BIG Solar Graz: Solar district heating in the city, 500,000 m² for 20% solar fraction

Results of a techno-economic feasibility study

@ the IEA Heat Pump Conference 2017 in Rotterdam, May 17th 2017
Who are we?

Planning, constructing and operating large solar thermal systems

Solar heating, solar process heat and solar cooling

SOLID uses absorption machines for
- solar cooling
- industrial waste heat utilization
- heat recovery through flue gas condensation
Overview

Graz
Situation → Goal

Solar heat
...for urban district heating

BIG Solar Graz
Results of the feasibility study

Source: Graz Tourismus

BIG Solar Graz @ 12th IEA Heat Pump Conference 2017, Rotterdam, 15. – 18. May 2017
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
District heating in Graz – Current 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, reliable & no add. costs

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

District heating Graz: 2020 ?!

2014
86% of Energy provided by Mellach

Electricity market <> gas price

Contract for delivery till 2020

End of technical life expectancy

Coal-fired power station
230 MW_th
226 MW_el

Source: BIG Solar Graz @ 12th IEA Heat Pump Conference 2017, Rotterdam, 15. – 18. May 2017
PLAN for future of DH in Graz

Condition today ➔ from 2020 onwards

Szenarien FW-Aufbringungsmix Großraum Graz

Anteil an Jahresaufbringung [%]

0% 20% 40% 60% 80% 100%

Ist 2013

6%

Plan bis 2030 fixe Maßn. und Maßn. in vertiefender Prüfung / ohne Mellach

100%

Anteil Erneuerbare [%]

Industrial waste heat

Heat pumps

Big Solar Graz

Source: Grazer Umweltamt & Energie Agentur, Prutsch, Götzhaber, Papousek; Vortrag bei Fernwärmetagen in Velden, 16.3.2016
Experience in solar district heating

Development from 2002 - 2016 …
… Contracting
… Open areas
… Field test
Big field solar collectors in DK

Collector array: 70.000 m² with long-term storage: 207.000 m³
SDH development in DK and Europe

Sources: PlanEnergi; Jan-Olof Dalenbäck – Chalmers University of Technology, SE
Feasibility study BIG Solar Graz
Excursion to Denmark
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 Fernwärmetagen in Velden, 16.3.2016
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
Solar area: roof cadastre?

5.6 Mio m² surfaces that are suitable for solar collectors
System concept
Optimising calculations

**Simulation | Variationsrechnung | Dimensionierung**

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System concept optimum

Solar coverage: approx. 20%
Total capital expenditures: approx. 200 Mio. EUR
Simulated monthly generation shares

450,000 m² collectors + 1,800,000 m³ pit heat storage + 100 MW AHP

- Heat load (w/o summer)
- Heat blow off
- Heat losses from pit
- HP driving heat
- Solar heat via HP
- Solar heat - direct
- Ind. waste heat

Month in 2nd simulation year
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

Conventional biomass floor space requirement for same energy amount

factor of 30

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

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
und
Erneuerbare Energien 2016-1
BIG Solar Graz: 500.000 m² Solarkollektoren für 20 % Solaranteil bei Grazer Fernwärme
http://www.aee.at/aee/index.php?option=com_content&view=article&id=908&Itemid=113

Patrick Reiter
Mail: p.reiter@solid.at
S.O.L.I.D. Gesellschaft für Solarinstallation und Design mbH
Puchstraße 85, 8020 Graz, Austria
Storage temperatures

**Speichertemperaturverläufe**

450.000 m², 1,8 Mio m³

- Speicher oben
- Speicher mitte
- Speicher unten

[Graph showing temperature changes over months]