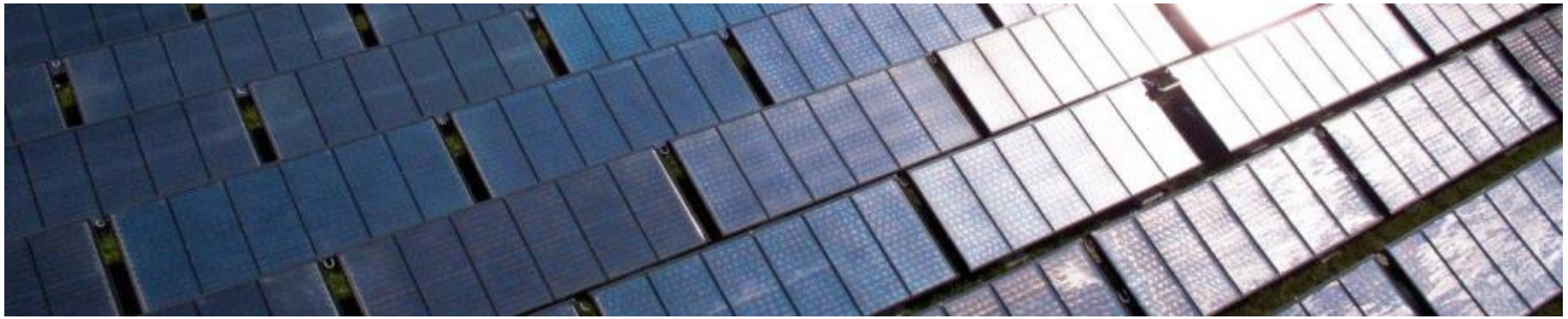
Big Solar-
from the first idea to a European dimension

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 26 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)

Solar District Heating

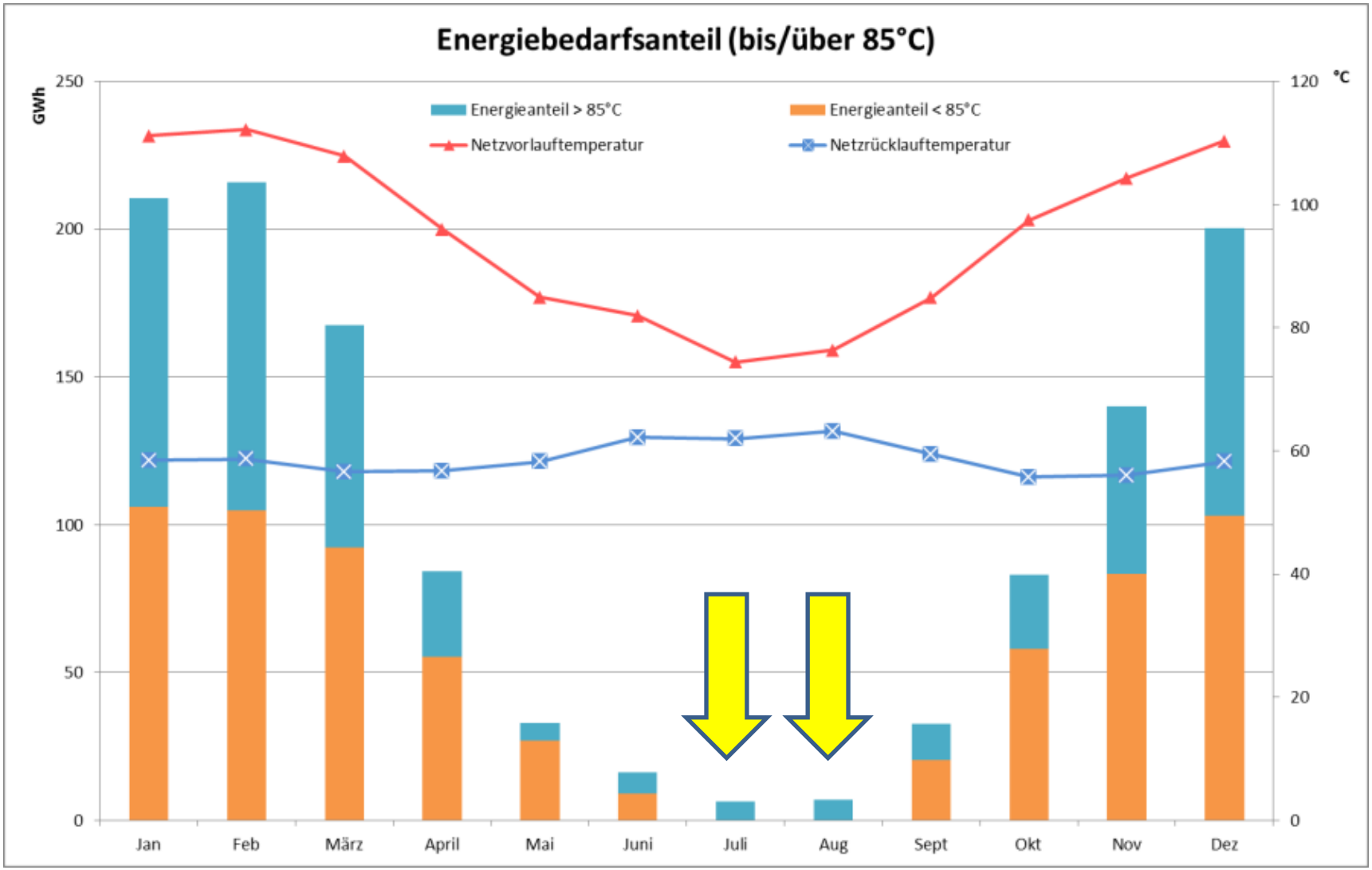
1st Integration Urban Solar District Heat

Solar Panels
1430 m²/ 1 MW

Start 2002

Solar energy is directly used in the grid, peak solar generation is significantly below lowest heat load in grid in summer

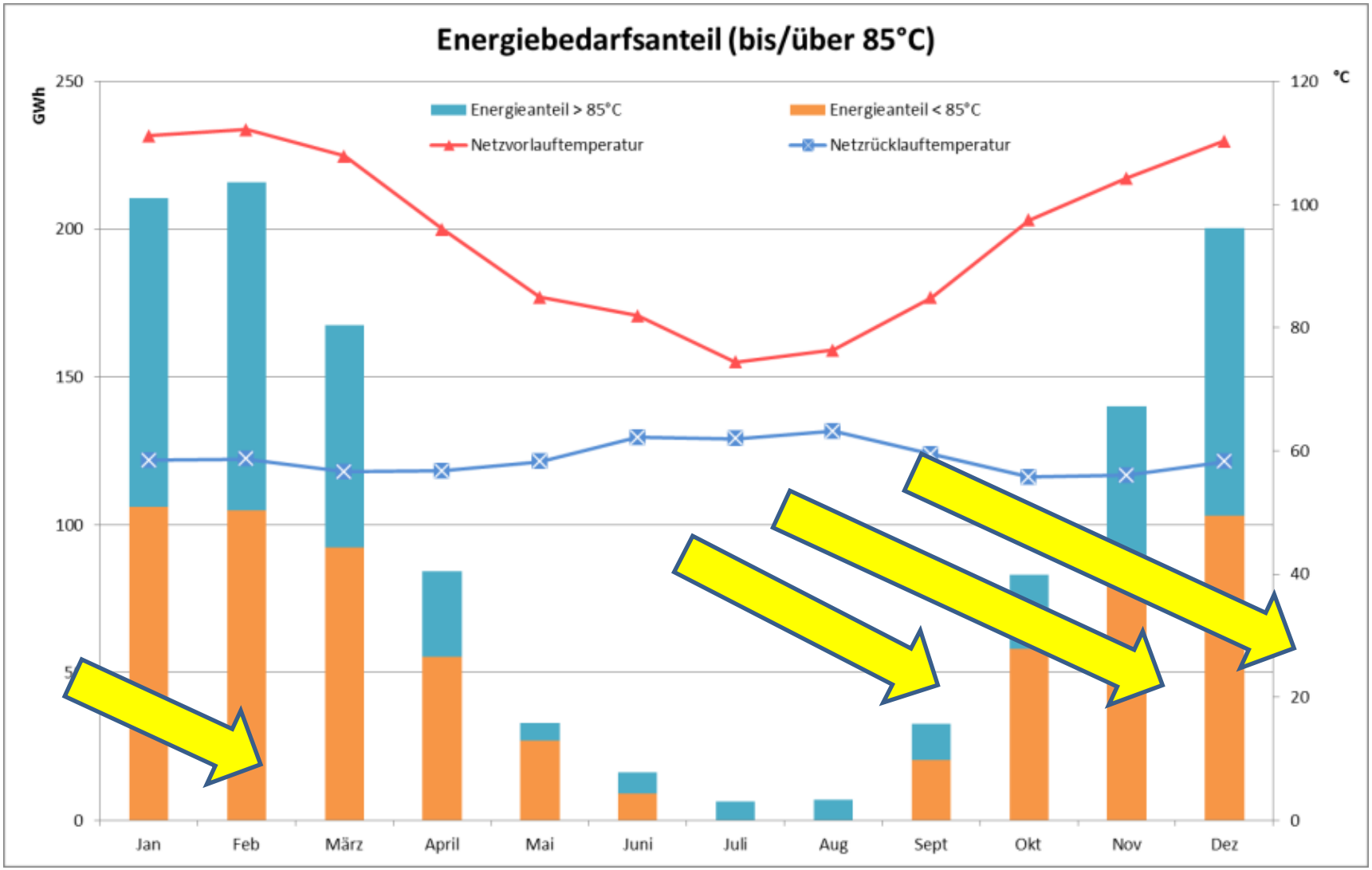
Typical annual demand



216 solar thermal plants for the generation of heat and cold each with more than 500 m^2 collector area/350 kW_{th} nominal capacity

BIG Solar
Storing summer heat for winter

Typical annual demand



Seasonal storage & solar collectors

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

Trends behind new targets

SOLID solarinstallation+design

NATIONALE UND INTERNATIONALE TRENDS

ENERGIE STEIERMARK

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]

Current Steps According to Utility

- Industrial Consortium for investment formed.
- Land for storage and buildings secured
- Acquisition of land for collectors mostly secured
- Preparation of permissions and administrative procedures
- Financing negotiations ongoing

Targeted date for completion of approving:

1st Quarter 2019

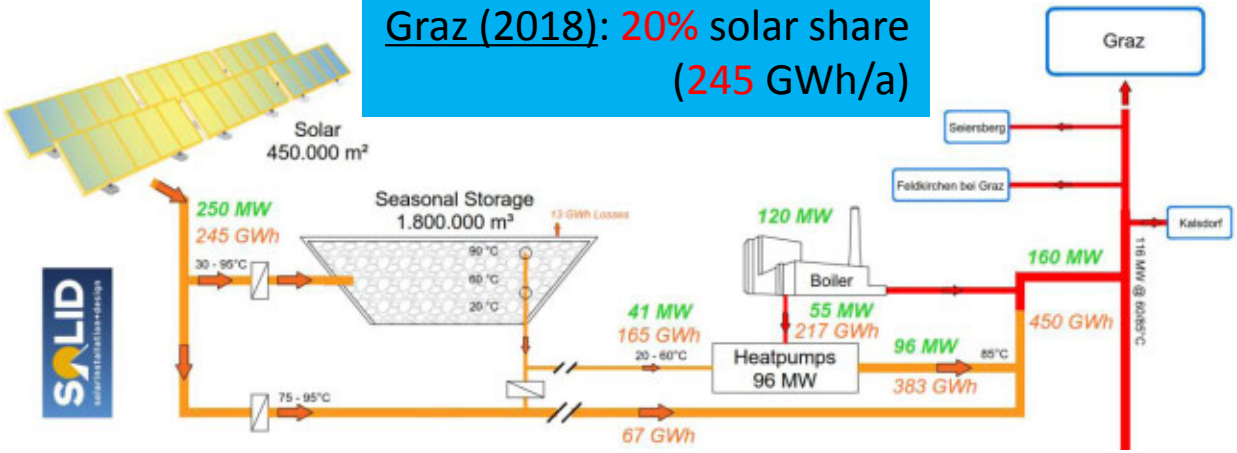
Potential

SDH examples

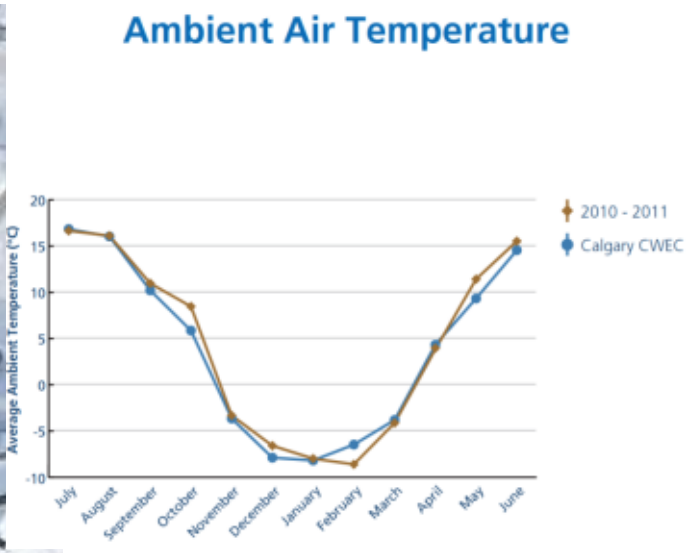
Silkeborg (2016): 20% solar share (80 GWh/a)

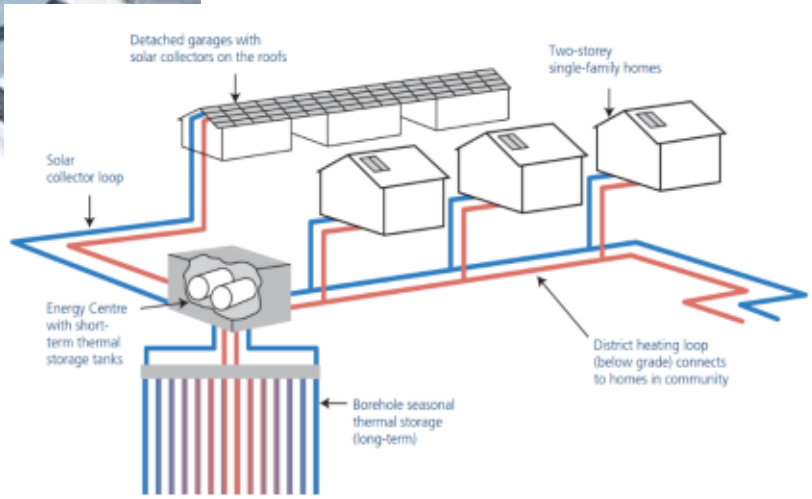
Vojens (2014): 50% solar share (35 GWh/a)

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

Success Factors, Challenges and Opportunities

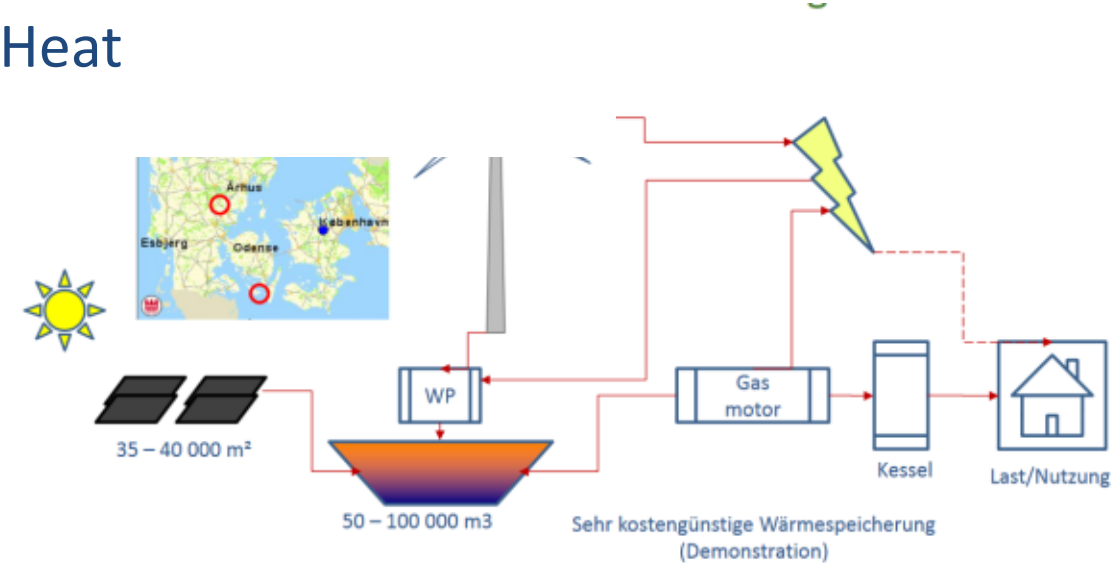
Relevant Success Factors & Challenges

- Return Temperatures of District Heating
  - The lower the more solar fraction !
- Competetive heat supply and costs
  - Waste Heat
  - Coal
  - Biomass and Natural Gas
- Space requirements
- Integration of storage/Heat pump for added value
- Minimum size for seasonal storage needed

Added Values

- Storage
  - used for waste heat (CHP, industry)
  - P2H, in times not needed for solar
  - Peak energy supply

- Heat Pump
  - Flue Gas Condensation/
    Cooling to recover Heat



Potential Austria

- Minimum DH size app. 20 – 30 GWh Heat demand/year
- Cities of more than 8.000 Inhabitants
- In Austria, 4.4 Mio live in this target cities
- Solar Fraction between 30 and 70% achieveable
- Current Austrian DH consumption is app. 24 TWh/year

- Assuming future development of DH, **10-12 TWh solar** contribution are reasonable
- That translates to 17 Mio. m² Solar Collectors and app. 4.5 Bio € Investment

  space demand = 6* 6 km for all of Austria
  current inventory solar collectors 5 Mio m²
- Achievable CO_2 savings 2.4 Mio ton

  8% of Austrian saving target

Potential Europe

- Minimum DH size app. 20 – 30 GWh Heat demand/year
- Cities of more than 8.000 Inhabitants
- Urbanisation is going on
- Solar Fraction between 30 and 70% achieveable
- Current DH consumption is app. **600 TWh/year**

- Assuming future development of DH, **200-300 TWh solar** contribution are reasonable
- That translates to 400 Mio. m² Solar Collectors and 120 Bio €
  current inventory 50 Mio m²
  Current Power Investments in Europe: 40- 60 Bio €/year
- Achievable Annual CO_2 savings 60 Mio ton
  Austrias total emisions today 70 Mio ton, target 50 Mio ton

Summary

- Big Solar has a huge potential and can contribute to decarbonizing District Heating significantly
- 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

Thank you for your attention!

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