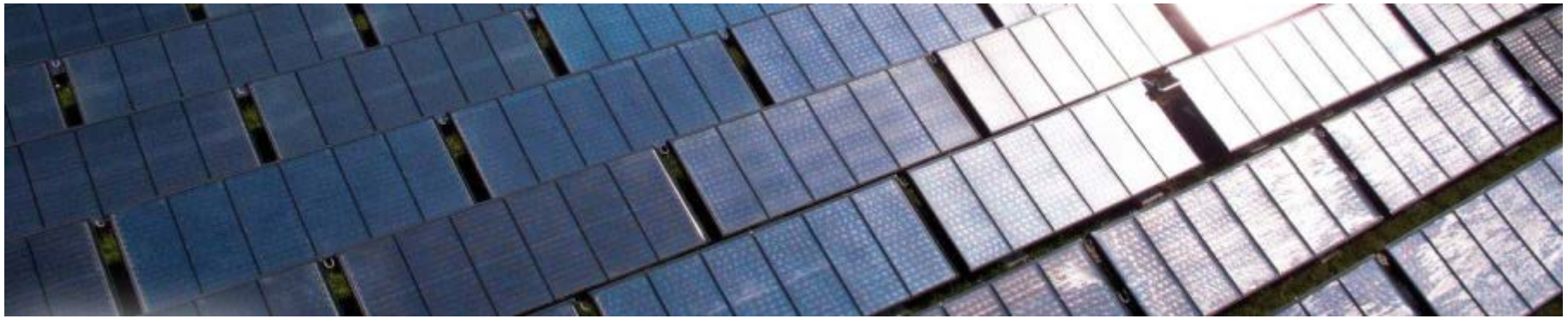
Solar Heat –
A future major source for district heating

Sustainable Energy Solutions for Large Facilities



SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

SOLID GmbH since 1992

Puchstraße 85, A-8020 Graz, www.solid.at, office@solid.at

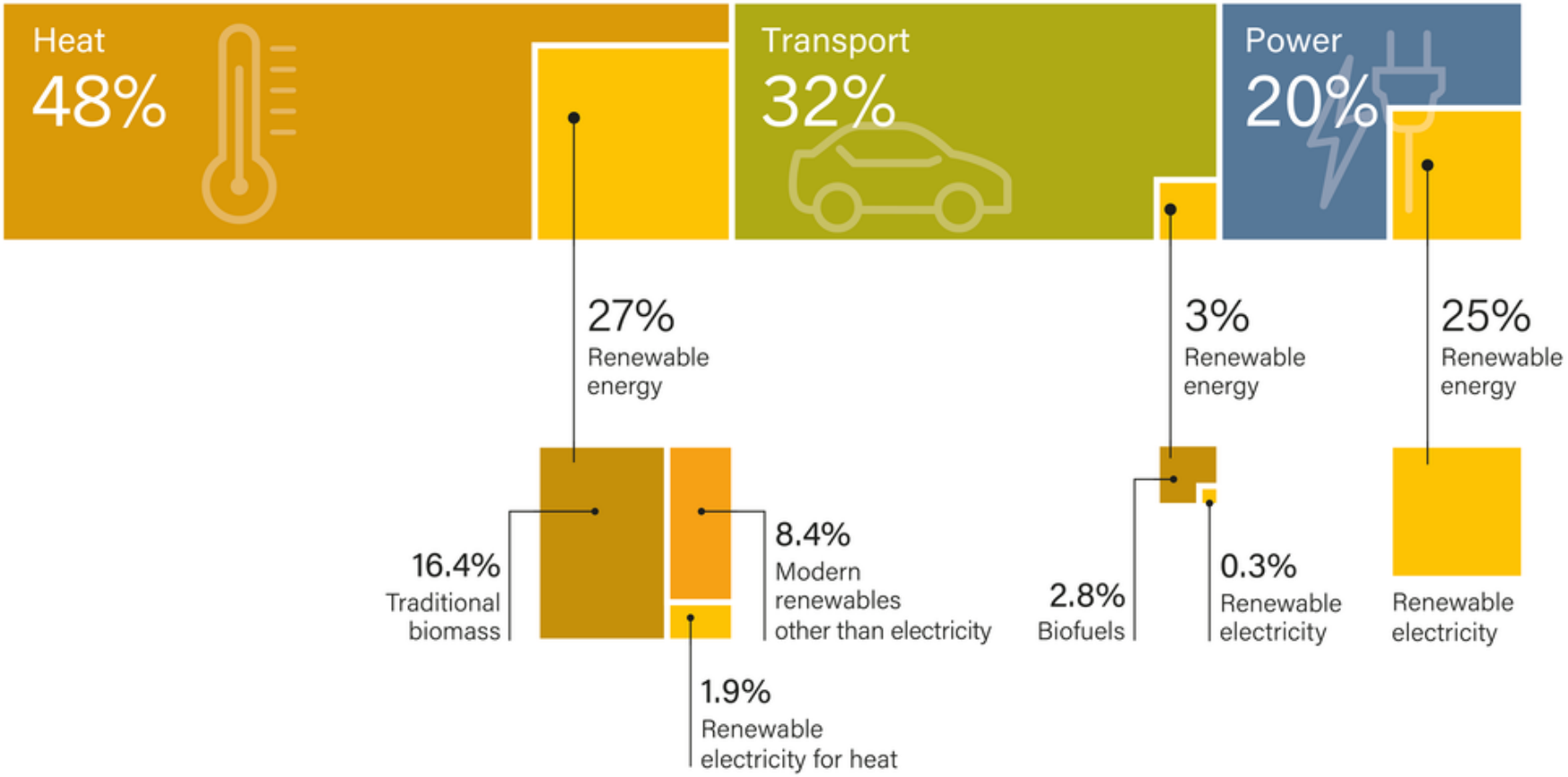
My background

- ✓ **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)

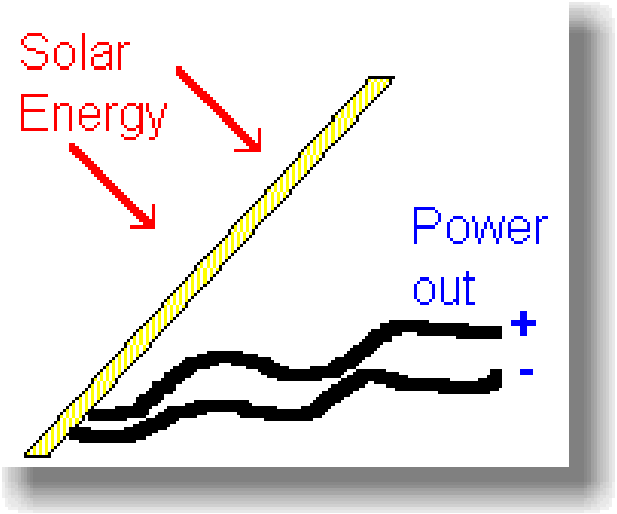
Heat- Mobility- Electricty

FIGURE 3. Renewable Energy in Total Final Energy Consumption, by Sector, 2015

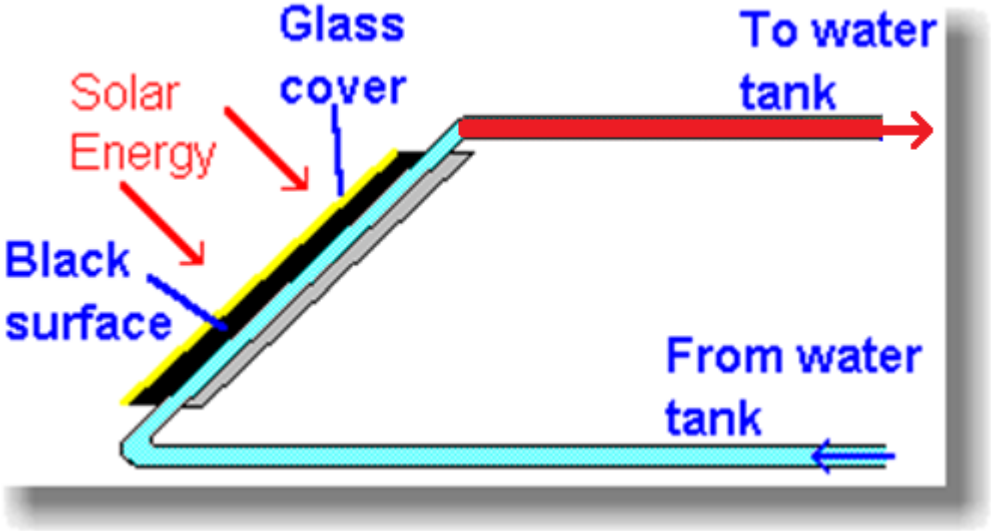


I talk about Solar THERMAL

- Solar PV (Electricity)



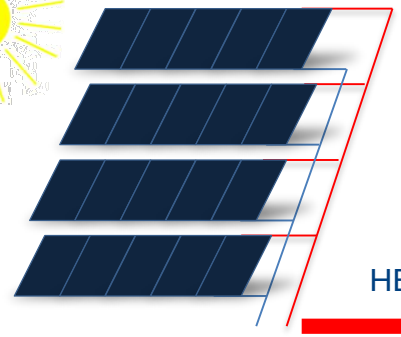
- Solar Heating (Heat)



> 500 % higher output per m² !

Solutions with Solar Thermal

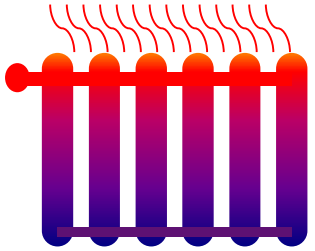
SOLID
solarinstallation+design



SOLAR YIELD

HEAT

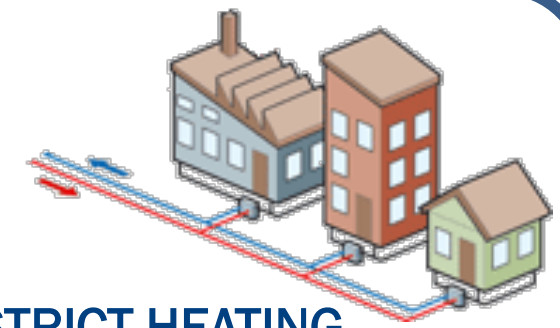
STORAGE



DOMESTIC HOT WATER
SPACE HEATING

GBE Factory

PROCESS HEAT



DISTRICT HEATING

SDH
solar district heating

THERMAL DRIVEN COOLING PROCESS

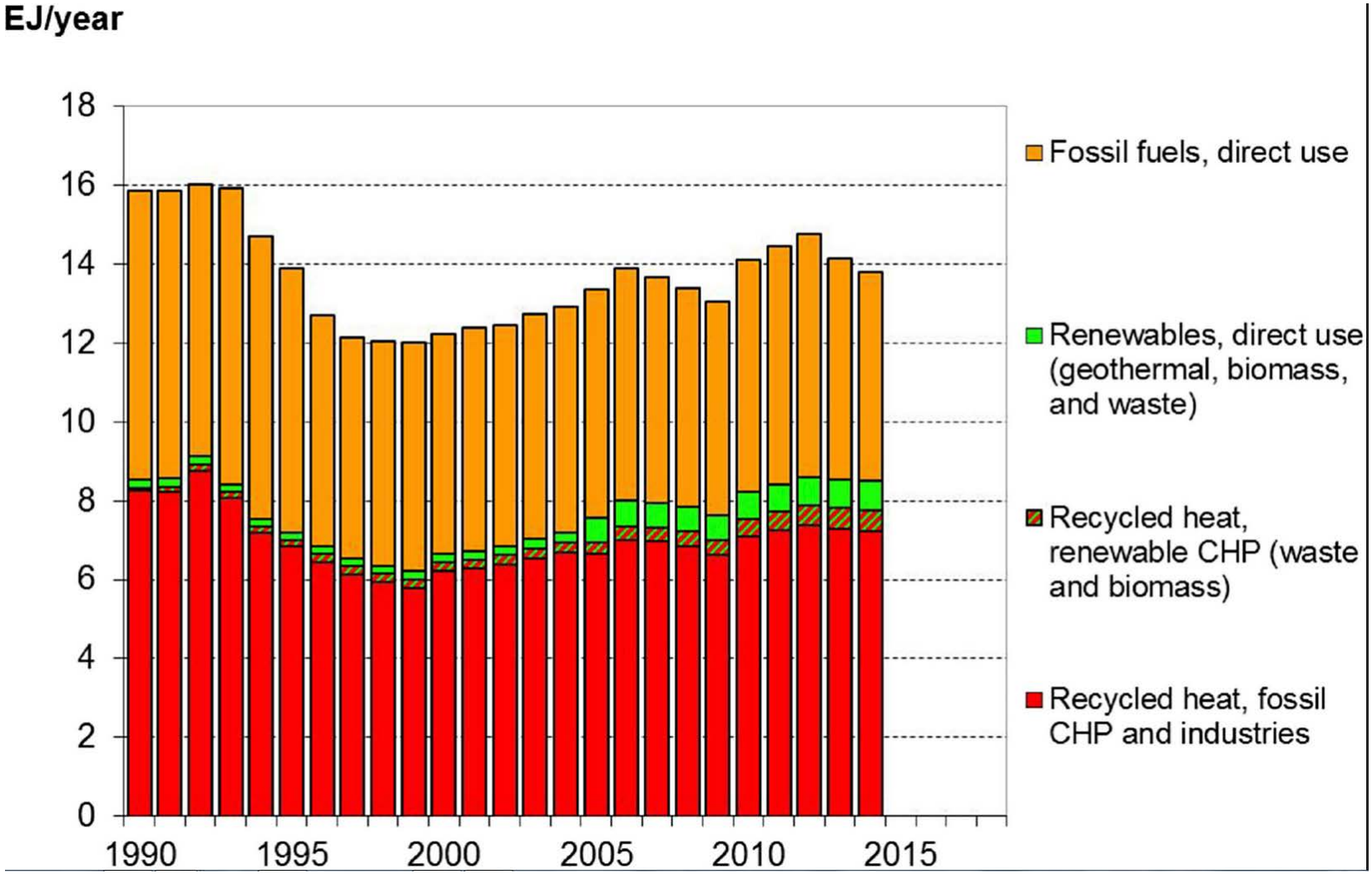
COLD WATER

CONDITIONED AIR

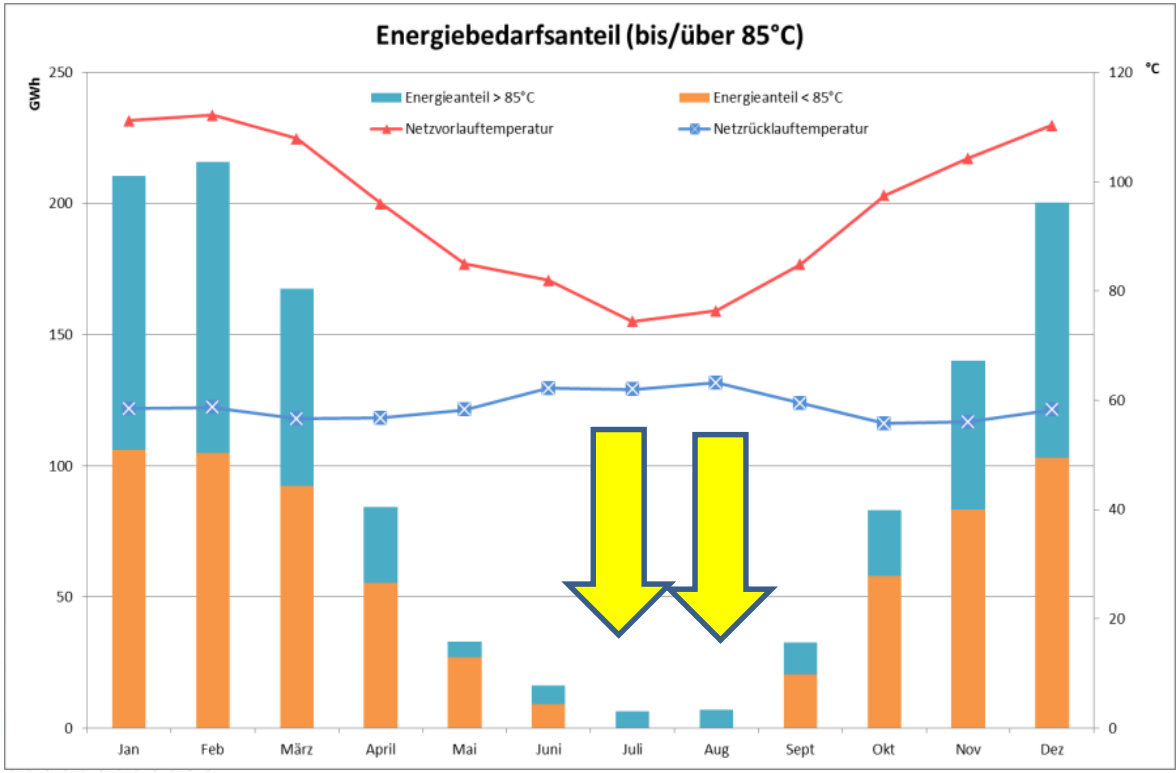
COOLING LOAD

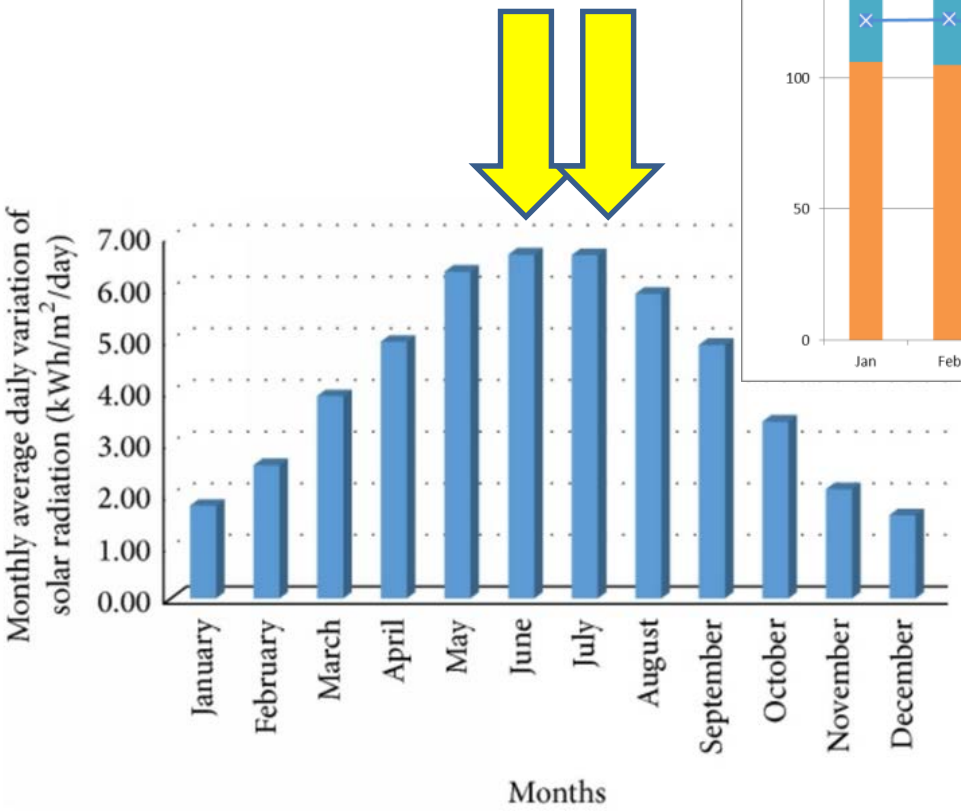
SOLAR COOLING

Todays sources DH world wide

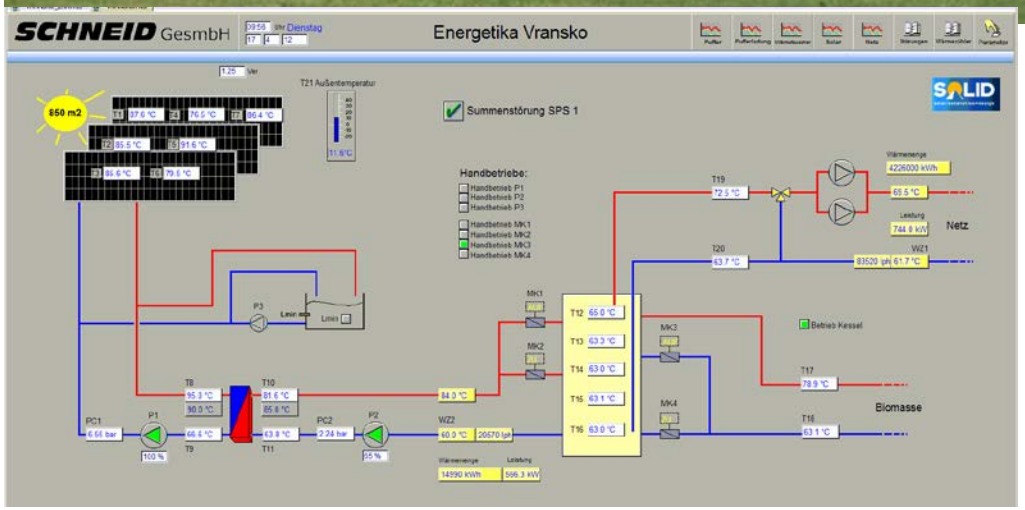


Typical annual demand





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

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

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

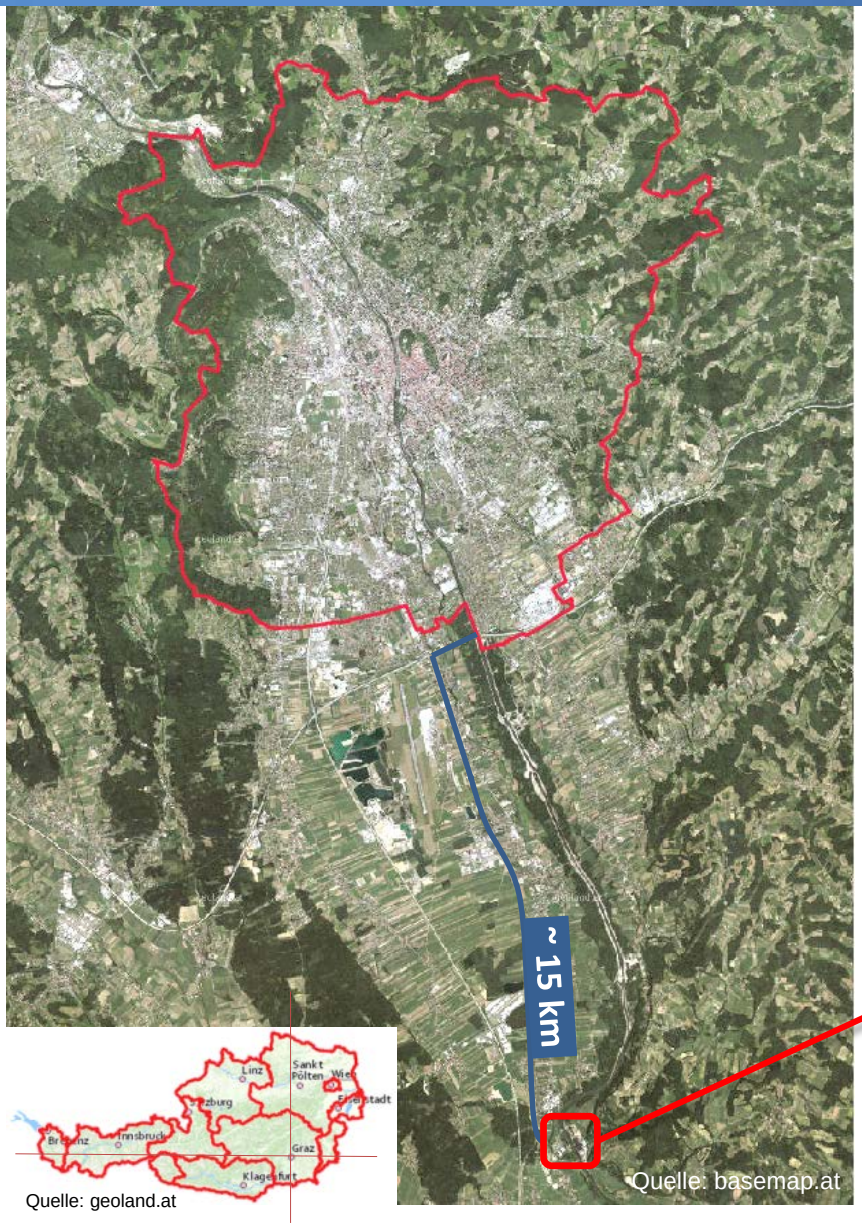
Limitations

- 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

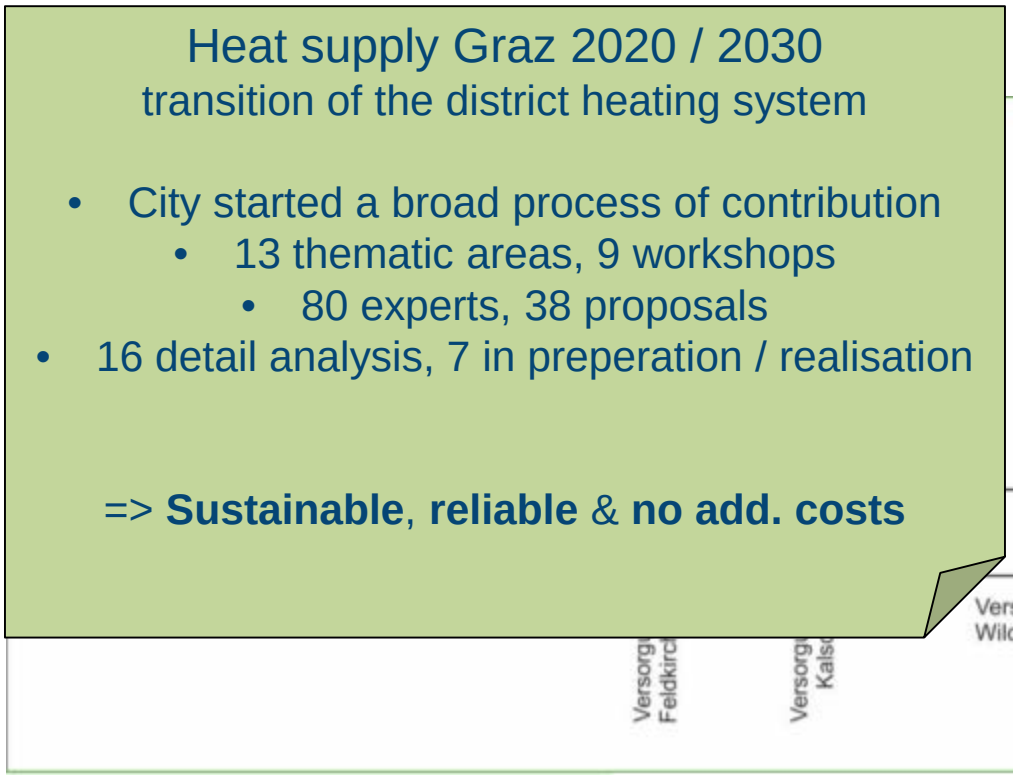
District heating in Graz – Current situation

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 preperation / realisation

=> **Sustainable**, **reliable** & **no add. costs**



Source: E-Stmk, C. Hackl, Vortrag: Erfahrungen mit Solar-Wärmeeinspeisung 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

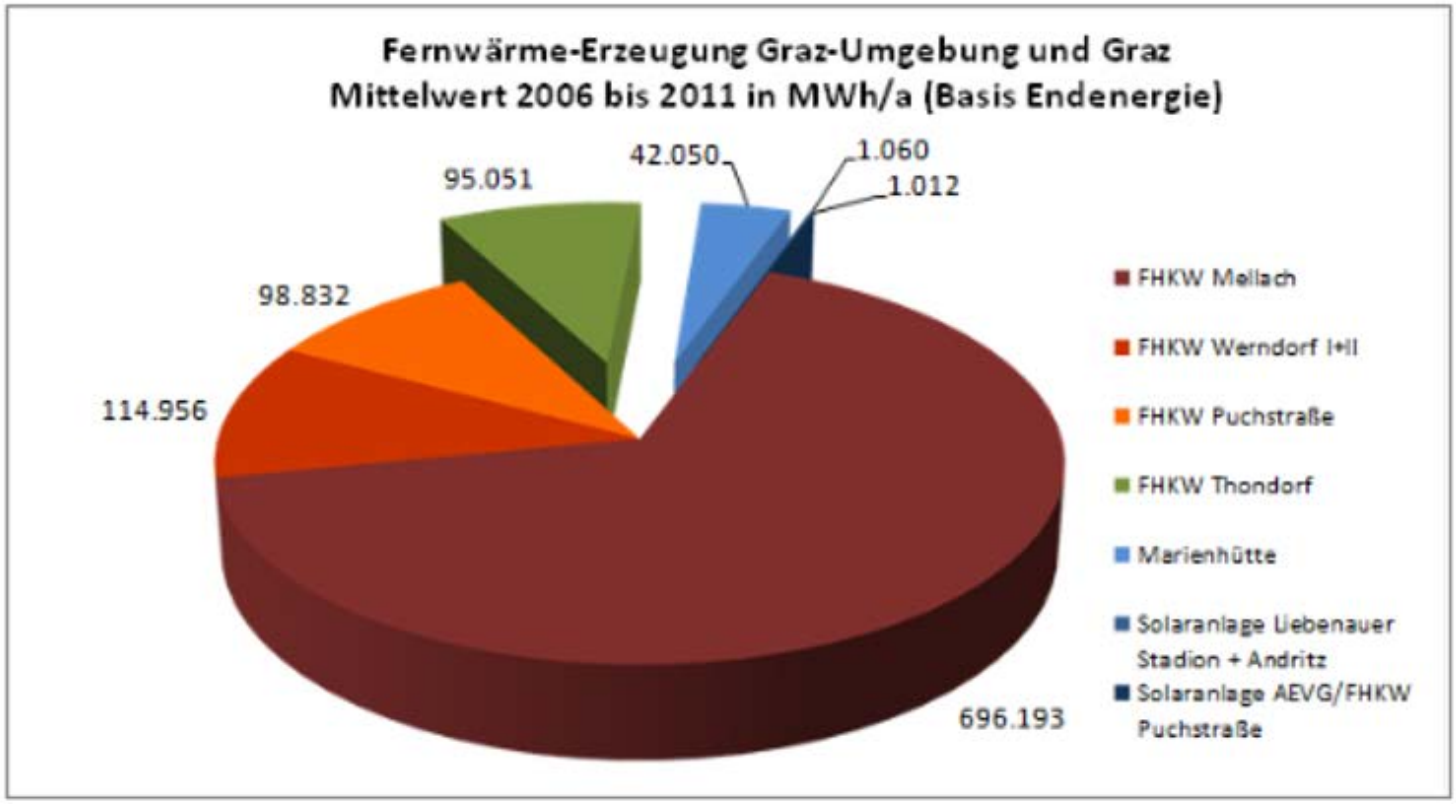
CCGT 400 MW_{th}
800 MW_{el}

Contract for delivery till 2020

End of technical life expectancy

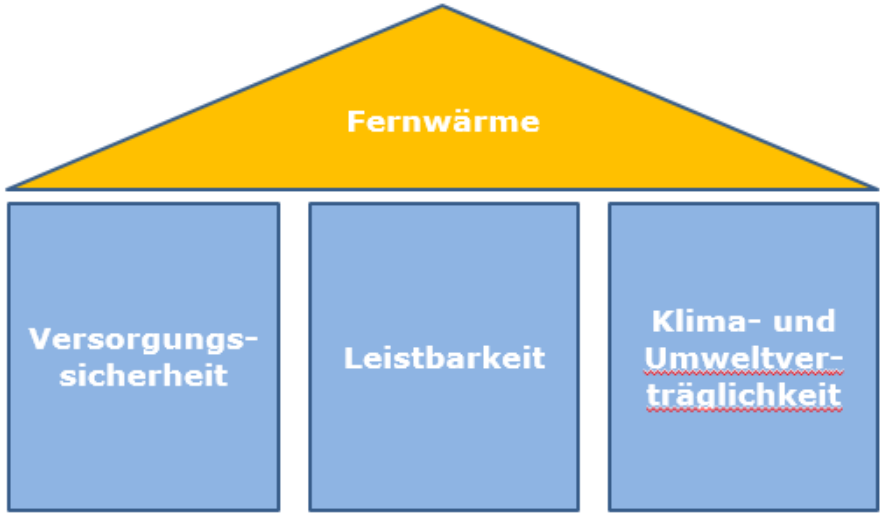
Coal-fired power station
230 MW_{th}
226 MW_{el}

Ausgangssituation Graz

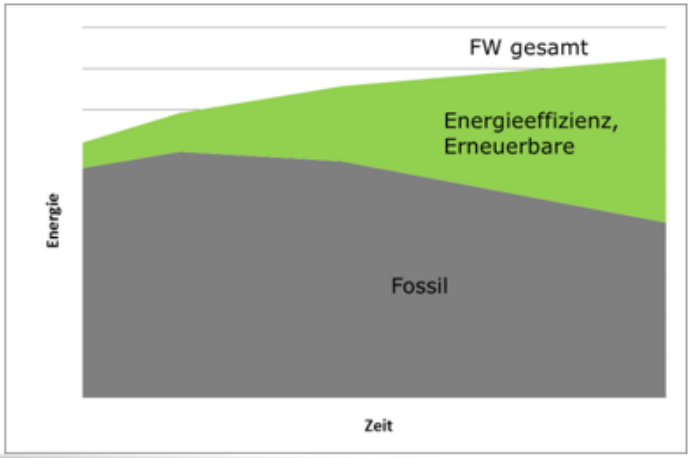


Spitzenlast: ca. 500 MW **Aufbringung: ca. 1.200 GWh**

Ausgangssituation Fernwärme

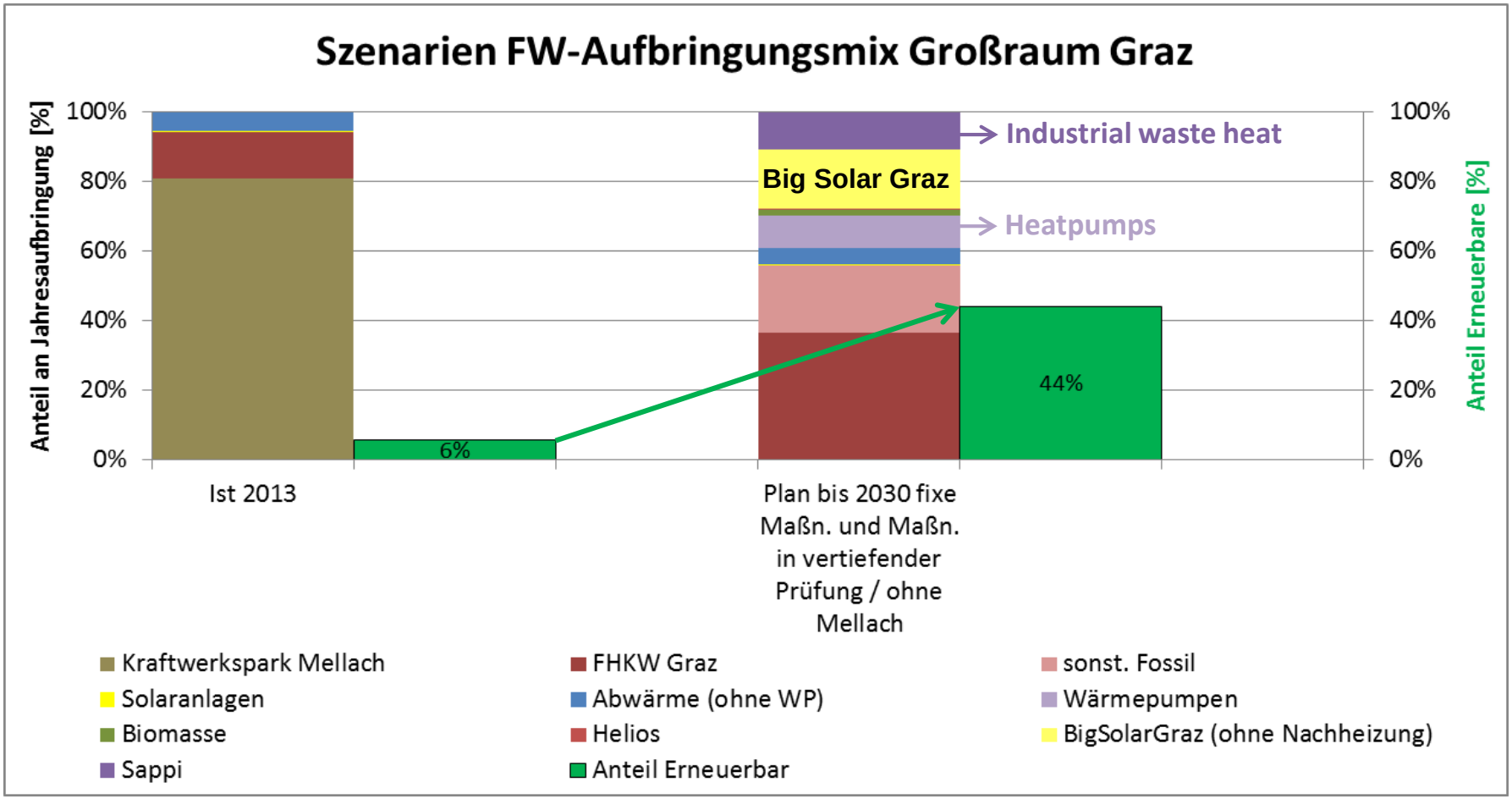


Wärmeversorgung 2030 und danach



PLAN for future of DH in Graz

Condition today → **from 2020 onwards**



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

Seasonal storage & solar collectors

Collector array: 70.000 m^2 with long-term storage: 207.000 m^3

Storage

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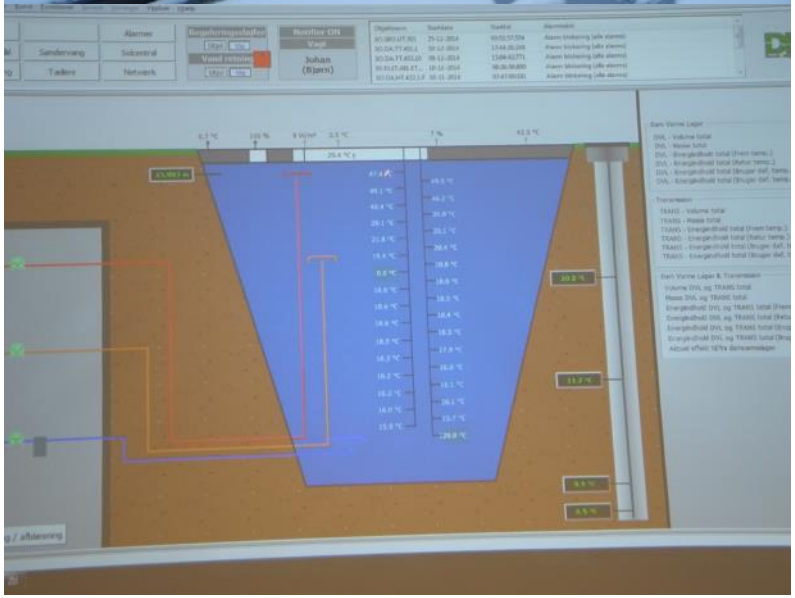
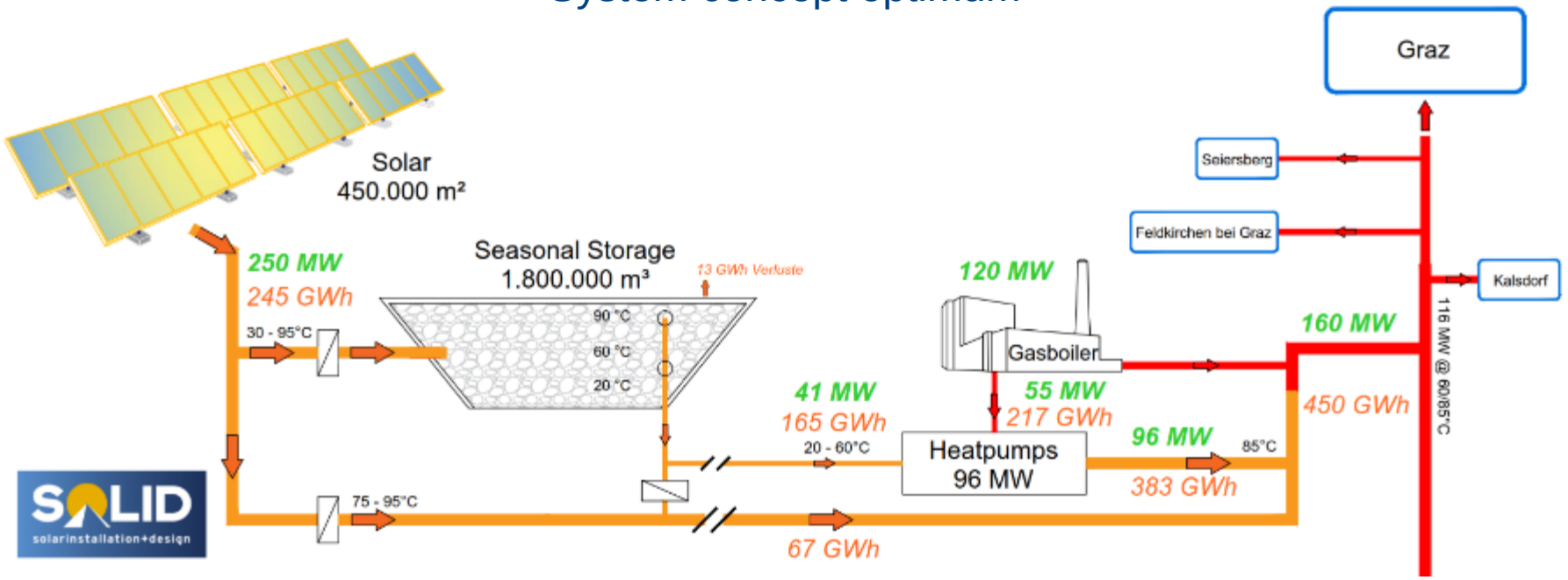
Storage



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 compareable to Natural Gas

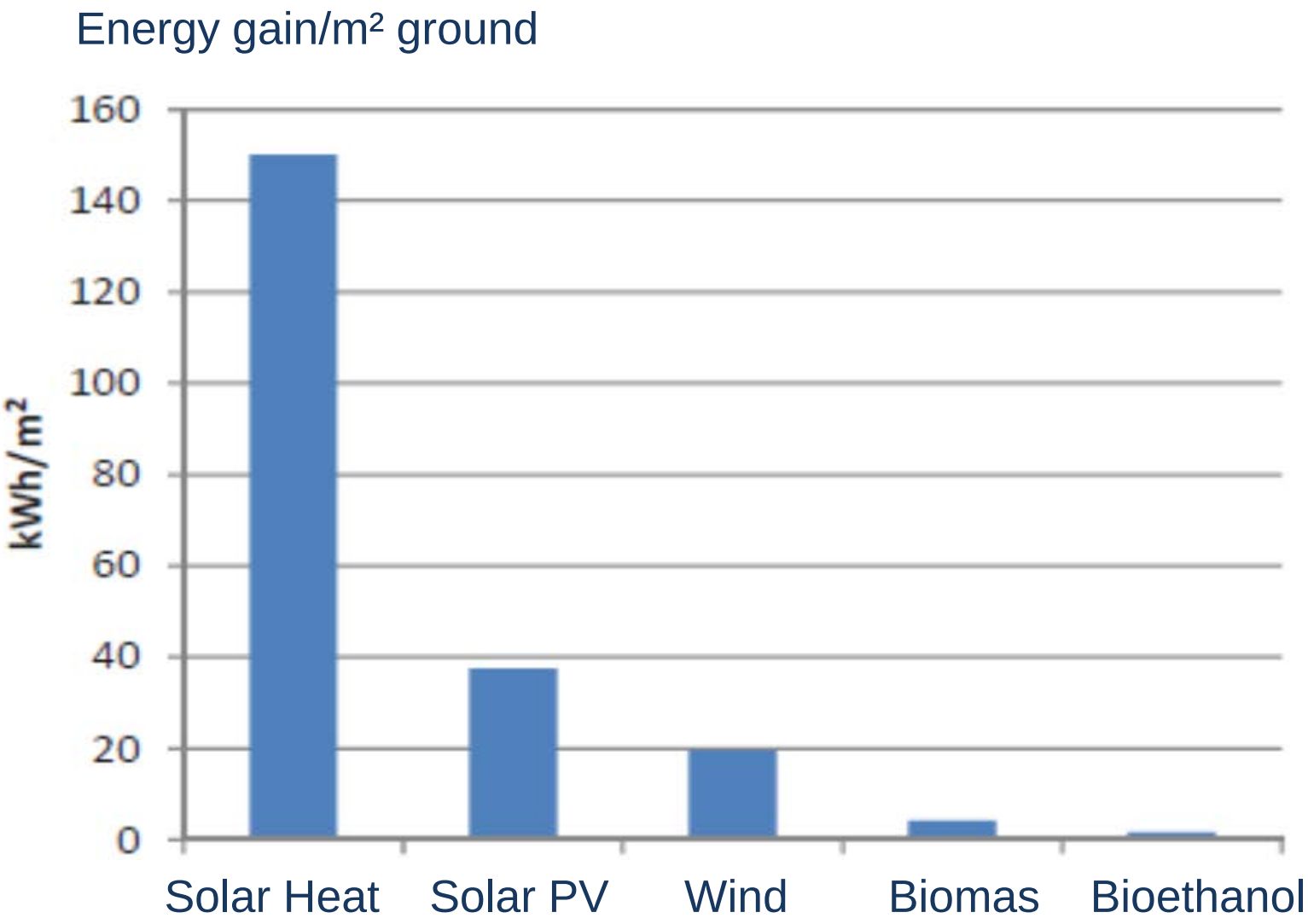
Feasibility

Volumen Saisonalspeicher [m³]

Specific capital cost €/MWh	200,000	400,000	600,000	800,000	1,000,000	1,200,000	1,400,000	1,600,000	1,800,000	2,000,000
50,000										
100,000	48	47	49	53	57	60	64			
150,000	47	41	41	42	43	46	48	50	53	55
200,000	49	42	39	39	39	40	41	43	45	47
250,000	49	44	40	38	38	38	38	38	38	39
300,000	50	45	41	39	37	37	37	37	37	38
350,000	53	45	42	40	39	37	37	37	37	37
400,000	56	45	43	41	40	38	37	37	37	37
450,000	56	48	44	42	41	39	38	37	36	37
500,000	60	51	45	43	42	40	39	38	37	38
550,000		54	46	45	43	42	40	39	39	39
600,000		54	48	46	44	43	41	41	41	41
650,000		58	49	47	46	44	43	43	43	43
700,000		58	51	49	47	46	44	44	45	45
750,000		58	52	50	49	47	46	46	47	47
800,000		60	54	52	50	49	48	48	49	49
850,000			55	53	52	50	50	51	51	51
900,000			56	55	53	52	52	52	53	53
950,000			58	56	55	54	54	54	54	55
1,000,000			59	58	56	56	56	56	56	56

Kollektorfläche [m²]

Required Space



required space: Big Solar Graz

required solar system area
< 0,8 % of the city area

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!

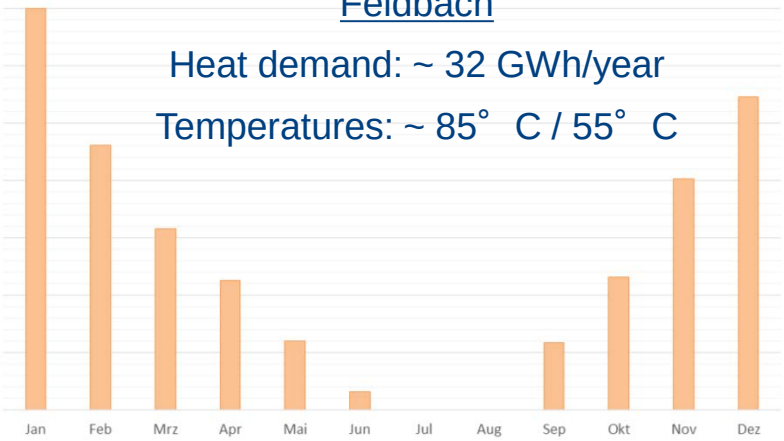
Feasibility Feldbach (example with 54.000 m² used space)

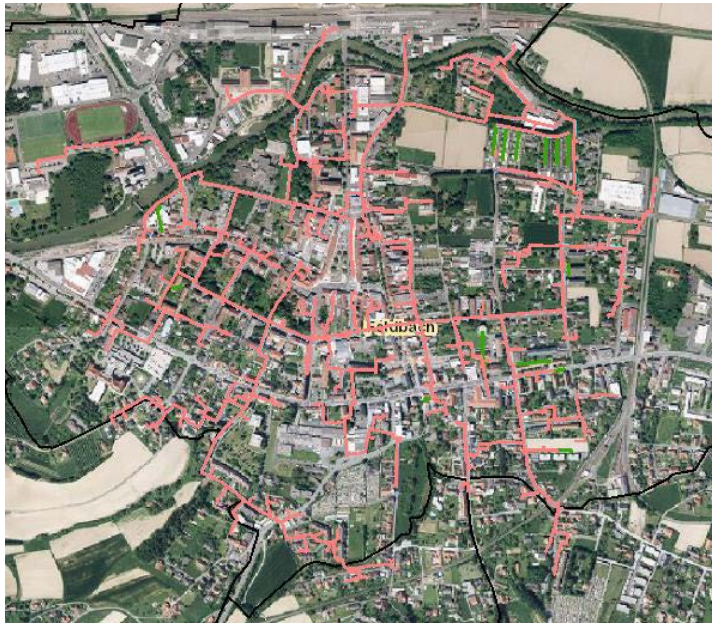
SOLID solarinstallation+design

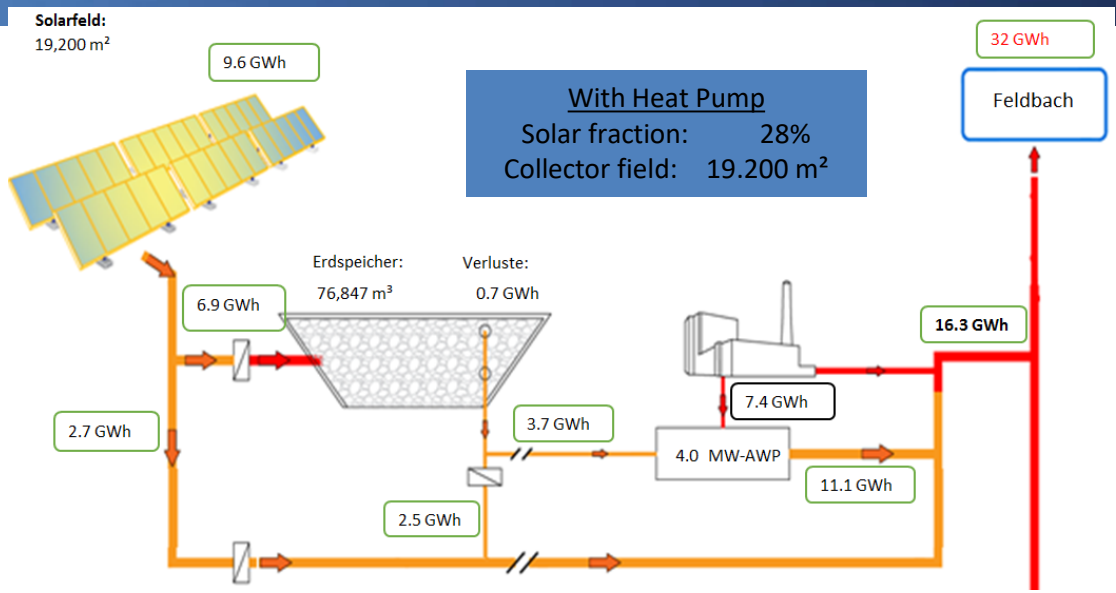
Feldbach

Heat demand: ~ 32 GWh/year

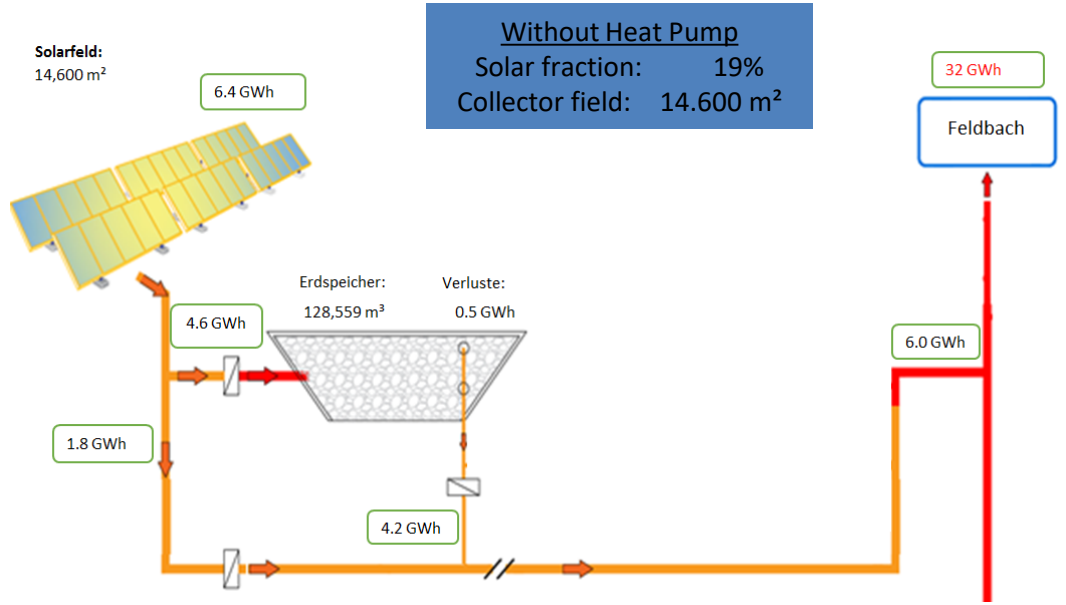
Temperatures: ~ 85° C / 55° C







With Heat Pump
Solar fraction: 28%
Collector field: 19.200 m²



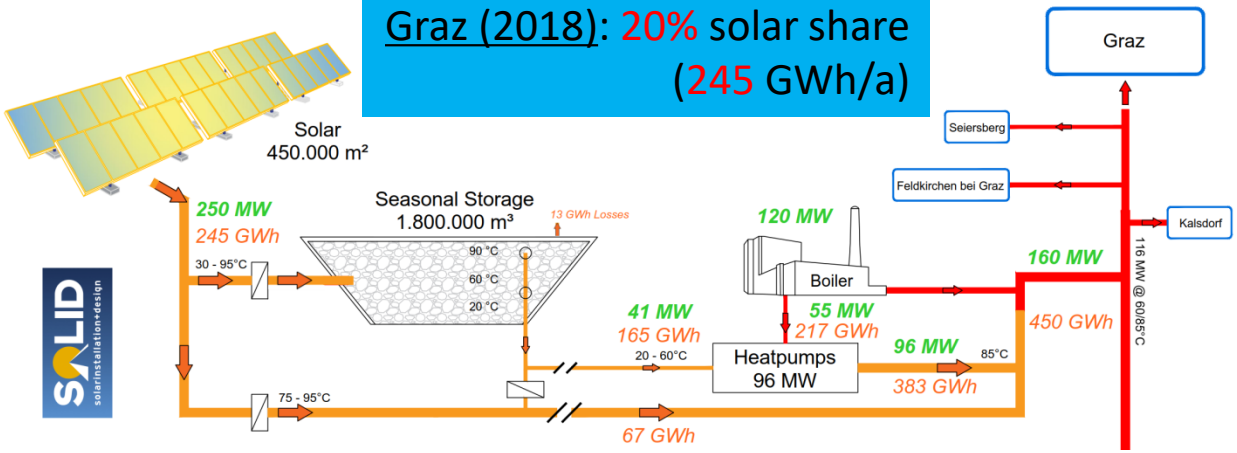
Without Heat Pump
Solar fraction: 19%
Collector field: 14.600 m²

SDH examples

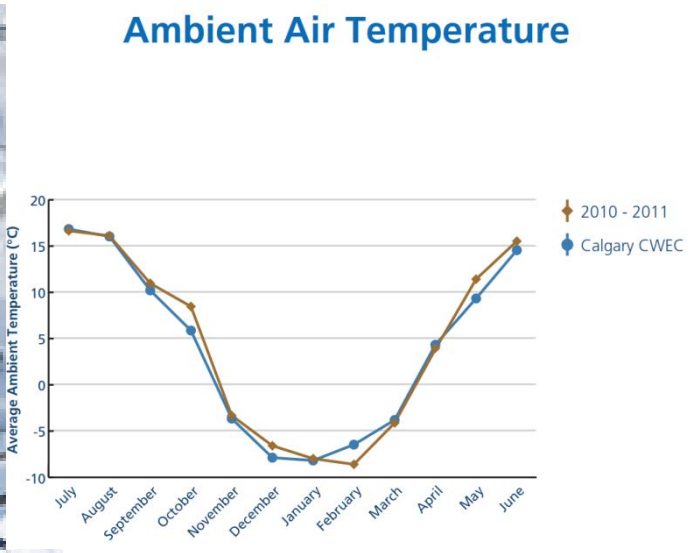
Silkeborg (2016): 20% solar share (80 GWh/a)

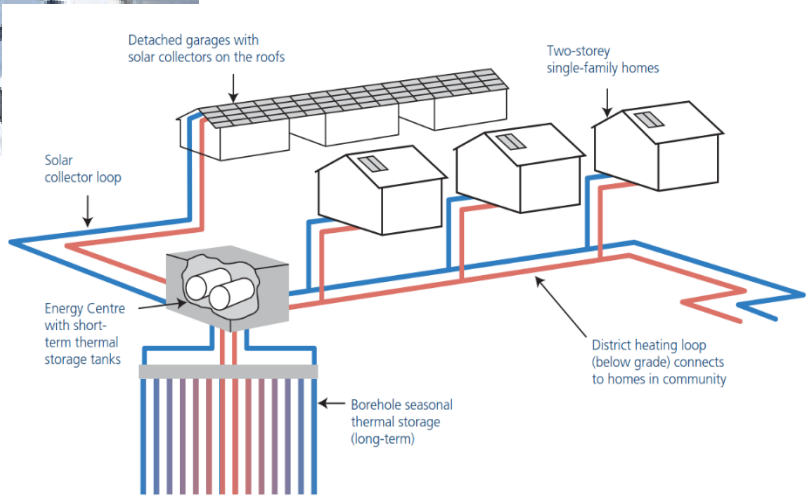
Vojens (2014): 50% solar share (35 GWh/a)

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 succesful 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
- Capactiy 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?

European Bank for Reconstruction and Development

- **Re**newable **D**istrict **E**nergy in the **We**stern **B**alkans
- ReDEWeB Programme aims to support the establishment of a market for ReDE investment through a range of measures
- **Re**newable 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.

Thank you for your attention!

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