solarcomplex:
sonne ▪ wind ▪ wärme




Renewable energy and especially district heating

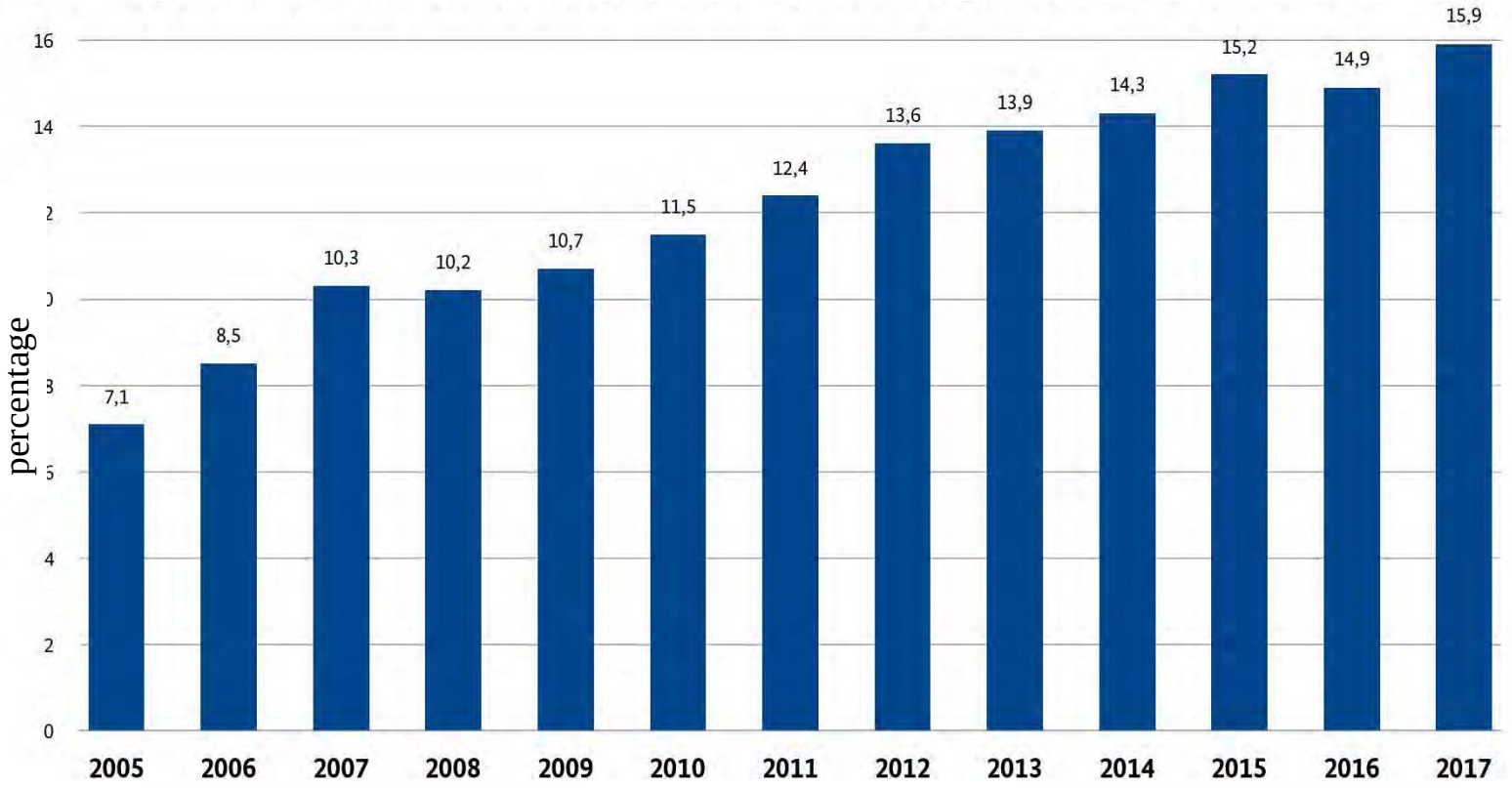
solarcomplex AG

November 30th 2019 Rottenburg

Bundesministerium
für Wirtschaft
und Energie

AGEE Stat
Arbeitsgruppe Erneuerbare Energien - Statistik

Development of renewable energy in the gross final energy consumption of Germany

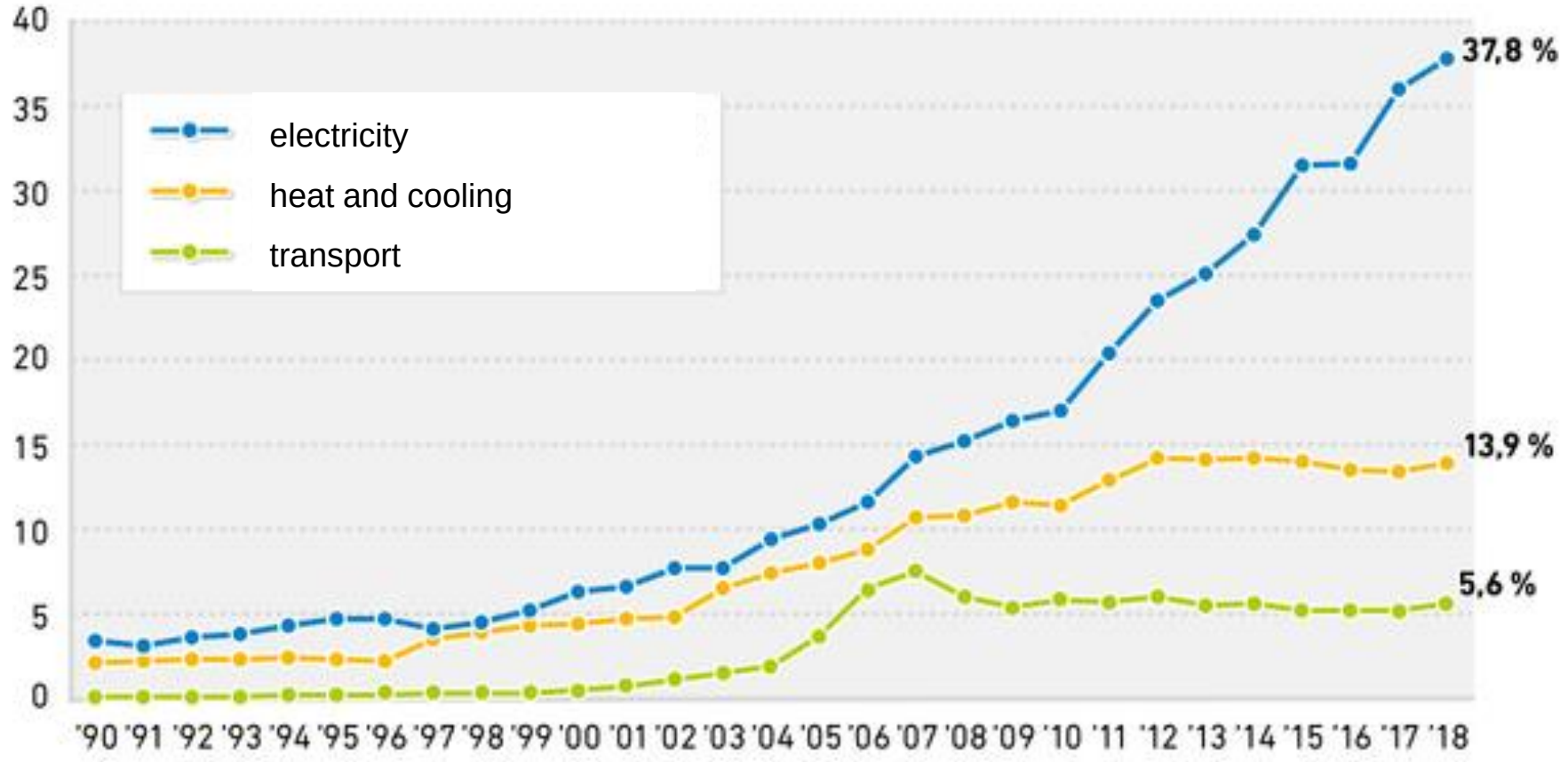


* Berechnet nach Energiekonzept der Bundesregierung; BMWi auf Basis Arbeitsgruppe Erneuerbare Energien-Statistik (AGEE-Stat); Stand: Dezember 2018; Angaben vorläufig

Percentage of renewable energy in the sectors of electricity, heat and transport

percent

, 1990-2018



Quelle: AGEE-Stat
Stand: 3/2019

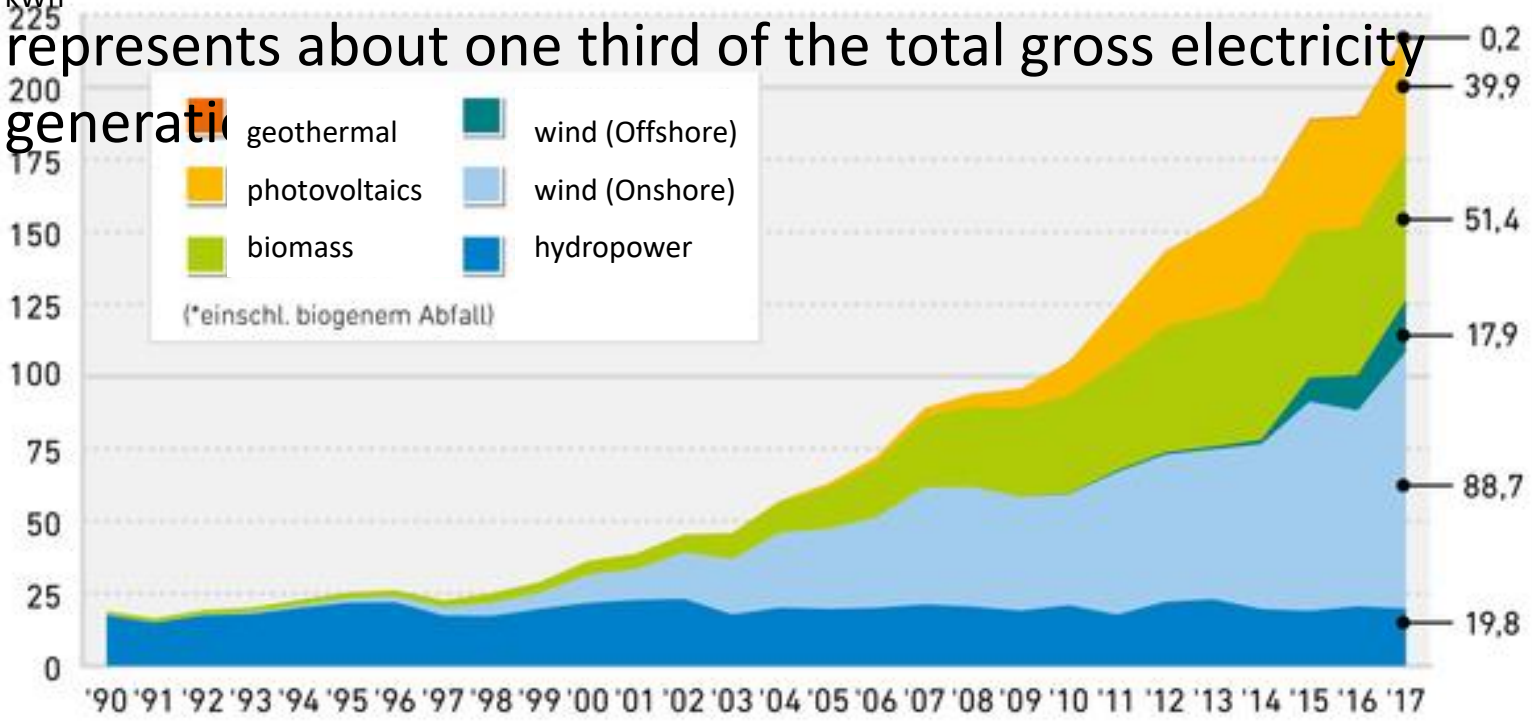
AGENTUR FÜR ERNEUERBARE ENERGIEN
unendlich-viel-energie.de

Electricity generation of renewable energies in Germany 1990-2017

In 2017, 218 billion kilowatt hours of renewable electricity were generated.

billion kWh

epresents a 15% increase over the previous year and represents about one third of the total gross electricity generati



Quelle: BMWi/AGEE-Stat
Stand: 3/2018

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Brown coal- open-cast mine Hambach

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Nuclear power plant Leibstadt, Switzerland

Reality itself has become impossible because it is realized but by no means viable in the long run, and while a utopia to be found is not real, it may be viable.

The motives of the founding partners

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- nuclear phase-out
- climate protection
- regional added value

The three essential aspects of solarcomplex

1. The future tasks are specifically tackled. solarcomplex becomes entrepreneurial, it is built.

2. This is done collectively. Everyone can participate in the newly emerging energy system.
   solarcomplex operates exclusively regionally.

3. The projects and facilities create employment and added value.
   on site and reduce the outflow of energy costs.
   The shareholders can tangibly witness what they are doing.

solarcomplex in brief: (as of end of 2018)

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- Goal: conversion of the regional energy supply to renewable energies.

- Founded in 2000 by 20 citizens, currently more than 1,200 shareholders -
  Private persons, companies, municipal utilities and citizen energy cooperatives.

- Founded with € 37,500, today € 18 million equity.

- € 65 million balance sheet total (31/12/2017)

- Small profits since 2003, every year.

- Moderate return expectation (4% on the share capital).

solarcomplex operates renewable energy facilities for the use of:

- Solar energy / photovoltaic and solar thermal
- Hydropower
- Wind power
- Biogas / electricity u. heat generation
- Wood pellets u. wood chips
- District heating networks

In short, “everything except geothermal energy"

solarcomplex interim balance, end of 2018:

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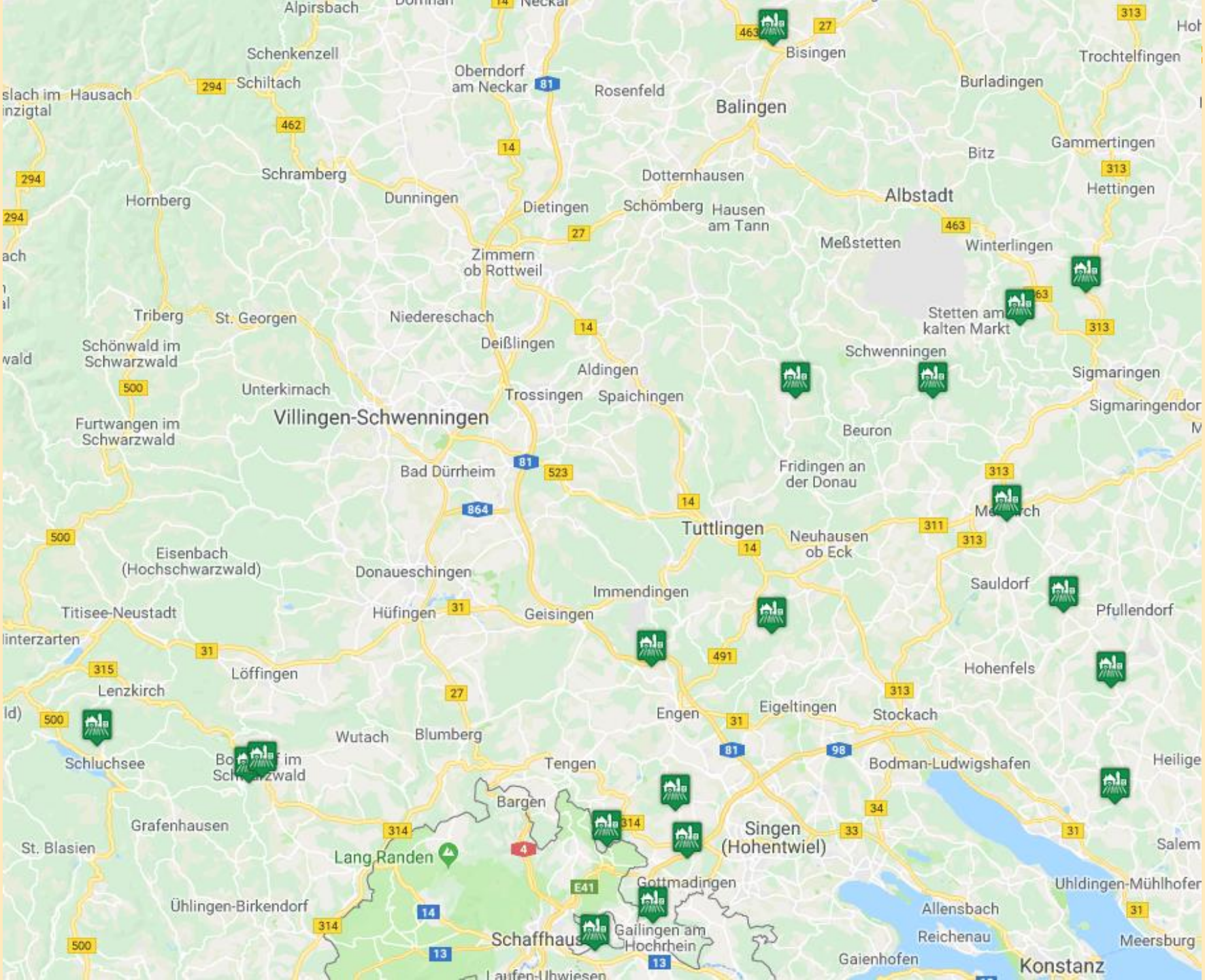
- ~ 14 MW roof systems PV (others under construction / planning).
- ~ 16 MW outdoor PV (more under construction / planning).
- Hydroelectric power station Musikinsel Singen.
- Wind power 13 MW (more in planning).
- Biogas plant Hof Schönbuch u. Hof Bucheli.
- Bioenergy villages Mauenheim, Lippertsreute, Schlatt, Randegg, Messkirch, ... a total of 16 heating grids.
- ~ 100 km local heating networks (others under construction / planning).
- Wood energy contracting, approximately 12 MWth (more under construction and planning).

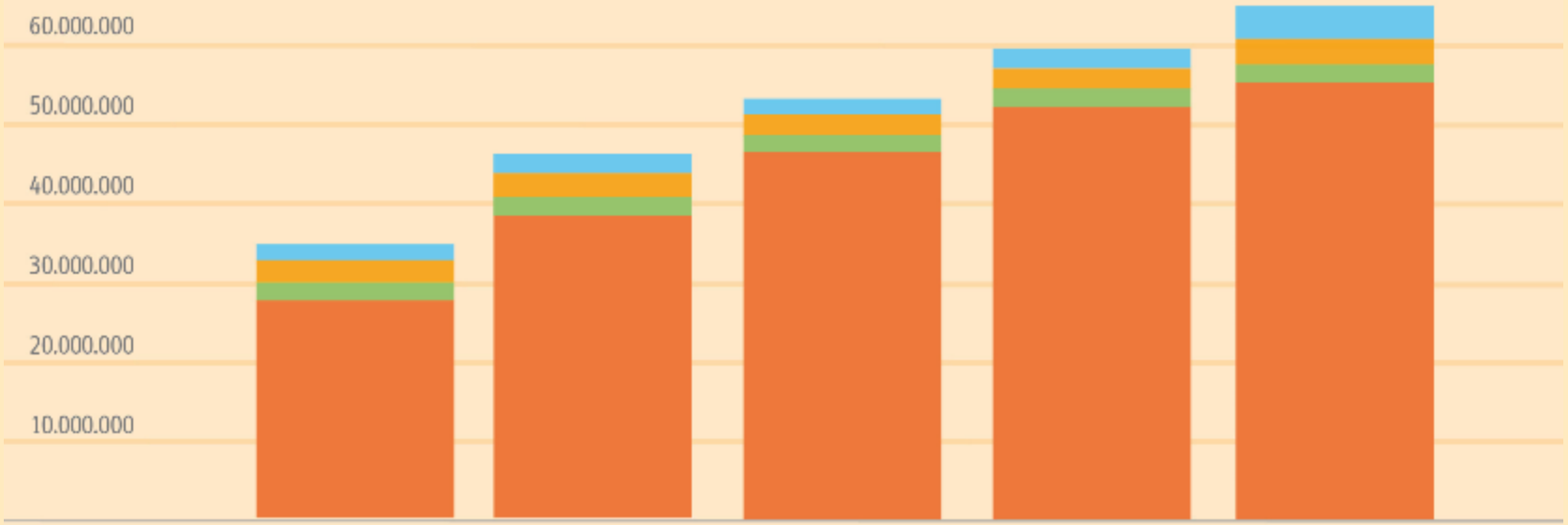
solarcomplex is the central force for the expansion of renewable energies at Lake Constance. Current investment volume of all projects: ~ € 150 million.


Alpirsbach
Schenkenzell
Schiltach
Oberndorf am Neckar
Rosenfeld
Bisingen
Balingen
Trochtelfingen
Burladingen
Hausach
Schramberg
Hornberg
Dunningen
Dietingen
Dotternhausen
Schömberg
Hausen am Tann
Albstadt
Bitz
Gammertingen
Hettingen
Meßstetten
Winterlingen
Zimmern ob Rottweil
Triberg
St. Georgen
Niedereschach
Deißlingen
Stetten am kalten Markt
Schwenningen
Sigmaringen
Schönwald im Schwarzwald
Aldingen
Unterkirnach
Trossingen
Spaichingen
Villingen-Schwenningen
Furtwangen im Schwarzwald
Beuron
Sigmaringendorf
Bad Dürrheim
Fridingen an der Donau
Tuttlingen
Neuhausen ob Eck
Eisenbach (Hochschwarzwald)
Donaueschingen
Immendingen
Sauldorf
Pfullendorf
Titisee-Neustadt
Hüfingen
Geisingen
Löffingen
Hohenfels
Lenzkirch
Engen
Eigeltingen
Stockach
Schluchsee
Wutach
Blumberg
Tengen
Bodman-Ludwigshafen
Bargen
Grafenhausen
Singen (Hohentwiel)
St. Blasien
Lang Randen
Gottmadingen
Uhldingen-Mühlhofen
Ühlingen-Birkendorf
Allensbach
Gailingen am Hochrhein
Reichenau
Meersburg
Gaienhofen
Konstanz

Electricity and heat production of solarcomplex AG

Data in kWh

Electricity for around 2700 three persons households each 3500 kWh | Heat for around 1300 buildings



	2014	2015	2016	2017	2018
Strom	**7.142.000**	**7.780.000**	**7.053.000**	**7.765.000**	**9.659.000**
Wind	1.945.000	2.423.000	2.061.000	2.503.000	4.094.000
PV	2.929.000	3.057.000	2.860.000	2.964.000	3.284.000
Biogas	2.268.000	2.300.000	2.132.000	2.298.000	2.281.000
Wärme	**27.548.000**	**38.216.000**	**46.361.000**	**52.061.000**	**55.137.000**
Biomasse, BHKW, Solarthermie					

Key figures

The figures are taken from the annual financial statements of our company prepared in accordance with German commercial law, rounded and certified by the auditor.

Data in thousand	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
total assets	7.142	11.409	24.506	28.631	39.840	42.045	48.757	54.921	63.333	64.245	65.348	60.324
tangible assets	4.510	9.005	19.102	23.169	32.500	35.020	41.150	46.702	51.581	51.002	50.330	51.045
equity	2.855	4.001	7.323	8.246	9.698	11.654	13.233	15.126	18.027	17.959	18.029	17.936
overall performance		6.848	11.039	12.080	14.251	9.943	10.048	11.204	10.279	13.844	12.510	11.597
EBITDA**	420	863	1.444	2.055	2.516	2.989	3.178	3.610	3.584	3.597	3.558	3.586
Result	103	152	330	198	225	247	202	298	165	104	66	91

* Equity including contribution made to make a capital contribution

** Earnings before interest, taxes and depreciation

Around 40 committed and qualified employees implement the corporate objectives of solarcomplex. There is a technical and a commercial department.

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2001 - the first project: 18 kW at a school in Singen

2011 – more than 6 MW

That's a factor of 300!



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Citizen-financed solar power plants on roof surfaces with more than 10 MW (megawatt)

module area	~ 70.000 sqm
investment	~ 35 Mio euros
power production	~ 10 Mio kWh annually
CO2-Einsparung	~ 6.000 t annually



Open space solar parks

- Rickelshausen, Langenried, Messkirch, Denkingen,
  Hundertjauchert and Mooshof
- 10 MW output, ~ 11 Mio. kWh earnings/ a
- CO2 reduction ~ 6.600 t / a
- investment about 30 Mio Euro

Rickelshausen

Langenried

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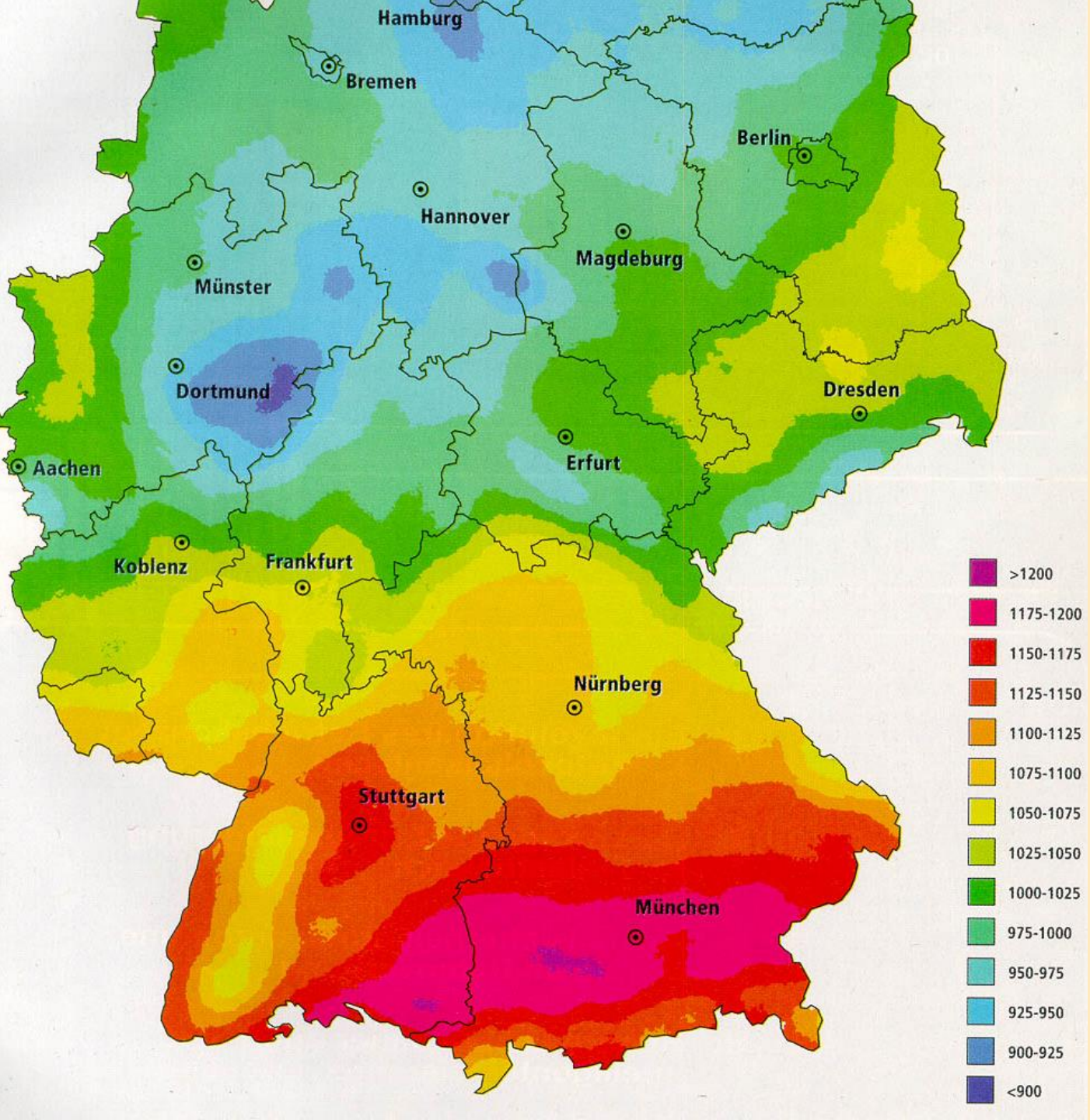

The gift
of the sky ...

Annual total solar radiation
(in kWh / m²)

10 kWh = energy content of one liter of fuel oil

In the south of Germany
> 100 l fuel oil / m²

Solar park Rickelshausen

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- This solar park reflects the success story of photovoltaics

- In 2006, one kilowatt of installed capacity cost around 4,000 euros, in 2016 it was around 1,000 euros

- The remuneration fell in the same period from 40 to 8.7 ct / kWh

- More than a factor of 4 within 10 years in terms of costs and reimbursement

- Production costs from new Outdoor PV below 6 ct / kWh!

- In southern Germany !

2018: Even energy-intensive businesses rely on PV

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- GUK folding machines at Rottweil, demand about 3 million kWh / year
- solarcomplex builds 514 kW with east-west orientation!
- with generation costs below 6 ct / kWh, primarily own consumption (> 80%)
- Only surpluses are still fed (<20%)

Practical example heating center in Bonndorf

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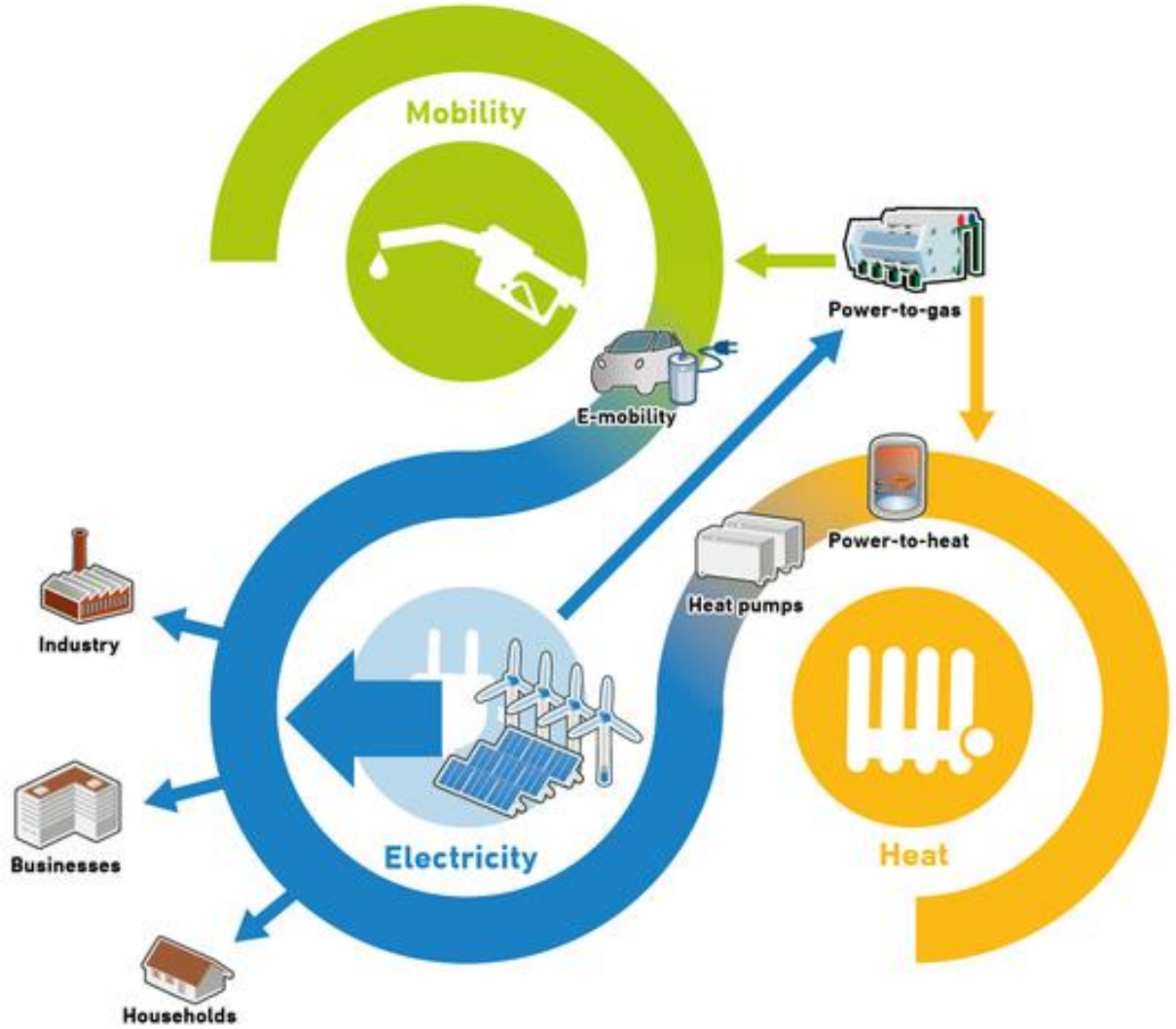
- Plant 55 kW
  own power share ~ 30%
  especially network pumps
  HS-snails,
  control, regulation

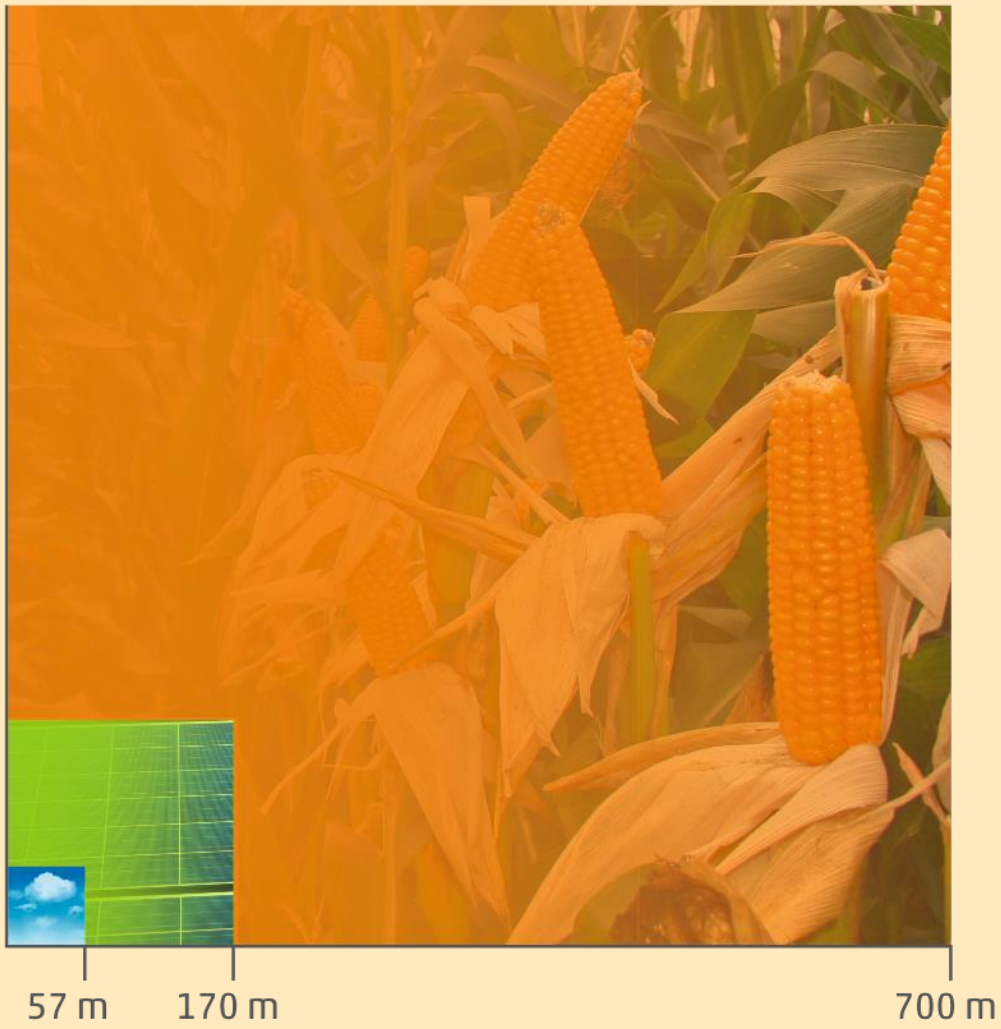
Sector coupling



Source: forum-synergiewende.de
11/2018

RENEWABLE ENERGY AGENCY
renewables-in-germany.com

Space requirement for 1 Mio. kWh



Biogas
50 ha

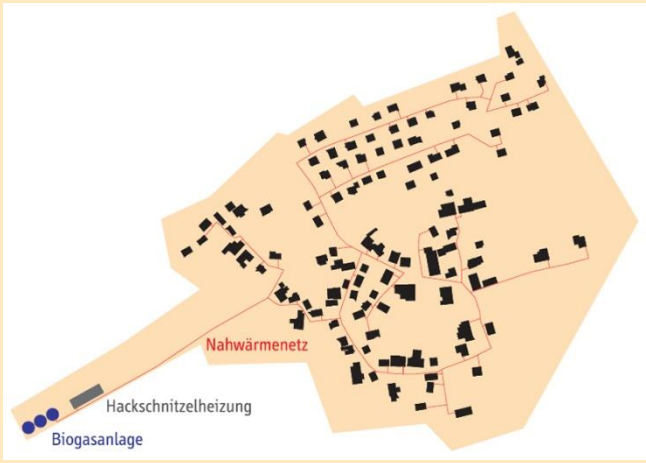
PV
3 ha

Wind
0,3 ha

If you want to provide as much regenerative energy as possible in a country with limited areas, you should focus on those technologies that bring a high yield per hectare, that is wind and sun.

Regenerative heating networks of solarcomplex, the first dozen is in operation ...

Mauenheim	(commissioning 2006)
Lippertsreute	(commissioning 2008)
Schlatt	(commissioning 2009)
Randegg	(commissioning 2009)
Lautenbach	(commissioning 2010)
Messkirch	(commissioning 2011)
Weiterdingen	(commissioning 2011)
Büsingen	(commissioning 2012)
Emmingen	(commissioning 2013)
Grosselfingen	(takeover 2013)
Bonndorf I	(commissioning 2014)
Hilzingen	(takeover 2015)



bioenergy village Mauenheim

green = with waste heat from biogas combined heat and power plant

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... the second dozen is in progress:

Bonndorf II	(commissioning 2016)
Wald	(commissioning 2016)
Renquishausen	(participation 50%, since 01.01.2017)
Veringendorf	(under construction, for NRS, 2017 / 2018)
Storzingen	(under construction, for NRS, 2017 / 2018)
Schluchsee	(in planning, 2018 / 2019)

green = with waste heat from biogas combined heat and power plant

2006: Bioenergy Village Mauenheim – The Beginning

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Combination biogas heat and woodchips

Woodchip boiler and buffer

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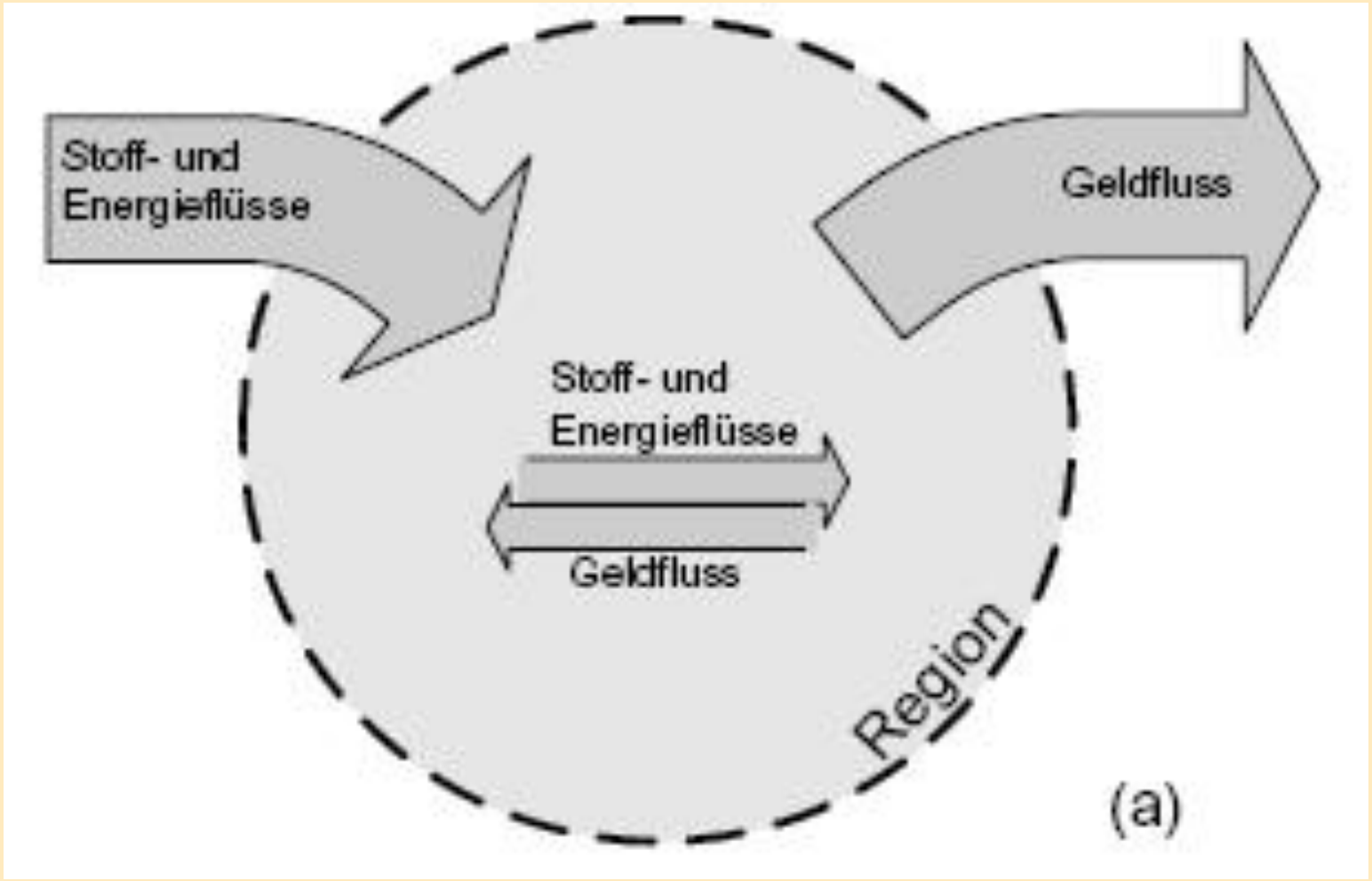
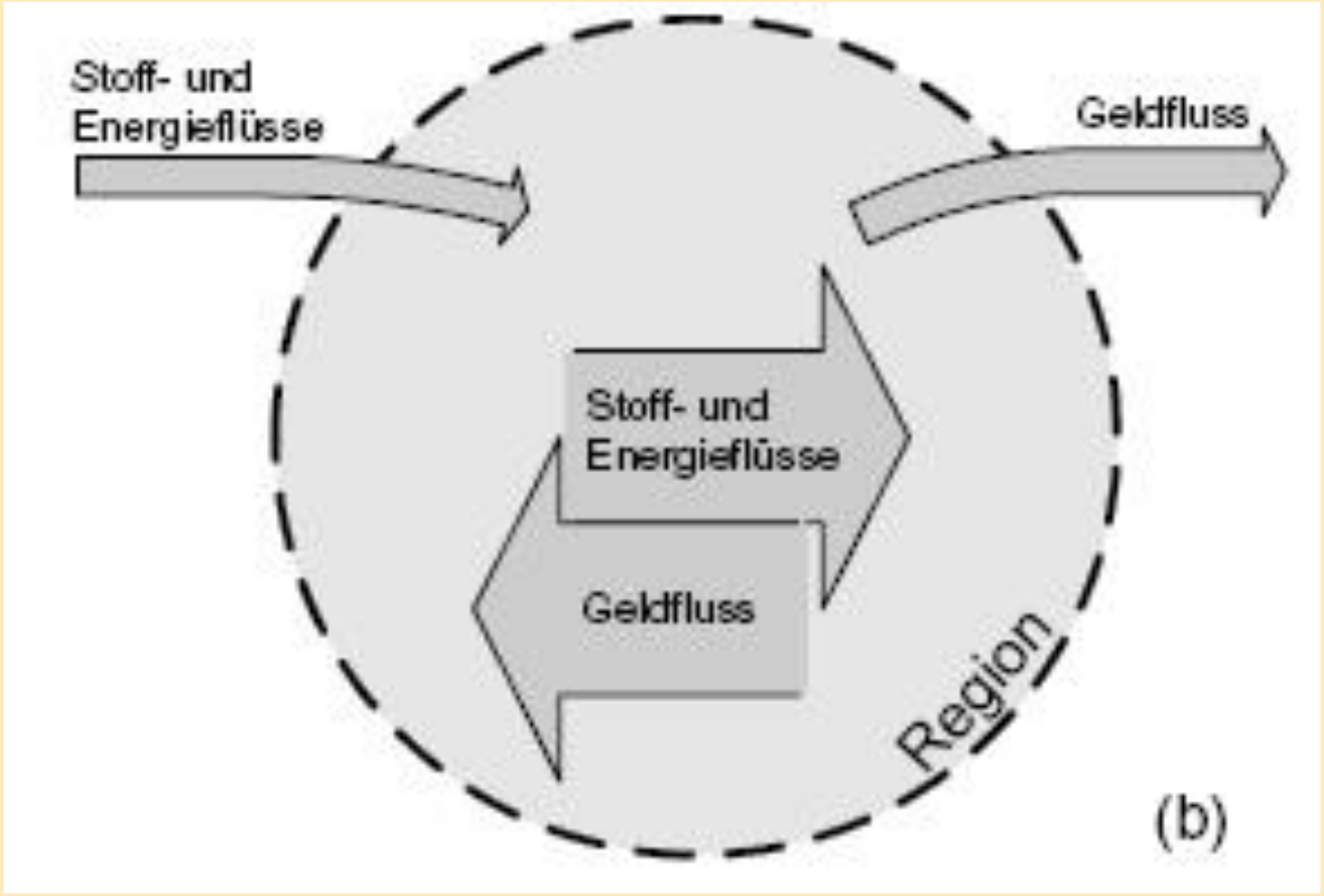


Predominantly fossil-fueled region = loser region

growing purchasing power outflow and wealth loss itself
at constant energy consumption (due to rising prices)



Mainly locally supplied region = winner region

high purchasing power and securing prosperity

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More flexibility, bigger heat buffers

- 1.000 cubicmeter buffer.
- short term additional power 1.000 kW.
- flexible production of electricity, full heat provision.

- future of biogas: flexible production of heat and power.

2012: Solar Energy Village Büsingen

First solar district heating project

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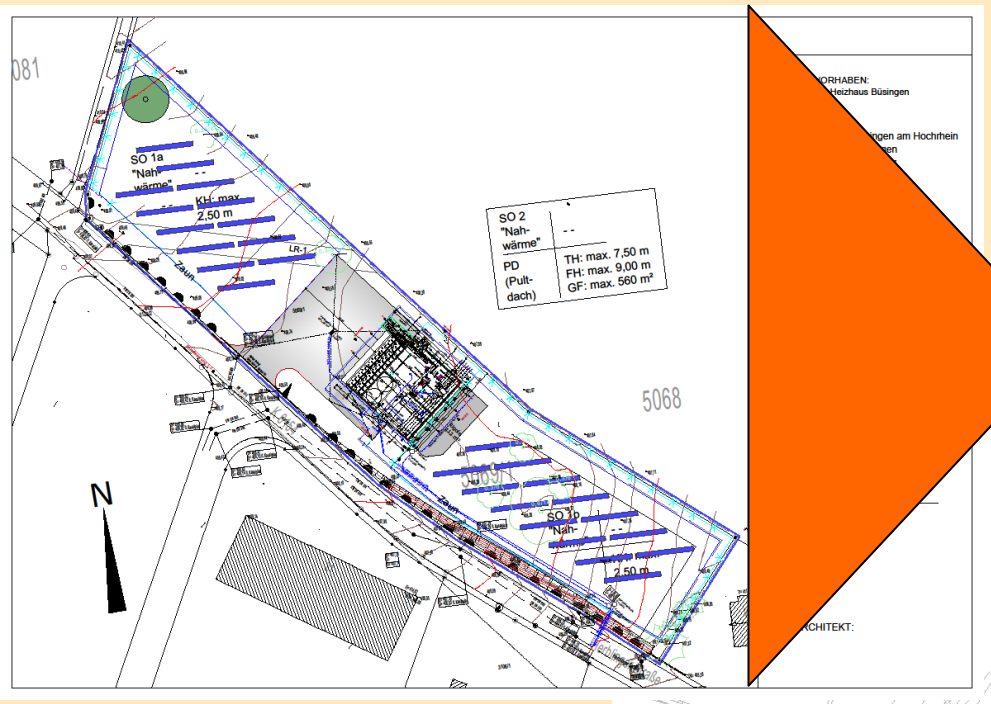

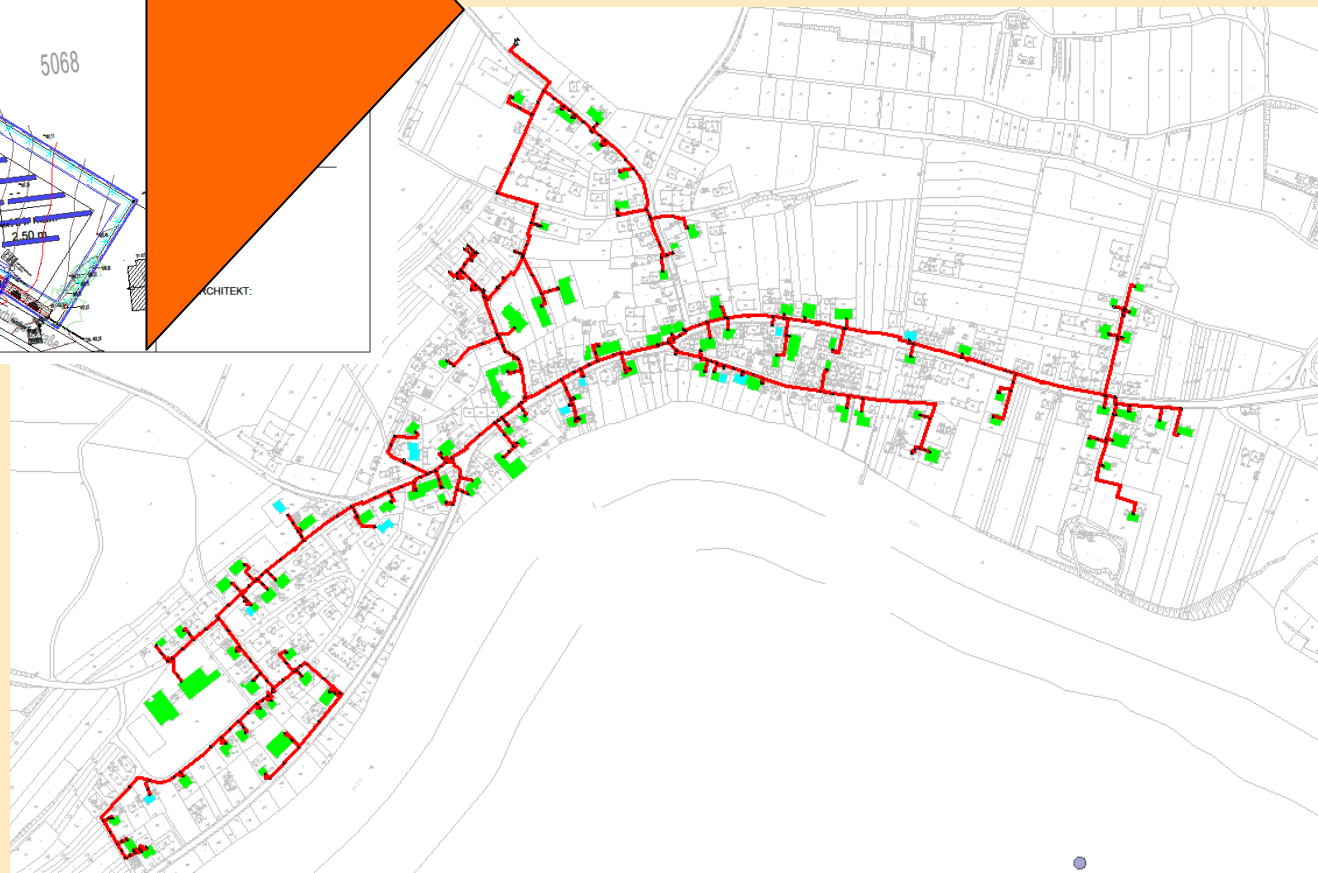

underconstruction like pv

- rammed steal profiles
- no fundamentation, soil nearliy untouched

2018: district heating Randegg
Addition of solarthermal plant

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- wood plus solar

- 2.400 qm solar field
- 300 m³ buffer
- started in August 2018
- summer heat 100%,
  annual contribution around 20%

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... but down,
in the net

pipe in the unpaved area

Core drilling from the house ditch into the building

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Wall passage with sealing ring

House connection station

- hydraulic separation mains - heating distribution with heat exchanger
- Remote maintenance + meter reading via data line
- Space requirements such as electric meter box

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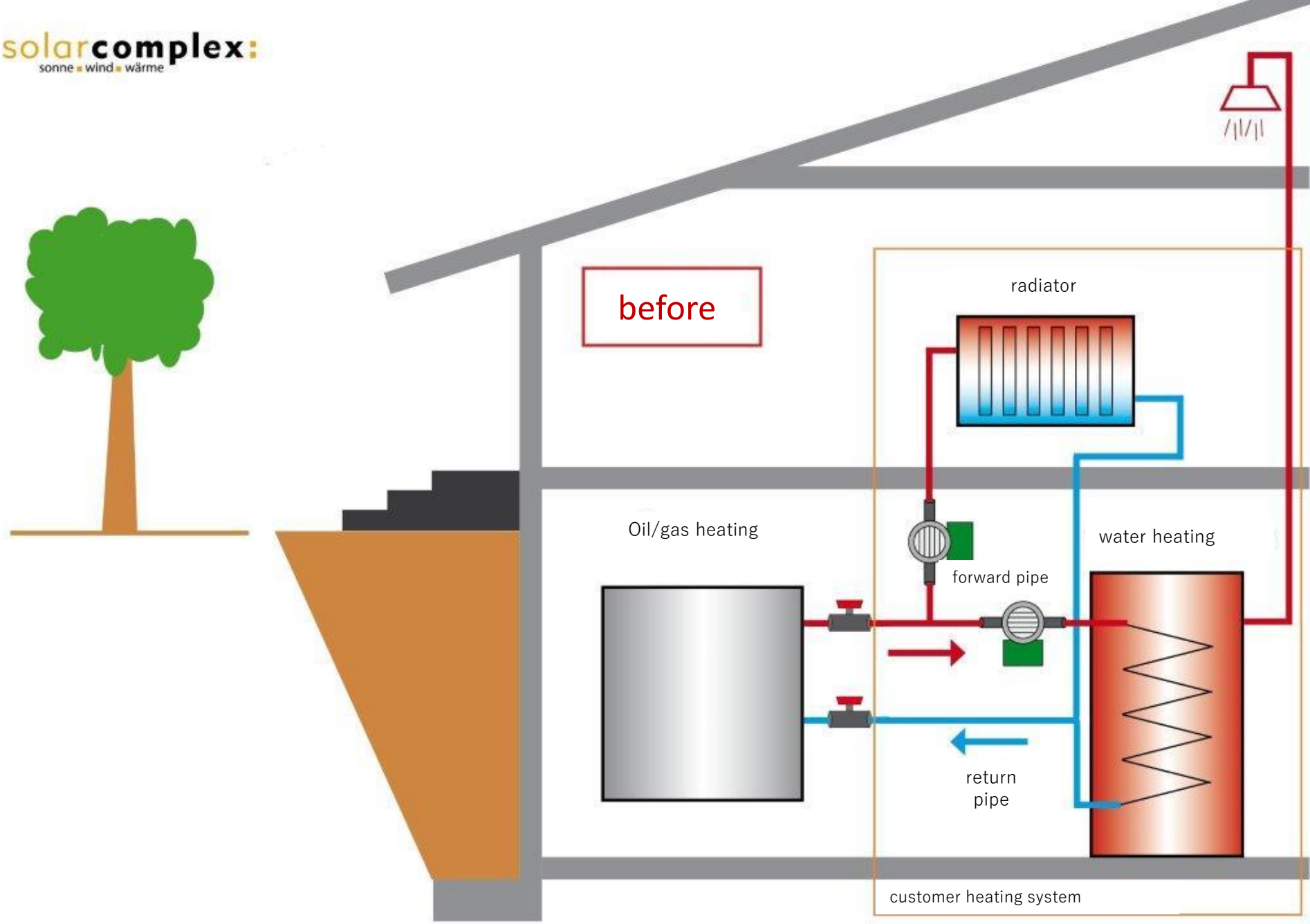
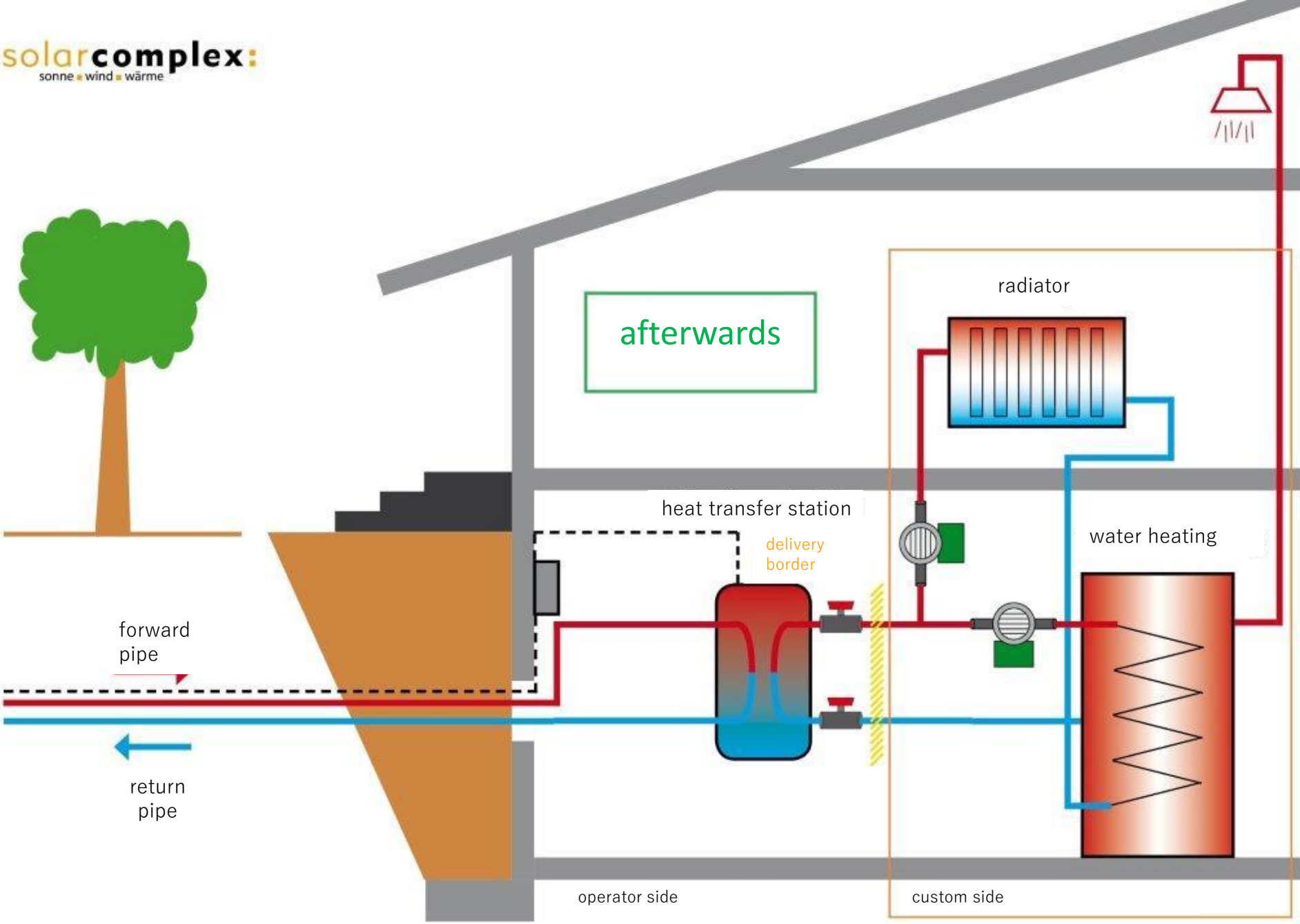


solarcomplex:
sonne wind wärme



Local heating networks are future-proof because they can be used with several technologies

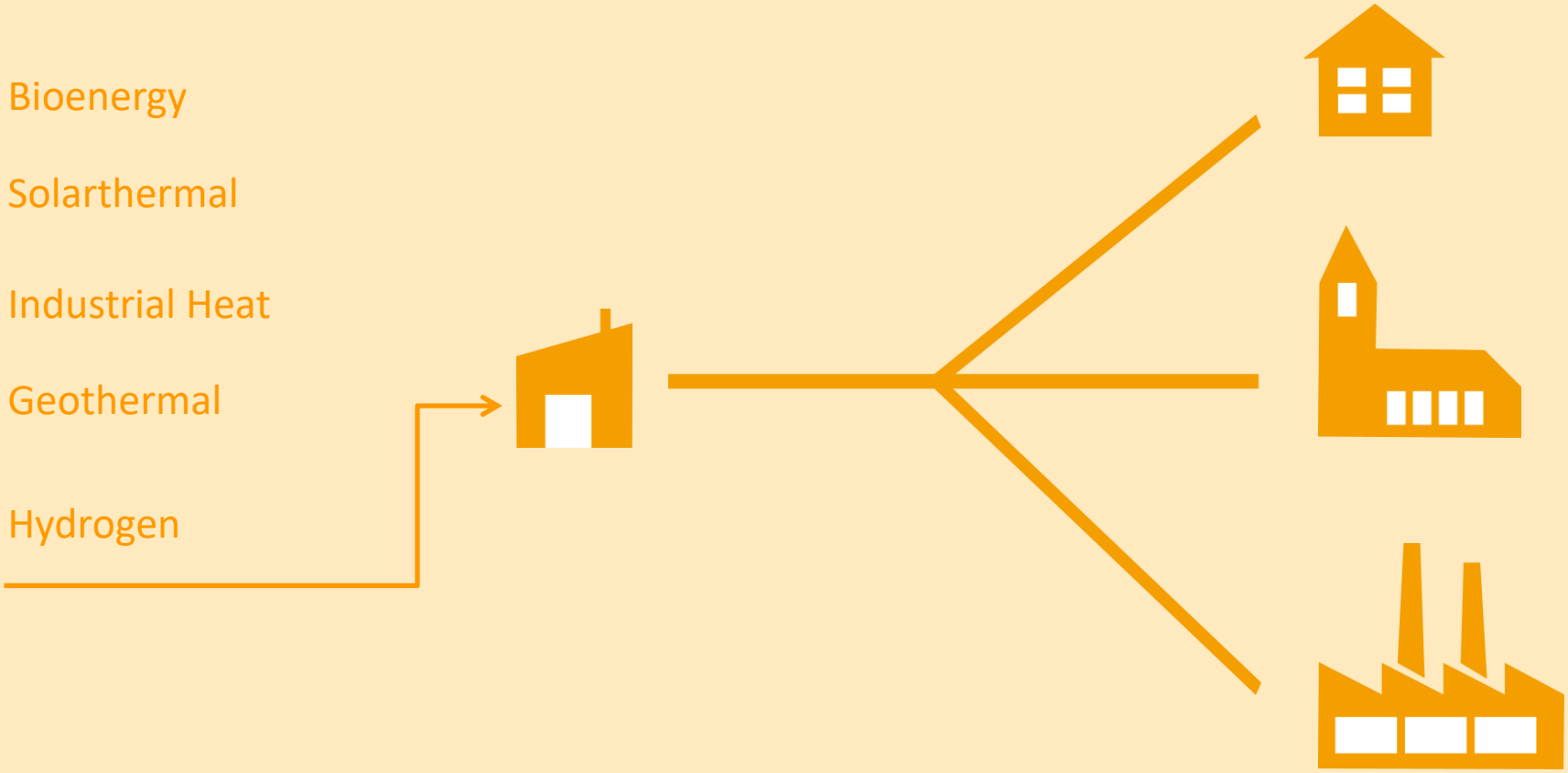
Bioenergy

Solarthermal

Industrial Heat

Geothermal

Hydrogen



Practical example of office and residential buildings

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Flat roof system is elevated east-west:
Better space utilization, better match of supply and demand
In addition, west, south and east facade occupied

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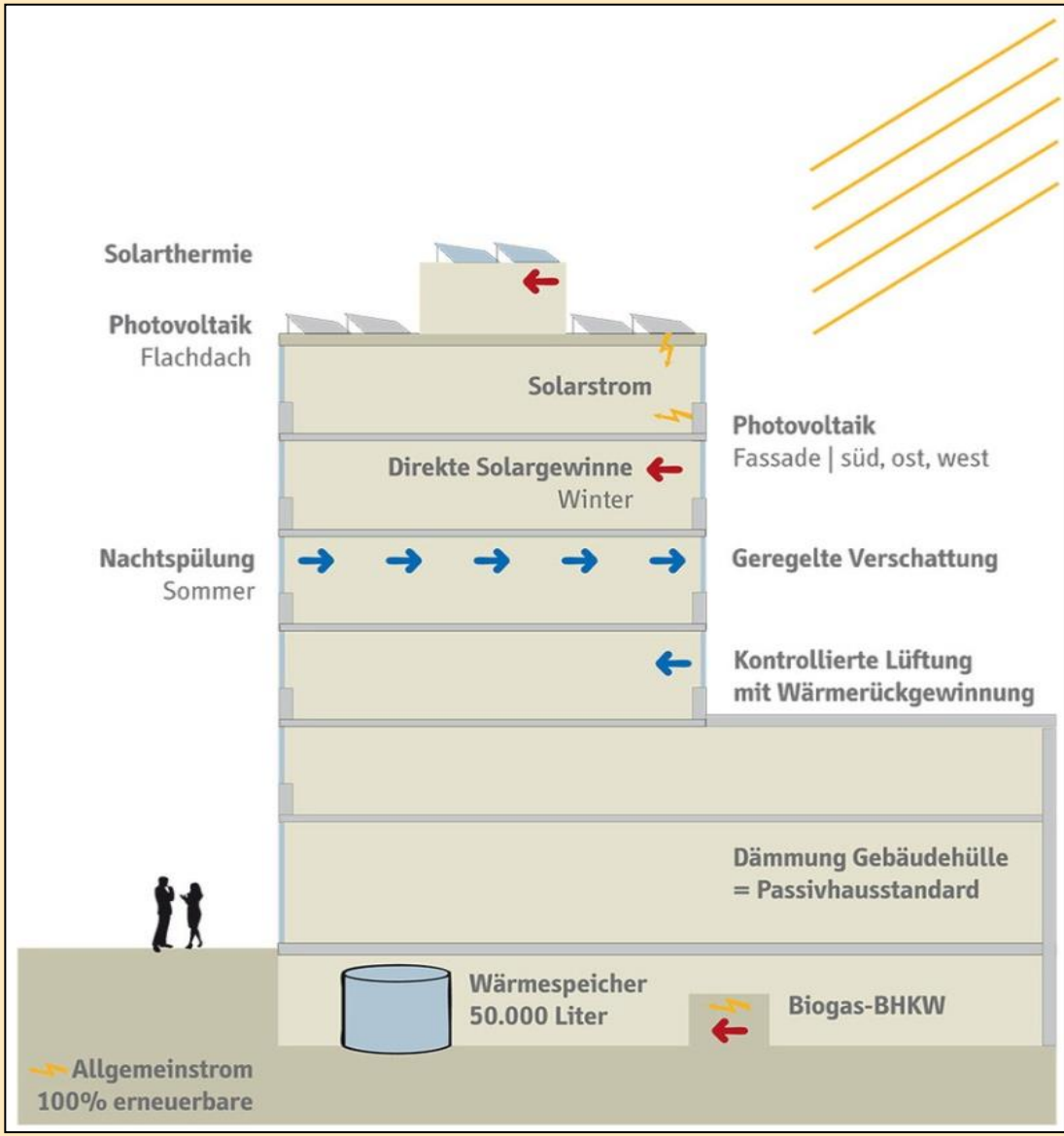

Wärmeerzeugung

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Solar thermal plant roof top

40 m² = 28 kW

Biogas BHKW

10 kW th

5 kW el

Thank you for your attention

End of the presentation

Beginning of the discussion round