SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

IEA SHC Task 55

"Towards the Integration of Large SHC Systems into DHC Networks"

OA Sabine Putz
IEA SHC Research Co-operation Workshop
June 5, 2019, Vienna

Why SHC TASK 55?

- Successor of SHC TASK 45 (Large scale solar thermal)
- Substituting fossils and pushing the overall energy efficiency in urban areas for solar district heating and cooling
- Step from MEGAWATT to GIGAWATT systems
- Need for low system cost – need for reduced heat price – need for validated increased collector field efficiency and output
- Task 55 acts as exchange platform for interested Stakeholders and Experts from research and industry

SHC TASK 55 Short Facts

- Duration: **September 2016 – August 2020**
- Approx. 65 Experts from 40 organizations from 12 countries are currently involved
- **> 60% experts from industry**
- Access to project results of ≈ 35 projects
- Output: FACT SHEETS
- 2 Expert Meetings/Workshops each year
- 12 participating countries: Austria, Canada, China, Denmark, Finland, France, Germany, Italy, Spain, Sweden, The Netherlands, United Kingdom
- Cooperation with IEA DHC (e.g. DHC Annex TS2)

TASK 55 Subtasks

SUBTASK A - Network Analysis and Integration
Lead: AUSTRIA: AIT – Austrian Institute of Technologies (Ralf-Roman Schmidt); DHC Collaboration; DHC ExCo Austria

SUBTASK B - Components testing, system monitoring and quality assurance
Lead: CHINA: SUNRAIN (Jiao Qingtai)

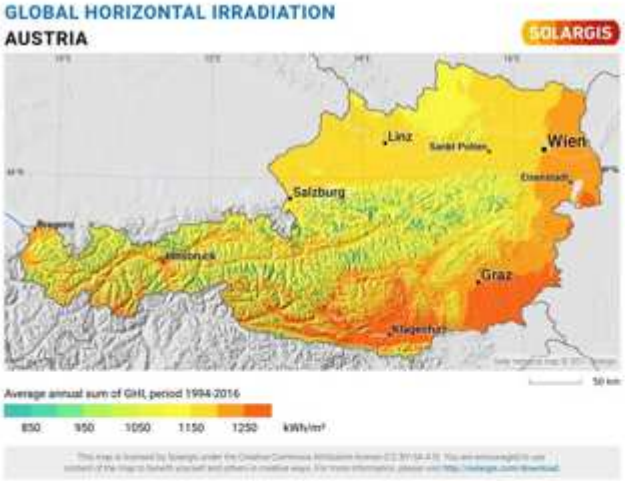
SUBTASK C - System design
Lead: DENMARK: PlanEnergi (Jan-Erik Nielsen)

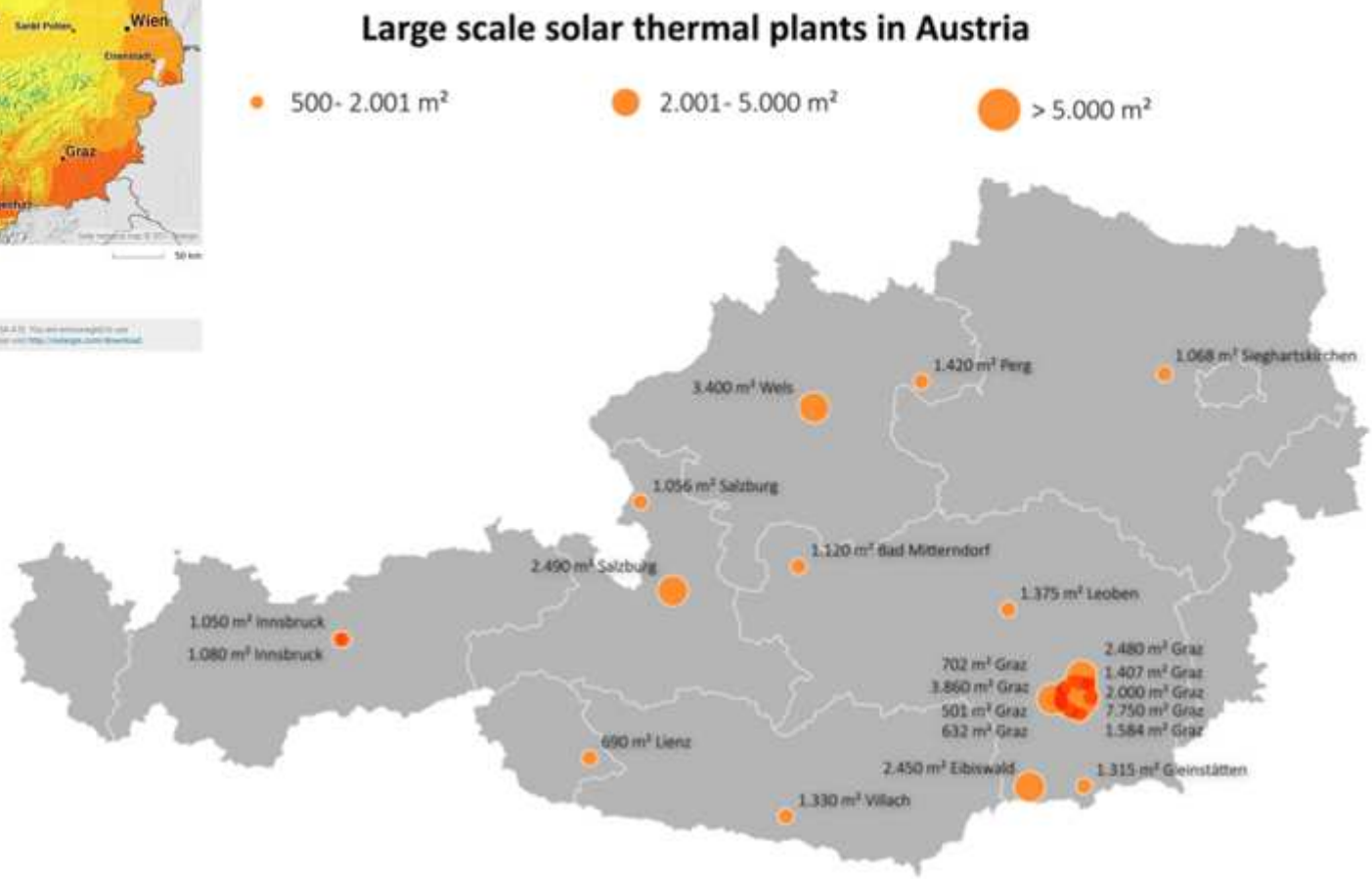
SUBTASK D - Economic Aspects and Promotion
Lead: GERMANY: SOLITES - Steinbeis Research Institute for Solar and Sustainable Thermal Energy Systems (Magdalena Berberich)

District Heating in Austria

Source:
Zahlenspiegel 2018 – Gas und Fernwärme in Österreich (FGW – Fachverband der Gas- und Wärmeversorgungsunternehmungen, 2018)

Large scale solar thermal district heating in Austria





Source: AEE INTEC

Large scale solar thermal district heating in Austria

- End of 2017: 22 large-scale systems in operation with a total aperture area of 37,300 m² (26.1 MW)
- System sizes: 501 m² to 7,750 m²;
  Systems in medium range of 100 m² to 500 m² are also widespread, with around eight times more systems built in this range between 2010 and 2016 compared to large-scale systems
- Unlike in Denmark, for the majority of the plants – 18 out of 22 – the collectors are mounted on or integrated into the roof (usually on roofs of tower blocks or boiler houses)
- Most systems have buffer storages - no seasonal storage
- For the majority of the plants, the solar fraction ranges from 10% to 20%, covering the lion share of the summer load.
- The funding percentage is 40% (> 2,000 m²: 30%, > 5,000 m²: 20%; +5% for SME) with a limitation of 750,000 EUR per project

klima+ energie fonds

Project „Kraftwerk Simmering“

Completed in 2018

Pre-heating the make-up water for the district heating network of Vienna

- **Gross collector area**: 796 m²
- **Solar yield**: 736 kWh/m^2_{Ap}a (projected)
- Heating the make-up water from ~20°C to ~65°C
- In **68 meter** height

GREENoneTEC 1

Project FHW III

Completed in 2018

SDH plant in Graz (AT)

- 7750 m² collector area
- **+ 504 m² collector area**

Project „DH Mürzzuschlag“

Building phase

- **Gross collector area**: 5.000 m²
- **Buffer storage**: 2x 100 m³
- **Solar yield**: 471 kWh/m²$_{Ap}$a (projected)
- **Solar fraction**: 8,7% (projected)

Solar District Heating in Europe

Market figures EU:

~ 300 plants (> 350 kW_{th})
Capacity: 1,100 MW_{th}
Newly installed: +30 %/a
Production: 660 GWh/a
(Solites, 2017)

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Solar District Heating in Denmark

Status Spring 2019

Jan Erik Nielsen

PlanEnergi

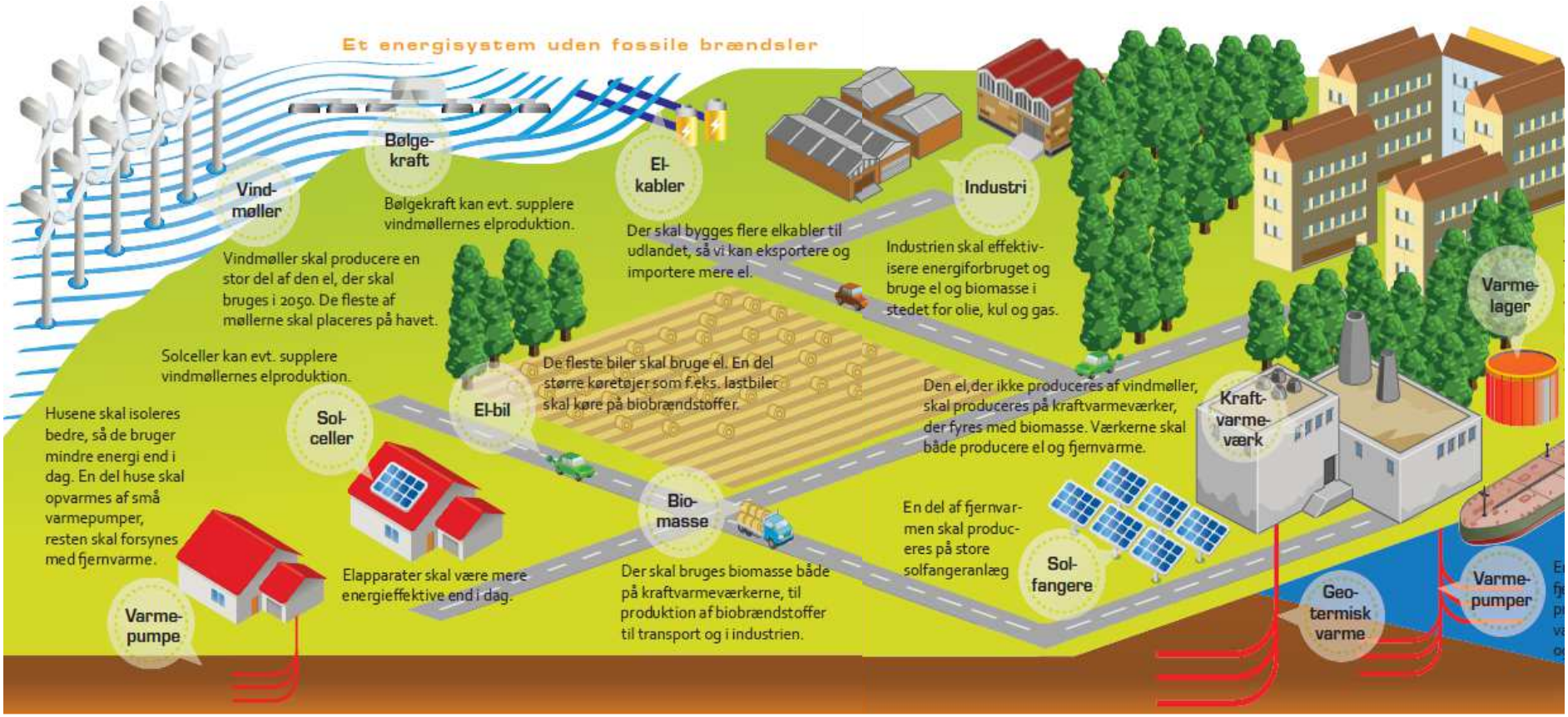
- Consultant Engineers
- 40 employees
- 35 years with renewable heating
  - biomass, biogas, solar heat, heat pumps, district heating, …

Solar District Heating in Denmark

Status Spring 2019

Denmark plans to:

- **Phase out all fossil fuels before 2050**
- **Heating and electricity all by renewable energy before 2035**

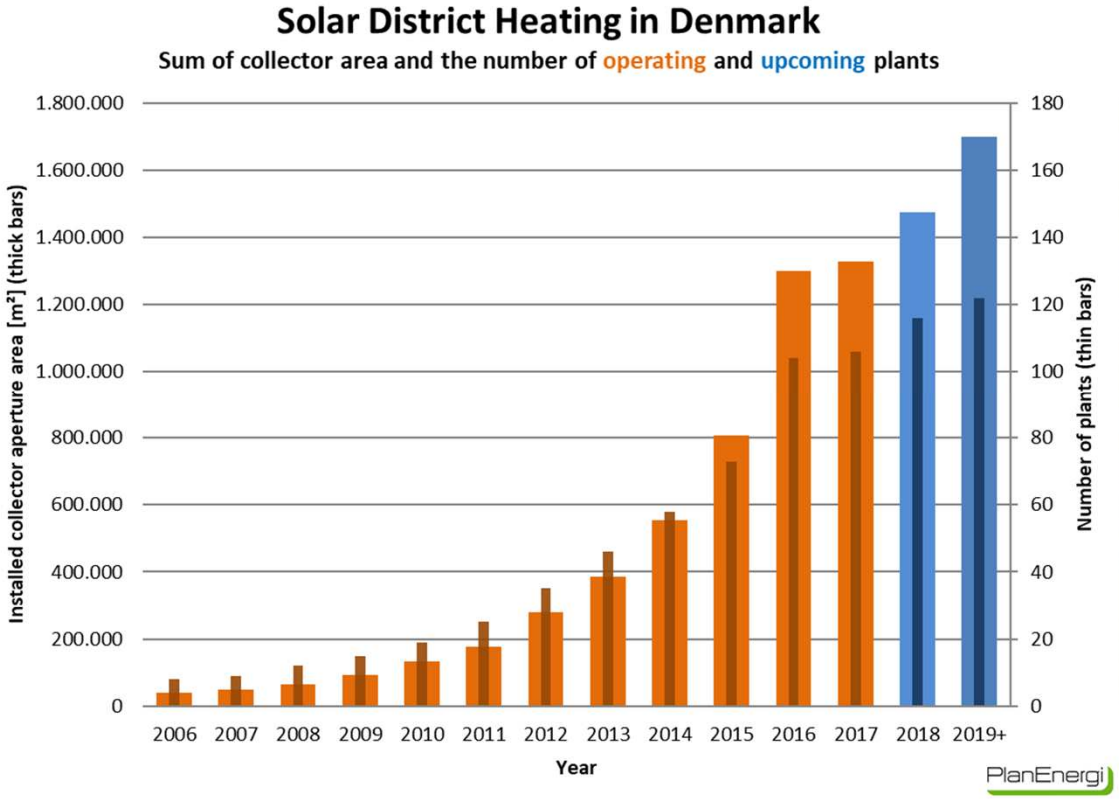


Solar District Heating in Denmark

Status Spring 2019

Solar thermal potential in DK:

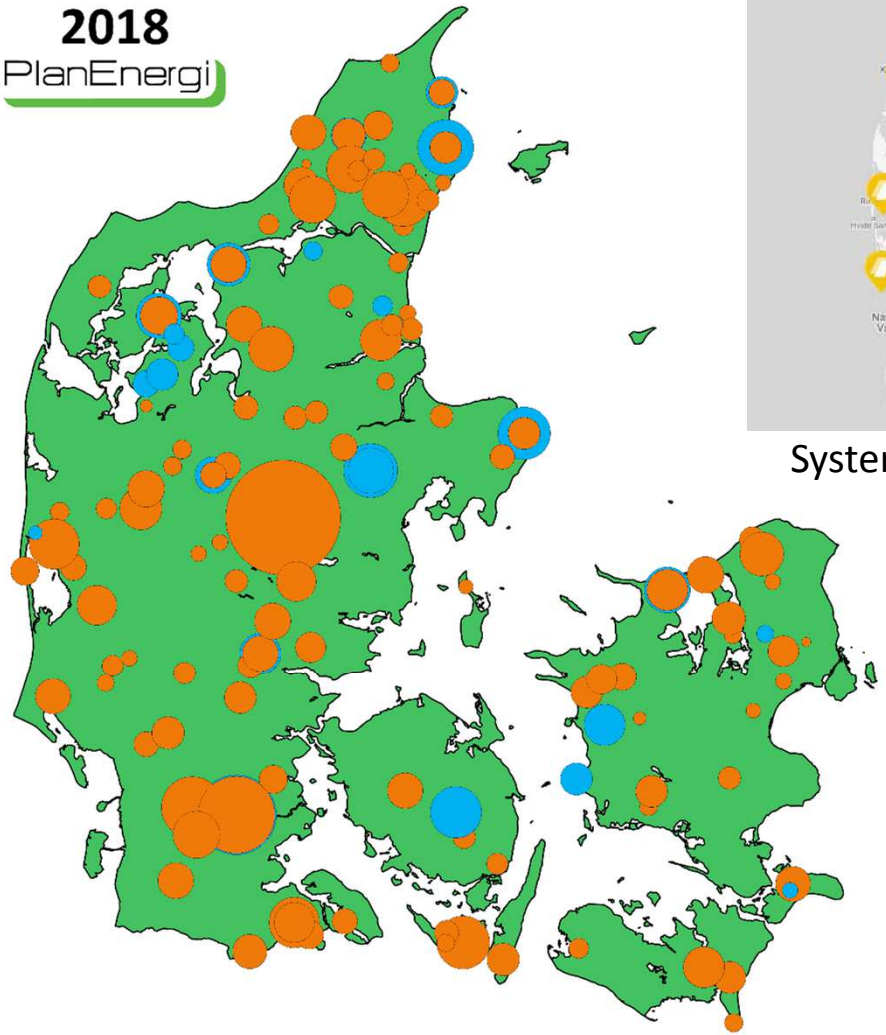
- 2030: → 15 % of district heating demand
- 2050: → 40 % of decreased district heating demand

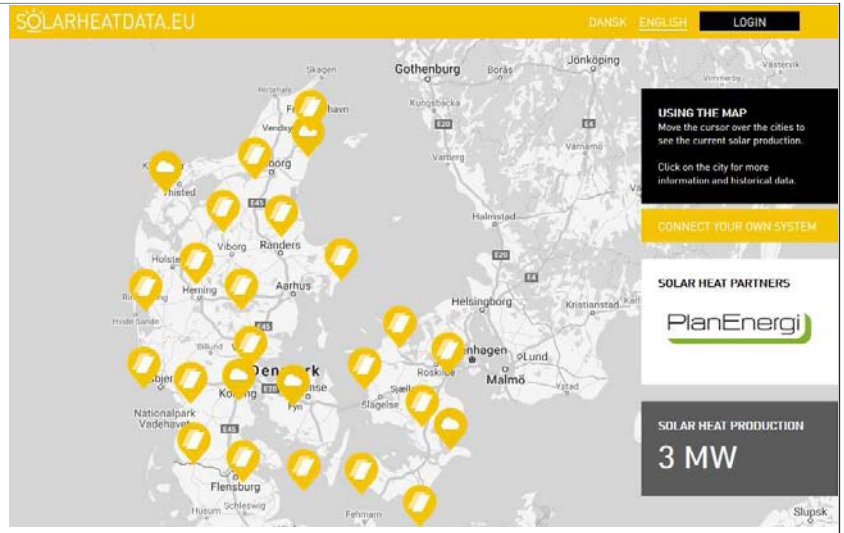


	District heating total (ENS 2014, 2017)	Solar District (PlanEnergi)	
	PJ	PJ	%
2012	136	0,45	0,3%
2013	135	0,63	0,5%
2014	122	0,9	0,7%
2015	130	1,31	1,0%
2016	135	2,11	1,6%
2017	136	2,15	1,6%
2018	136	2,24	1,6%
2019	136	2,58	1,9%

Solar District Heating in Denmark

Status Spring 2019





System descriptions and measurements at:
www.solarheatdata.eu

In operation

Planned / planned expansion

Total collector area (in operation): 1 384 675 m^2

Total collector area (planned): 254 253 m^2

WHY so successful in DK?

- Long time tradition for district heating
- Good price / performance of ground mounted collectors
- High tax on natural gas
- Small subsidy - approx. 10 % of system price
- Competive heat production price
- Interaction with liberal electricity market
- Many small user owned district heating companies

Solar District Heating in Denmark

Status Spring 2019

Long time tradition for district heating in Denmark

- 60 % of all heating demand* is now supplied by district heating
- Low temperatures
  - Forward 70 - 80°C; Return 35 - 45°C … still going down
- Available district heating networks in the country side with cheap ground
- Special structure of de-central district heating companies: Small, user owned -> local back-up -> positive attitude from local authorities

*) Low application temperature: < 80°C

Solar District Heating in Denmark

Status Spring 2019

Good price of installations

- Prices down to 190 €/m² collector ≈ 270 €/kW (system in operation)
- Average around 250 €/m² ≈ 360 €/kW
- Large modules - fast installation

Good performance

- Max. collector field output > 530 kWh/m²; max. efficiency > 50 %
- Average output: 440 kWh/m²; average efficiency: 40 %

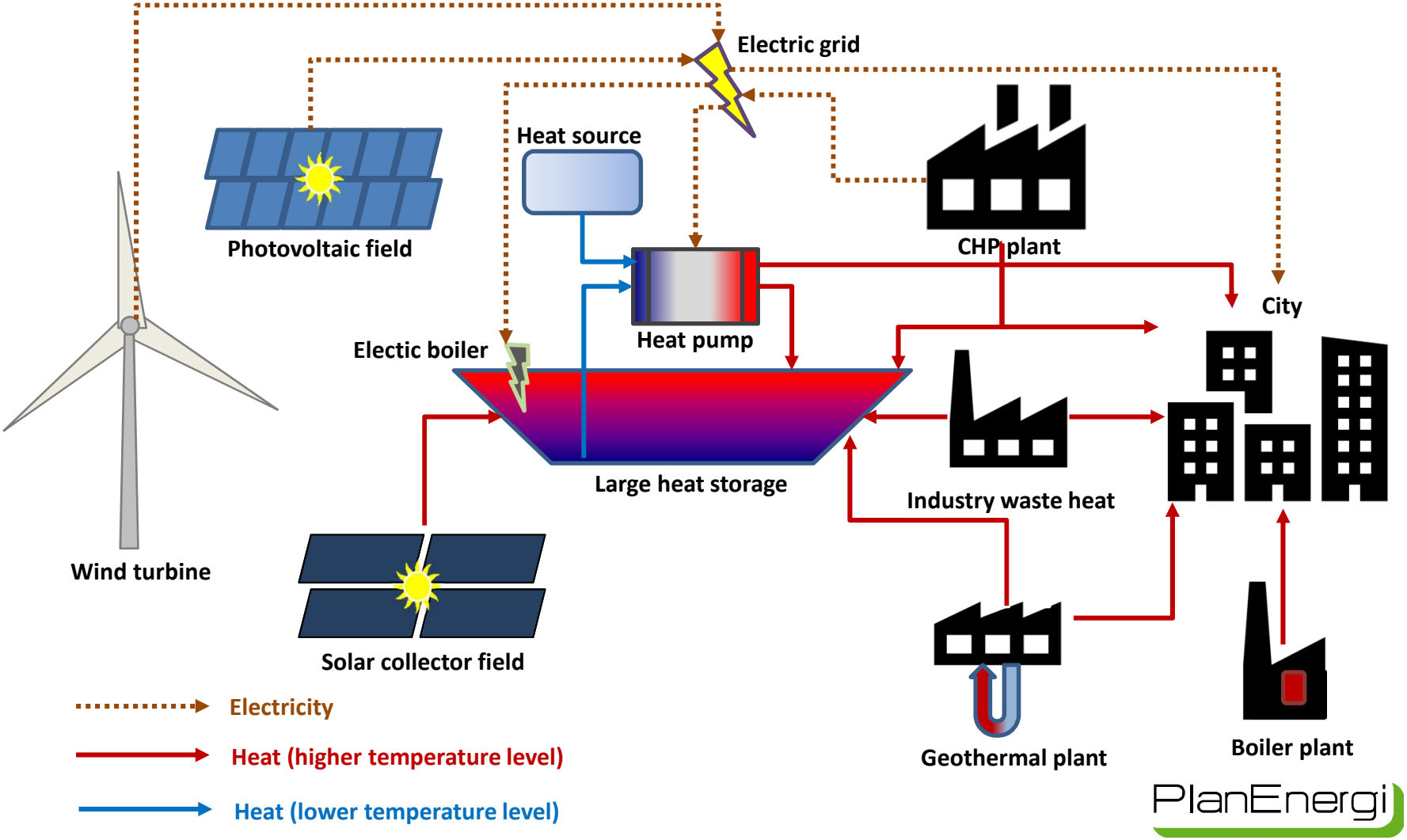
Good heat production price

- Prices down to 30 €/MWh (0.03 €/kWh)
- Average around 45 €/MWh (0.045 €/kWh)

Solar District Heating in Denmark

Status Spring 2019

Solution: Combined technologies and heat storage interacting with the electricity grid …



PlanEnergi

Black ikon from https://pngtree.com/free-icon

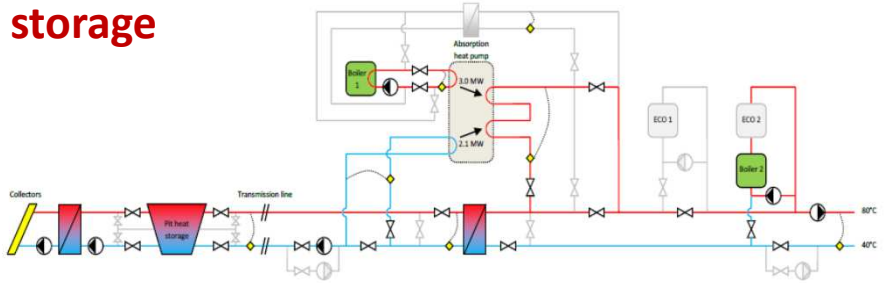
PlanEnergi

Solar District Heating in Denmark

Status Spring 2019

Dronninglund: 37 500 m² & 60 000 m³ pit heat storage

- ❑ 2,1 MW absorbtion heat pump
- ❑ Gas engine
- ❑ Bio oil boilers
- ❑ Solar fraction 40 %
- ❑ **Annual store heat loss 10 % !**



Solar District Heating in Denmark
Status Spring 2019

Vojens: 71 500 m² & 200 000 m³ pit heat storage

- Solar fraction 50 % (est)

http://www.vojensfjernvarme.dk/

Solar District Heating in Denmark

Status Spring 2019

Gram: 41 000 m²; 110 000 m3 water pit storage

http://www.gram-fjernvarme.dk/

Combined collector fields - *Tårs*

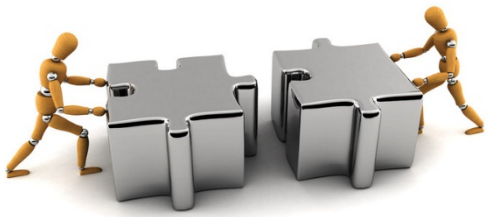
Solar District Heating in Denmark

Status Spring 2019

Solar District Heating in Denmark

Status Spring 2019

Jan Erik Nielsen, PlanEnergi:



- ✓ District heating is a good argument for solar heating
- ✓ Solar heating is a good argument for district heating

- ✓ Renewable electricity production
  - ❑ Solar (PV, CSP)
  - ❑ Wind
  - ❑ CHP (biomass)

FITS VERY WELL WITH:

- ✓ Renewable heat production
  - ❑ Solar (thermal)
  - ❑ Heat pump (wind)
  - ❑ CHP (waste heat)
  - ❑ ***HEAT STORAGE***

Thank you for your attention

jen@planenergi.dk

www.planenergi.dk

SDH in China, Tibet

- Langkazi - 100.000m² residential heating space
- 22.275m² flat plate collectors; 15.000m³ pit storage
- DH net temp. 65/35
- 3MW electric boiler
- All implemented components from Europe
- 100% sponsored by China's central government

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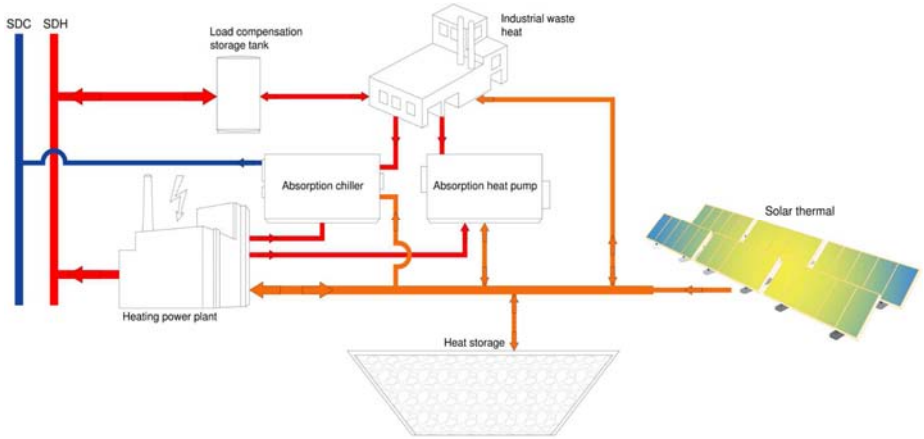
SDH in China, Tibet

SDH Trends and Core Topics

- Denmark large scale installations and long term experience “infects” several countries around the world
- Barriers and opportunities to maximize ST share are core topics for researchers
- Development of seasonal storages concepts; seasonal storage for more flexibility in the DH net
- Model based control strategies for the whole system (ST, DH…)
- Design of solar thermal systems including hybrid technologies like seasonal storages, biomass, waste heat, interaction with CHP, etc.

Next Task 55 Meeting



7th TASK 55 Meeting and DH Workshop

Location: Sweden, Härnösand (Host ABSOLICON)

Date: 7 - 9 October 2019

If you want to participate in one of the next meeting please contact the operating agent s.putz@solid.at

3rd SHC Task 55 Meeting in Abu Dhabi

34 industry and research Experts from 12 Countries
27/28 October 2017

www.iea-shc.org

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