

# RELATIONSHIP STATUS

Single

In a Relationship

Engaged

Married

It's Complicated

In an Open Relationship



# Lessons learnt and guidelines for large-scale solar thermal and storage applications for district heating in an Austrian context

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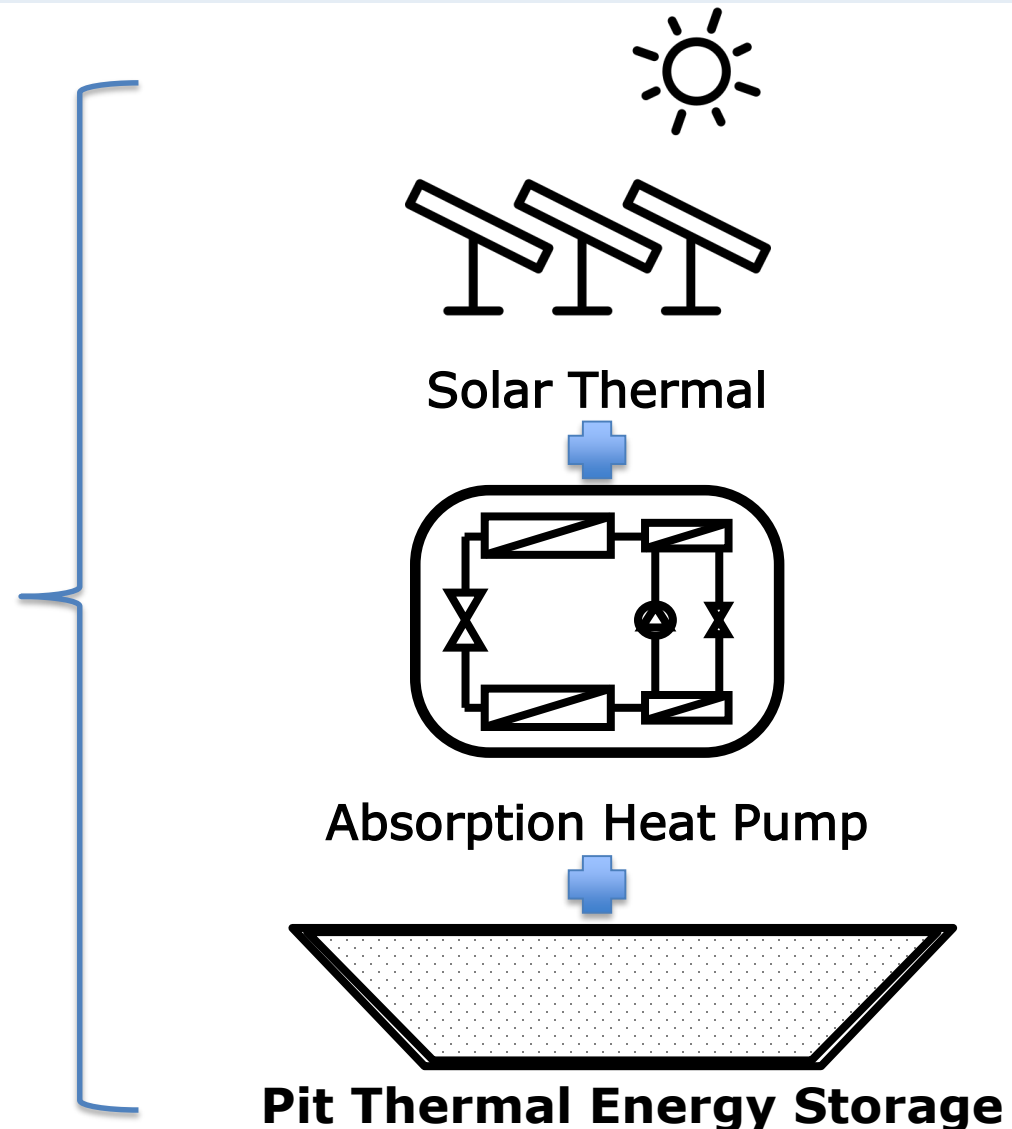
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Hermann Schranzhofer, Ingo Leusbrock,

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# Solar thermal + Pit Thermal Energy Storage + Absorption Heat Pump = sustainable DH system?



**Sustainable DH system**

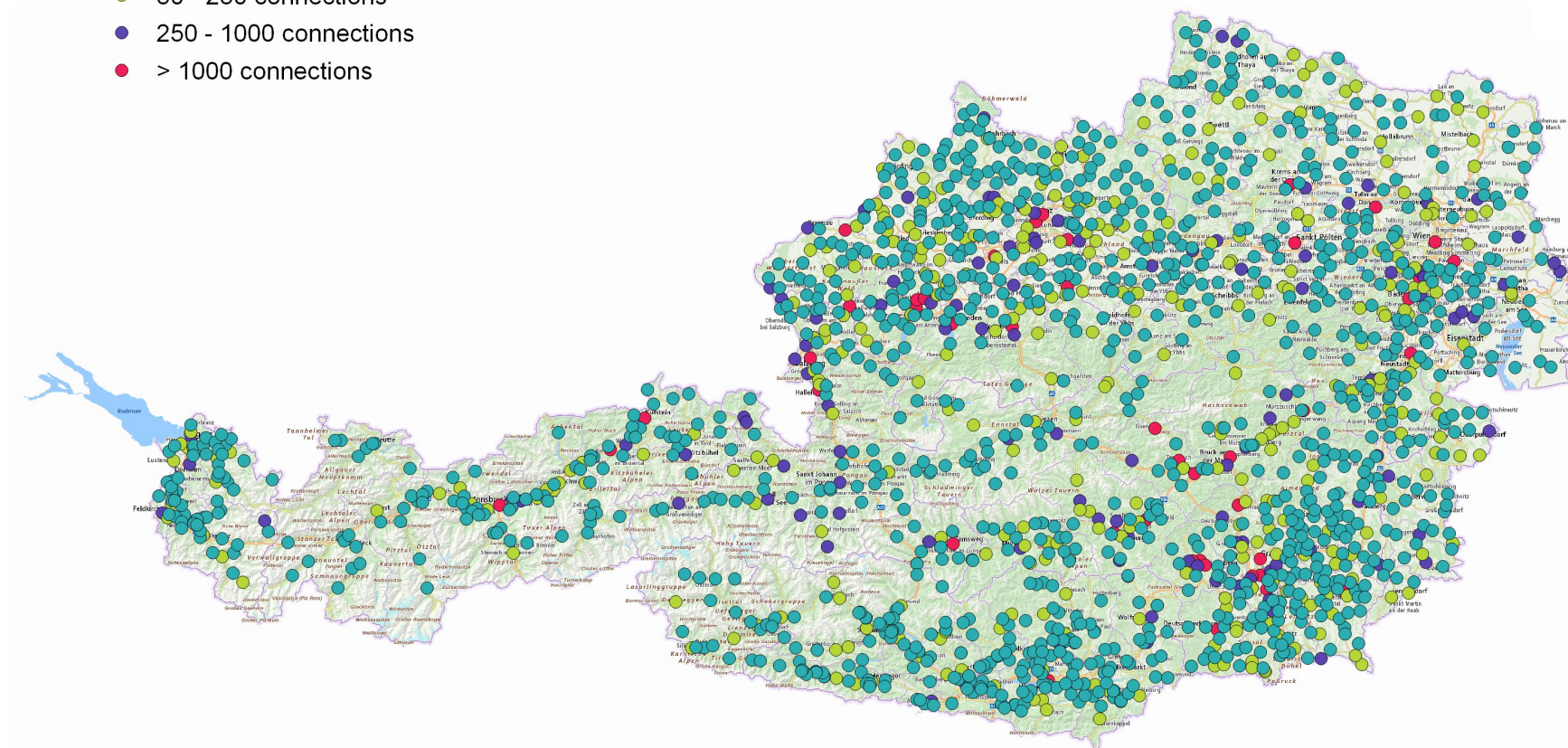


# What are the challenges for integration?

- Level of technologies? Interaction of technologies with each other?
- Integration in existing DH systems? Added value?
- Financial aspects?

# More than 3000 district heating systems in Austria

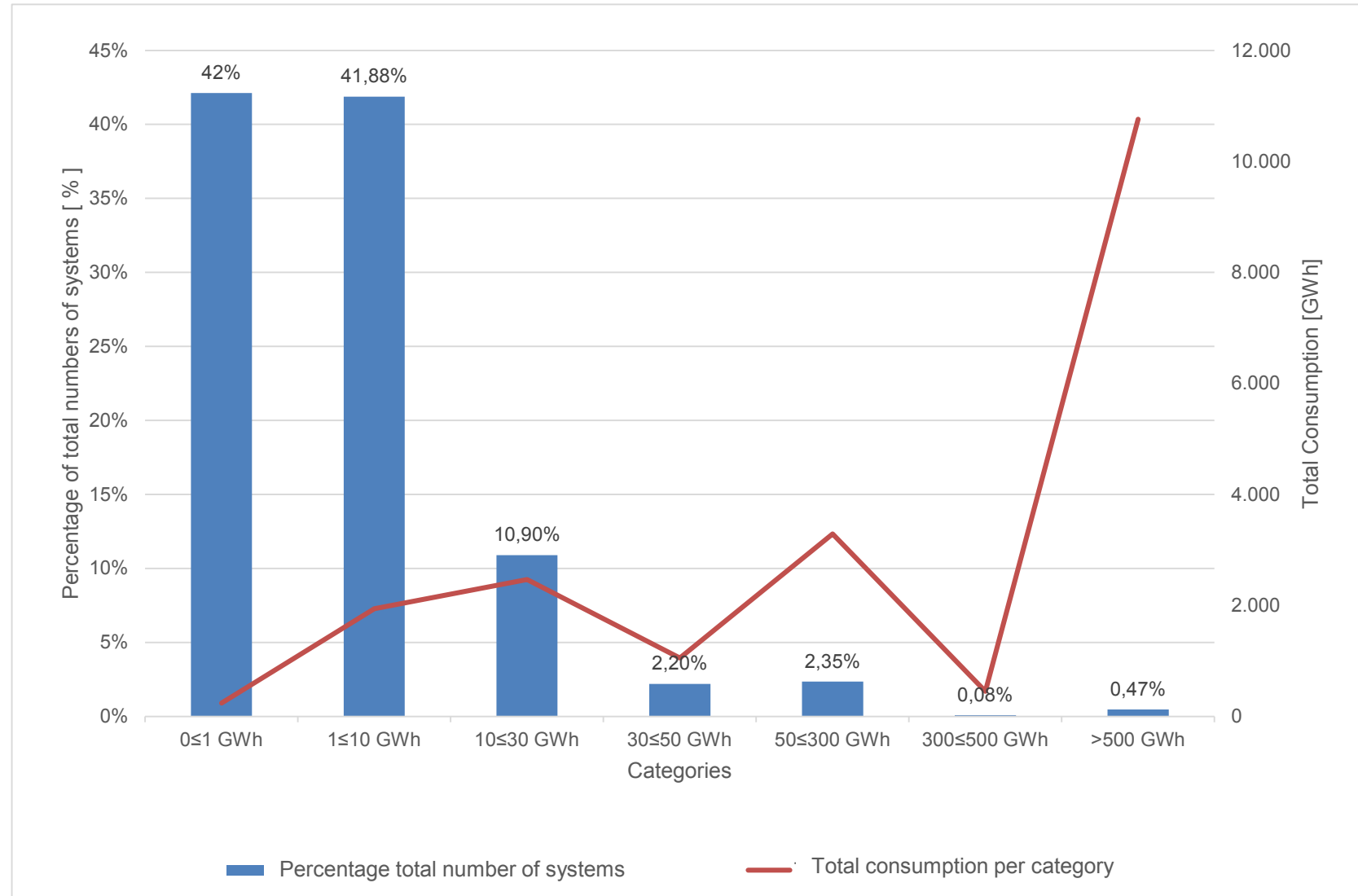
- < 50 connections
- 50 - 250 connections
- 250 - 1000 connections
- > 1000 connections



Data sources: <http://www.austrian-heatmap.gv.at>

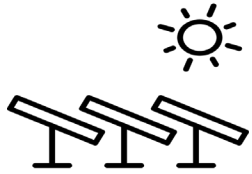
Map data © [www.openstreetmap.org](http://www.openstreetmap.org)

# Distribution of DH Networks in Austria grouped by yearly heat production



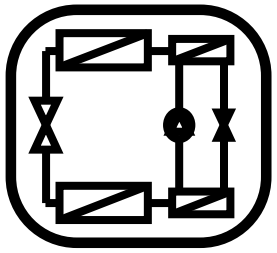


# Current level of technologies



Solar Thermal

- Solar thermal
  - Mature technology, widely available



Absorption Heat Pump

- Absorption heat pumps
  - Versatile, yet complex
  - Has strict boundary conditions
  - First applications in DH, yet no „standard“ so far



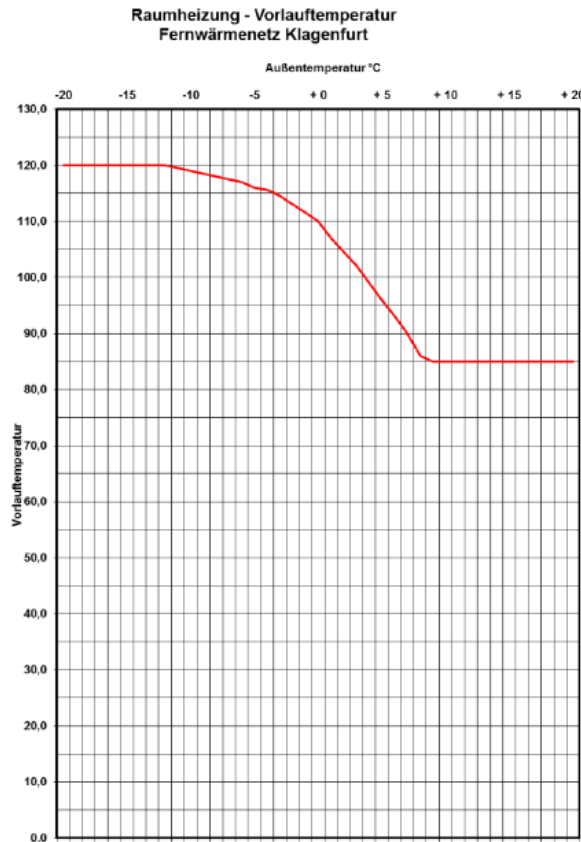
Pit Thermal  
Energy Storage

- Pit thermal energy storage
  - Promising
  - Only proven so far in Denmark

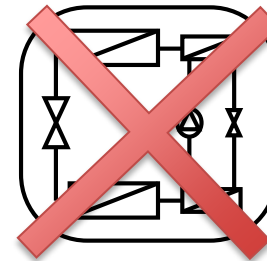


Erik Christensen [CC BY-SA]  
Reinraum [Public domain]  
Dronninglund Fjernvarme A.m.b.A

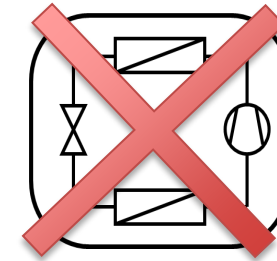
# Bottlenecks for system integration: Supply temperature in larger systems $> 100^{\circ}\text{C}$



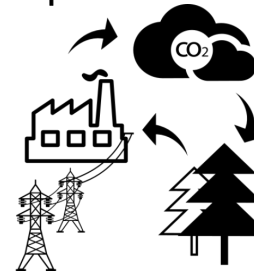
- Temperatures from solar thermal and pit storage  $< 90^{\circ}\text{C}$ 
  - Need for post-heating to reach supply temperature



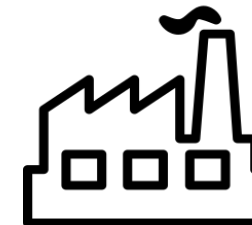
Absorption Heat Pump



Compression Heat Pump



Biomass



Gas

- Costs for post-heating?



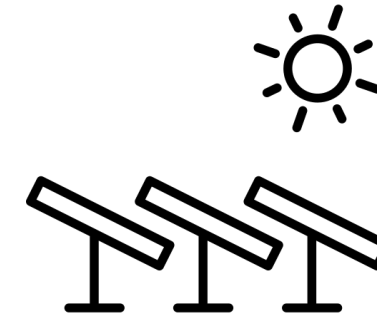
# Klagenfurt: Scenario for large-scale solar thermal and pit storage



**Klagenfurt**

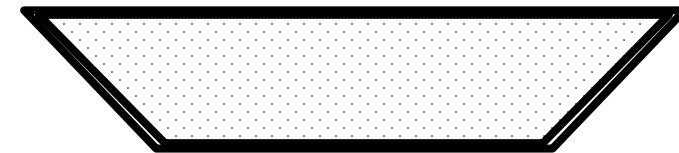
425 GWh/a

165 MW peak demand



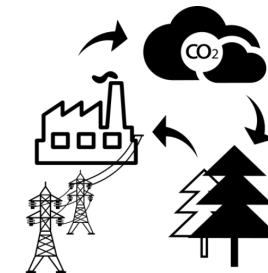
**Solar Thermal**

150000 m<sup>2</sup>



**Pit Thermal Energy Storage**

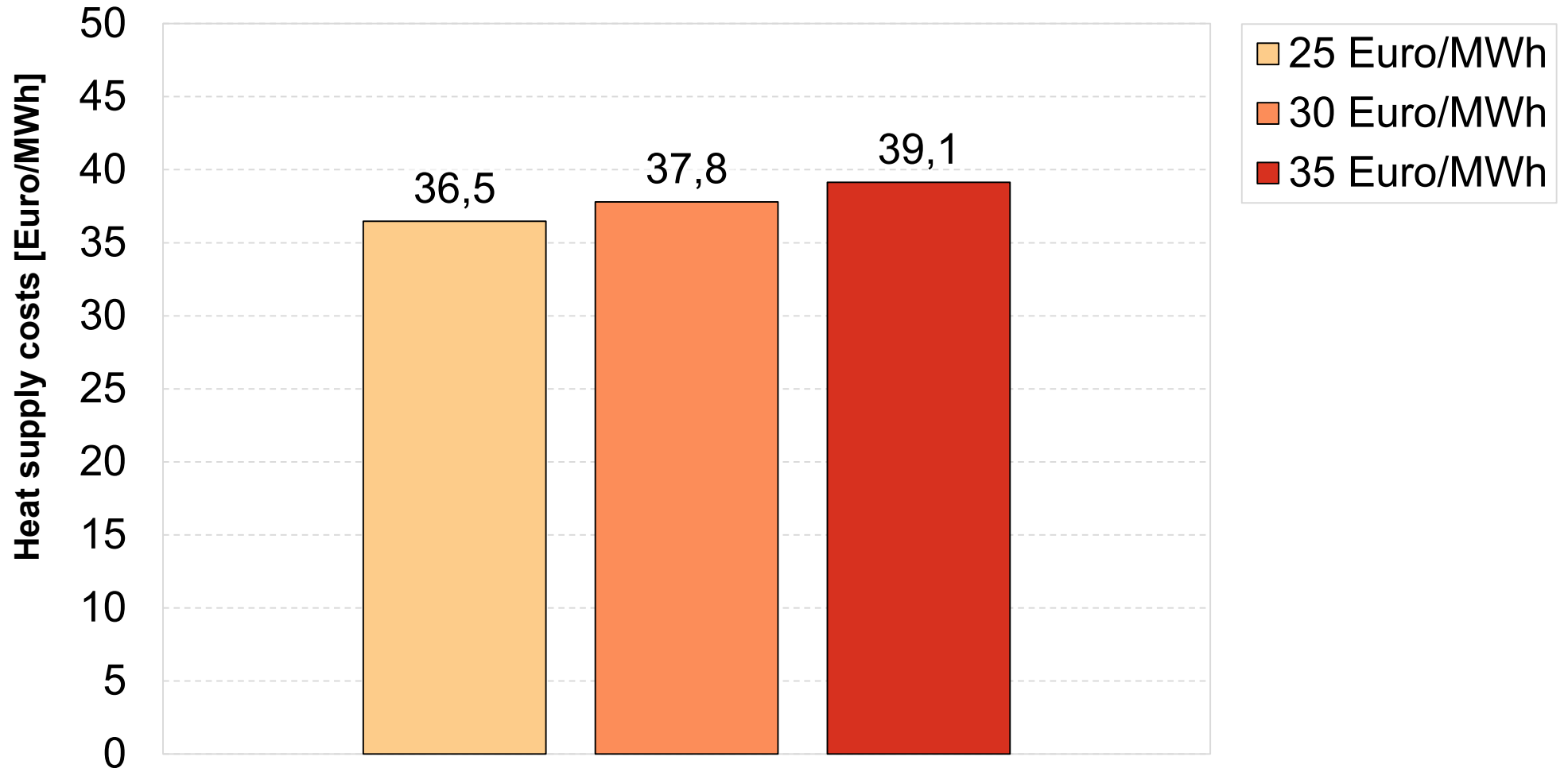
125000 m<sup>3</sup>  
90°C



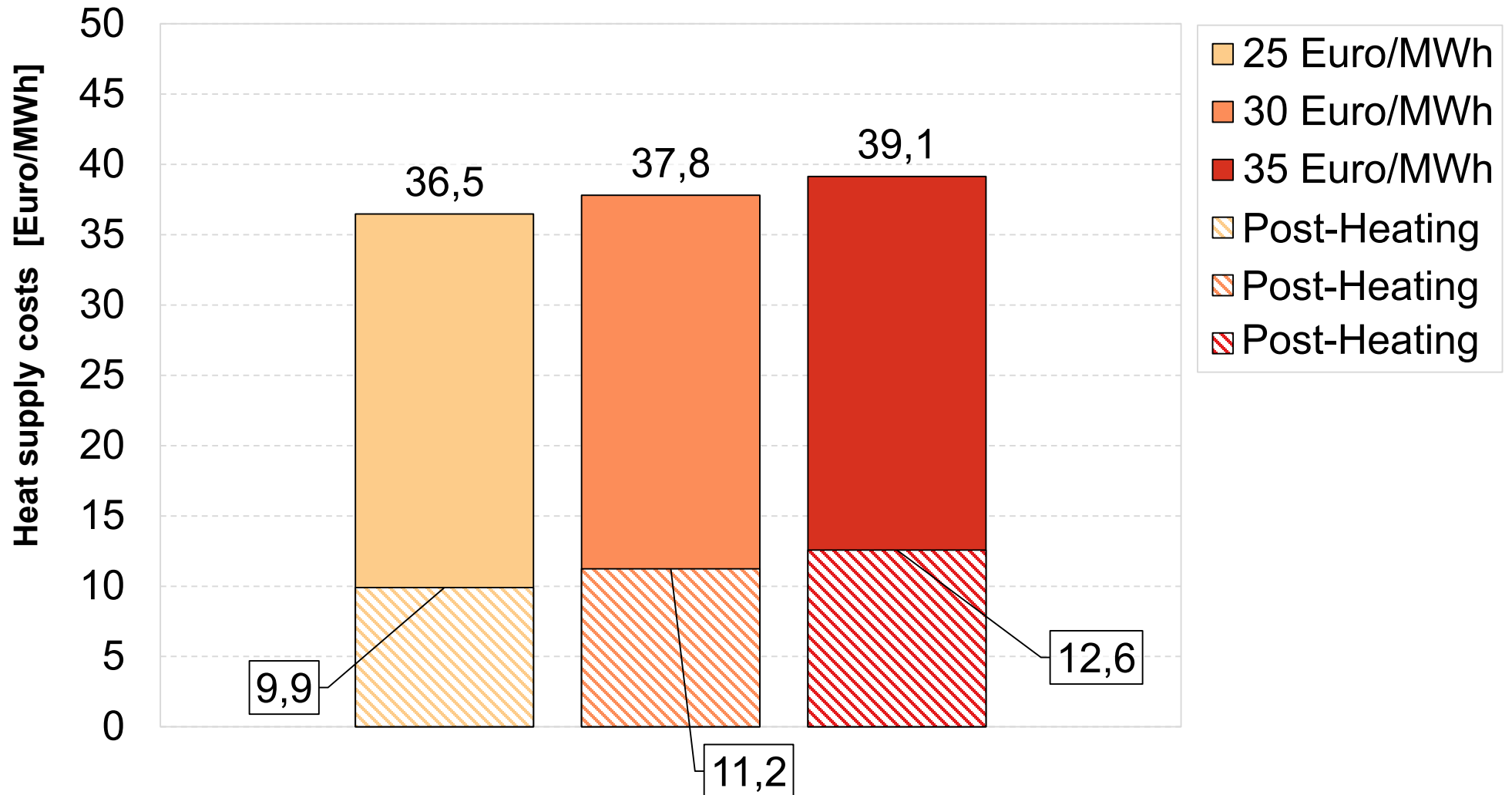
**Biomass for post-heating**

10 MW

# Costs per MWh (150000m<sup>2</sup> solar thermal, 125000m<sup>3</sup> pit storage, 10 MW biomass post-heating)



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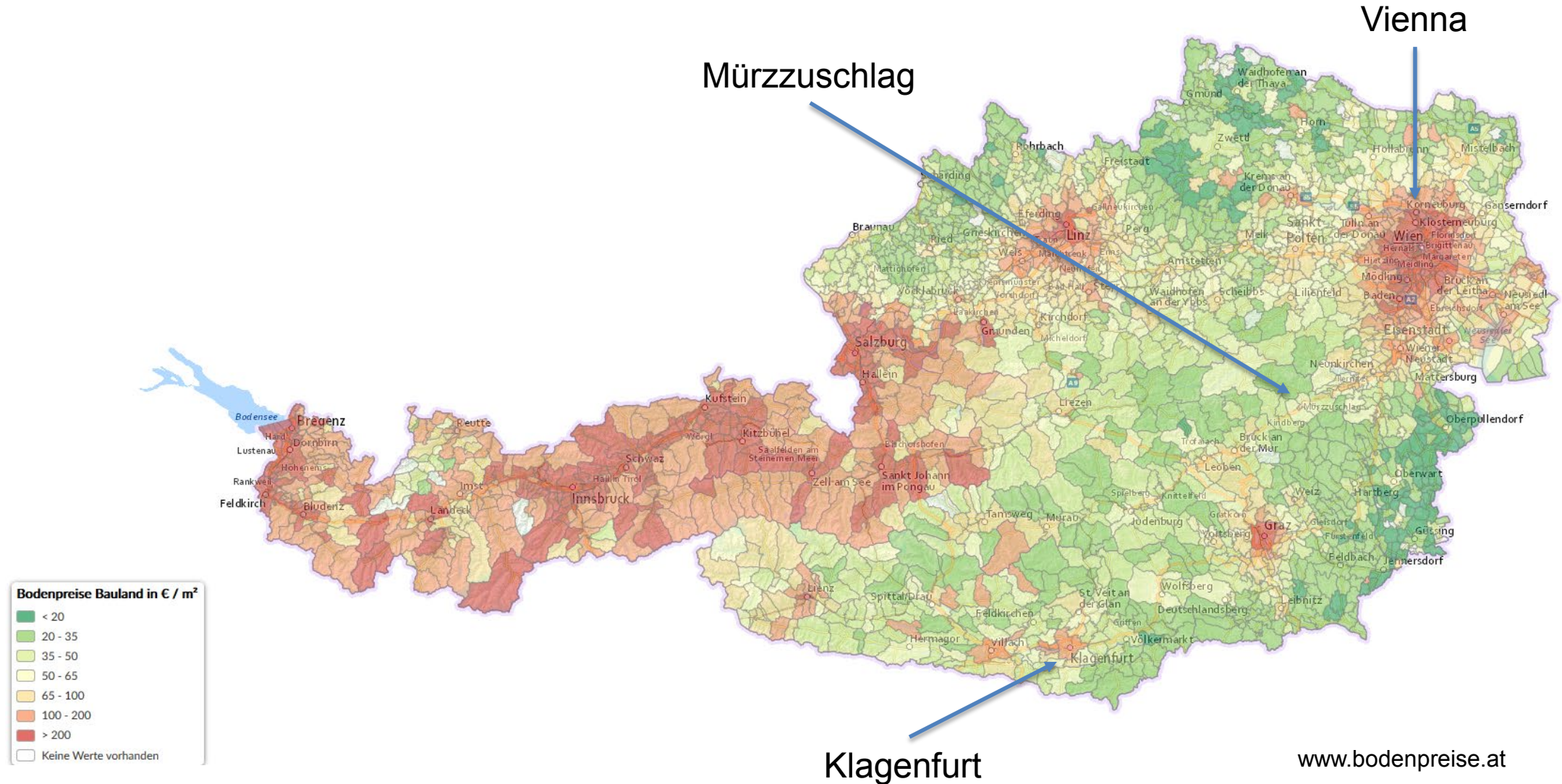


# Bottlenecks for integration: Costs

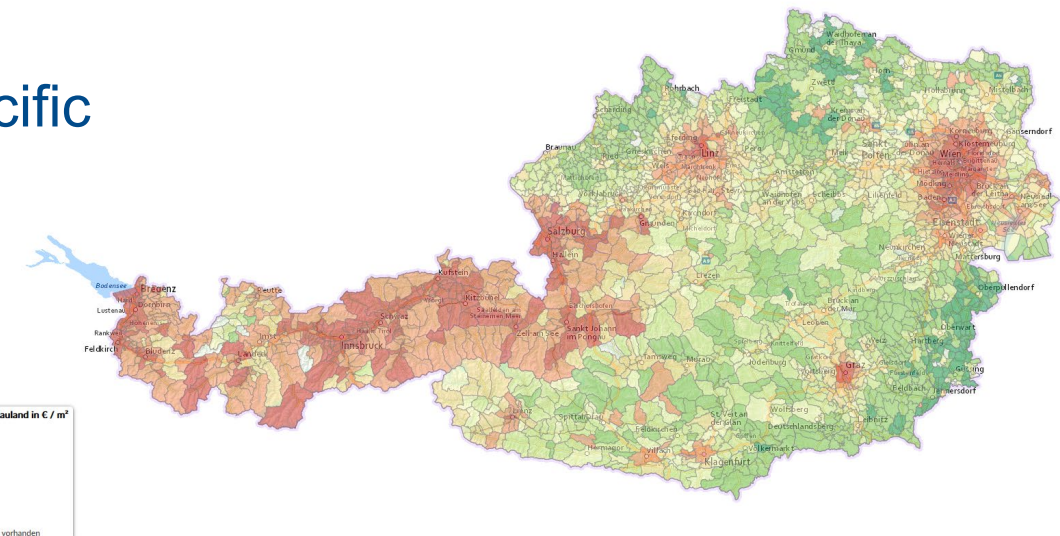


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# Ground prices in Austria



- Rural areas → limited issue
- Urban areas
  - High competition
  - Niches? Brownfields?
  - „Unattractive“ areas
    - Close to highways, railroad, etc..
- Pit thermal energy storage need specific hydrogeological conditions





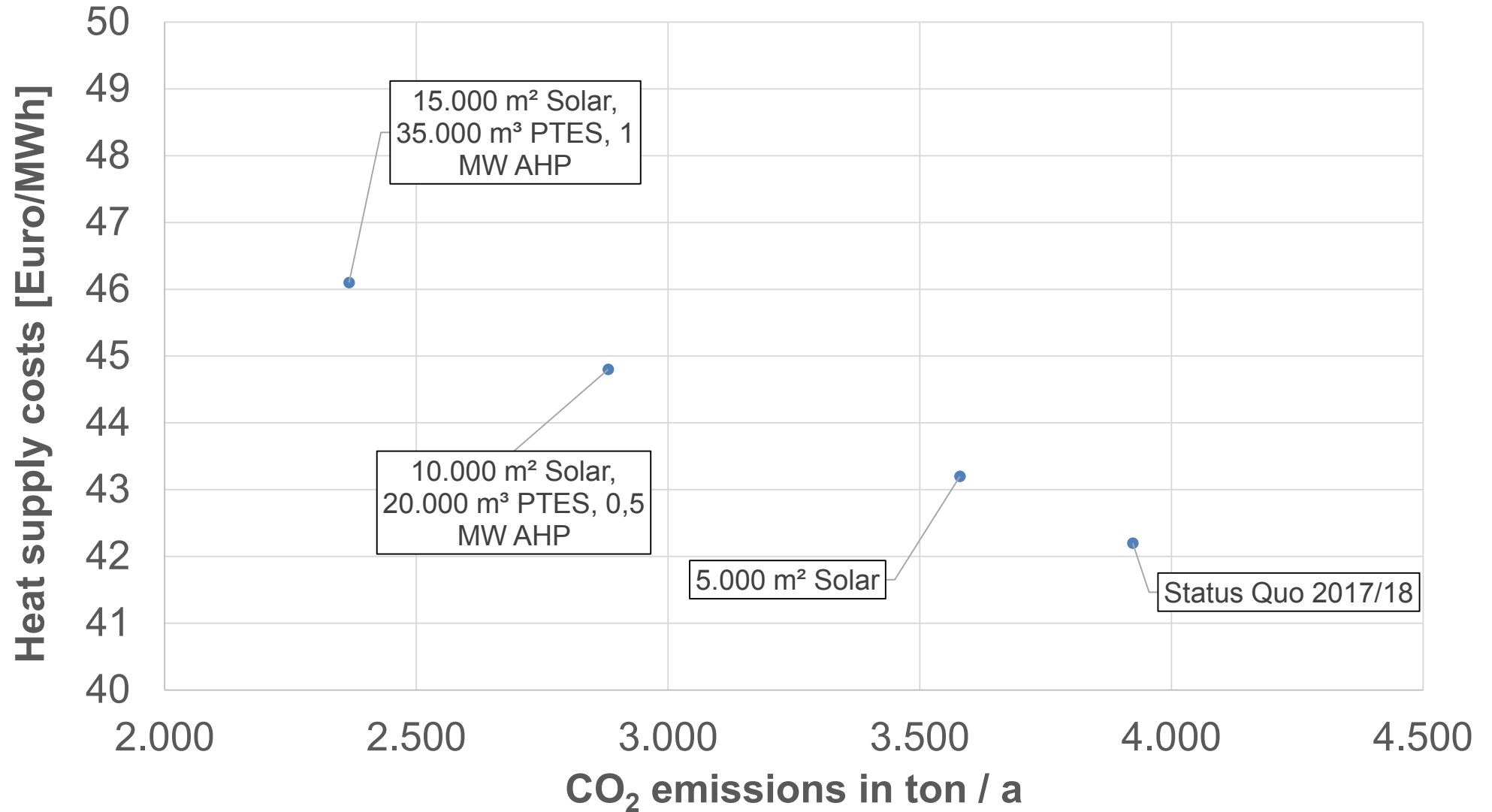
# Impact of CO<sub>2</sub> taxes on heat supply costs & economic feasibility

- Mürzzuschlag
  - 24.8 GWh
  - 16 MW cap.
  - mainly biomass
  - 2017 / 2018: 69,2 % covered by renewables

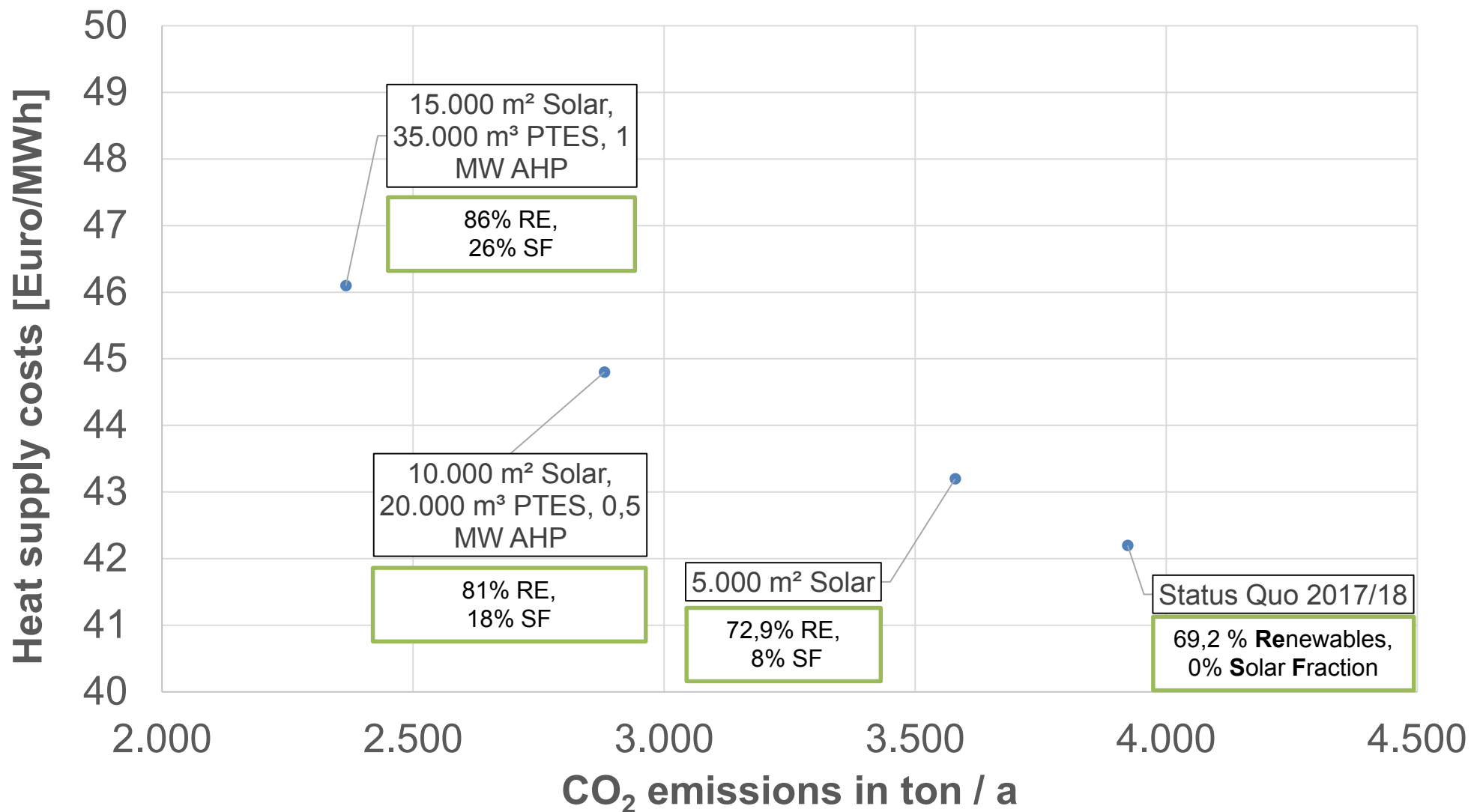




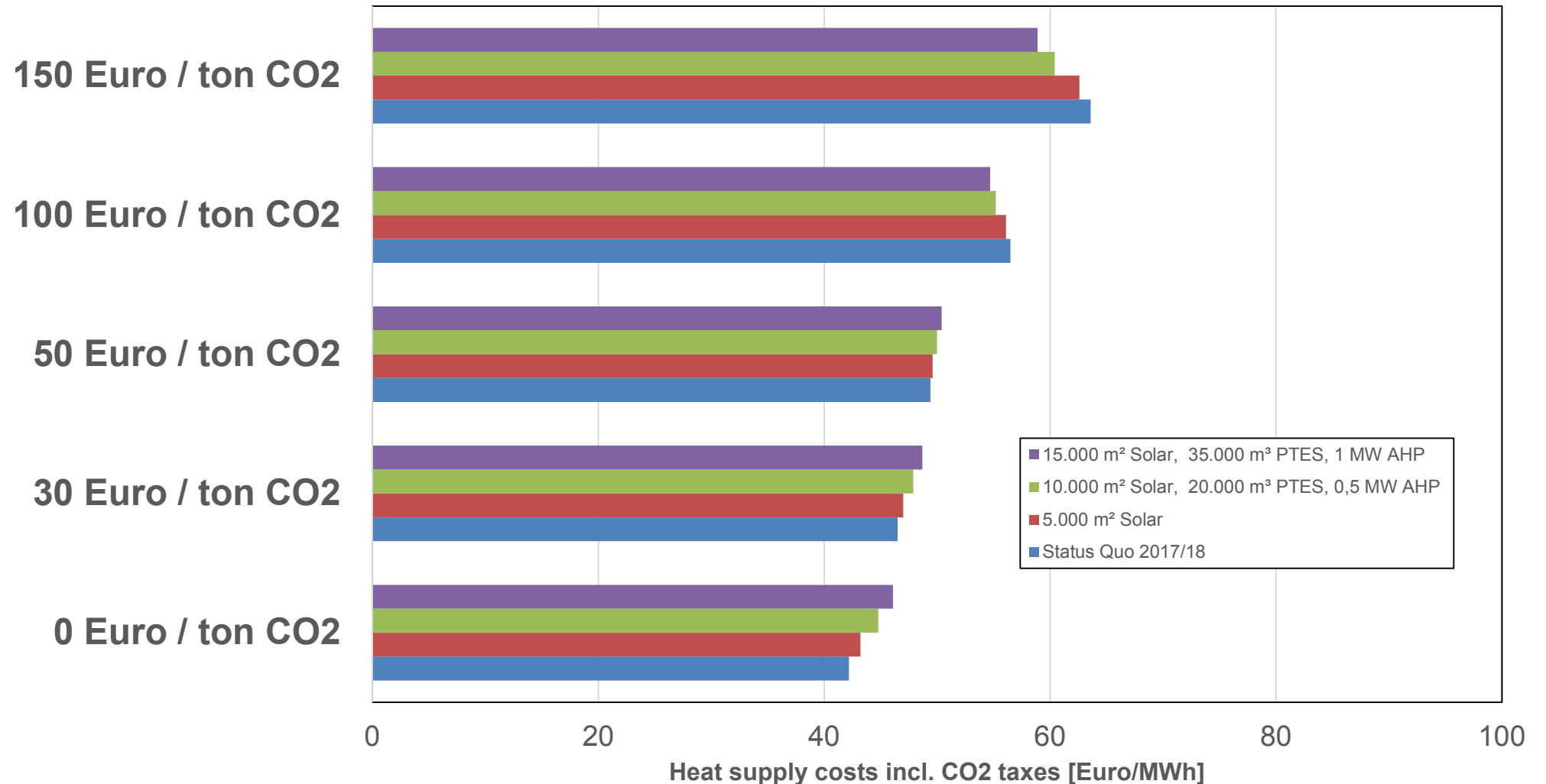
# CO<sub>2</sub> emissions vs heat supply costs: Example Mürzzuschlag (24.8 GWh, 16 MW cap., mainly biomass)



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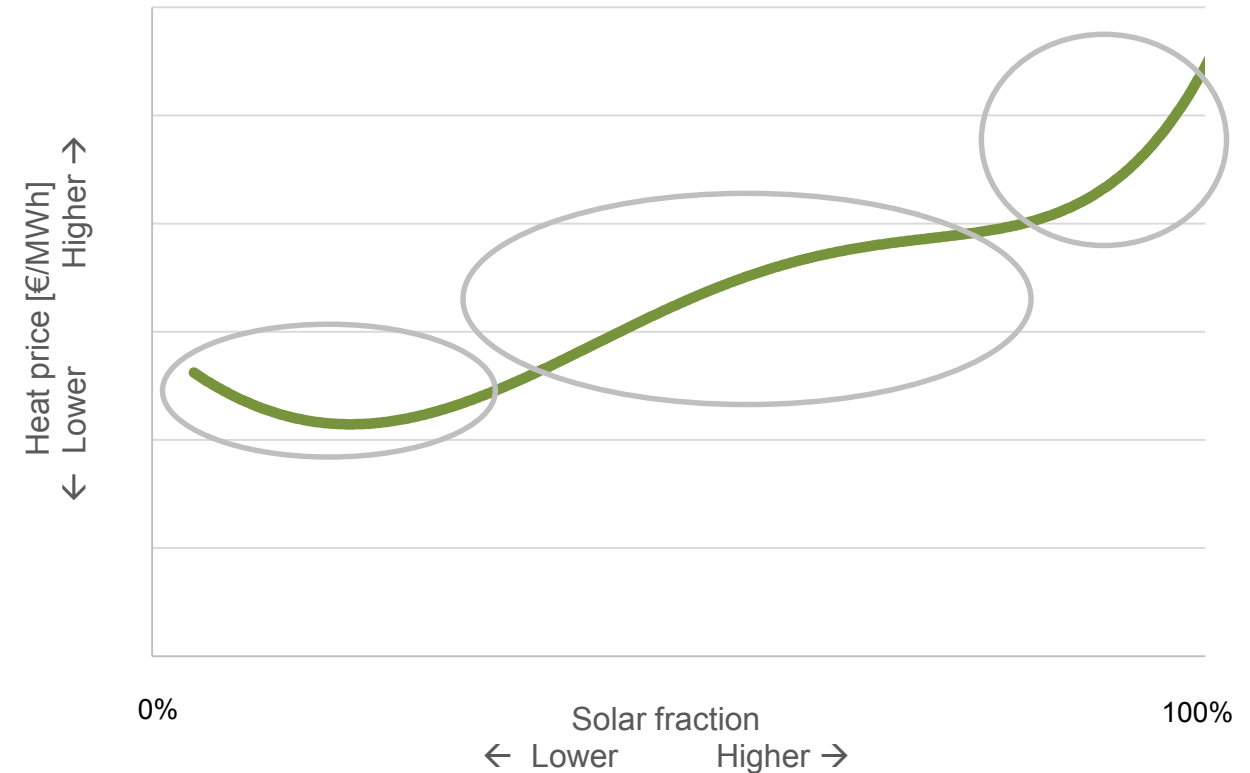


# Impact of CO2 taxes: Example Mürzzuschlag (24.8 GWh, 16 MW capacity, mainly biomass)



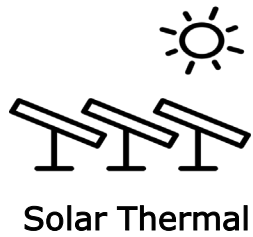
# How to become 100% renewable?

- For small solar fractions:
  - Tank storage → minimum heat price is seen
- For medium & large solar fractions:
  - Pit storage
  - economy of scale vs cost increase from storage losses/lower yield per m<sup>2</sup>
- Getting closer to 100%
  - ...

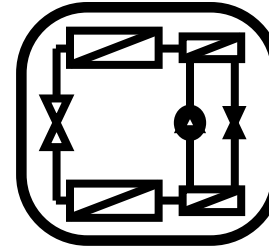


# What are the challenges for integration?

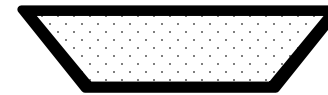
## ■ Level of technologies?



*Just Married*



Absorption Heat Pump



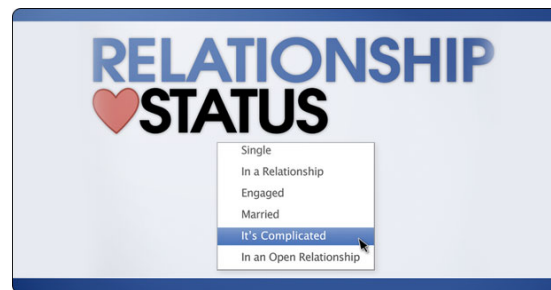
Pit Thermal Energy Storage



## ■ Interaction with / extension of existing DH systems? Added value?



## ■ Financial aspects?







**AEE INTEC**

**IDEA TO ACTION**

This project has been funded in scope of the Austrian „Stadt der Zukunft, 3. Ausschreibung“ Research program, project no. 854666.

 Bundesministerium  
Verkehr, Innovation  
und Technologie



FFG



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