

# IEA EBC Annex 84

## **Demand management of buildings in thermal networks (DHC systems)**

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

IEA EBC Technical Day  
June 22, 2023 Copenhagen



# 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.

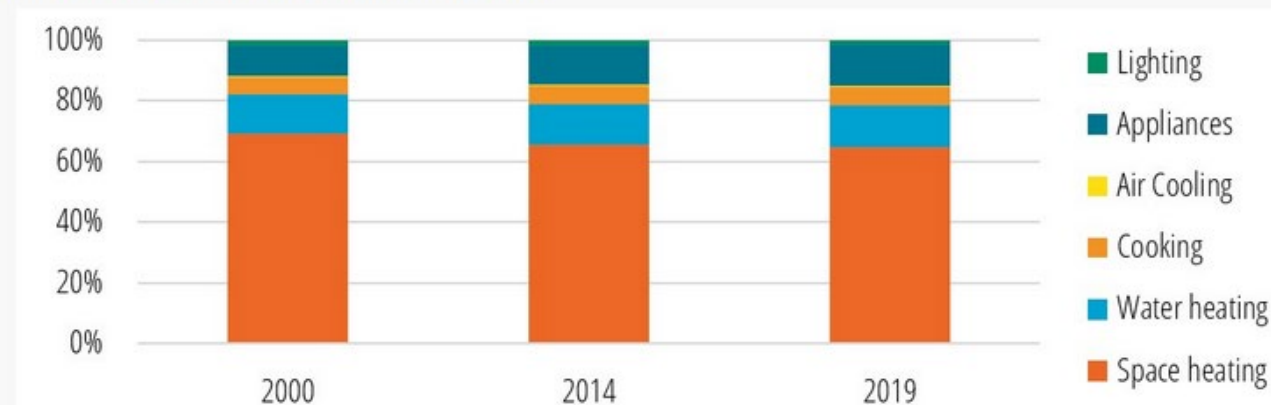
Buildings are capable of offering flexibility to the power grid by smart control of their demands. Yet, the connection point between building and utility, the impact of individual building and thereby the operational challenges of DHC systems differ from the power grids.

## 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!)

Figure 3: Household energy consumption by end-use in the EU



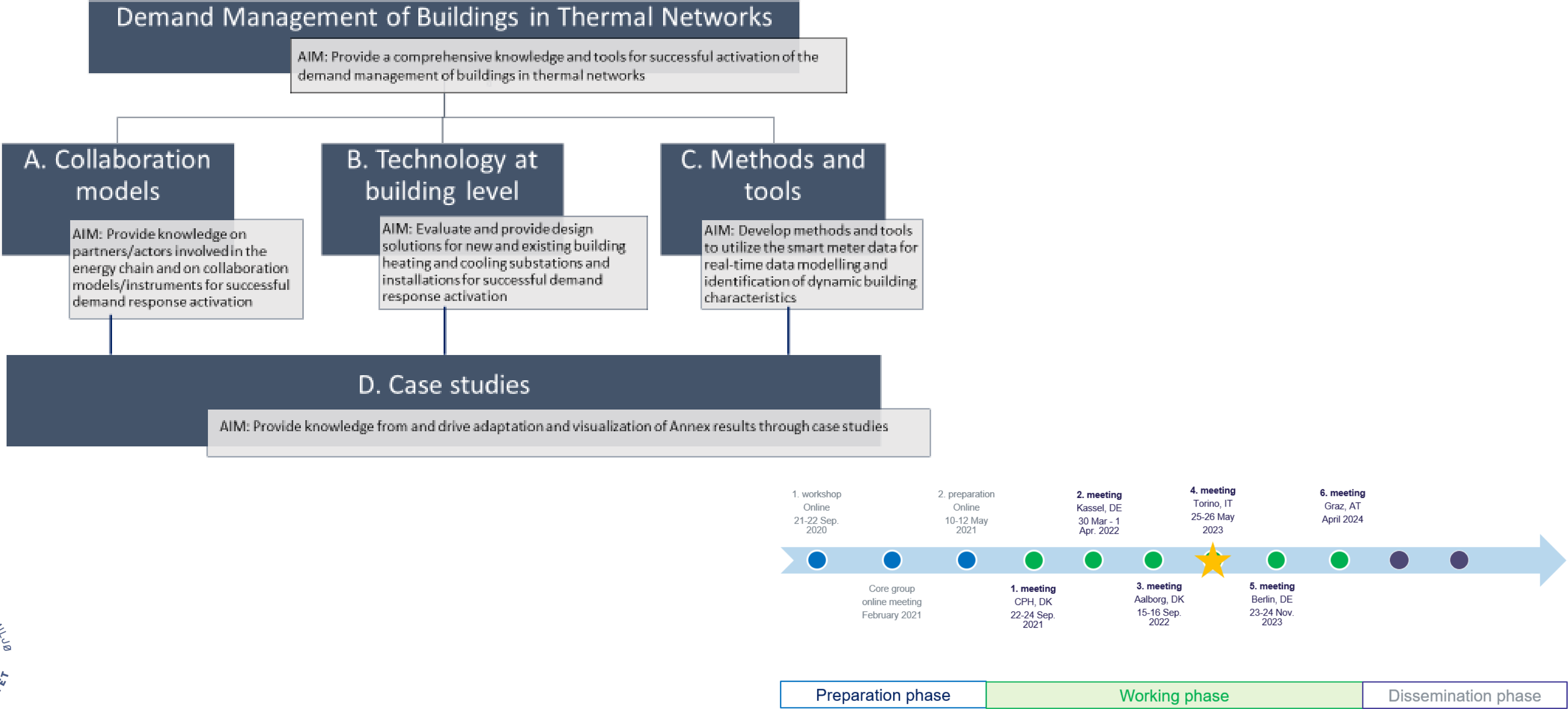
Source: Odyssee

## URBANIZATION AND MIGRATION

(a) SHARE OF THE WORLD'S POPULATION LIVING IN URBAN AREAS



# Annex84 scope & timeframe





# Participants

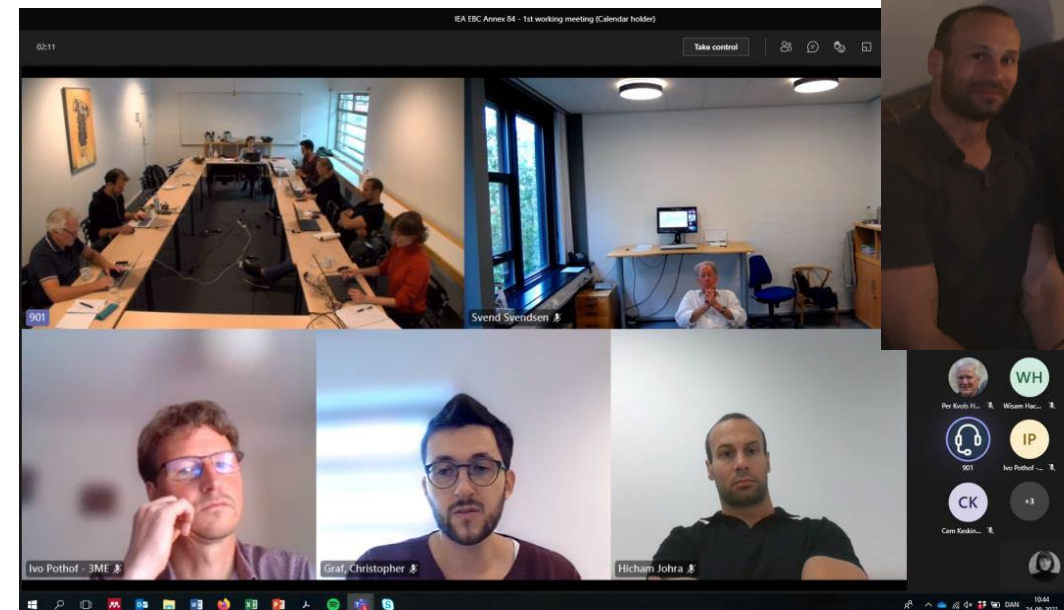
Ca 20+ participants

Academic participants with close collaboration with DHC utilities

EU domination

DH systems domination

Collaboration with DHC TCP via common workshops and meetings (Aalborg'22, Berlin'23)

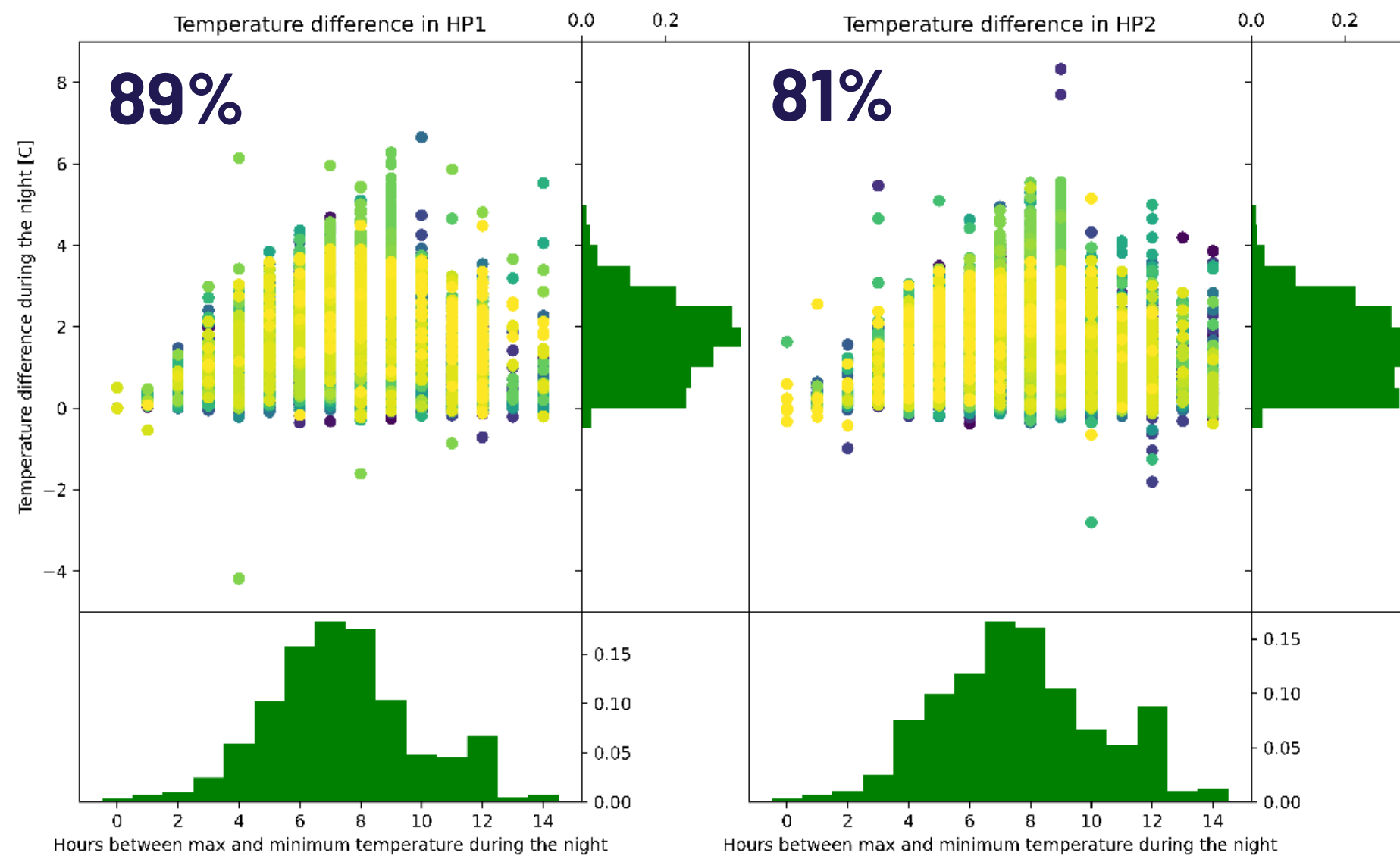




## Annex84 results

# STA collaboration models

## Do the end-users remember to activate DR?

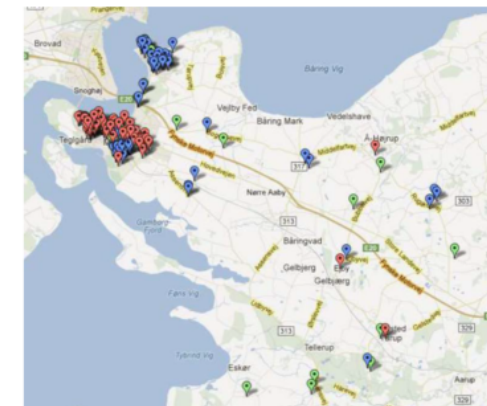


## Field study

- 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 [m <sup>2</sup> ]	Construction year
Detached house	47	1	6	<= 90	3
Town house	15	2	31	91-120	23
Row house	7	3	16	121-150	19
Farm house	2	4	9	151-180	19
Other	1	5+	10	>=181	8
<b>Total</b>	<b>72</b>		<b>72</b>	<b>72</b>	<b>72</b>




# Annex84 results

## STA collaboration models

### 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>



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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	<a href="https://www.survey-xact.dk/LinkCollector?key=8GYJLW4FUJCP">https://www.survey-xact.dk/LinkCollector?key=8GYJLW4FUJCP</a>	

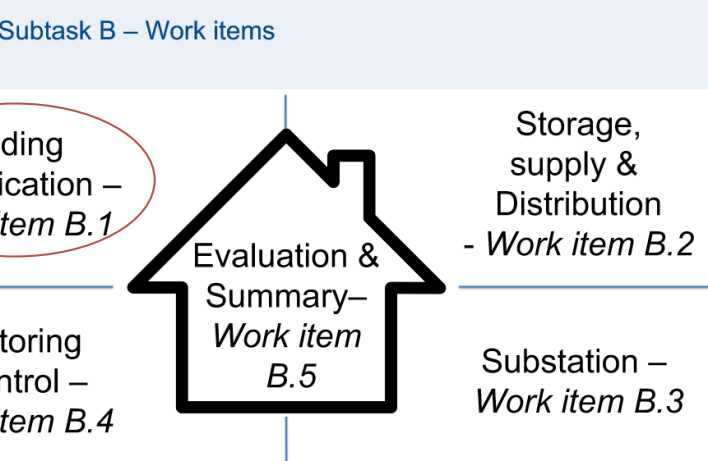
# Annex84 results

## STB hardware

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

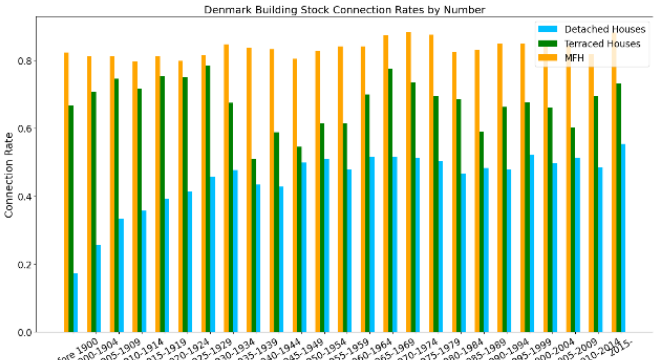
3 layers of detail:

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)

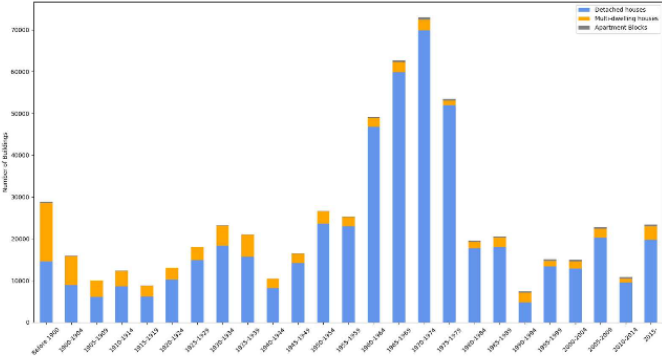


### Residential Building stock connected to DH Systems - Denmark

Connection Rates of Residential Buildings to DHN



Absolute number of residential buildings connected to DHN



- Multi-family homest (including apartment 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		Connection rate to DH networks	Heated Area Connected		Average Specific Heat Demands	Source(s)
	Construction Year	Usage*		Construction Year	Usage*		
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 hardware

### Report on DHC substations and ....

- Part 1:
- Activity 1: Collection of information on the currently most often used DHC substations (state-of-the-practice)
  - Activity 2: Definition of flexibility readiness status with differentiation between building typologies, DHC network characteristics and climate zones
- Part 2:
- Activity 3: Smart DHC substations
  - Activity 4: Integration of substations with new/smart components of DHC
  - Activity 5: Retrofitting options for existing DHC substations
  - Activity 6: Heat boosting at substations

To be published fall 2023

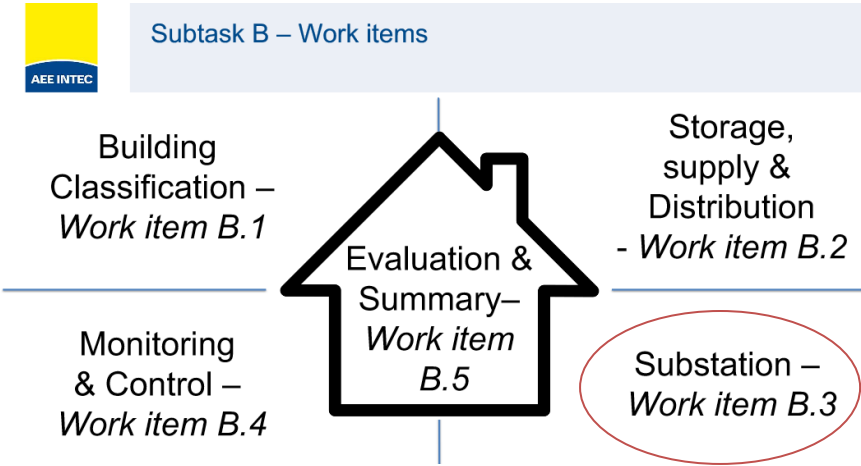


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# Annex84 results

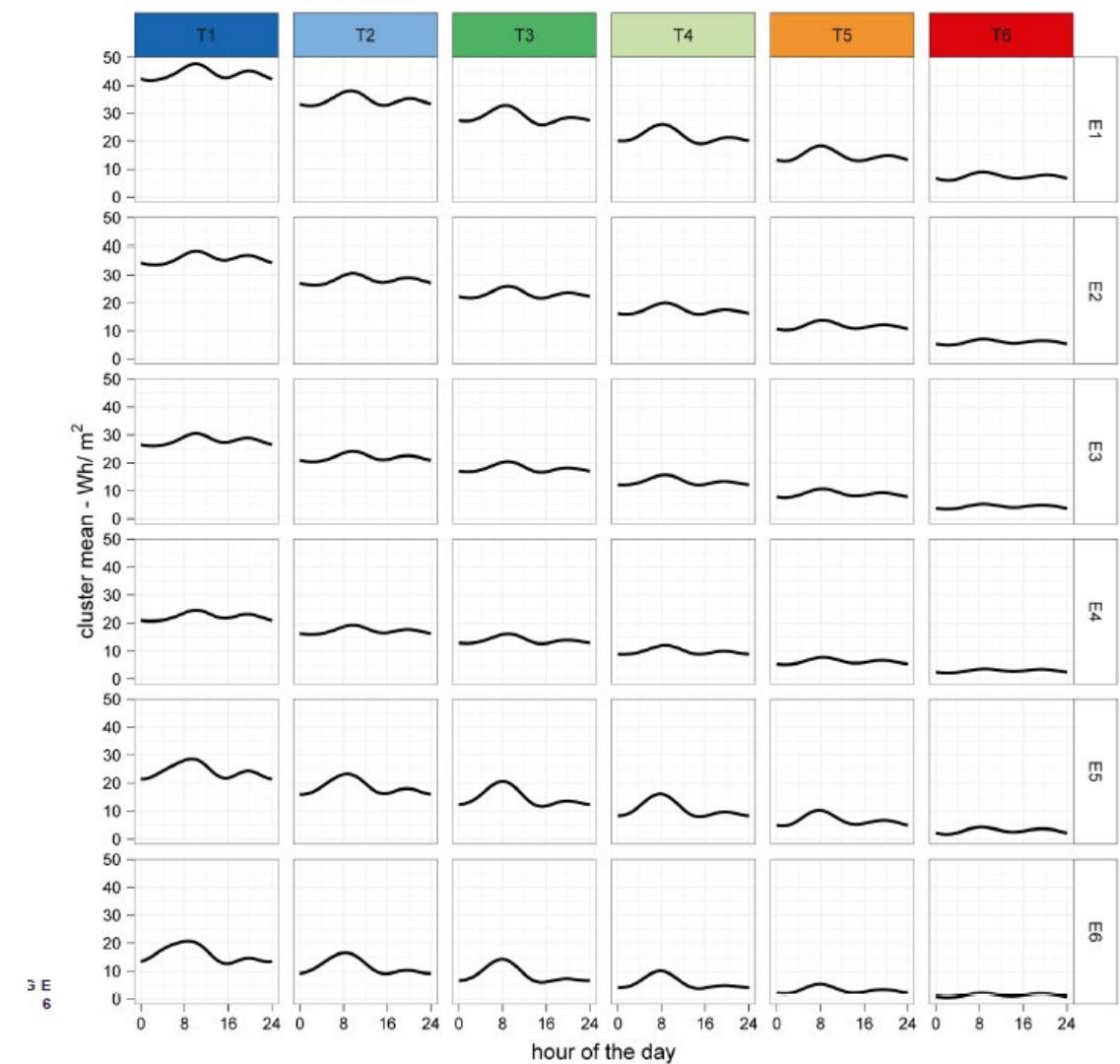
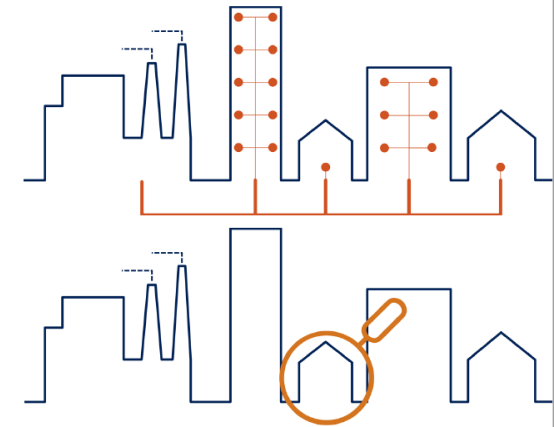
## STB software

### 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 patterns (holidays)
  - Decrease in DHW use with warmer temperatures
- E5 + E6 have a different shape from E1-E4

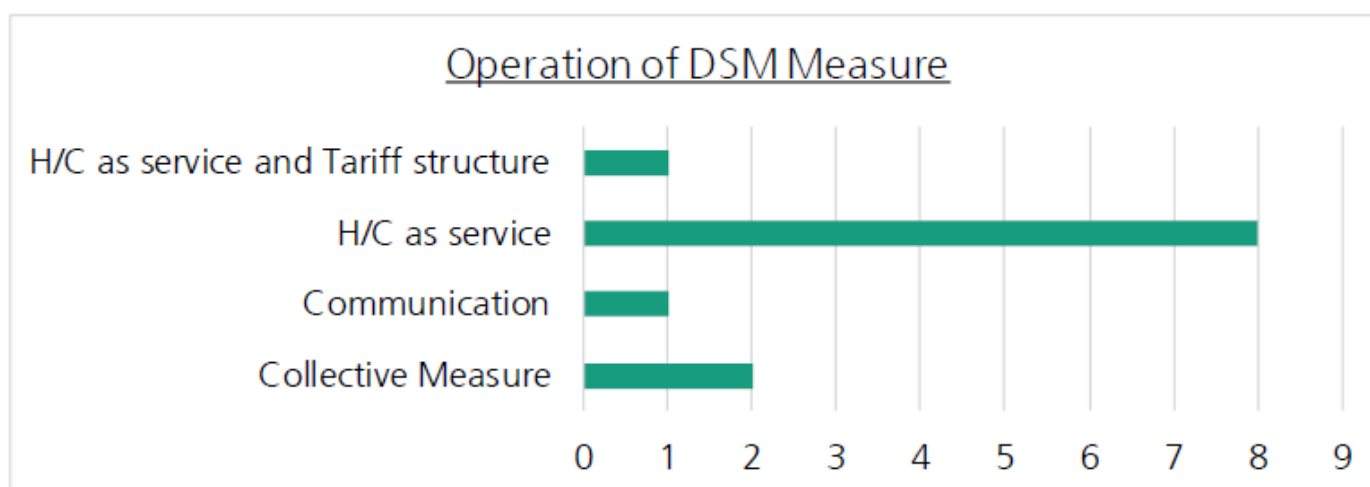
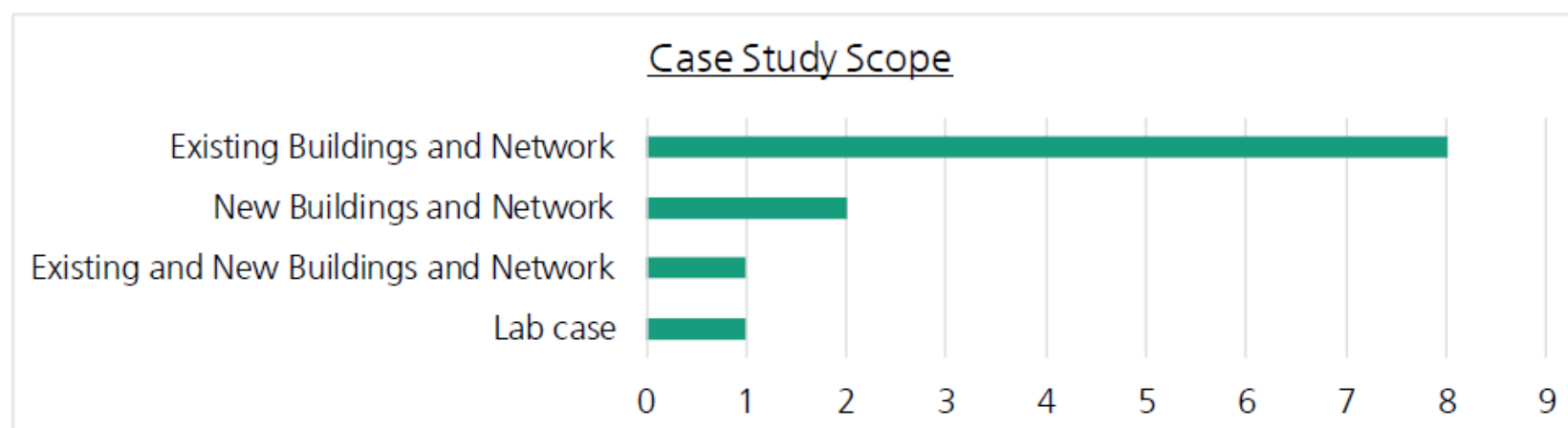
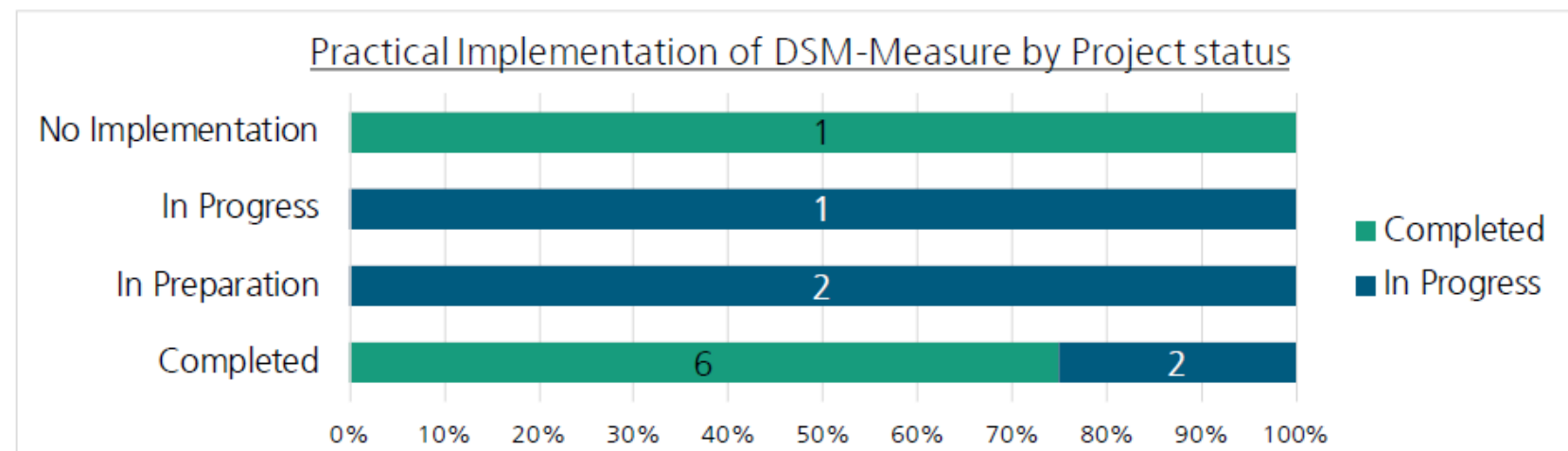
### Data

- 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

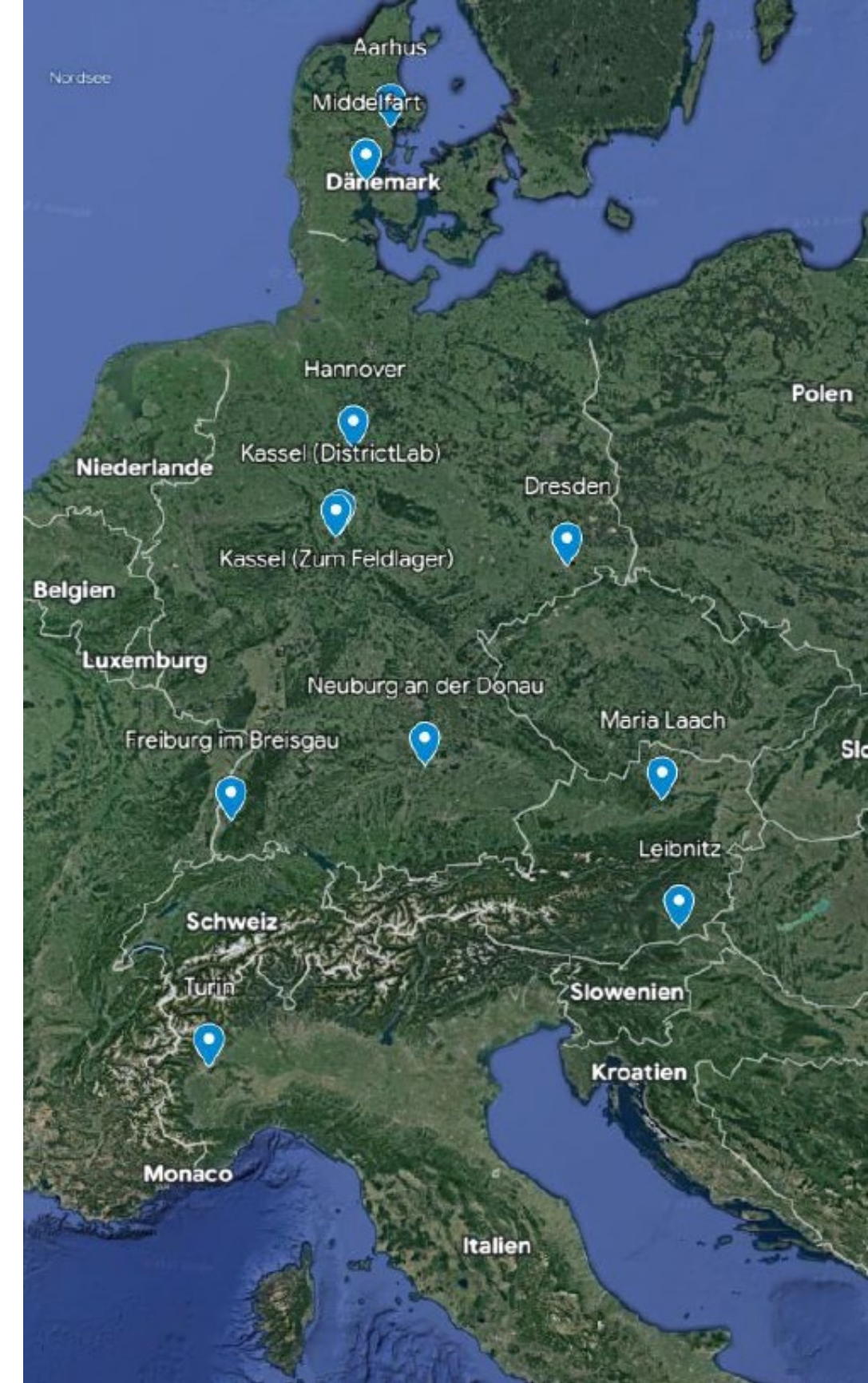


# Annex84 results

## STD 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





An aerial photograph of a cityscape featuring a river, modern residential buildings, and industrial structures in the background. Several construction cranes are visible, indicating ongoing development. The text 'THANK YOU' is overlaid in the center.

# THANK YOU

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