Solar Heat –
A future major source for district heating

Sustainable Energy Solutions for Large Facilities

SOLID GmbH since 1992
Puchstraße 85, A-8020 Graz, www.solid.at, office@solid.at
My background

✓ **SOLID is Pioneer**
  - Started 1992, today 27 years of experience
  - More than 300 references worldwide
  - Trendsetter for large scale solar thermal systems
  - 20 years experience in PPA models & operation
  - Research & development

✓ **SOLID is covering all steps in Value Chain**
  - Turn-key solutions (> 1MW)
  - Engineering and Design
  - Consultant
  - Feasibility Studies
  - Energy Services (ESCo)

Heat: 48%
- 16.4% Traditional biomass
- 27% Renewable energy
- 1.9% Renewable electricity for heat

Transport: 32%
- 8.4% Modern renewables other than electricity

Power: 20%
- 3% Renewable energy
- 2.8% Biofuels
- 0.3% Renewable electricity

SOLID
I talk about Solar THERMAL

- Solar PV (Electricity)
- Solar Heating (Heat)

> 500 % higher output per m²!
Solutions with Solar Thermal

- Solar Yield
- Heat
- Storage
- Domestic Hot Water
- Space Heating
- Process Heat
- Solar Cooling
- Cold Water
- Conditioned Air
- Cooling Load

District Heating

SOLAR INSTALLATION + DESIGN

GBE Factory
Today's sources DH world wide
Typical annual demand
Energetika Vransko, Slovenia

Solar Panels: 842.3 m²
Buffer Tank: 93 m³
(load management)

District Heating based on biomass and oil
http://www.energetika-vransko.si
Built on a industrial roof top

In operation since:
March 2012
Solar energy is directly used in the grid, peak solar generation is significantly below lowest heat load in grid in summer

Biggest Solar District Heating plant in Austria

District heating plant, Graz

Solar panels:
- 2007: 5,000 m²
- 2014: 7,000 m²
- 2015: 7,450 m²
- 2018: 8,350 m²/ 6 MW

ESCo

Source: Google Earth
Limitations

- Solar fractions stay in the < 1 to 20% range
  - So solar remains just a nice add on but has no relevance as key pillar in in a future heat supply
  - This is not the way for a transition of our heating system

We need to move to a next level including seasonal storage!
BIG Solar
Storing summer heat for winter
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
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
Ausgangssituation Graz

Fernwärme-Erzeugung Graz-Umgebung und Graz
Mittelwert 2006 bis 2011 in MWh/a (Basis Endenergie)

Spitzenlast: ca. 500 MW
Aufbringung: ca. 1.200 GWh
Ausgangssituation Fernwärme

Versorgungssicherheit
Leistbarkeit
Klima- und Umweltverträglichkeit

Wärmeversorgung 2030 und danach

FW gesamt
Energieeffizienz, Erneuerbare
Fossil

29.01.2016, Folie 4
PLAN for future of DH in Graz

Condition today from 2020 onwards

Szenarien FW-Aufbringungsmix Großraum Graz

Source: Grazer Umweltamt & Energie Agentur, Prutsch, Götzhaber, Papousek; Vortrag bei Fernwärmetagen in Velden, 16.3.2016
Seasonal storage & solar collectors

Collector array: 70,000 m² with long-term storage: 207,000 m³
Storage
Storage
Case study BIG Solar Graz

System concept optimum

- 25% of city’s district heating supply by solar
- Collector field: 450,000 m²
- Total capital expenditures: ~200 Mio. EUR
- Feasibility study 2015
- Heat Price comparable to Natural Gas
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Required Space

Energy gain/m² ground

- Solar Heat: 160 kWh/m²
- Solar PV: 40 kWh/m²
- Wind: 20 kWh/m²
- Biomass: 10 kWh/m²
- Bioethanol: 0 kWh/m²
required space: Big Solar Graz

comparison to other infrastructure areas in Graz

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

Areas for renewable energy need to become a part of urban planning!

Required solar system area < 0.8% of the city area
Feasibility Feldbach (example with 54,000 m² used space)

Feldbach
Heat demand: ~ 32 GWh/year
Temperatures: ~ 85°C / 55°C

With Heat Pump
Solar fraction: 28%
Collector field: 19,200 m²

Without Heat Pump
Solar fraction: 19%
Collector field: 14,600 m²
SDH examples

Silkeborg (2016): 20% solar share (80 GWh/a)
- 156,700 m² collectors (110 MW)
- https://silkeborgkommune.dk

Vojens (2014): 50% solar share (35 GWh/a)
- 70,000 m² collectors (50 MW)
- 207,000 m³ seasonal storage
- http://www.vojensfjernvarme.dk

Graz (2018): 20% solar share (245 GWh/a)
Drake Landing, Canada

- 798 solar collector modules (2293 m² gross area)
- 240 m³ of water for short-term heat storage
- 34,000 m³ of earth for seasonal heat storage (144 – 35 m boreholes)

We can cover >90 % with solar in a best practice village scale DH net
Bussines Models

- Heat Purchase Agreements (HPA), PPP
  - System run by a specialist- optimization
  - Easier financing
  - Risk free for DH companies- payment per MWh

- Own investment by DH company

- Full integration of other heat sources
Summary

- Big Solar has a huge potential and can contribute to decarbonizing District Heating significantly
  - ca. 50% of DH can be supplied by solar economically

- Scaling is realistic compared both to potential capacity of solar industry, space demand and investment size

- Technology is ready to go but will improve still in the next years
Needs for successful implementation

- Commitment to district heating and DH modernization
- Urban city planning considering land demands
- Financial support for first movers through
  - Feasibilities
  - Investment grants
  - Loan guaranties
- Capacity development in regional industry
- Technology is ready to go but will improve still in the next years
Worldwide Recognition of importance

• International Energy Agency Workgroup Task 55
• IFC Conference April 2018 Graz
• Multiple EU Projects: SDHp2M, ...
• Starting implementation in National Energy Plans
• Mission Innovation
• EBRD ReDEWeB

What is the ReDEWeB?

- **Renewable District Energy in the Western Balkans**
- ReDEWeB Programme aims to support the establishment of a market for ReDE investment through a range of measures
- **Renewable sources:**
  - Biomass
  - Biogas
  - Geothermal
  - Solar thermal
  - Heat pumps
  - Waste heat
- **DE:** District Heating (DH) & District Cooling (DC)
- Beneficiaries are **Web** countries:
  - Serbia, BiH, Macedonia,
  - Kosovo, Montenegro, Albania.