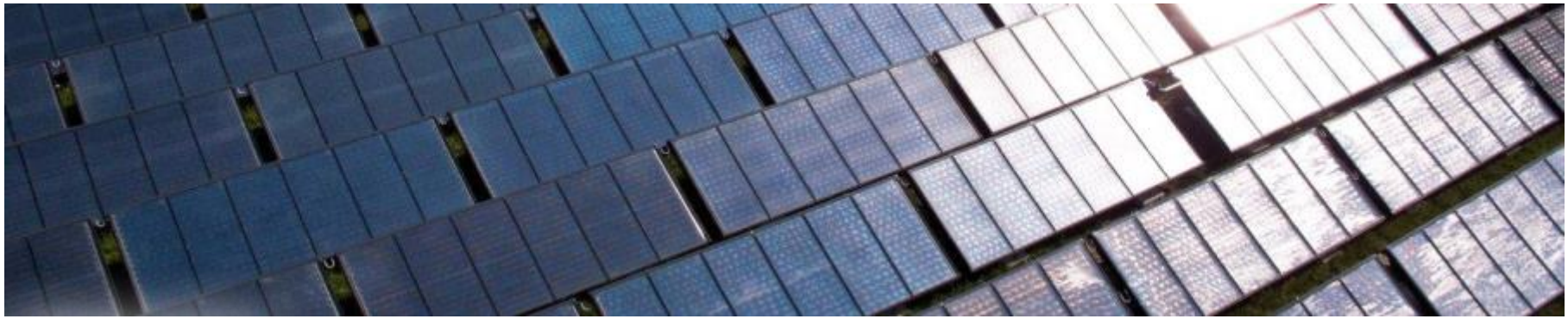
Solar District Heating

Big Solar- Adding seasonal storage to solar district heating

Sustainable Energy Solutions for Large Facilities



SOLID GmbH since 1992

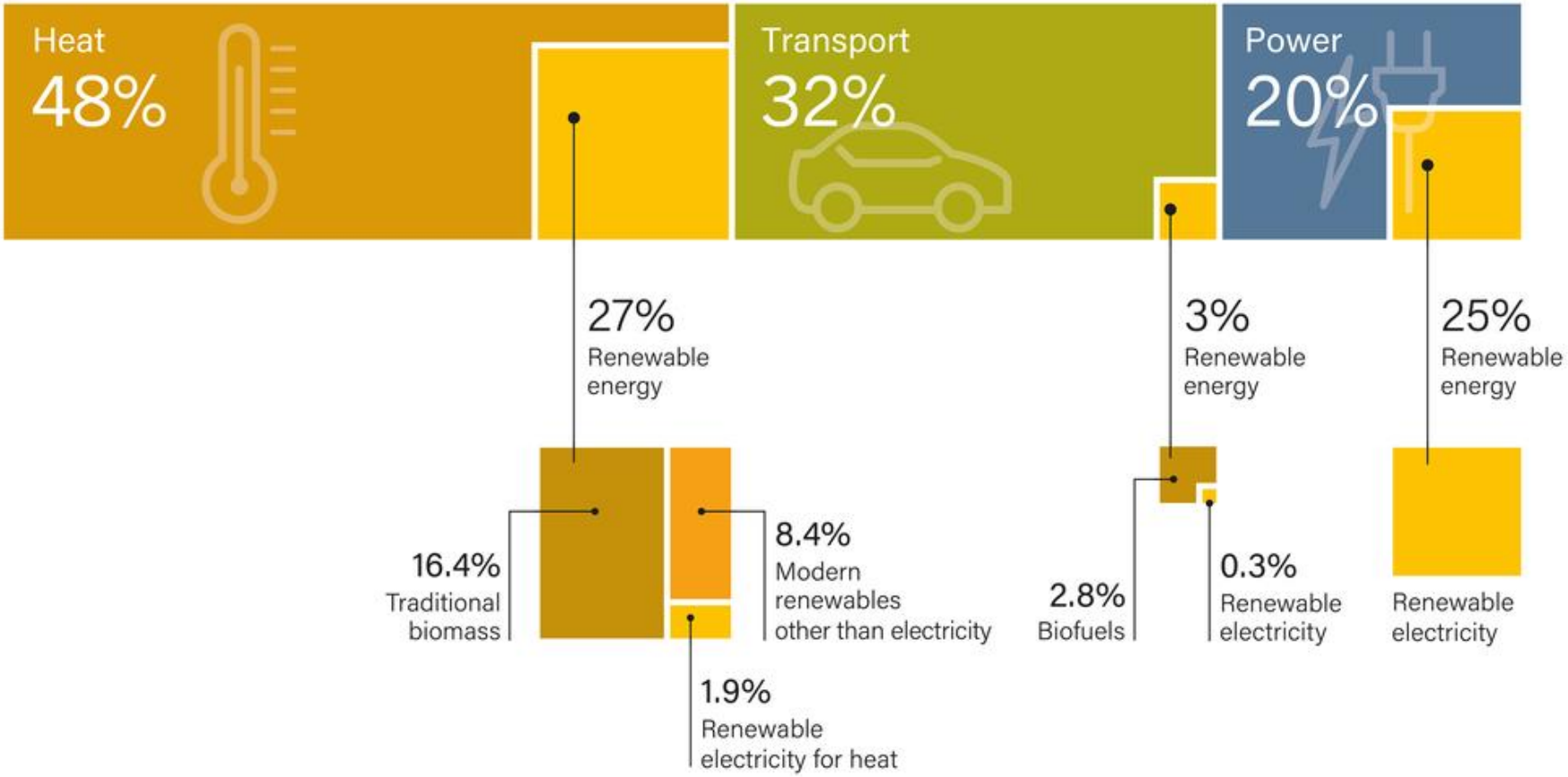
Puchstraße 85, A-8020 Graz, www.solid.at, office@solid.at

SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

Solar District Heating

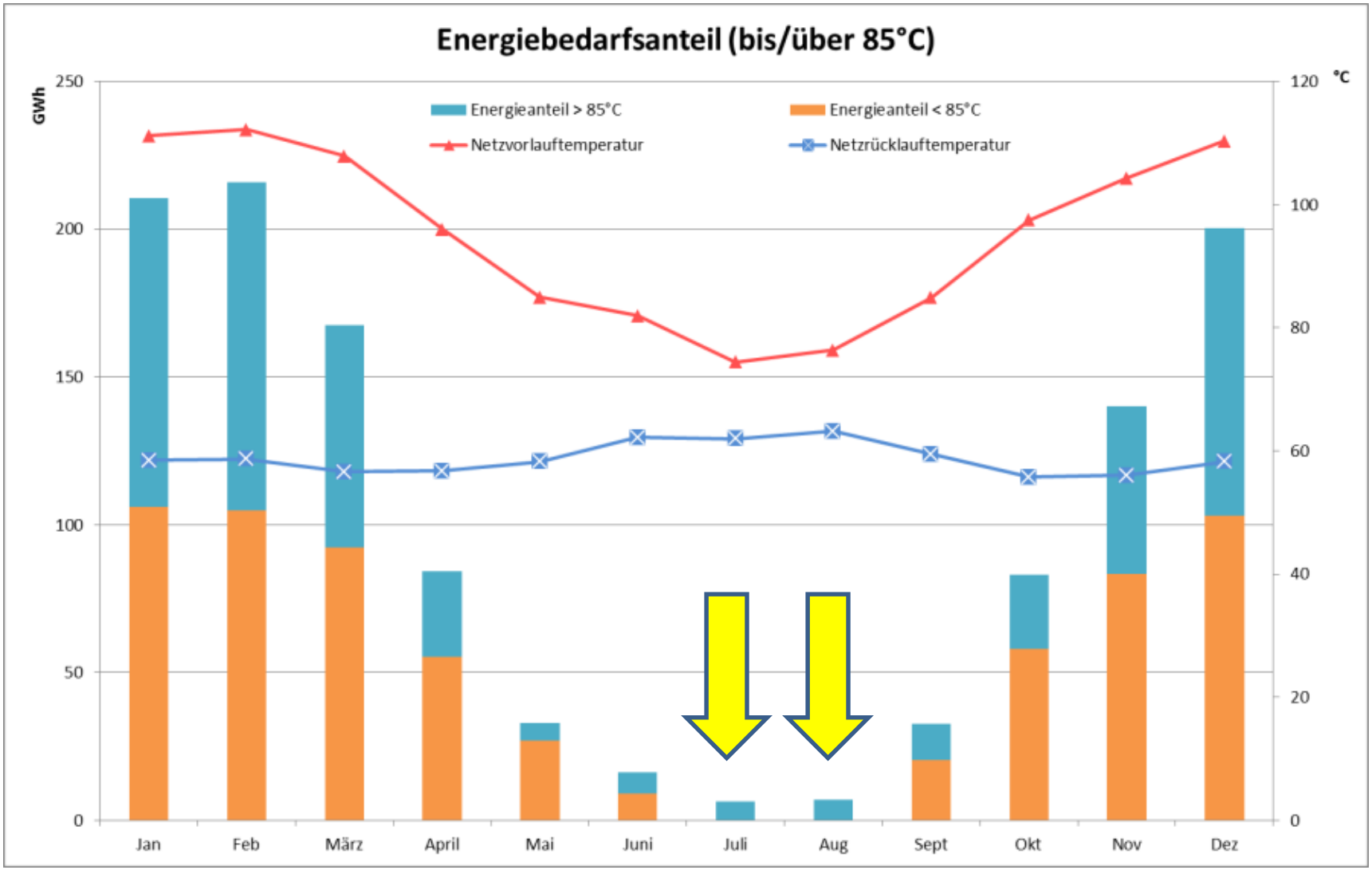
Heat- Mobility- Electricty

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



REN21 RENEWABLES 2018 GLOBAL STATUS REPORT

Typical annual demand



Solar fraction 0- 10%

European SDH projects

216 solar thermal plants for the generation of heat and cold each with more than 500 m² collector area/350 kW_{th} nominal capacity

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

District heating plant, Graz

Source: Google Earth

Solar panels :
2007: 5,000 m²

2014: 7,000 m²

2015: 7,450 m²

2018: 8.350 m²/ 6 MW

ESCo

Field test

Biggest Solar District Heating plant in Austria

References– Solar District Heating

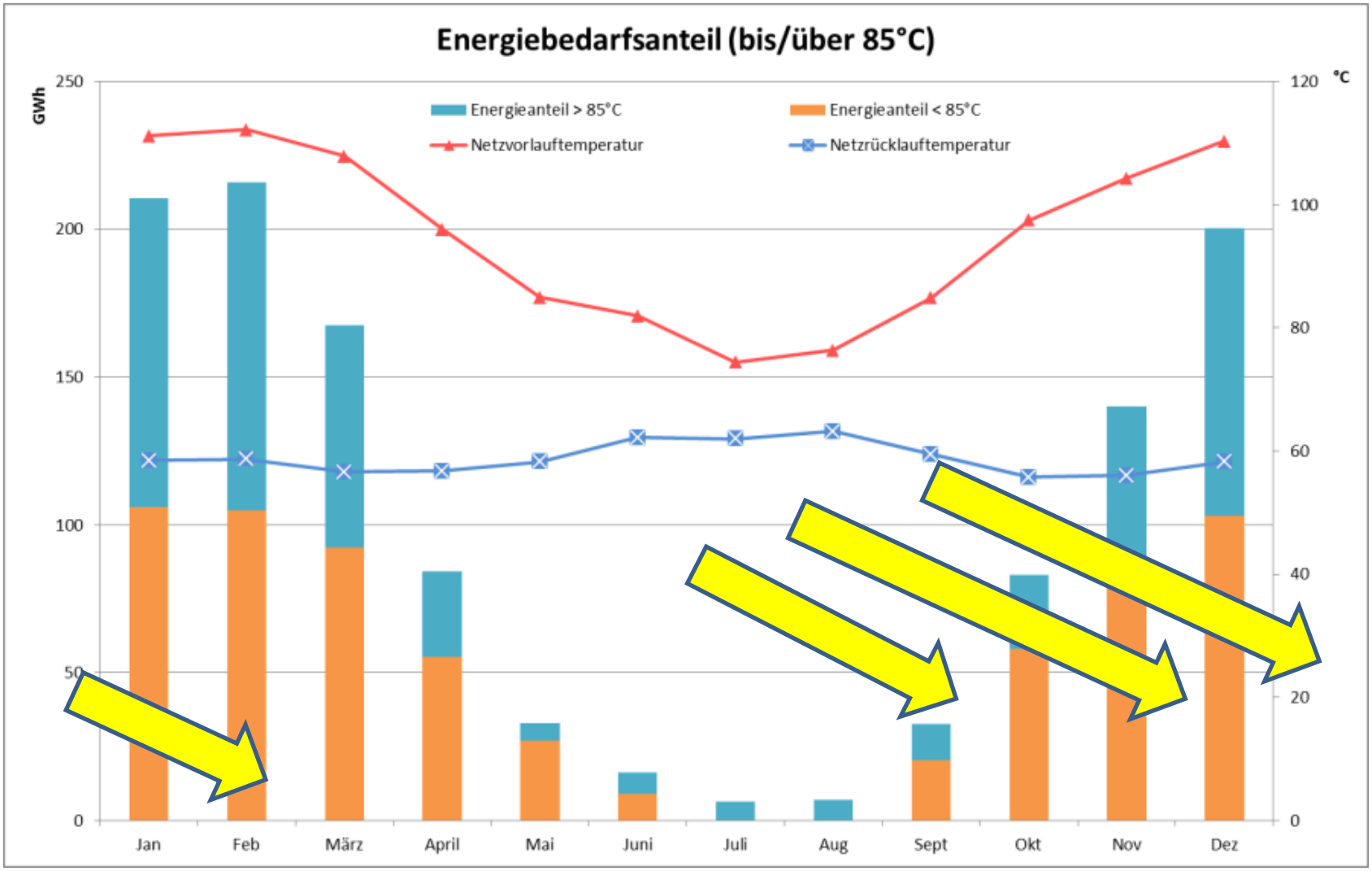
Location/Project	Stadt	Land	Constr.	Collector area
AEVG/Fernheizwerk, Phase 6	Graz	AUT	2016	254.2
AEVG/Fernheizwerk, Phase 5	Graz	AUT	2015	211.4
AEVG/Fernheizwerk, Phase 4	Graz	AUT	2014	2278
Eibiswald Ausbau	Eibiswald	AUT	2012	1200
AEVG 3	Graz	AUT	2009	1606
Eugendorf Nahwärme	Eugendorf	AUT	2009	772
Mattsee Nahwärme	Mattsee	AUT	2009	257
AEVG 2	Graz	AUT	2008	1956
AEVG 1	Graz	AUT	2007	1400
Gleinstätten Nahwärme	Gleinstätten	AUT	2007	1315
Grammar school	Crailsheim	DEU	2004	586
CBE 217 Hirtenwiesen	Crailsheim Hirtenwiesen	DEU	2004	448
Theodor-Körner-Straße 120	Graz	AUT	2004	246.5
UPC-Arena Liebenau	Graz	AUT	2002	1440
Lienz	Lienz	AUT	2001	690
Bolaring	Salzburg	AUT	2000	1056
Knittelfeld Retirement home	Knittelfeld	AUT	1999	135
Kroatisch Minihof	Kroatisch Minihof	AUT	1998	655
Schwanberg	Schwanberg	AUT	1998	395
Orust	Gothenburg	SWE	1997	764
FHW Biomasse	Urbersdorf	AUT	1996	340
Nahwärmegenossenschaft	Bildein	AUT	1995	450
Deutsch Tschantschendorf Nahwärme	Deutsch Tschantschendorf	AUT	1994	325

BIG Solar
Storing summer heat for winter

Trends behind new targets

CHP reduced operation
Waste inceneration
Decarbonisation

Typical annual demand



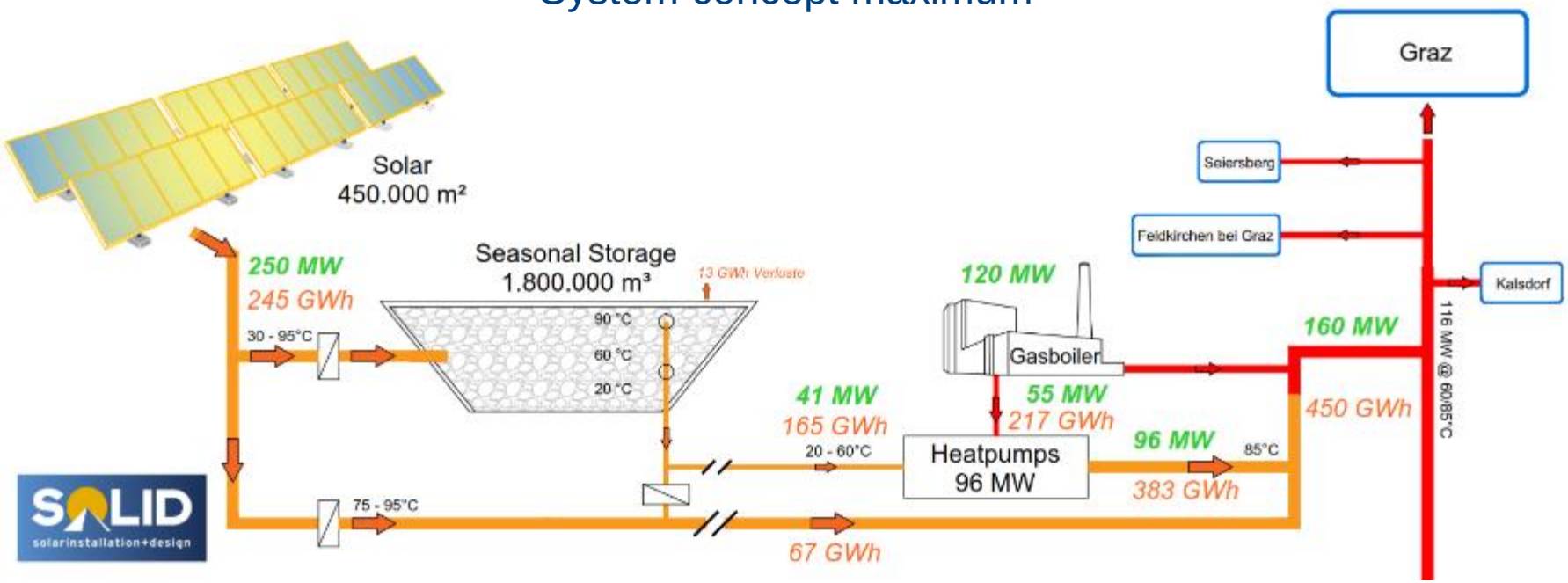
Solar fraction 10- 90%

Seasonal storage & solar collectors

Collector array: 70.000 m² with long-term storage: 207.000 m³

Case study BIG Solar Graz

System concept maximum



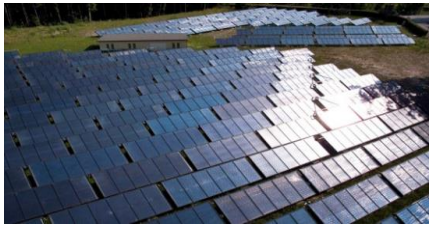
- 25% of city's district heating supply by solar
- Collector field : 450,000 m²,
- Total capital expenditures: ~200 Mio. EUR
- Feasibility study 2015
- Heat Price compareable to Natural Gas

Feasibility

Volumen Saisonalspeicher [m³]

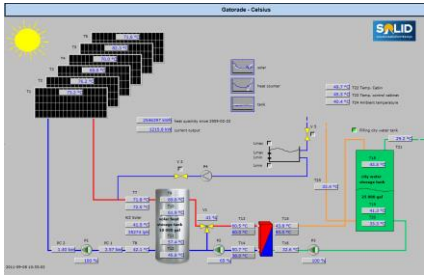
Specific capital cost €/MWh	200,000	400,000	600,000	800,000	1,000,000	1,200,000	1,400,000	1,600,000	1,800,000	2,000,000
Kollektorfläche [m²]										
50,000										
100,000	48	47	49	53	57	60	64			
150,000	47	41	41	42	43	46	48	50	53	55
200,000	49	42	39	39	39	40	41	43	45	47
250,000	49	44	40	38	38	38	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

Main Parts



1) Big Solar Field installations

2) Absorption Heat pump



3) Control engineering

4) Seasonal Storage

State of the art

Soon State of the art

Kleine Zeitung – 27.02.2016

SOLID solarinstallation+design

GRAZ, SAMSTAG, 27. FEBRUAR 2016 www.kleinezeitung.at

KLEINE ZEITUNG

WETTER

Heute. Teilweise föhnig mit Auflockerungen, zum Teil aber auch bewölkt.

SEITE 28

THEMA

Die „Unerwünschte" kontert

Athen lud Innenministerin Johanna Mikl-Leitner aus. Im *Kleine*-Interview verteidigt sie die Position Österreichs und holt zum Konter aus.

SEITEN 2–4

HOFFMANN

Graz plant größten Solarspeicher der Welt

Megaprojekt. Nach Vorbild einer Anlage in Dänemark (Bild) soll bei Graz die größte solarthermische Speicheranlage der Welt entstehen. Auf fast einer halben Million Quadratmeter Fläche sollen Kollektoren die Stadt das ganze Jahr über mit Wärme versorgen. **SEITEN 20/21** LASO LAUMARK-MOELLER

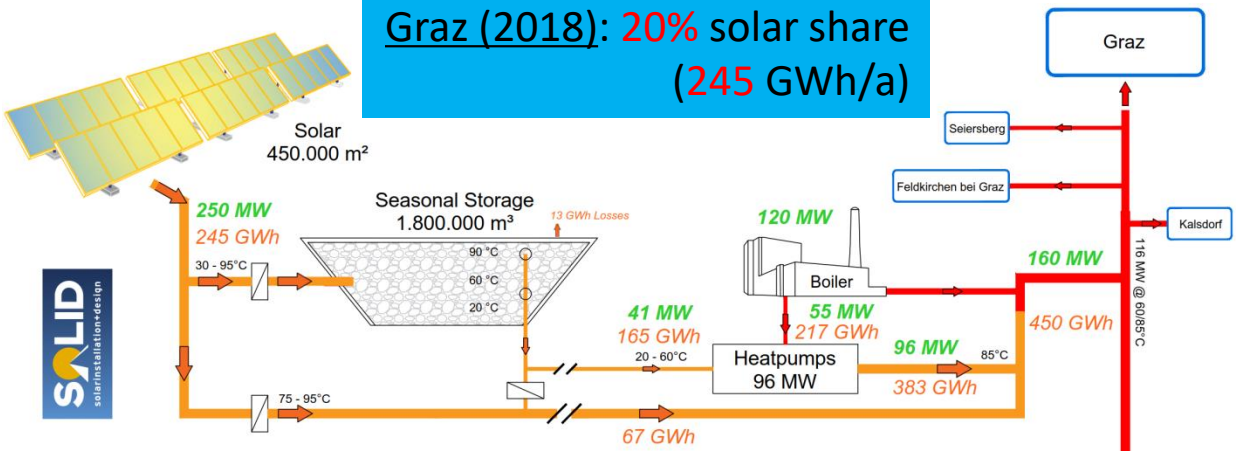
Potential

SDH examples

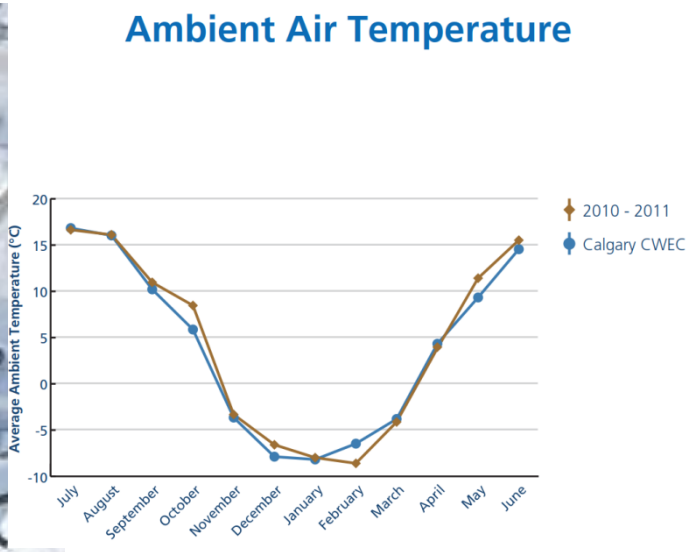
Silkeborg (2016): 20% solar share (80 GWh/a)

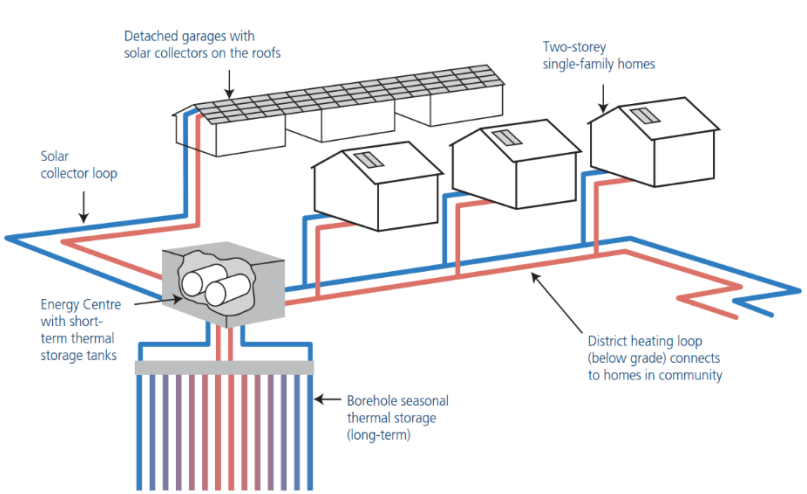
Vojens (2014): 50% solar share (35 GWh/a)

Graz (2018): 20% solar share (245 GWh/a)



Drake Landing, Canada

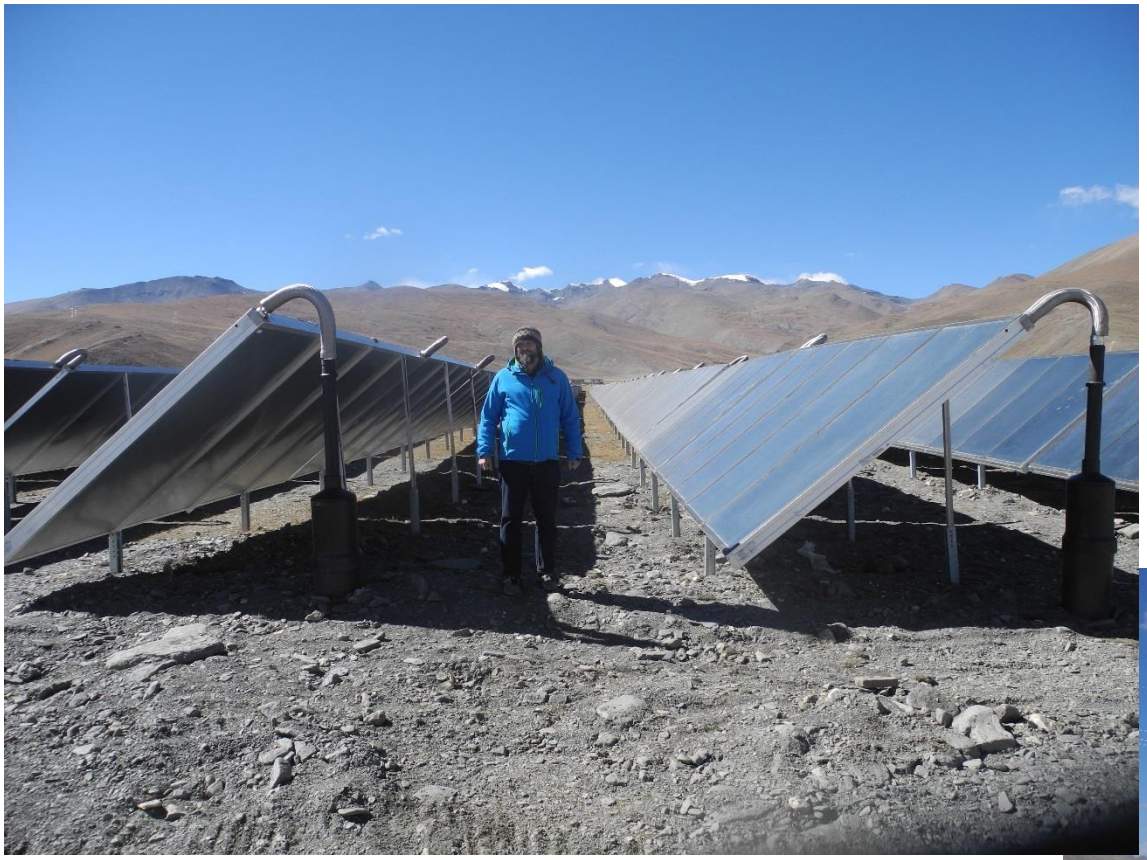




- 798 solar collector modules (2293 m² gross area)
- 240 m³ of water for short-term heat storage
- 34,000 m³ of earth for seasonal heat storage (144 – 35 m boreholes)

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

Langkazi, Tibet



Target >90% Solar Fraction

A new dimension with District Heating

We have adapted and upgraded the concept to supply big Cities in different climates !

> 15 Studies done

Sonntag, 21. August 2016 — GRAZ EXTRA — Seite 19

▶ Machbarkeitsstudie gibt Okay ▶ Es hängt an Behörden und Grundeigentümern

Das Mega-Solarprojekt bei Graz

„Big Solar" im Grazer Süden wäre weltweit größte Solar-Thermie-Anlage – die Finanzierung ist gesichert, nun liegt es an den Behörden

Potential for Investment in 20 years

To change supply structure

Austria	4.4 Bn €	12 TWh	22 Mio m²	50% of DH
EU	70 Bn €	200 TWh	350 Mio m²	30% of DH
China	250 Bn €		1.400 Mio m²	

Todays installed capacity: EU 50 Mio m²

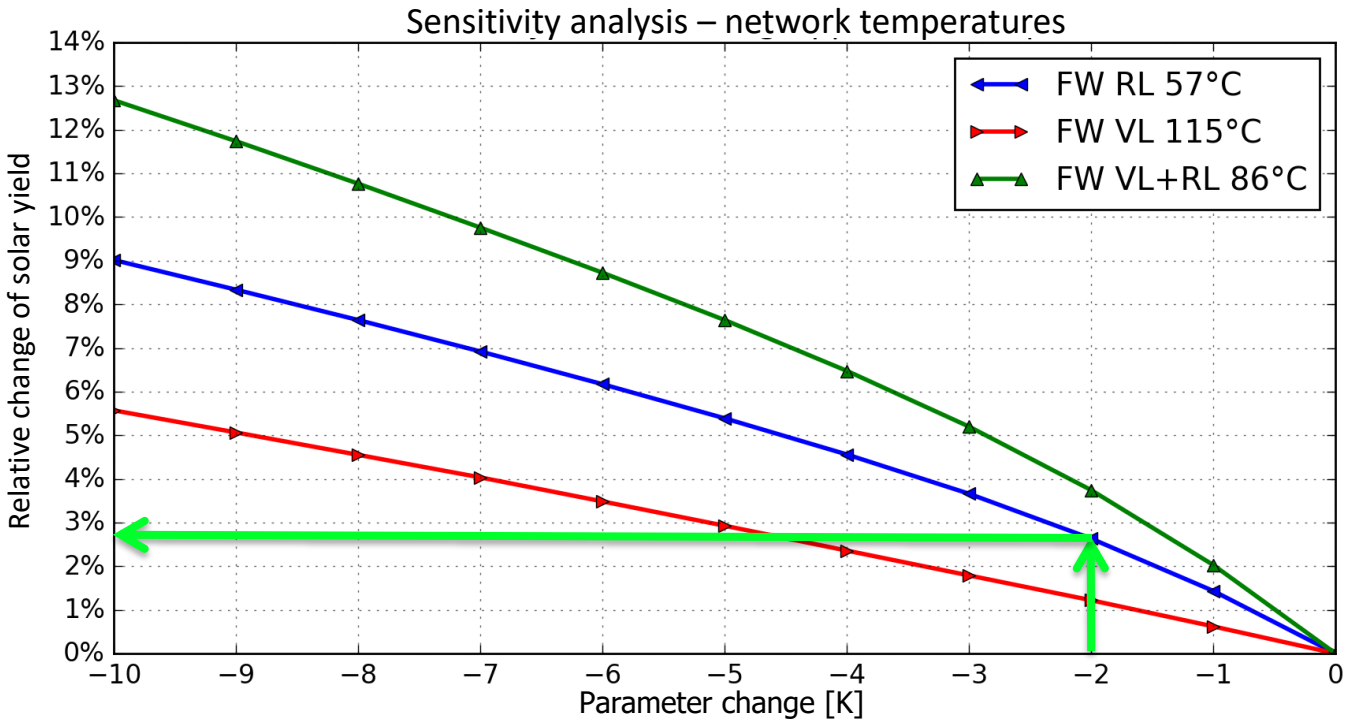
China 500 Mio m²,

Relevant Success and Risk Factors

✓ **For project development**

- Return Temperatures of District Heating
  - The lower the more solar fraction !
- Space requirements
- System Integration of storage/Heat pump for added value

Sensitivity - Network Temperature



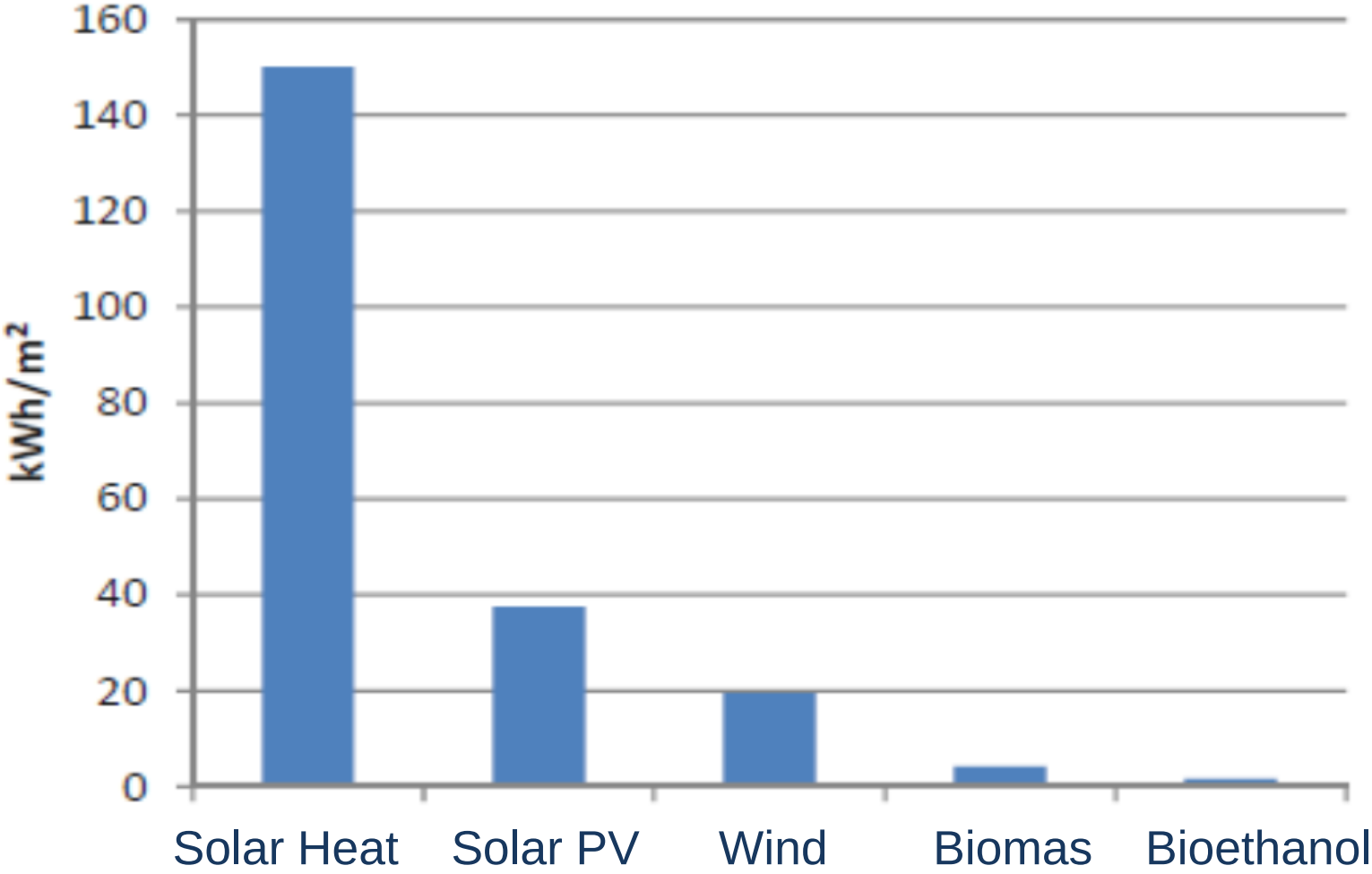
Example:
Reduction return 57 °C → 55 °C increase in solar yield: 2.8 %

4th Generation, return flow → 47°C increase in solar yield: 10 %

Further increase of renewable share!

Required Space

Energy gain/m² ground



Thank you for your attention!

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