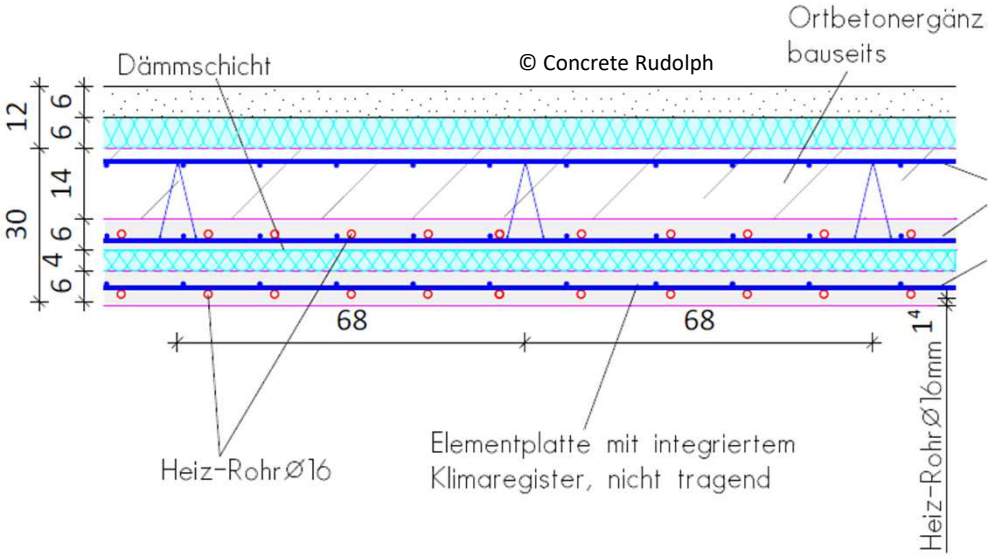
- fit maximum charge to predicted demand (180 h)

Gefördert durch:
Bundesministerium für Wirtschaft und Klimaschutz
aufgrund eines Beschlusses des Deutschen Bundestages
FKZ: 03ET1612A
FKZ: 03EN6013A

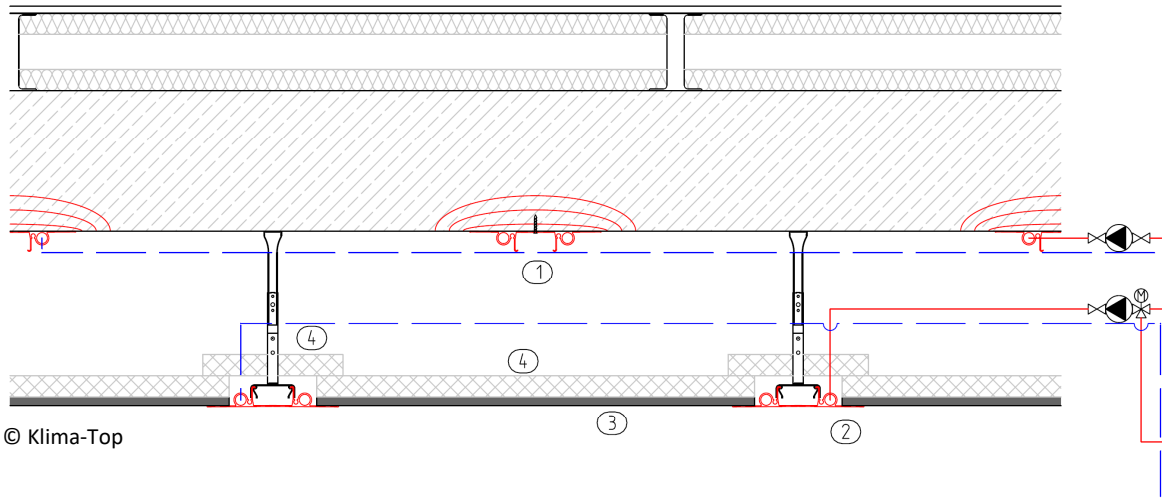
Storage

Insulated TABS

new building / retrofit



© Concrete Rudolph



© Klima-Top

Gefördert durch:
Bundesministerium für Wirtschaft und Klimaschutz
aufgrund eines Beschlusses des Deutschen Bundestages
FKZ: 03ET1612A
FKZ: 03EN6013A

Fraunhofer IBP

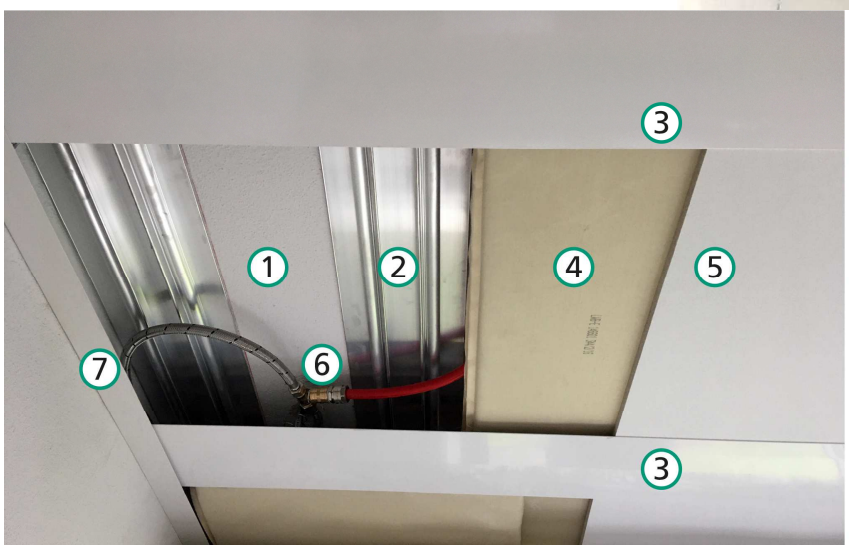
Storage – Lab measurements

Insulated TABS

new building / retrofit

© Fraunhofer IBP

© Fraunhofer IBP



1) Existing concrete ceiling
2) BCA loading profile
3) Profiles for active discharging
4) Calostat insulation panel with glass fiber lining
5) Supporting plate
6) Hydraulc coupling for media supply
7) Marginal profile as cavity seal

© Fraunhofer IBP

Gefördert durch:
Bundesministerium für Wirtschaft und Klimaschutz
aufgrund eines Beschlusses des Deutschen Bundestages
FKZ: 03ET1612A
FKZ: 03EN6013A

Fraunhofer IBP

Storage – in situ measurements

Insulated TABS

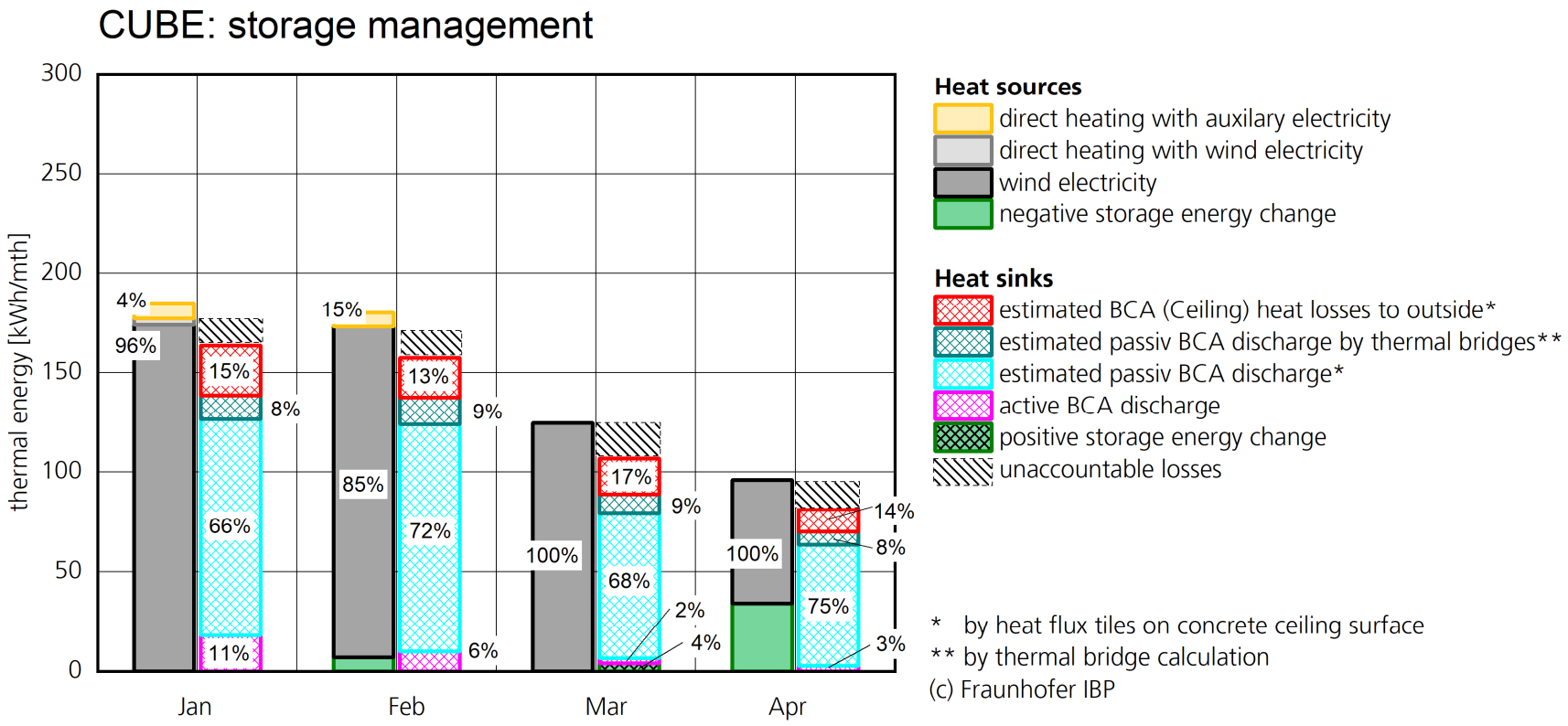
new building / retrofit

Gefördert durch:
Bundesministerium für Wirtschaft und Klimaschutz
aufgrund eines Beschlusses des Deutschen Bundestages
FKZ: 03ET1612A
FKZ: 03EN6013A

Fraunhofer IBP

Measurement results

Charging power



* by heat flux tiles on concrete ceiling surface
** by thermal bridge calculation
(c) Fraunhofer IBP

Gefördert durch:
Bundesministerium für Wirtschaft und Klimaschutz
aufgrund eines Beschlusses des Deutschen Bundestages
FKZ: 03ET1612A
FKZ: 03EN6013A

KPI of Windheizung 2.0

avoid
grid stress

avoid
redispatches

low / negative
power prices

cheaper than
GEG 2020

> 200 - 400
€ / m² (25 a)

> 7 - 16
kg CO_2 / (m²a)

Kat II acc.
DIN EN 15251

KPI

grid friendly

market friendly

economic

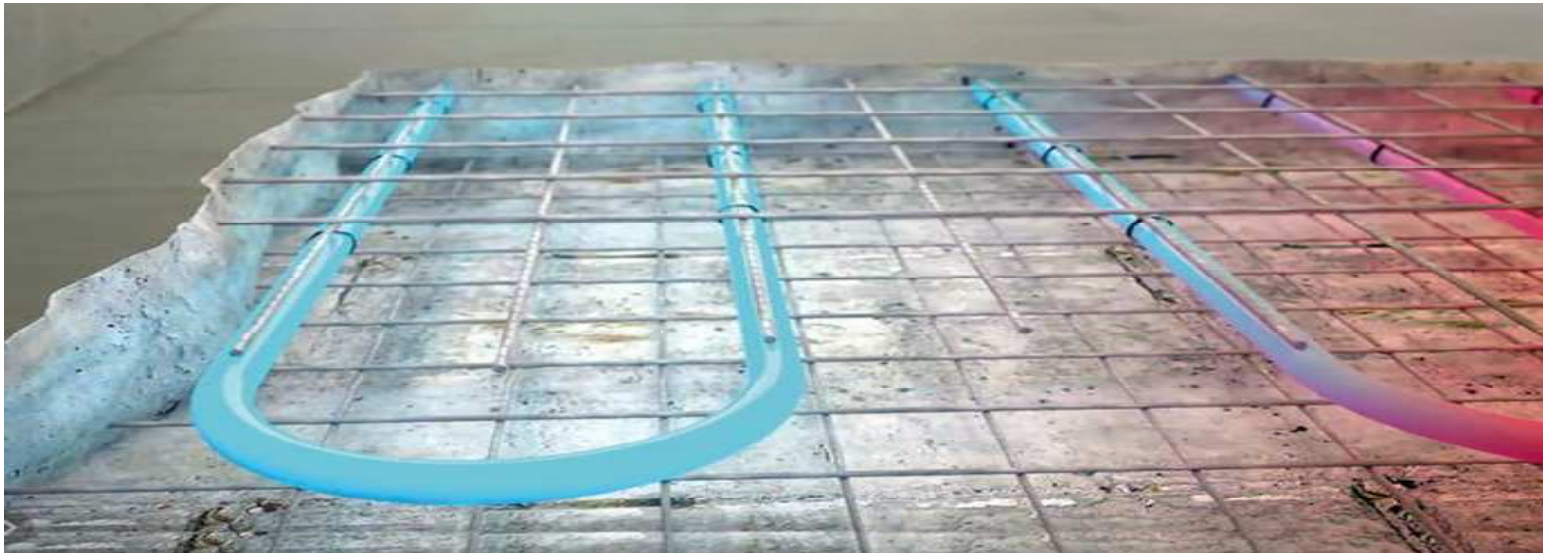
sustainable

comfortable

Gefördert durch:
Bundesministerium für Wirtschaft und Klimaschutz
aufgrund eines Beschlusses des Deutschen Bundestages
FKZ: 03ET1612A
FKZ: 03EN6013A

Dr.-Ing. Matthias Kersken
Fraunhofer Institute for Building Physics IBP
Fraunhoferstrasse 10
83626 Valley/Oberlaindern
Germany

+49 (0)8024 643 204
matthias.kersken@ibp.fraunhofer.de



Standardized use of building mass as storage for renewables and grid flexibility

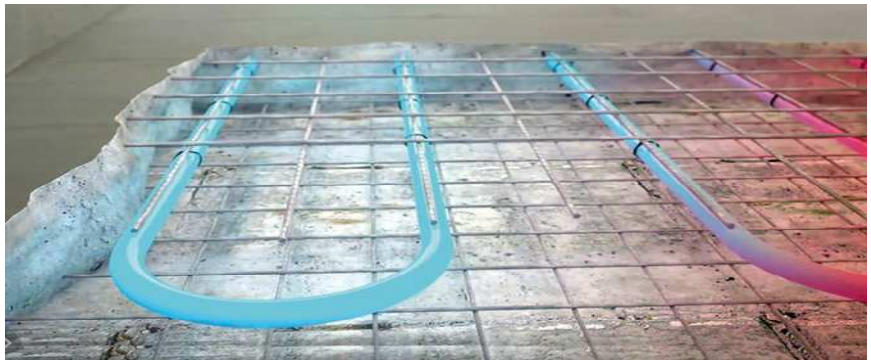
IEA ES Task 43

Christoph Rohringer, John Grunewald, Daniel Muschick, Alireza Afshari, Joscha Reber

Thermal building mass storage – the technology

Thermal component activation ... refers to systems that use the building masses to **regulate temperature**. These systems are used for the sole or supplementary **cooling** of a building and, to a lesser extent, in some cases also for **heating**[1].

→ This allows also for the use of the building masses as abundantly available energy storage



Source: AEE INTEC

[1]Wikipedia page on thermal building mass activation, 23.11.2021

Task structure - Subtasks

AEE INTEC

energy storage
IEA Technology Collaboration Programme

iea

EBC
Energy in Buildings and Communities Programme

Annex 82
Annex 84

Subtask A
Construction & Materials

Subtask B
System Integration & Control

Subtask C
Non-technical Challenges

Scientifically oriented

KPIs and boundary conditions

Research findings

Subtask D
Standardisation and KPIs

Towards generalization and market interaction

ISEC, 10. April 2024

Thermal Component Activation –
Research and Monitoring Projects in Austria

VEREINIGUNG DER ÖSTERREICHISCHEN ZEMENTINDUSTRIE www.zement.at Claudia DANKL | Zement und Beton / VÖZ

Is this the world's cheapest battery?

© Aichinger Hoch- und Tiefbau GmbH

Water temperature in the pipe registers:

Winter (heating) → 24 to 28°C
Summer (cooling) → 20 to 23°C

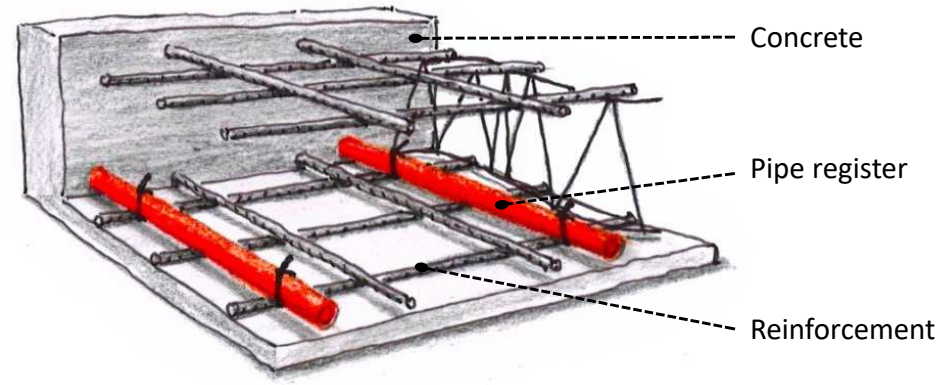
Thermal Component Activation

WHY CONCRETE ?

- high thermal conductivity
- high specific weight of 2,400 kg/m^3

WHY FLOOR CEILING ?

- excellent cooling
- excellent radiation exchange



Simulation room **2011**

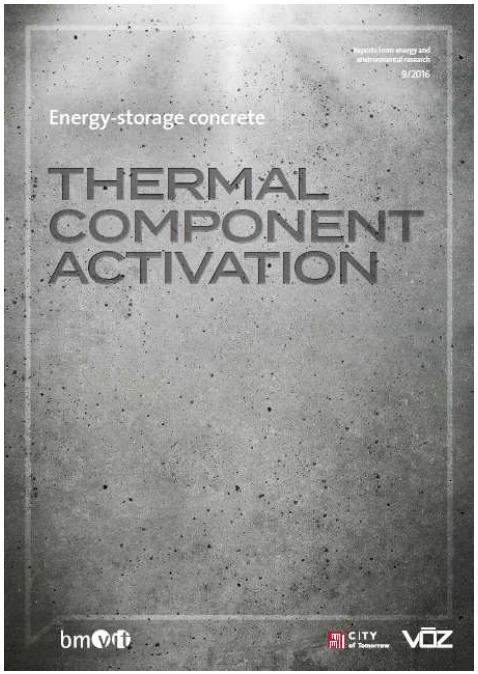
Haus H **2016**

MGG[22] **2020**

10 years

Research → Practice

Planning Guide
Single family and terraced houses

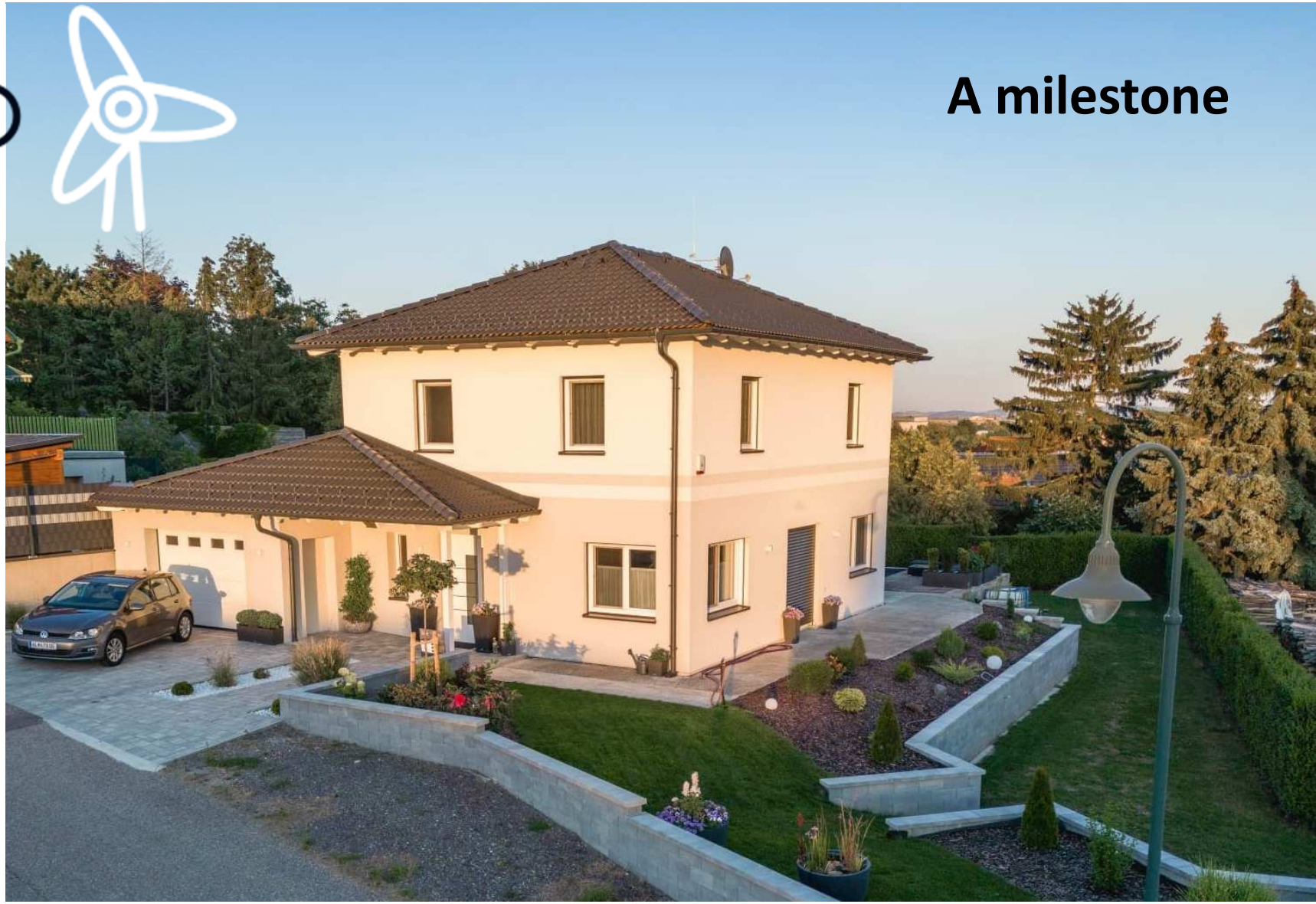


- Editor BMVIT STADT der Zukunft
- 5,000 books (120 pages) printed
- Basis for training and further education
- Calculation examples

Free download

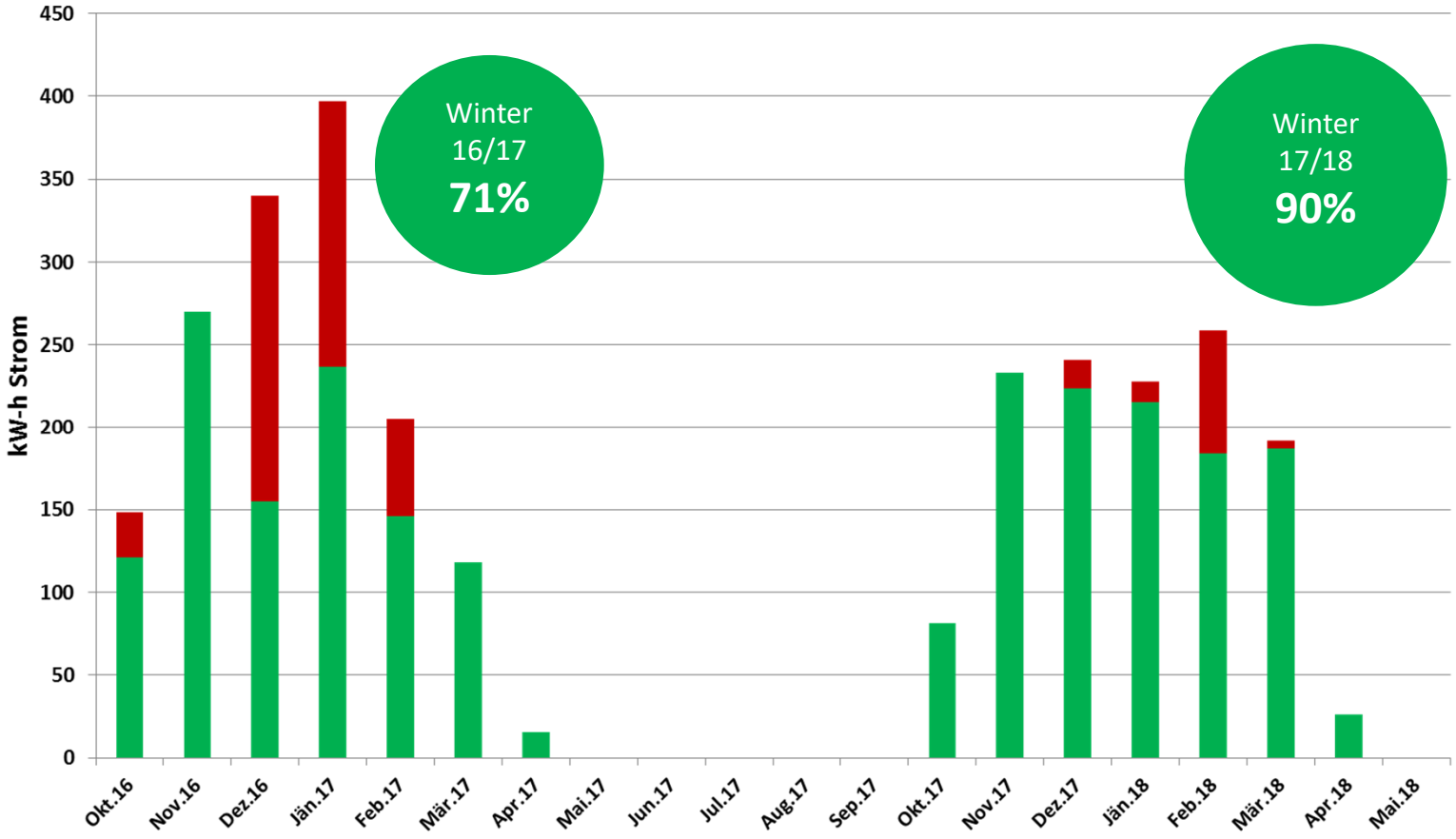
www.zement.at/services/publikationen/energiespeicher-beton
https://nachhaltigwirtschaften.at/de/sdz/publikationen/planungsleitfaden-energiespeicher-beton_broschuere.php

A milestone



Single family home
near Vienna

Beton speichert überschüssigen Windstrom



Share of excess wind energy (green) for the heat pump for TABs

TABs enables the use of renewably electricity for the heat pump

Source: S. Spaun, VÖZ

Monitoringprojekt „Gebäude als Speicher“, Stadt der Zukunft
https://nachhaltigwirtschaften.at/resources/sdz_pdf/schriftenreihe-2019-13-gebaeude-speicher.pdf

Heating + cooling with TABs in multifamily building in Vienna for the first time

MGG22: Mühlgrundgasse

© Norbert Mayr

© Zement+Beton/Kromus

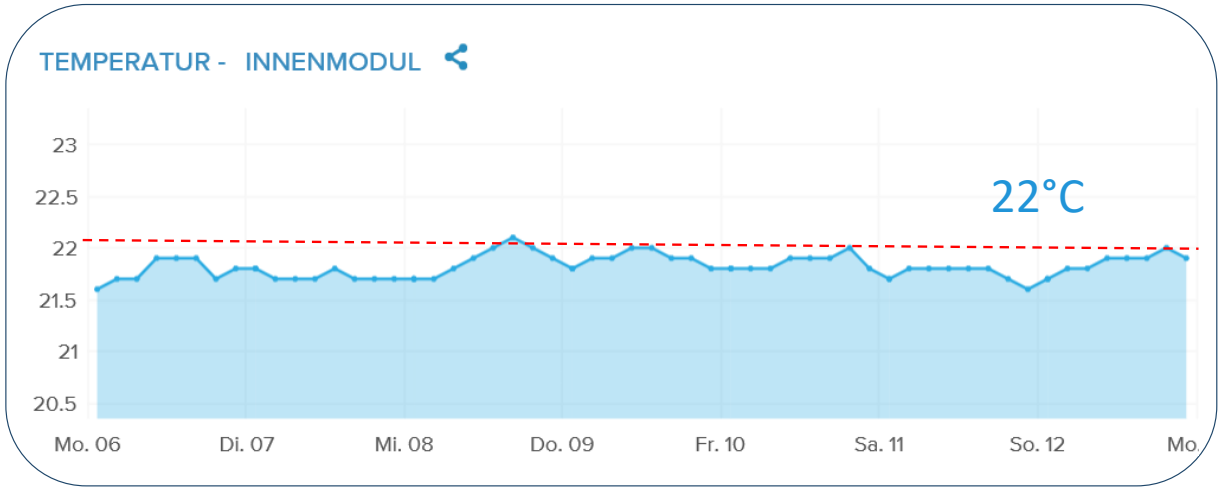
Thermal component activation + heat pump + wind (excess) energy

Heatwave in the demo flat MGG22, Vienna

Outdoor temperature
„heat wave“

6. – 13. July 2020

Indoor temperature



0 Aktuellere Zahlen?
; 2022-07-01T06:29:27.171

Wohnpark Wolfsbrunn in Sommerein

- 14 terraced houses and residential building (22 apartments)
- Thermal component activation for heating and cooling
- Brine-to-water heat pumps in connection with geothermal probes (70 m), use of wind excess energy with wind signal from EVN, starting October 2021
- Monitoring in cooperation with VÖZ, carried out by Dr. Klaus Kreč

PROJECT DATA Residential park Wolfsbrunn
2453 Sommerein, Wolfsbrunn

Developer:
SÜDRAUM / EBSG

Architect:
AW/Architekten

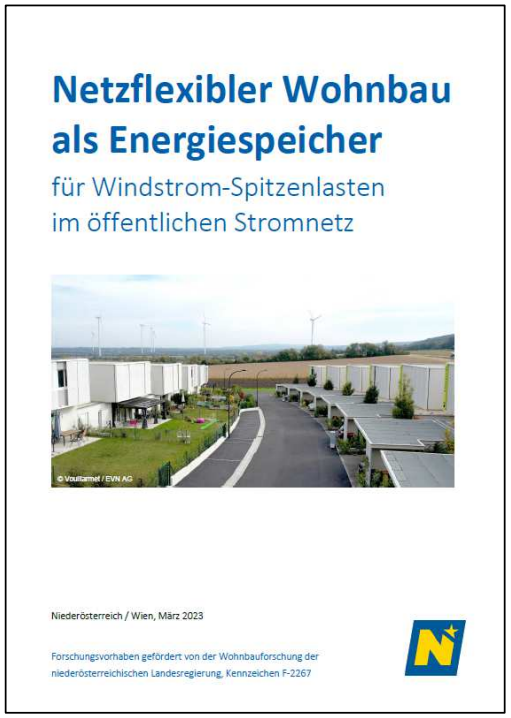
Building component activation:
FIN – Future is Now, Kuster Energielösungen GmbH, vollSOLAR GmbH

Monitoring:
Klaus Kreč, eNu, VÖZ

Eröffnung:
Fertigstellung Reihenhäuser: Herbst 2019

Generationenwohnen: Frühjahr 2020

Concrete increases the share of renewable energy



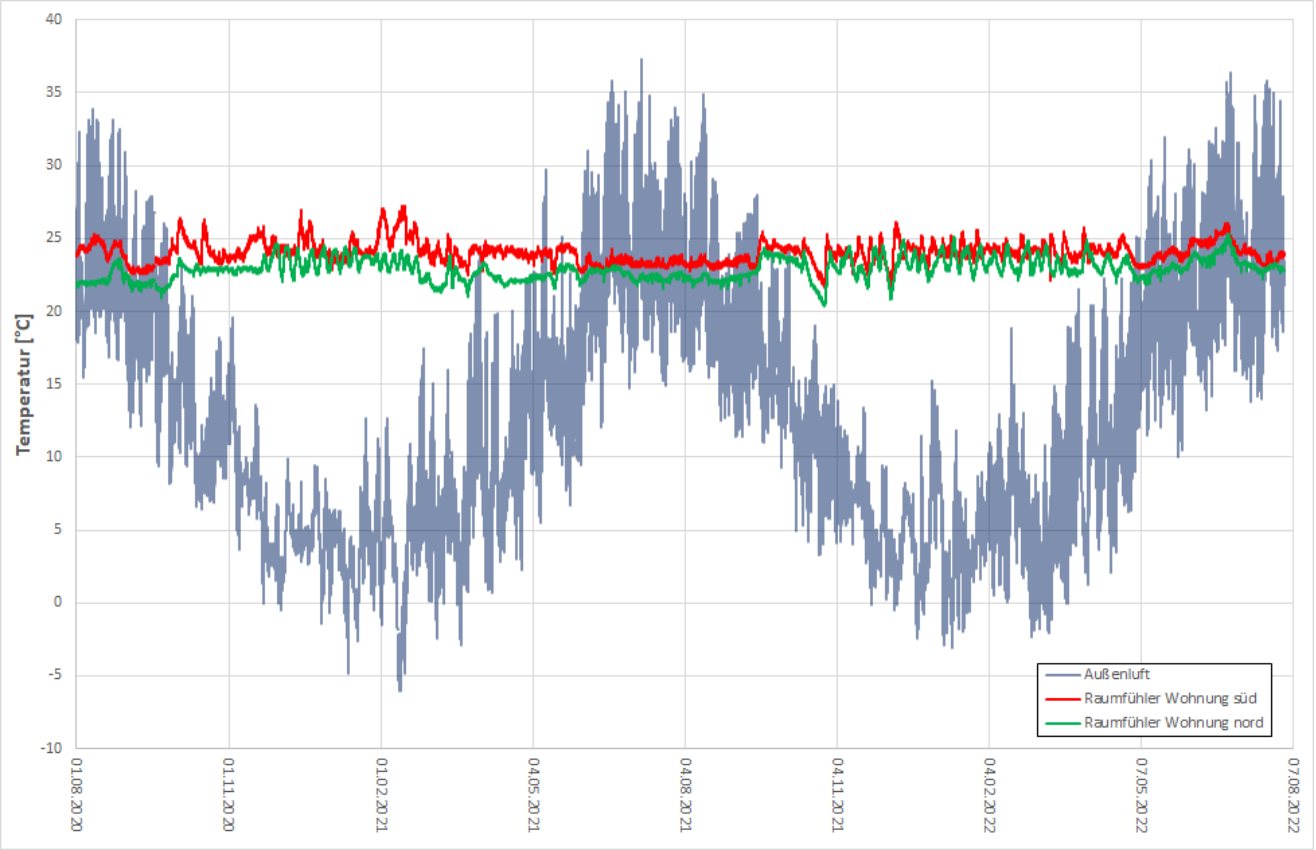
Grid-flexible housing as energy storage
for wind power peaks in the public grid

- Wind power peaks can be utilised in a targeted manner to drastically reduce heating requirements during periods of low wind (monitoring residential building from January to April 2022)
- without any noticeable influence on thermal comfort!
- Control according to the wind signal must be considered in planning of building services from the beginning (residential building ⟷ terraced houses!)

Website NÖ Wohnbauforschung, Projekt 2267
https://www.noe.gv.at/noe/Wohnen-Leben/ENDBERICHT.pdf

Monitoring Sommerein – Thermal Comfort

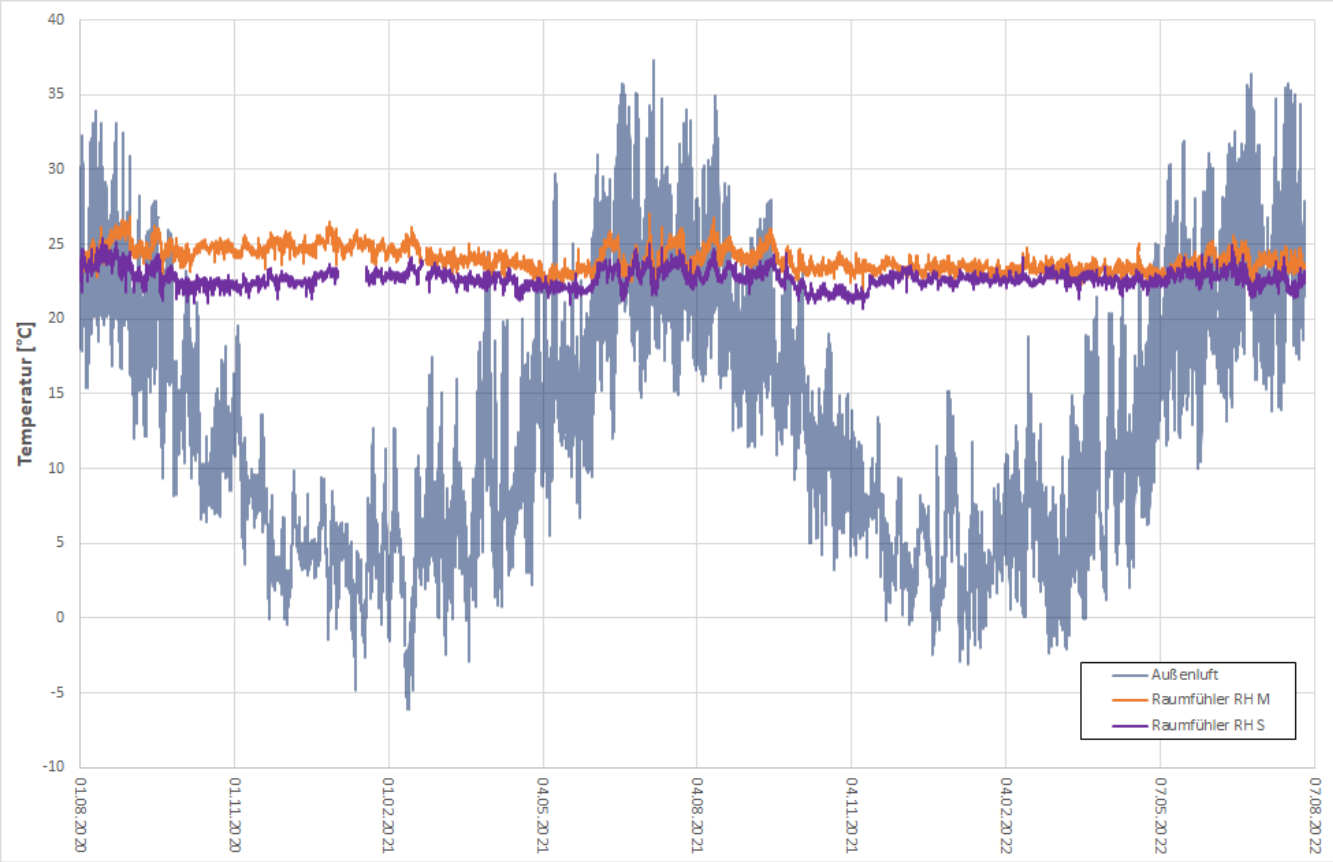
Room temperatures in the **residential building** / two apartments, facing North and South



Quelle: Klaus Kreč

Monitoring Sommerein – Thermal Comfort

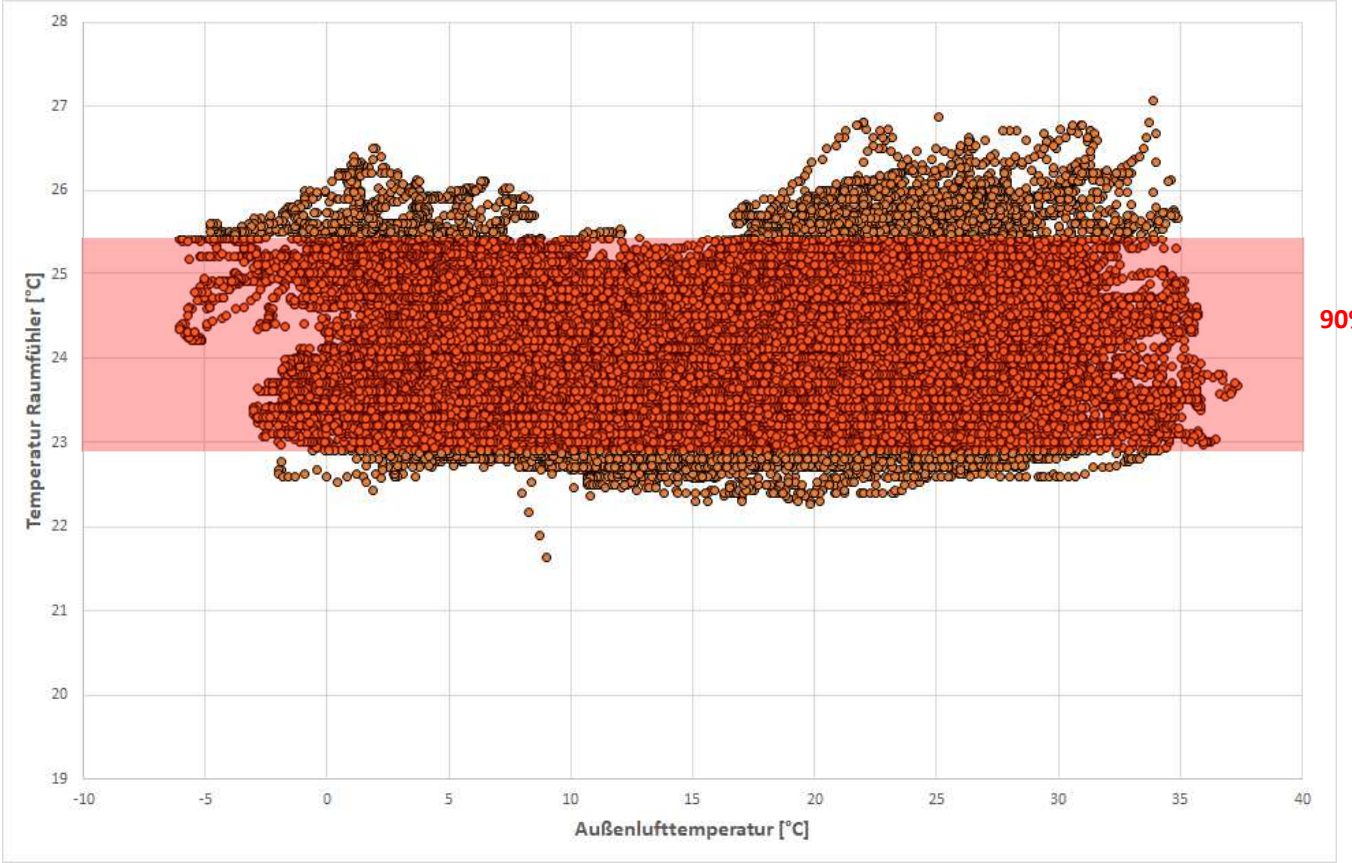
Room temperatures **in the terraced houses /** RH_M und RH_S



Quelle: Klaus Kreč

Monitoring Sommerein – Thermal Comfort

Room temperatures / Outdoor temperature, terraced house RH_M

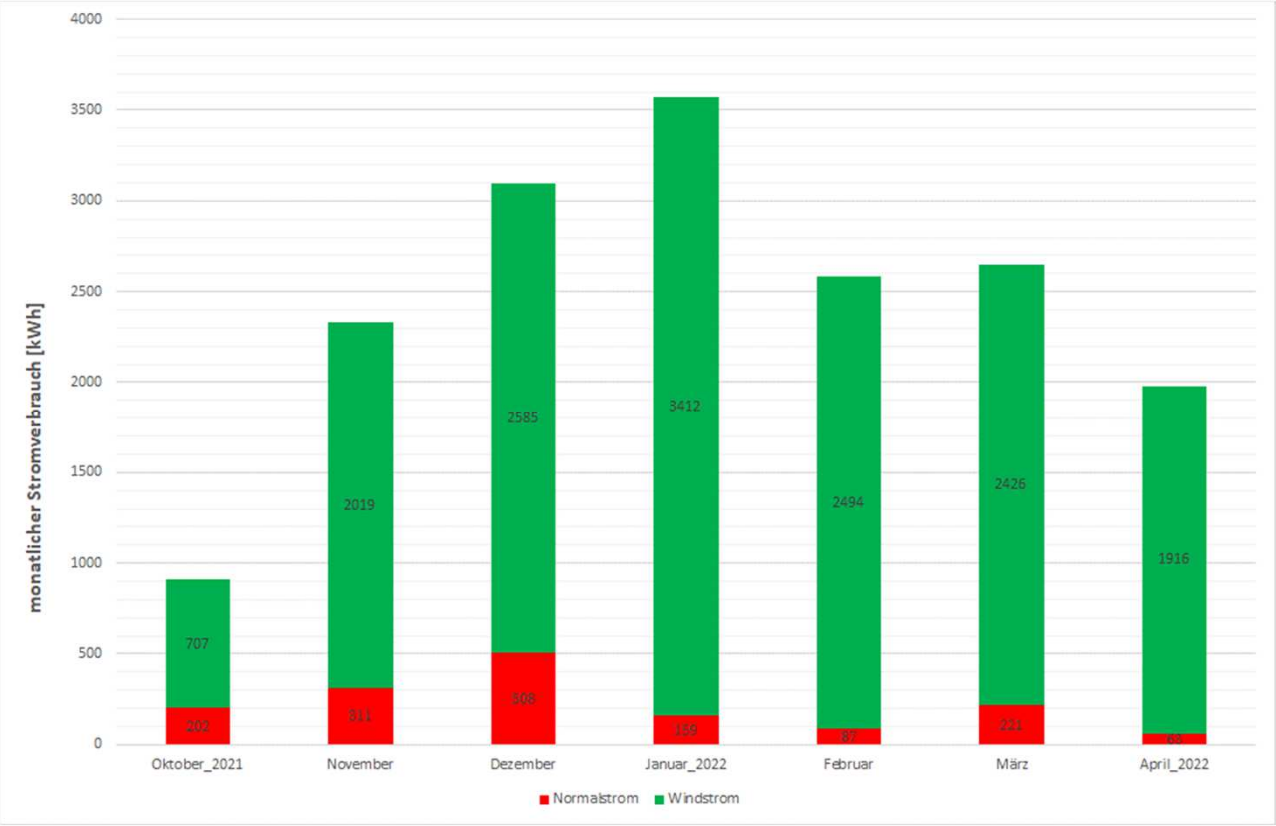


90% of all measured data

Quelle: Klaus Kreč

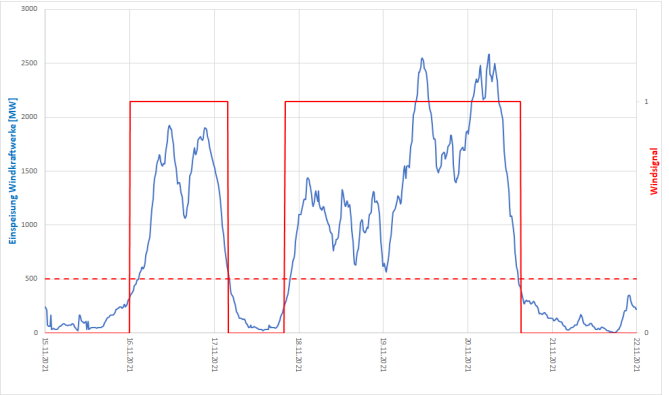
Energy flexible residential building for storage

Power consumption of the heat pump of the residential building with control according to wind signal



Quelle: Klaus Kreč

Comparison of power generation of wind power plants and wind signal (red), week 46 / 2021



Specifications for wind signal:

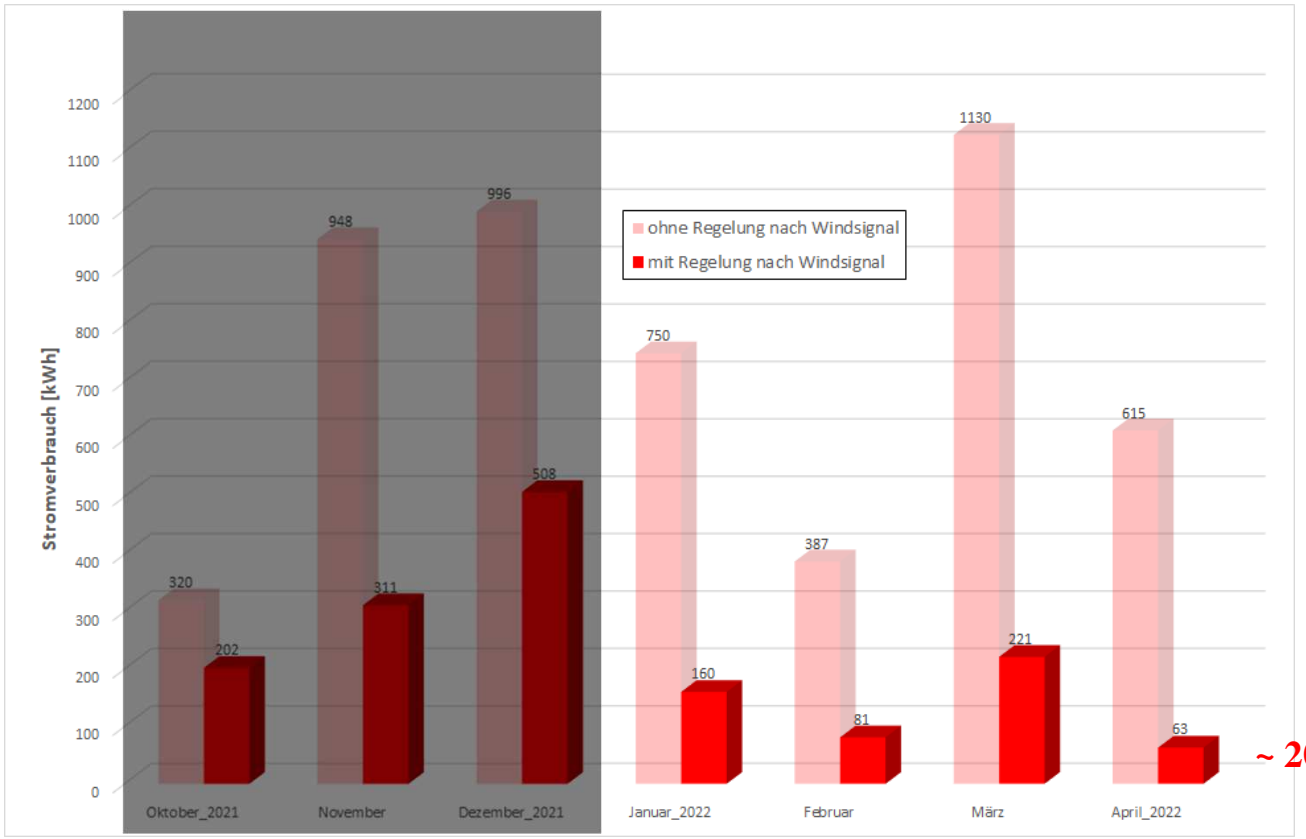
based on a test phase in spring 2021, signal should not last less than 1 hour

Switch on when the feed-in of wind power plants into the Austrian Power Grid (APG) control area exceeds a threshold value of 500 MW

Generation of the signal in advance, based on APG forecast

Energy flexible buildings for storing energy

Residential building: Electricity consumption of the heat pump in times without excess wind

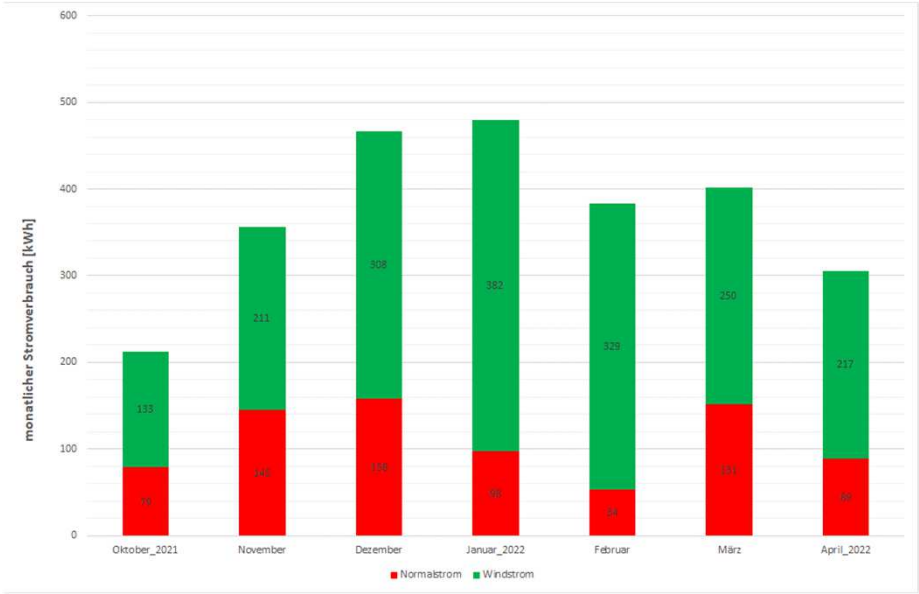


Troubles with operation of heat pump

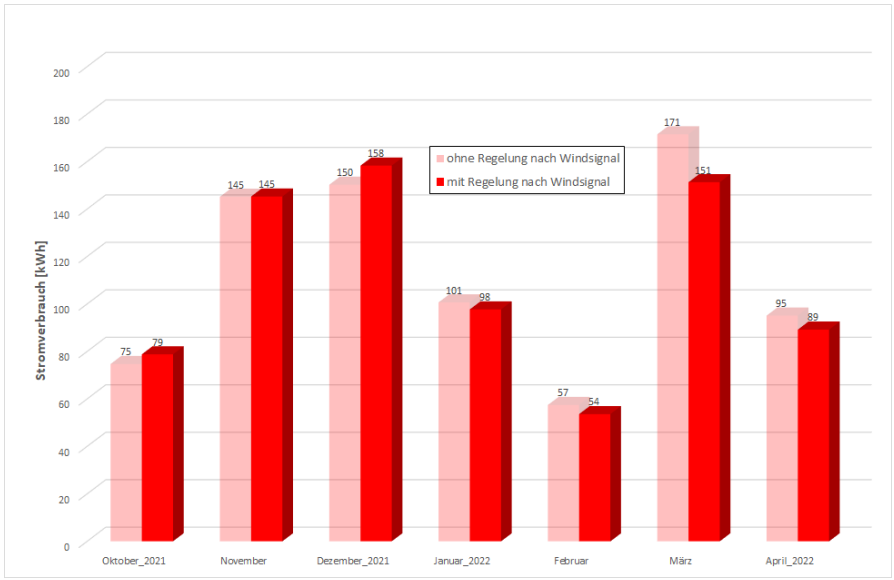
Abbildung 39

Quelle: Klaus Kreč

Terraced House RH_M: Power consumption of the heat pump, control with wind signal (heating season 2021/22)



Terraced house RH_M: Power consumption of heat pump **in times without wind excess energy**



Quelle: Klaus Kreč

Control according to wind signal does not influence power consumption during periods of low wind!

Current Research Projects

Build4Climate – demo project in Klagenfurt, Carinthia

- Thermal component activation in an office building, in combination with BIM

Hybrid LSC

- Thermal component activation as part of energy communities (Local Sustainable Communities): different demo projects, including the demo site in Sommerein

PnP controls TABs

- Plug-and-play control of heat pumps in buildings with thermally activated components

Thermally Activated Building Structures as Flexibility Option for the Electricity Market

Guntram Preßmair[1], Wolfgang Amann[2], Alina Stipsits[1],Sama Schoisengeier[1] and Florian Wenig[3]
[1] e7 energy innovation & engineering, Austria [2] IIBW, Institute for Real Estate, Construction and Housing, Austria [3] University of Applied Sciences Burgenland, Austria
Correspondence: Guntram Preßmair, guntram.pressmair@e-sieben.at

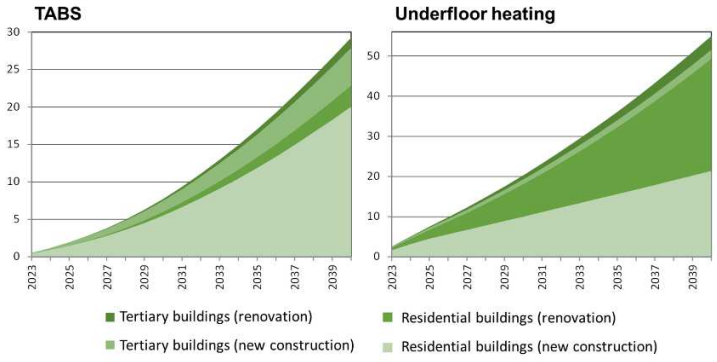


Fig. 3: Estimated cumulative development of thermally activated area by 2040 (million m²)

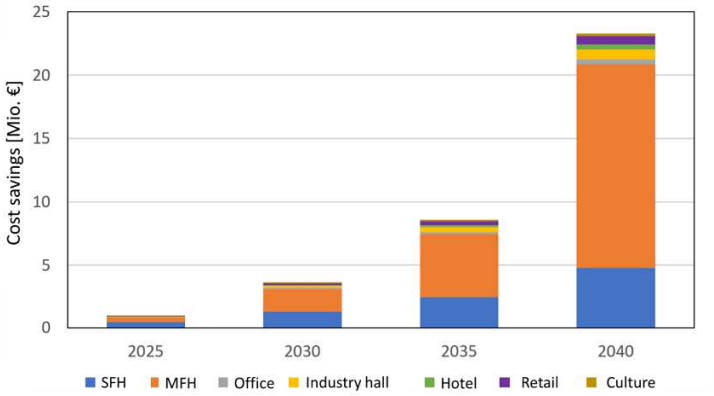


Fig. 4: Cost savings in million € in 2040 by utilising the flexibility potential of the entire thermally activated building stock, differentiated by building type

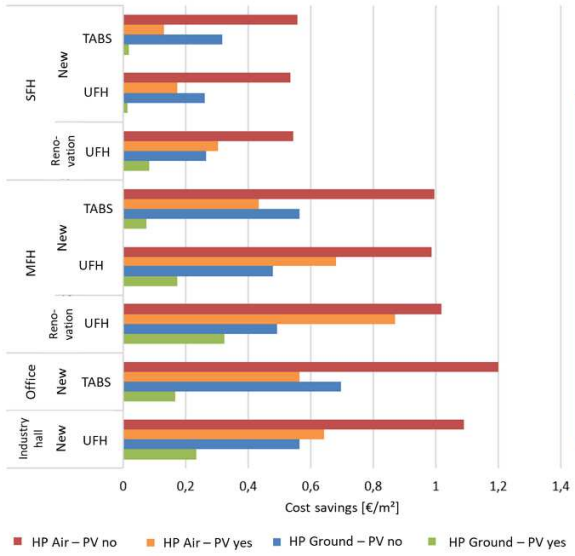


Fig. 5: Specific cost savings in €/m² in 2040 per building type

PnP Control TABS

A specific business model for using the flexibility from heat pumps in component-activated buildings is being developed in the PnP Controls research project.
The aim of the project is to design a standardised plug-and-play control strategy in which an optimisation algorithm reacts to dynamic price signals and also positive or negative flexibility calls can be made by an energy supplier. In the project, the energy supplier is a wind power producer who wants to balance its portfolio in the short term by directly controlling flexible heat pumps and thus minimise balancing energy costs.

Fig. 6: PnP Control TABS (Source: Green energy Lab)

*The work published in this paper has been financially supported by the Austrian Research Promotion Agency (FFG) through the study "**Bewertung der Bauteilaktivierung als Option für Flexibilität im Strommarkt**" and the project **PnP Control TABS**. The knowledge gained is disseminated to international stakeholders through active participation in the technology collaboration programme **IEA ES Task 43 - Standardized use of building mass as storage for renewables and grid flexibility**.*

Thank you for your attention!

Claudia DANKL

Vereinigung der Österreichischen Zementindustrie / Association of the Austrian Cement Industry

1030 Wien, Franz-Grill-Straße 9

T: +43 1 714 66 85 – 63

E: dankl@zement.at

W: www.zement.at

Member of acr austrian cooperative research