



Sept. 27<sup>th</sup> 2016

# BIG Solar Graz: Solar district heating in the city, 500.000 m<sup>2</sup> for a solar fraction of 20%

@ 2<sup>nd</sup> International Conference on Smart Energy Systems and 4th Generation District Heating



# Presentation - Overview

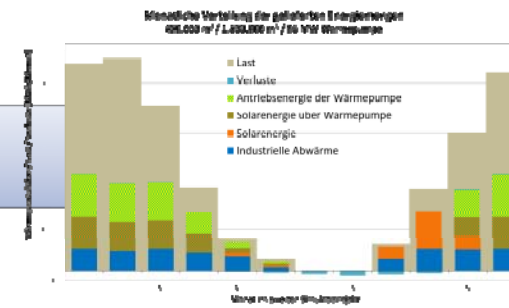
Graz                      Situation → Goal



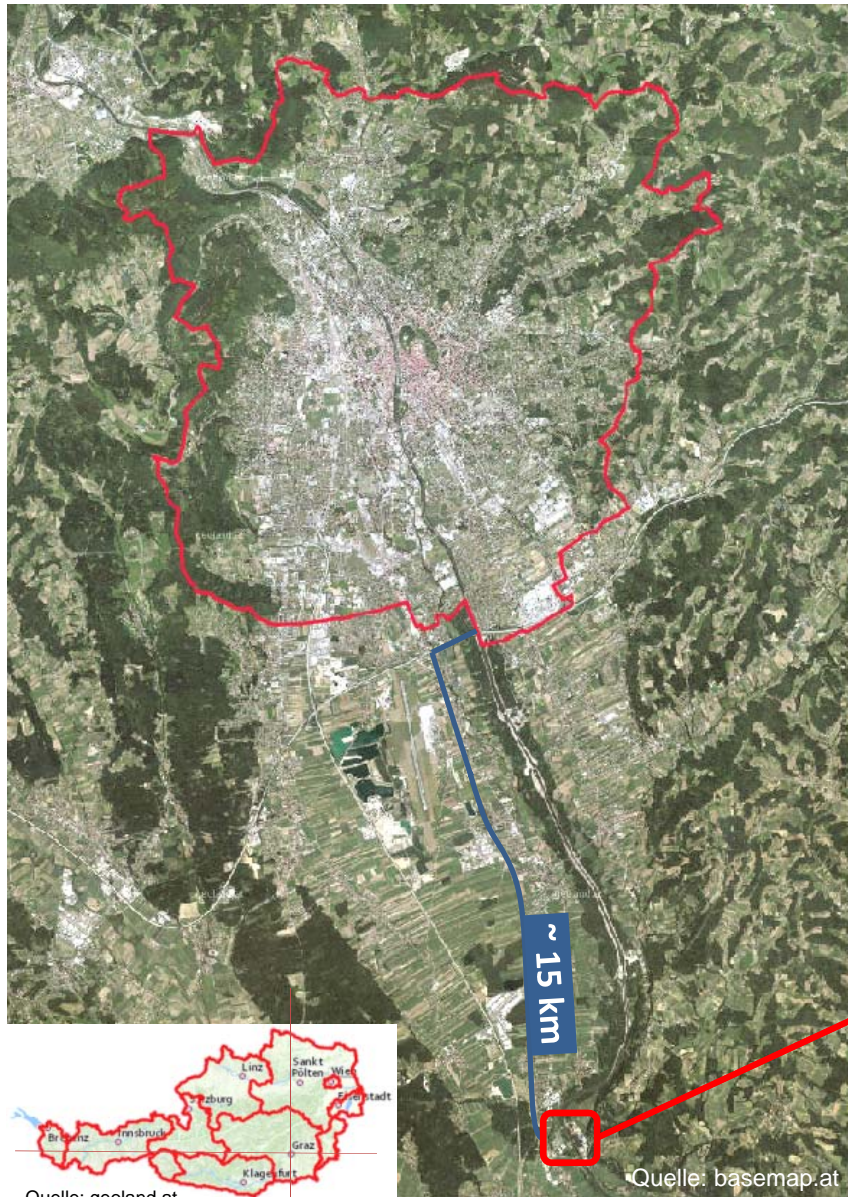
Solar heat                      ...for urban district heating



BIG Solar Graz                      Results of the feasibility study



# Graz – Overview



The second largest city of Austria

Approx. 300.000 inhabitants

Approx. 120.000 people supplied by district heating

District heating demand: 1.200 GWh/a

Peak load: 530 MW



Quelle: geoland.at

Quelle: basemap.at



# District heating in Graz - SITUATION

approx. 400 MW NEW are necessary

Heat supply Graz 2020 / 2030  
transition of the district heating system

- City started a broad process of contribution
  - 13 thematic areas, 9 workshops
    - 80 experts, 38 proposals
- 16 detail analysis, 7 in preparation / realisation

=> Sustainable, reliabel & no add. costs

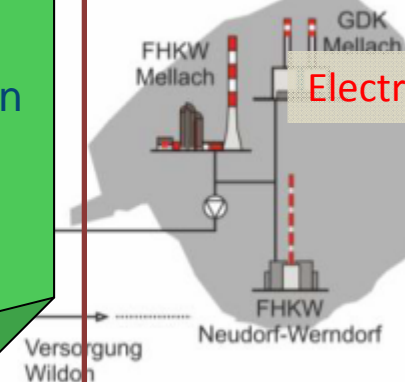
## District heating Graz: 2020 ?!

2014  
86% of Energy  
provided  
by Mellach



Electricity market <> gas price

CCGT 400 MW<sub>th</sub>  
800 MW<sub>el</sub>



Contract for delivery  
till 2020

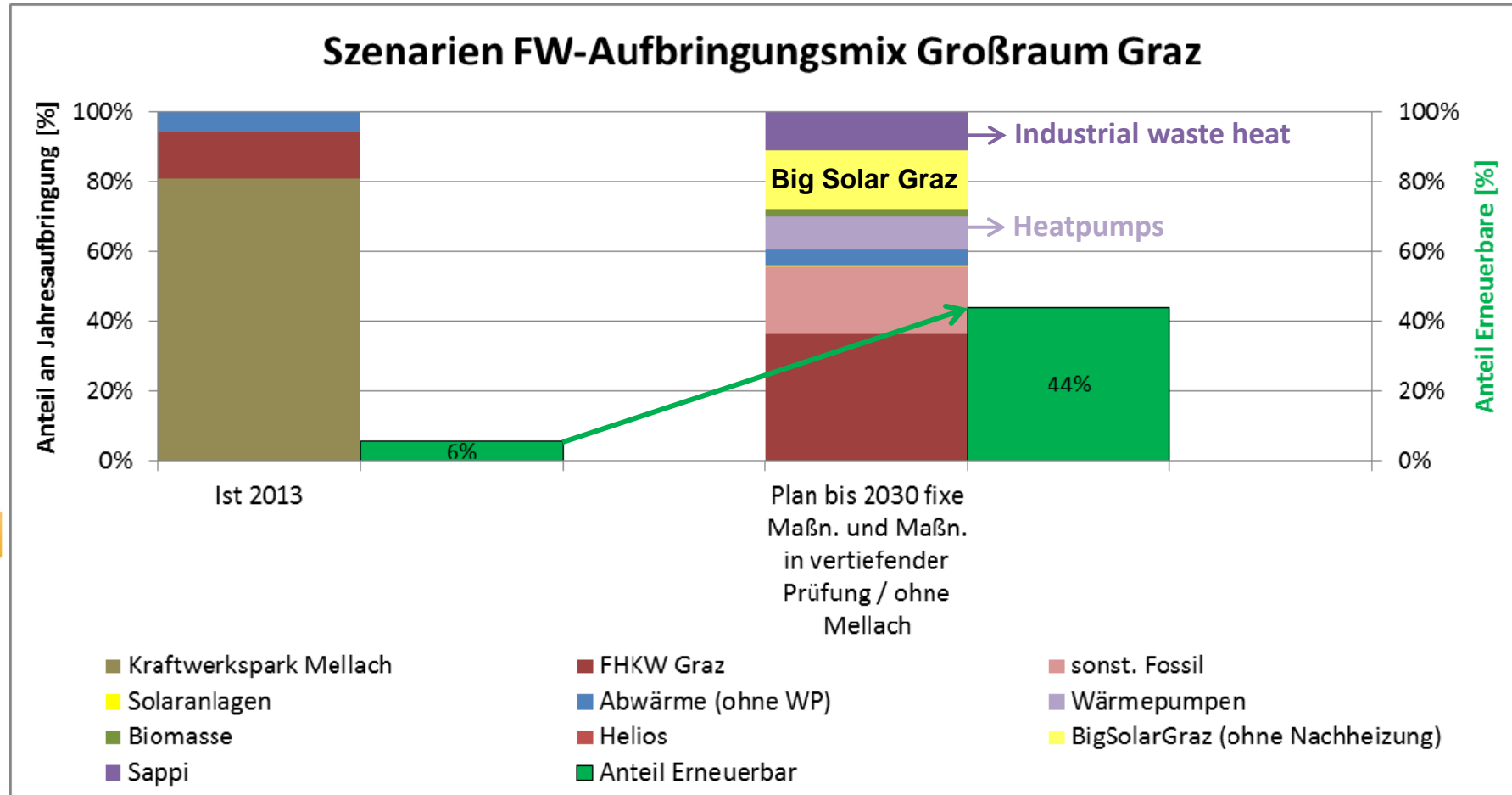


End of technical life expectancy  
Coal-fired power station  
230 MW<sub>th</sub>  
226 MW<sub>el</sub>

Source: Wärmeversorgung Graz 2020/2030, Workshops  
Source: E-Stmk, C. Hackl, Vortrag: Erfahrungen mit Solar-Wärmeeinspeisung in Graz, 27.05.2015

# PLAN for future of DH in Graz

Condition today → from 2020 onwards



Source: Grazer Umweltamt & Energie Agentur, Prutsch, Götzhaber, Papousek; Vortrag bei Fernwärmetag in Velden, 16.3.2016





➤ Heat supply in Graz: Situation → Goals



➤ **Solar heat for urban district heating**



➤ „BIG Solar Graz“: Results of the feasibility study





# Experience in solar district heating

First integration  
of solar energy  
in Graz:  
1.430 m<sup>2</sup>/ 1 MW

**Start: 2002**





# Solar area: roof cadastre?

5,6 Mio m<sup>2</sup> surfaces that are suitable for solar collectors



Quelle: [http://geodaten1.graz.at/WebOffice/externalcall.jsp?project=solar\\_pv&client=auto](http://geodaten1.graz.at/WebOffice/externalcall.jsp?project=solar_pv&client=auto)



# Experience in solar district heating

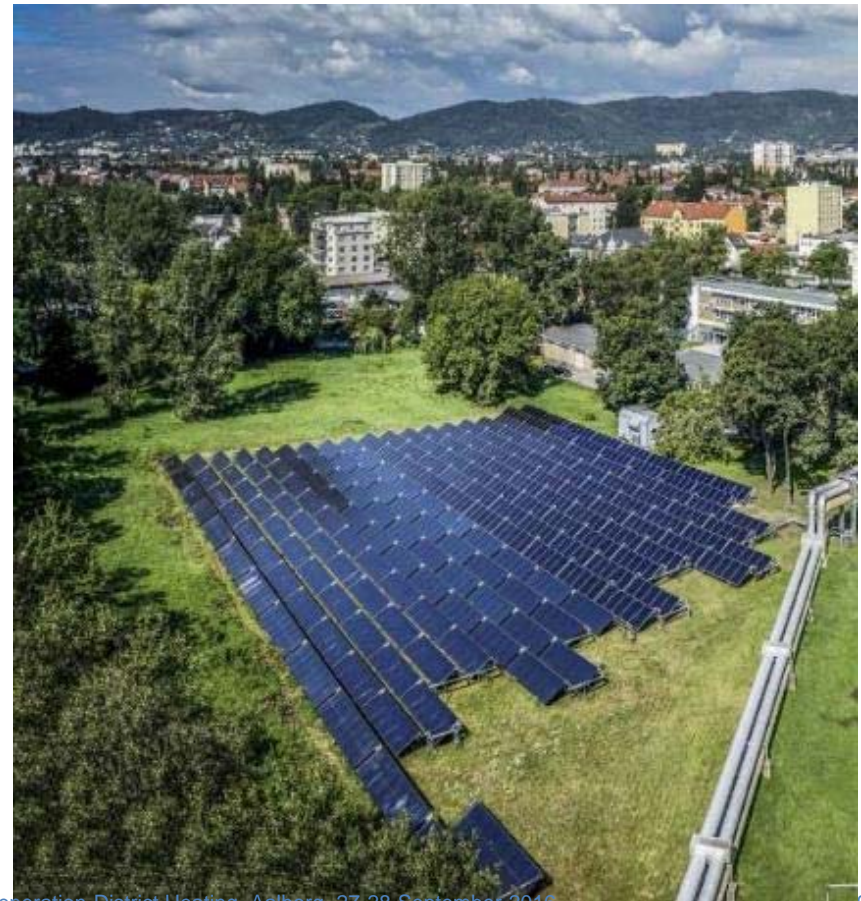


## Development from 2002 - 2016 ...

... Contracting

... Open areas

... Field test





# Big field solar collectors in DK



Source: Arcon Sunmark



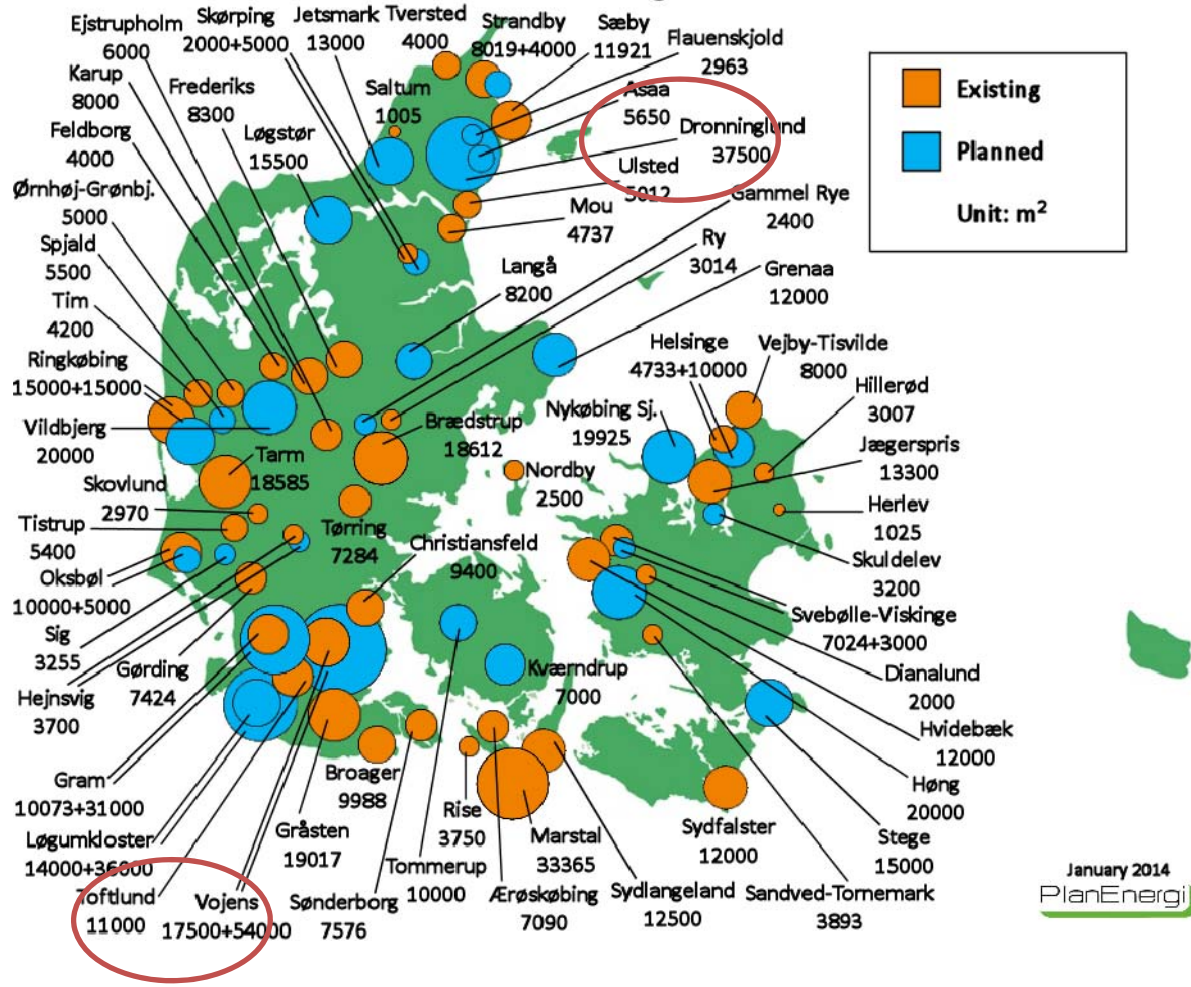
Collector array: 70.000 m<sup>2</sup> with long-term storage: 207.000 m<sup>3</sup>





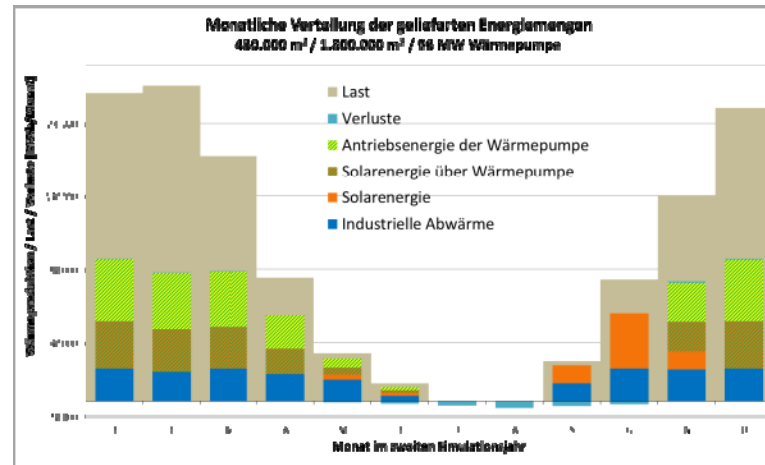
# SDH development in DK

## Solar district heating in Denmark



January 2014  
PlanEnergi





➤ Heat supply in Graz: Situation → Goals



➤ Solar heat for urban district heating



➤ **„BIG Solar Graz“: Results of the feasibility study**



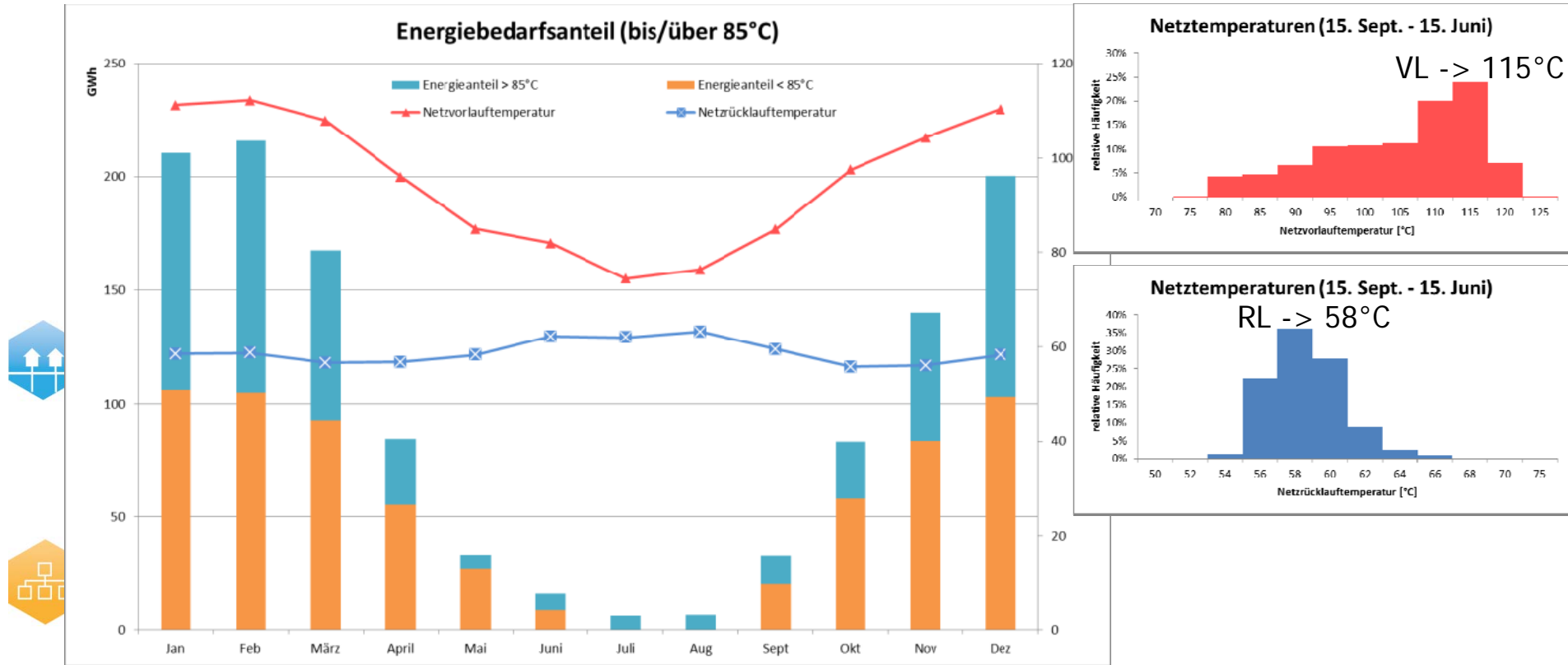


# Feasibility study BIG Solar Graz

## Excursion to Denmark



# Graz DH system conditions



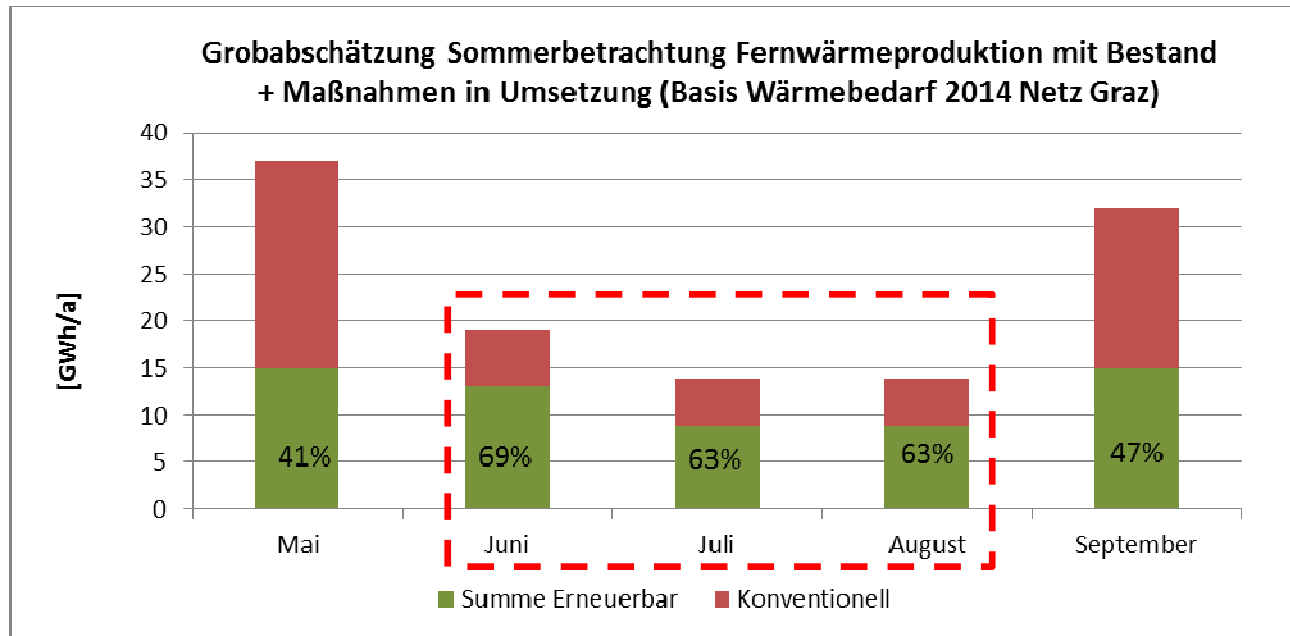
⇒ Current network temperatures allow a **maximum of about 30% solar coverage**

⇒ The results from the simulations show an **economic optimum at ~ 20% solar coverage**





# Summer supply: widely renewable already



■ In the summer months, the lion's share of district heating already comes from renewables

■ With further measures, a 100% coverage from renewables is reached in the summer months

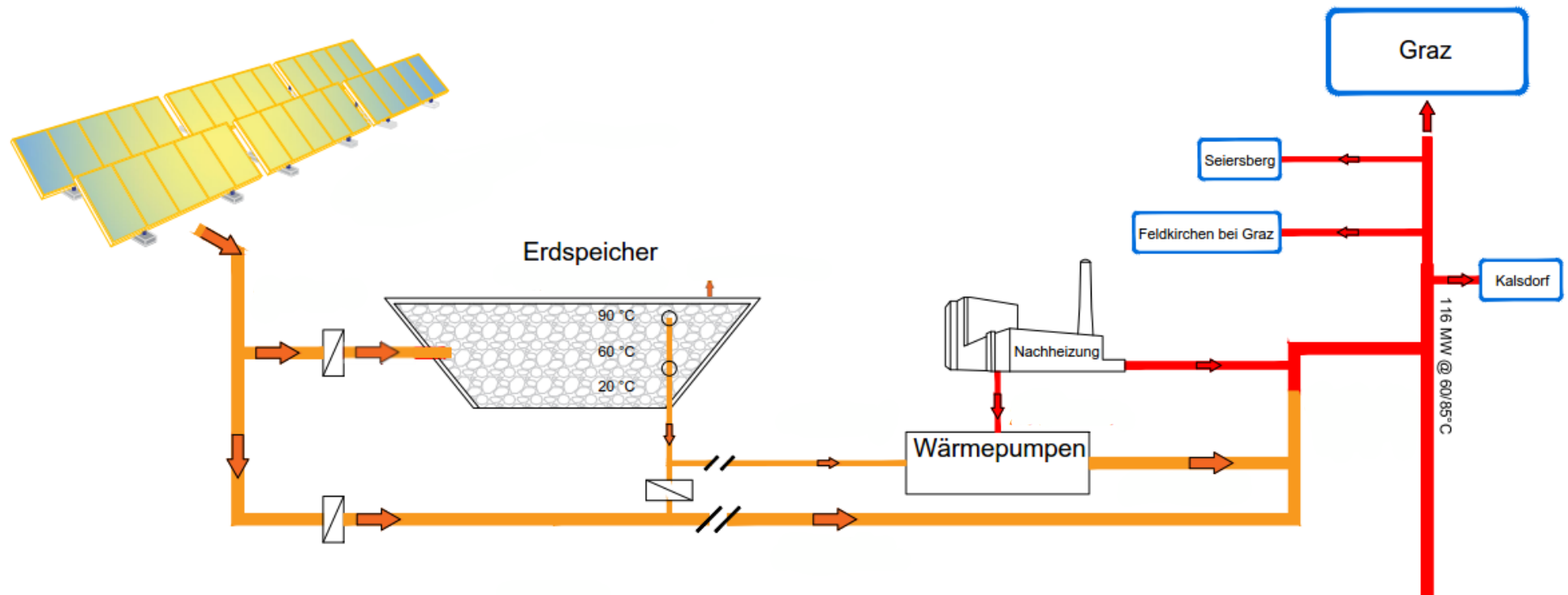


Every production in summer going beyond that, requires long-term storage



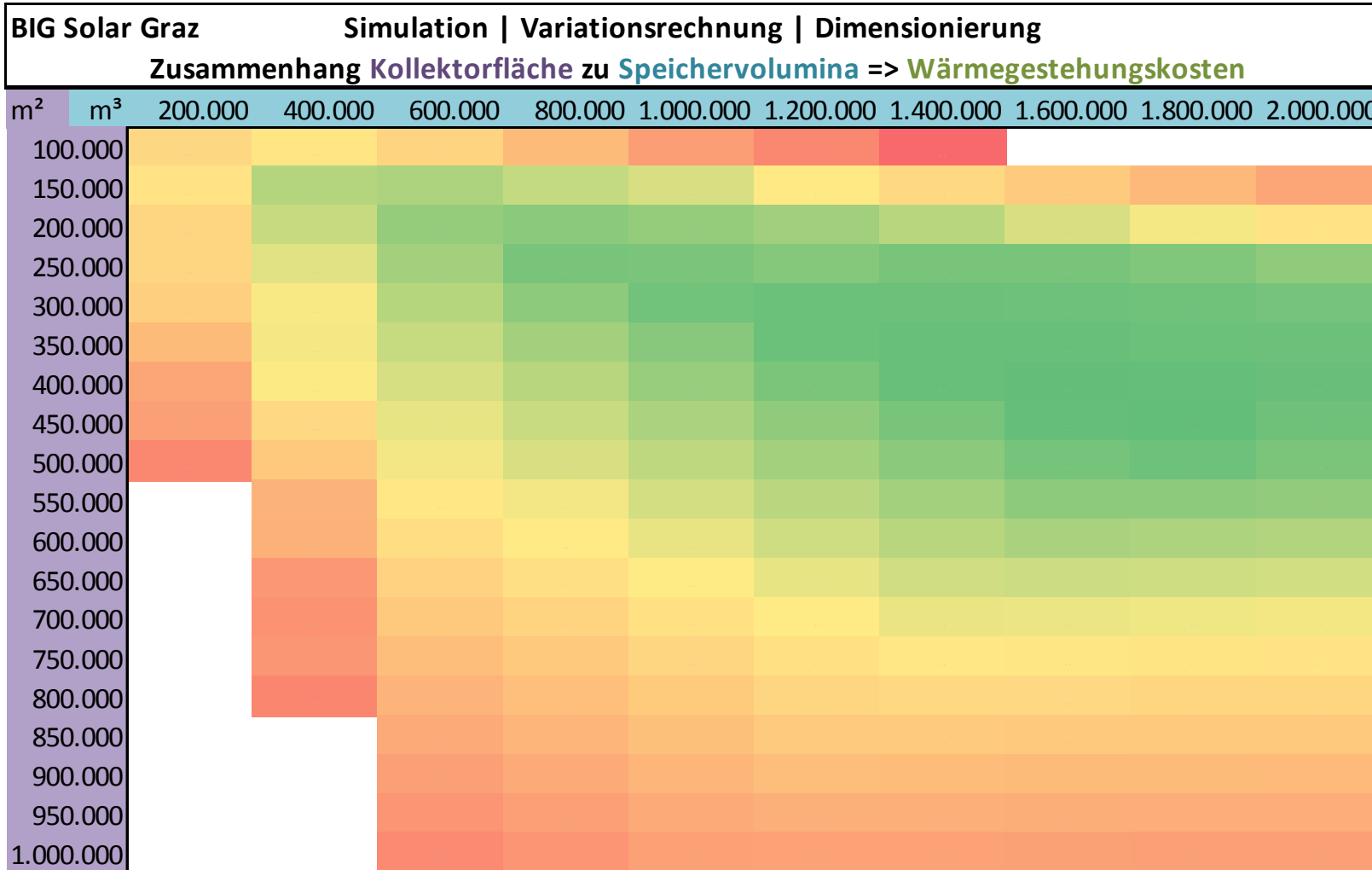
Source: Grazer Umweltamt & Energie Agentur, Prutsch, Götzhaber, Papousek; Vortrag bei Fernwärmefest in Velden, 16.3.2016

# System concept

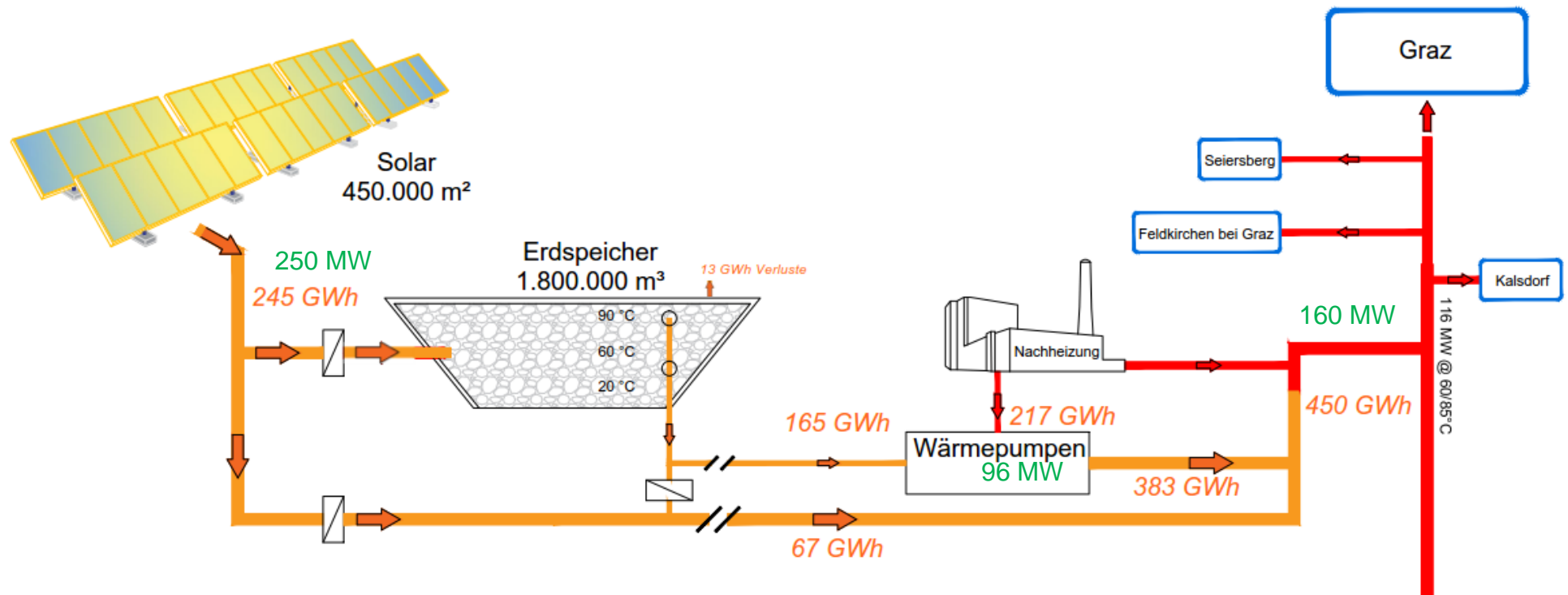




# Optimising calculations



# System concept optimum



Solar coverage:

approx. 20 %

Total capital expenditures:

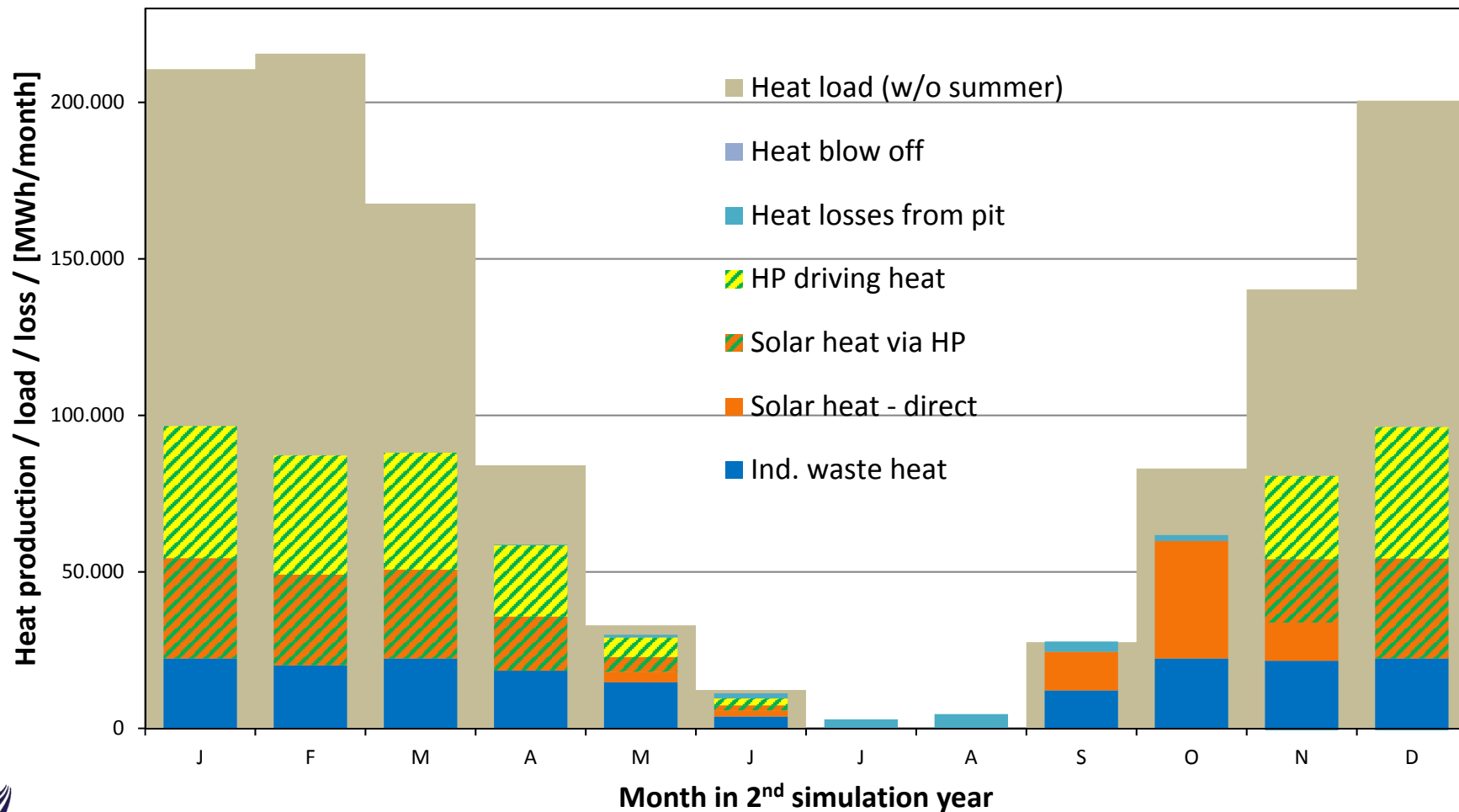
approx. 200 Mio. EUR



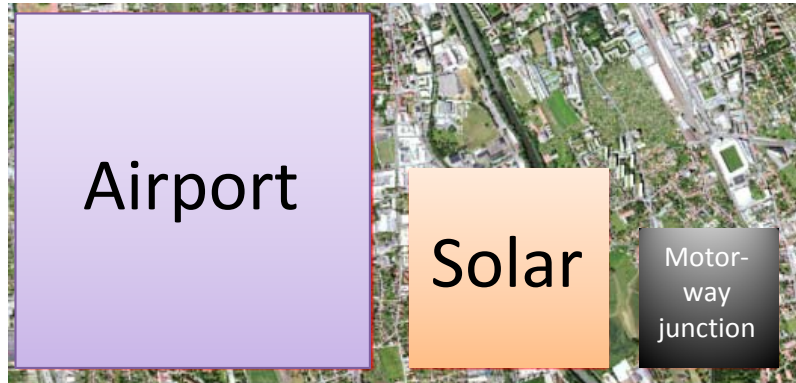


# Simulated monthly generation shares

450,000 m<sup>2</sup> collectors + 1,800,000 m<sup>3</sup> pit heat storage + 100 MW AHP



# Floor space required



## Comparison to other infrastructure areas in Graz

Airport Graz	~ 300 ha
Motorw. junc. Graz West	~ 40 ha
Generation System Mellach	~ 110 ha
Big Solar concept	~ 100 ha

Required solar system area  
 $< 0,8 \%$  of the city area

Needed space for fast growing biomass for same energy output

factor of 30

Conventional biomass floor space requirement for same energy amount

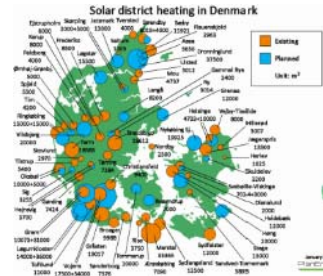
factor of 55





# Summary

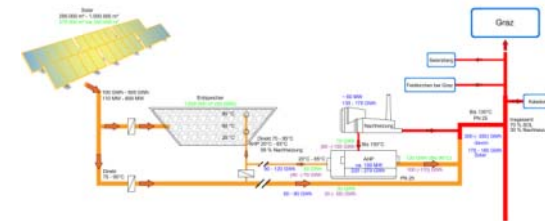
- Economic competitiveness



- System solution for available heat at anytime



- Security of supply



- Long-term price stability

– refinancing costs are projectable, independent from the development of prices of fossil energy sources





For further information visit: [www.solid.at](http://www.solid.at)

*Erneuerbare Energien 2015-3, Zeitschrift für nachhaltige Energiezukunft, AEE Intec*  
*Solarwärme neu gedacht - Fernwärme für Europas Städte*  
[http://www.aee.at/aee/index.php?option=com\\_content&view=article&id=874&Itemid=113](http://www.aee.at/aee/index.php?option=com_content&view=article&id=874&Itemid=113)  
und  
*Erneuerbare Energien 2016-1*  
*BIG Solar Graz: 500.000 m<sup>2</sup> Solarkollektoren für 20 % Solaranteil bei Grazer Fernwärme*  
[http://www.aee.at/aee/index.php?option=com\\_content&view=article&id=908&Itemid=113](http://www.aee.at/aee/index.php?option=com_content&view=article&id=908&Itemid=113)

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# Storage temperatures

## Speichertemperaturverläufe

450.000 m<sup>2</sup>, 1,8 Mio m<sup>3</sup>

— Speicher oben — Speicher mitte — Speicher unten

