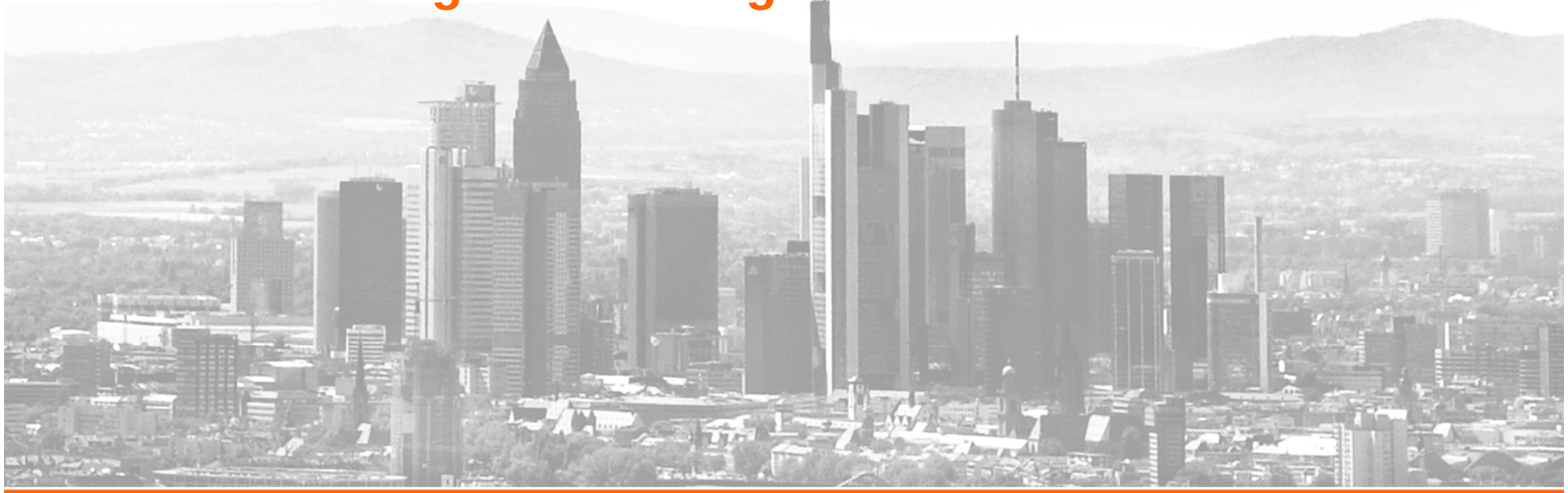
Near future challenges for R&D in the District heating and Cooling sector



Dr. Ingo Weidlich

November 13, 2013 Utrecht

AGFW - Who we are

source: AGFW

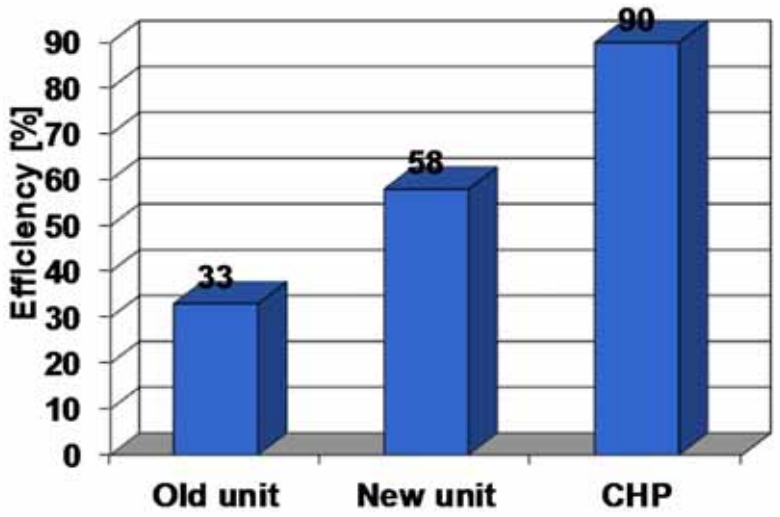
AGFW - Who we are

- AGFW is the independent and impartial association promoting energy efficiency, (district) heating, cooling and CHP at national and international levels
- AGFW reunites round about 500 (regional und municipal) district energy suppliers and industrial operators of this industry in Germany and Europe
- AGFW represents over 95 % of the heat load connected to German district heating systems – the largest scale in Western Europe (The district heating connected load in Germany is approximately 57.000 MWth).
- AGFW means over 40 years of experience in this field

source: AGFW

CHP-unit Berlin Mitte

source: Vattenfall Europe Wärme AG



Power plant primary energy efficiency.

- Elektric performance: 460 MW
- Thermal performance: 670 MW
- Primary energy efficiency: 90%

Cogeneration copes with mutual dependency on the electricity **and** the heat market.

EU Legislation – Energy Efficiency Directive – published October 2012

- **Memberstates have to achieve targets for energy saving.** The EED requires annual energy savings of 1.5% of the total distributed energy in the EU-member states in the period of the first of January 2014 until 31st of December 2020. According to this legislation energy shall not be wasted and efficient technologies must be supported.
- **This target may be reached partially by primary energy savings** e.g. using district heating
- **The member states have to analyse their heat market**
- **The potential for hight efficient chp and DH must be evaluated by the member states.**
- **Measures to use this potential have to be taken.**
- **…**

source: AGFW

Political targets in Germany (energy conception)

	Today	2020	2030	2040	2050
Cut in greenhouse gas emissions (against 1990)	- 27 %	- 40 %	- 55 %	- 70 %	- 80 %
Proportion of renewable energy in gross final energy consumption	10 %	18 %	30 %	45 %	60 %
Share of renewables in electricity consumption	16 %	35 %	50 %	65 %	80 %
Cut in primary energy consumption (against 2008)	- 6 %	- 20 %			- 50 %
Cut in electricity consumption (against 2008)	- 7 %	- 10 %			- 25 %
Cut in energy consumption in transport sector (against 2008)		- 10 %			- 40 %

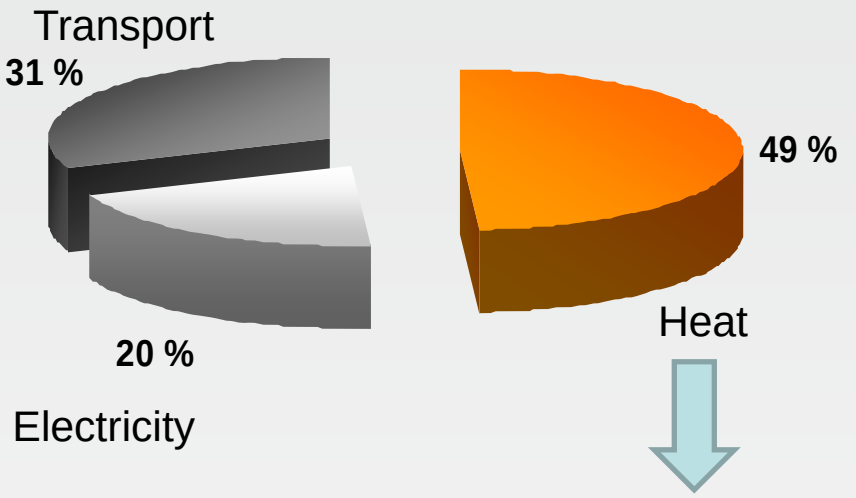
source: BMWi

VISION and REALITY

Vision: Hybrid ring-storages?

Source: Popp

Reality: Primary energy cosumption in the EU 2010.

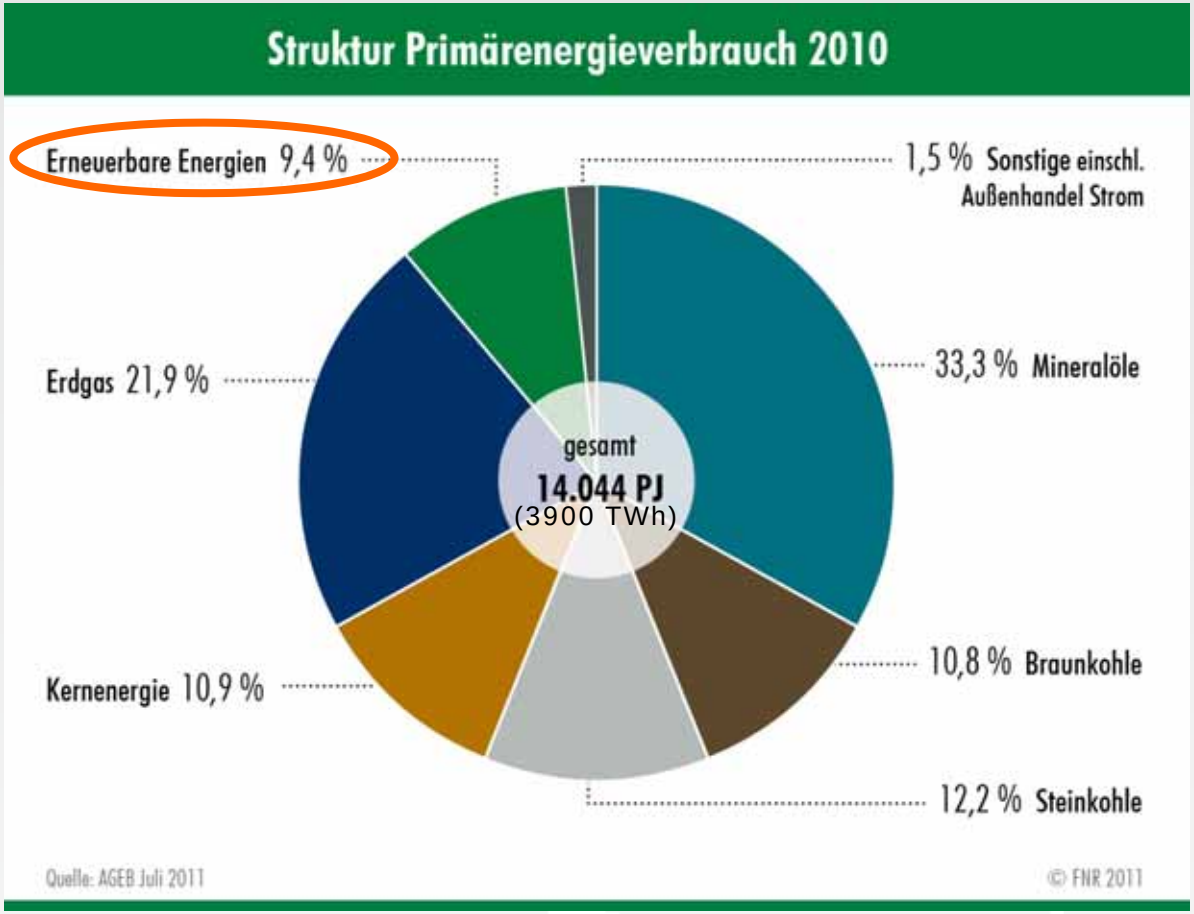


Heat distribution is a major key for the energy turnaround!

source: AGFW

PRIMARY ENERGY CONSUMPTION

- **55 % of the German primary energy consumption is covered by oil and gas**
- **9.4 % RE (1320 PJ) bzw. 370 TWh primary energy consumption**

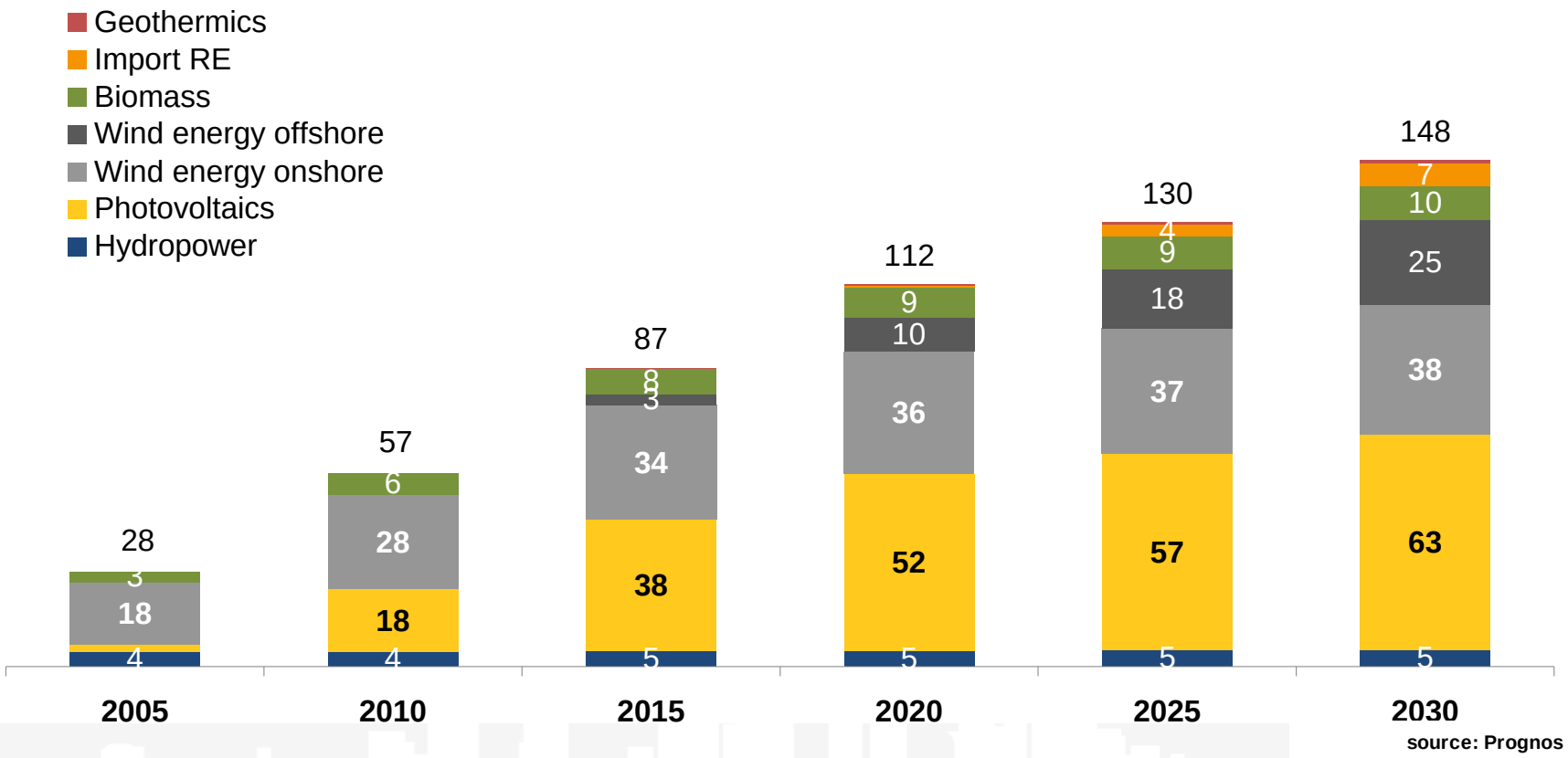


Increased exploitation of the renewable energy ressources is necessary!

source: AGFW

» The installed capacity of RE in Germany must increase rapidly

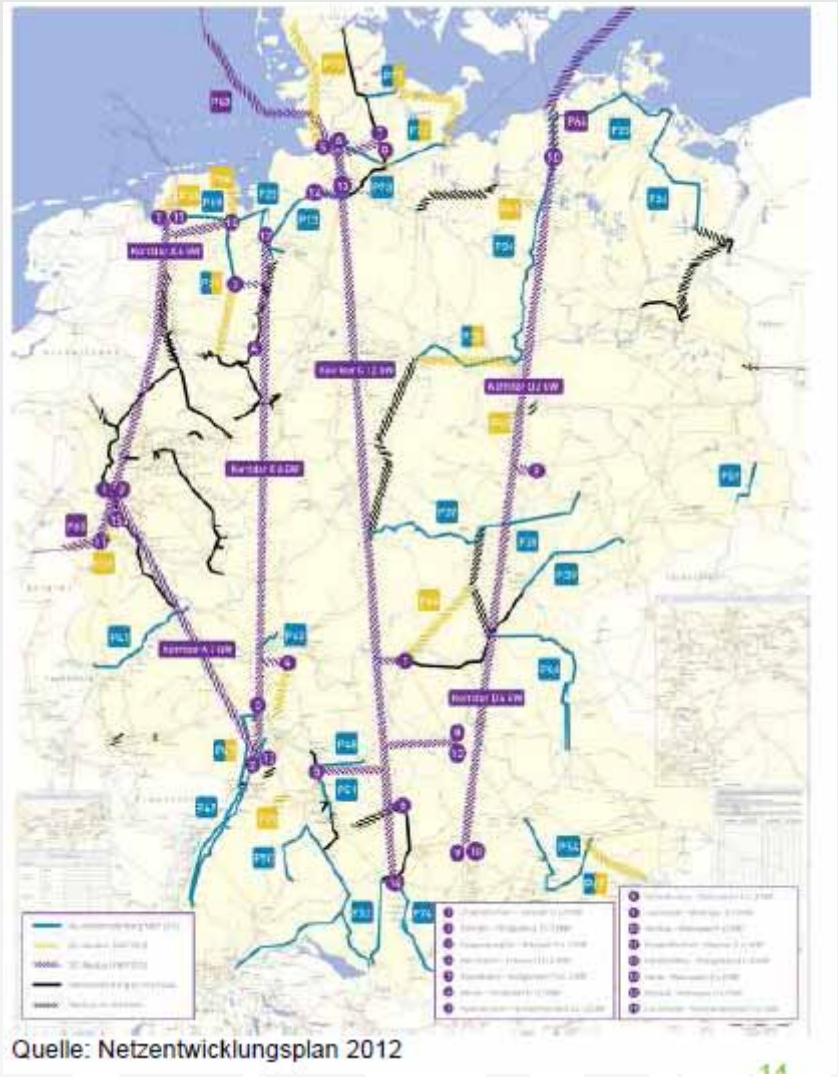
Expansion of RE according to the German pilot study 2010 in GW



source: Prognos

source: AGFW

CHALLANGES FOR THE ELECTRICTIY GRID



Quelle: Netzentwicklungsplan 2012

Target: 80% renewable electricity generation by 2050

Balancing power from +35GW to -24GW is necessary
(peak load management)
(Storages)
(import of renewable electricity)
(customer behaviour)

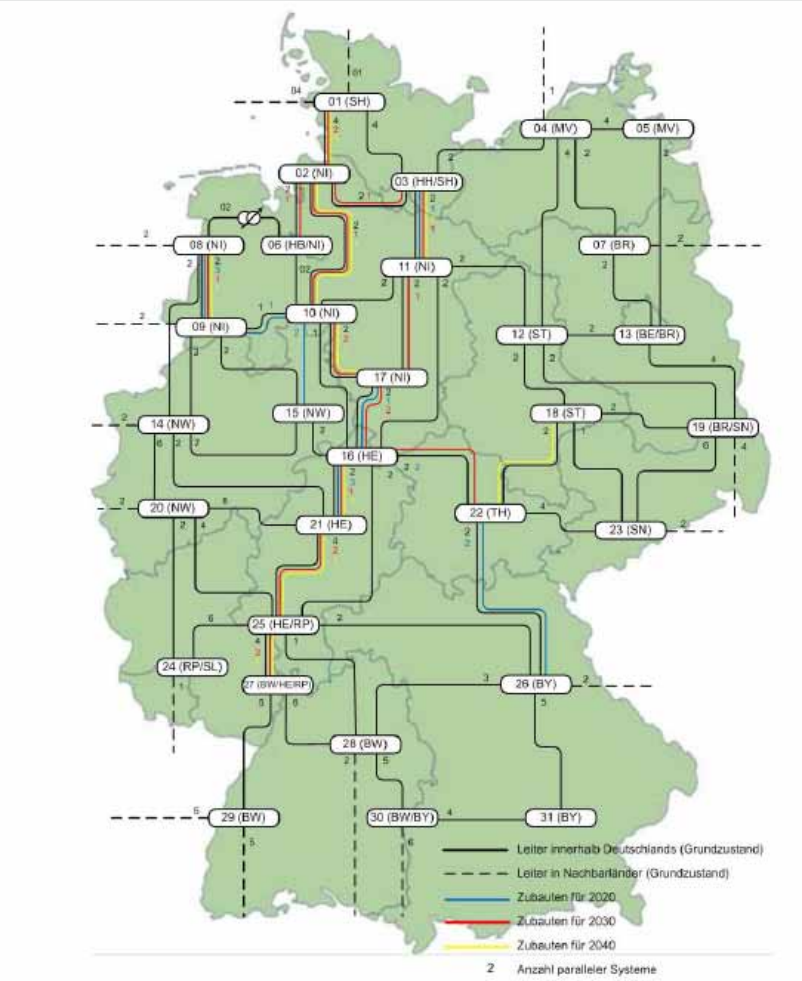
Grid expansion is necessary for transmission and distribution

Smart market and smart grid shall be started up.

Source: Prof. Rehtanz, Technical University Dortmund, 2013

source: AGFW

CHALLANGES FOR THE ELECTRICTIY GRID



Estimated costs for grid expansion:

transmission grid: 20 Billion EUR

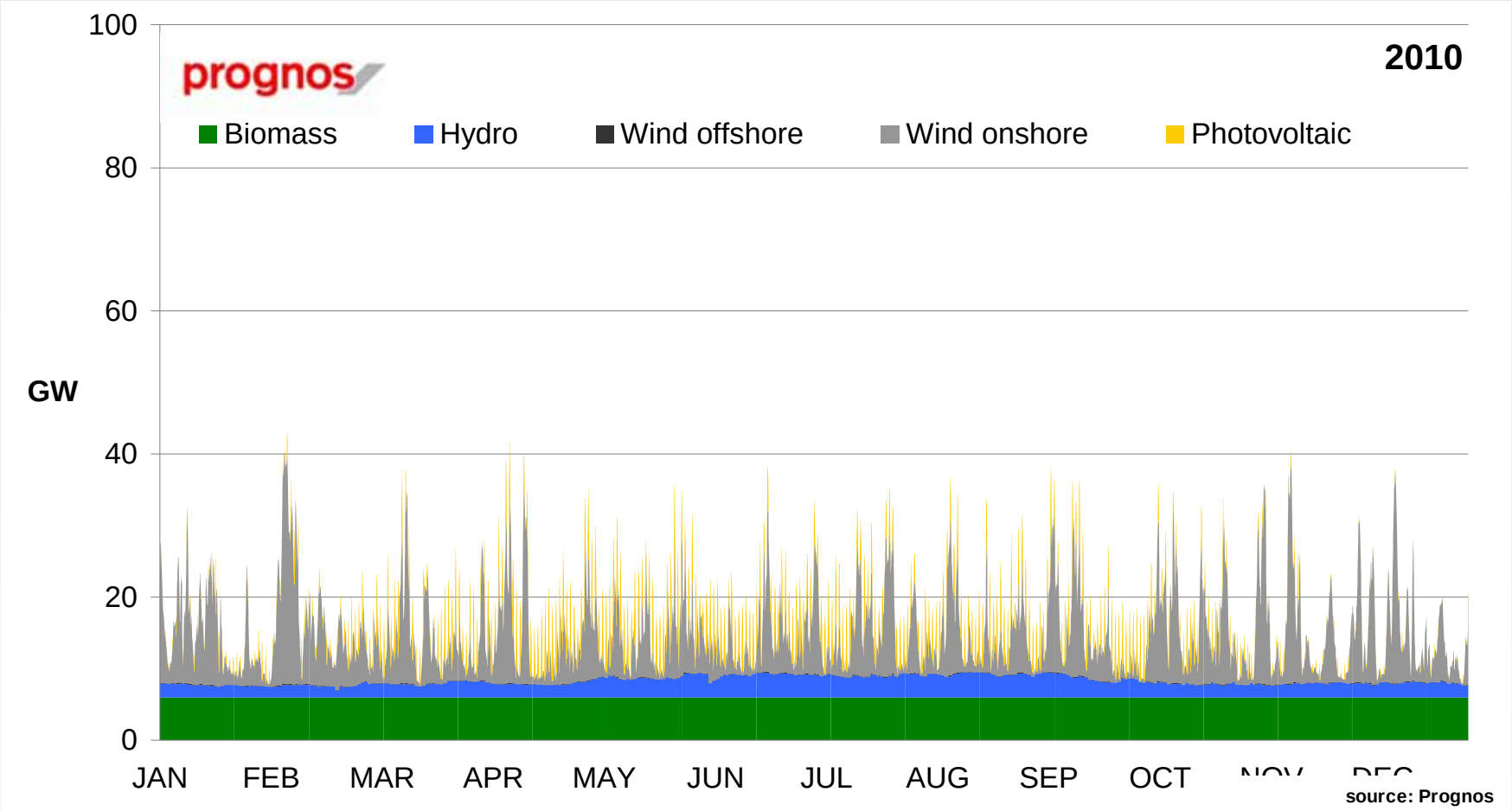
Distribution grid: 27-42 Billion EUR

Optimisation of grid engineering is necessary.

Source: Prof. Rehtanz, Technical University Dortmund, 2013

source: AGFW

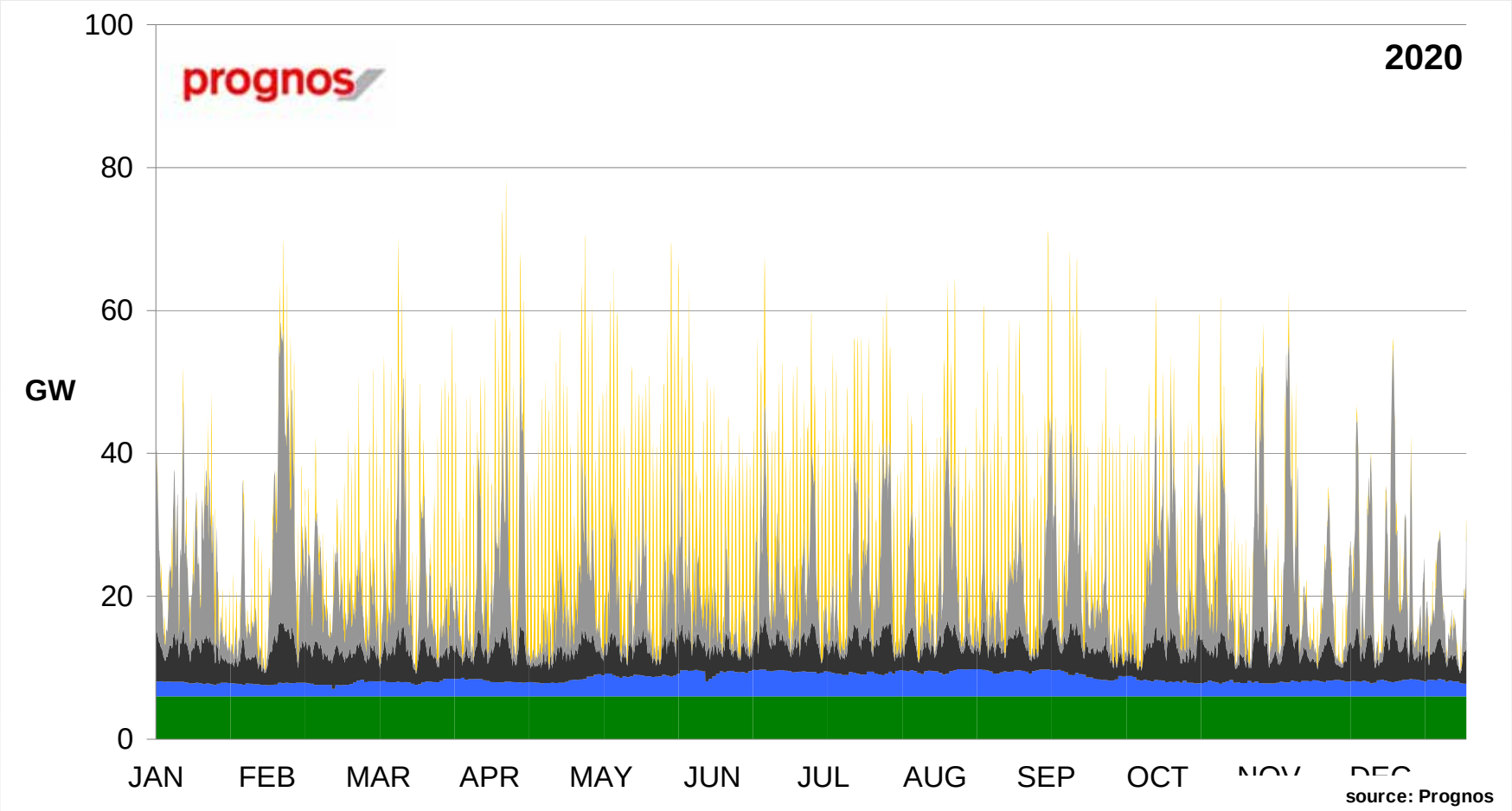
» The renewable energy feed-in reaches up to 40 GW for a few hours a year



source: AGFW

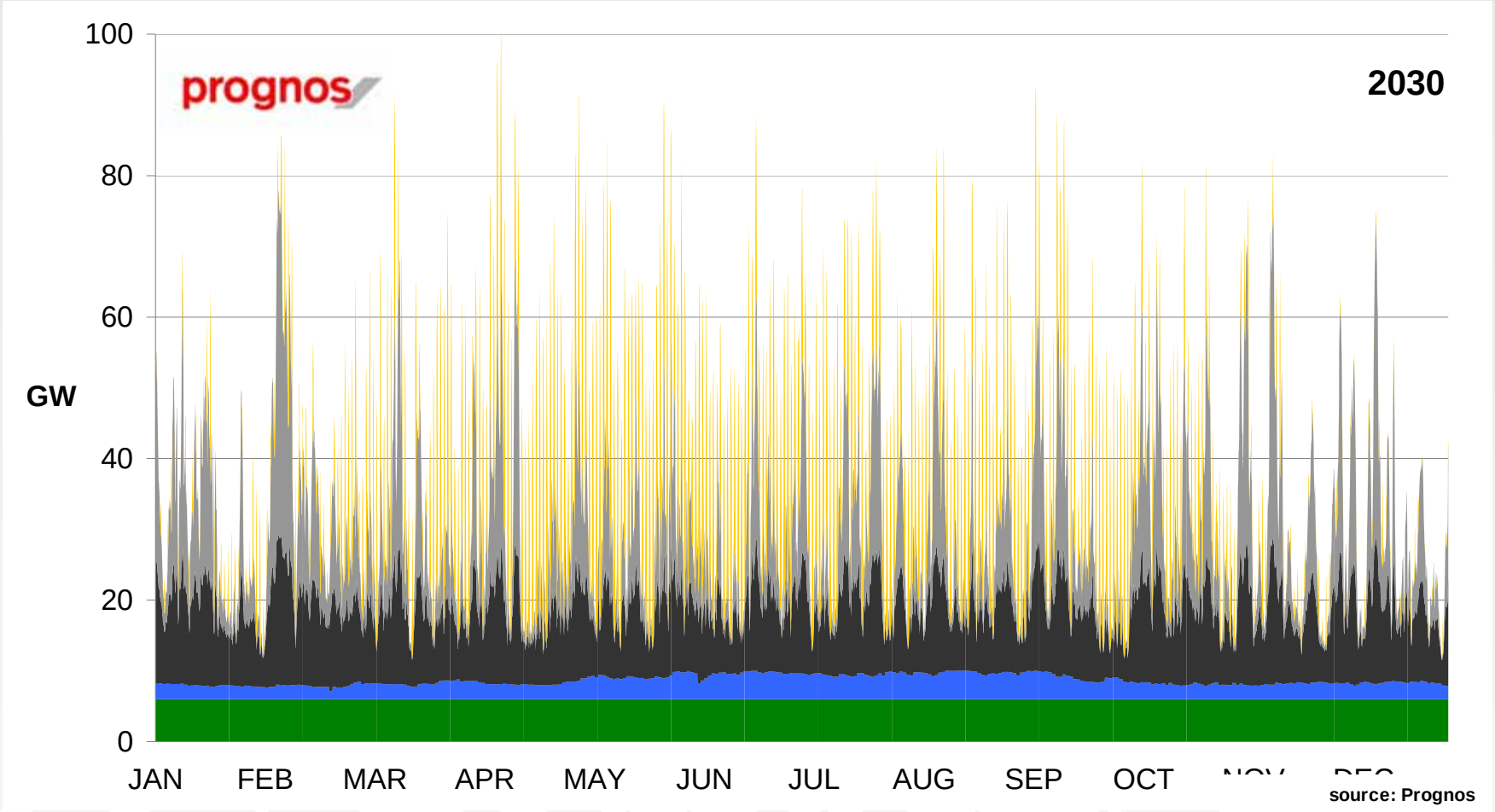
Renewable Electricity Feed-in 2020

- **60 GW are reached on a regular basis**
- **In hours with high wind and solar feed-in the peak reaches up to 70 GW**



source: AGFW

» **Except for the winter time renewable feed-in has peaks around 70 GW to 90 GW**



source: Prognos

source: AGFW

CHALLANGES FOR THE ELECTRICTIY GRID

- Overcome challanges of high investments for grid expansion.
- Stable and save operation.
- Security of supply.
- Electricity storage.
- Interaction with different technologies, markets and solutions.

Remember: High efficient cogeneration copes with mutual dependency on the electricity **and** the heat market.

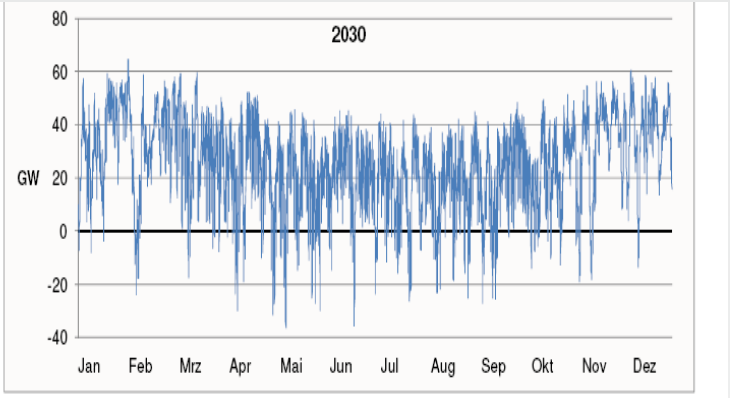
source: AGFW

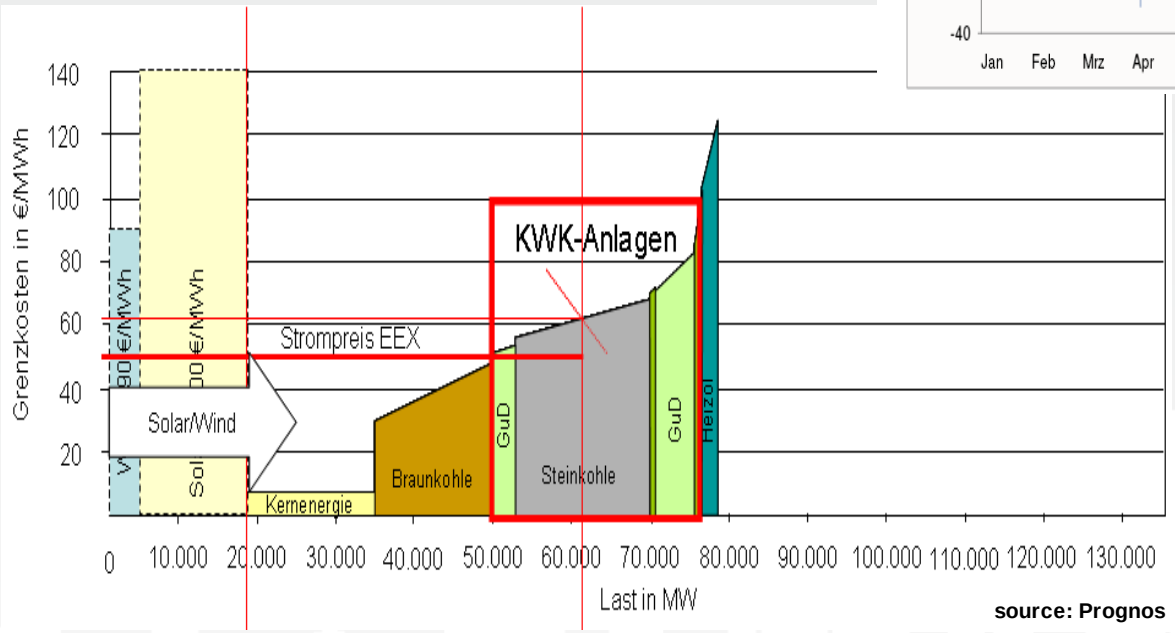
CHALLANGES FOR CHP

Barriers for accelerated development of DHC and CHP

- Market situation for CHP installations is deteriorating
- The base load is slowly deteriorating
- Installations reach lower full load hours
- Higher flexibility (at higher costs) is necessary

Base load disappears (residual load 2030 in GW)





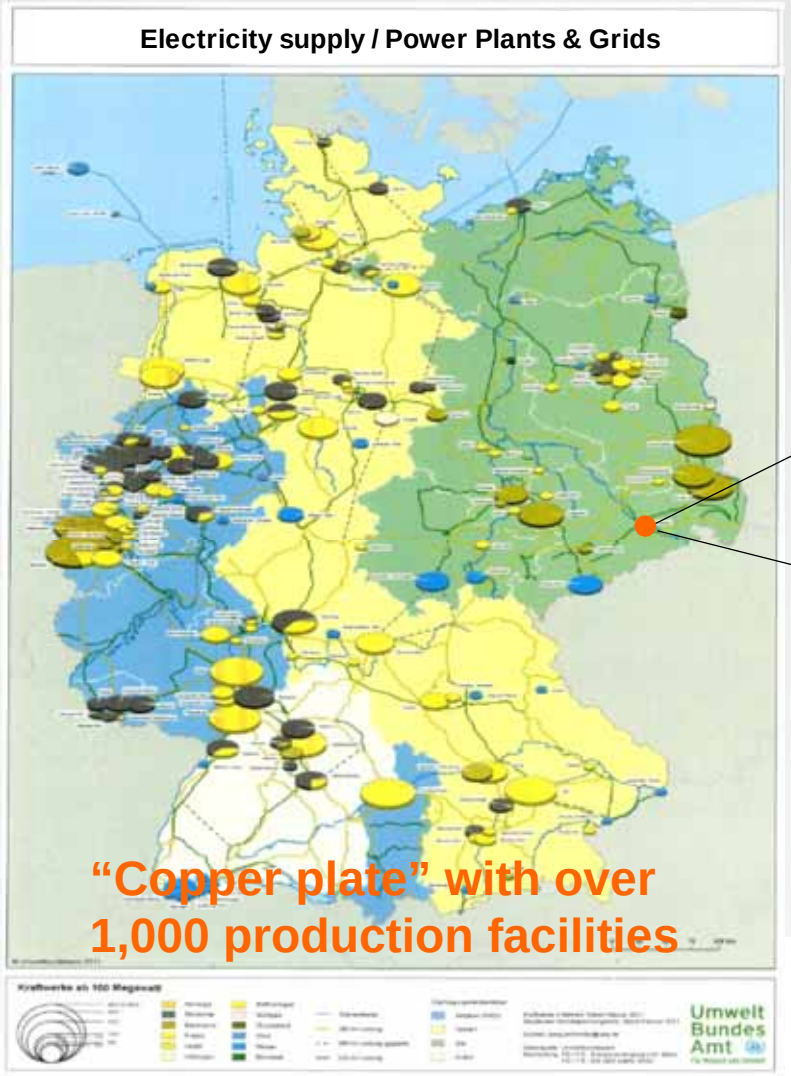
source: Prognos

CHP installations are pushed out of the market because of Merit Order in Germany

source: AGFW

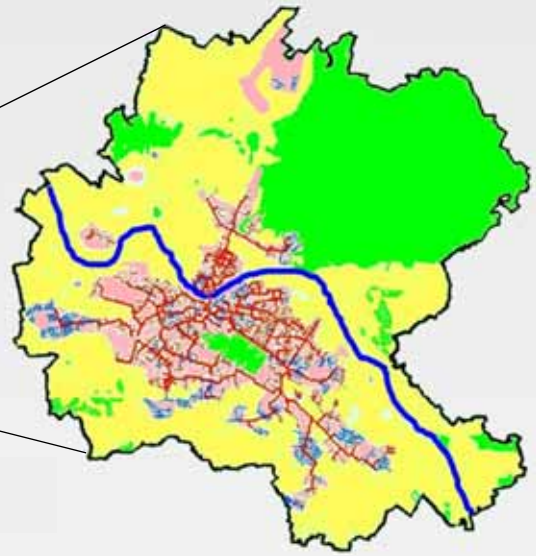
CHALLANGES FOR CHP

… in comparison to the electric grid –every production facility is systemic



“Copper plate” with over 1,000 production facilities

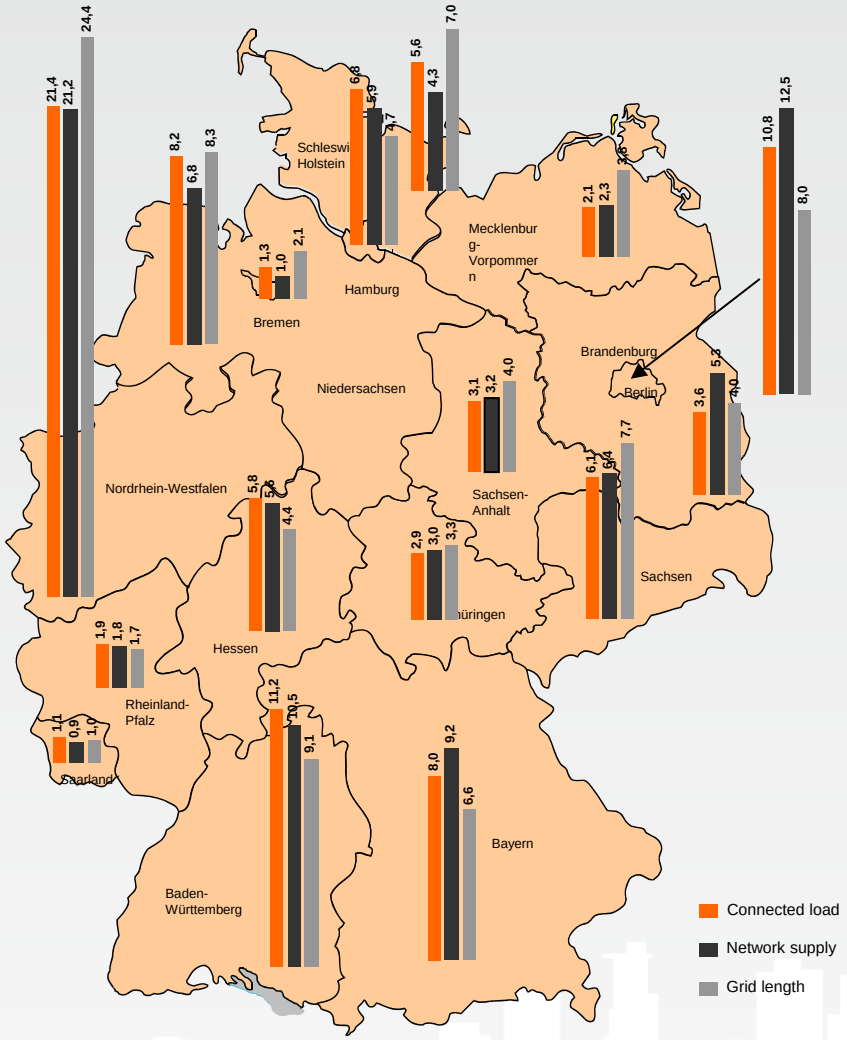
District Heating supply
e. g. medium sized city



District Heating system in parts of the city with 4 CHP installations

source: AGFW

CHALLANGES FOR CHP

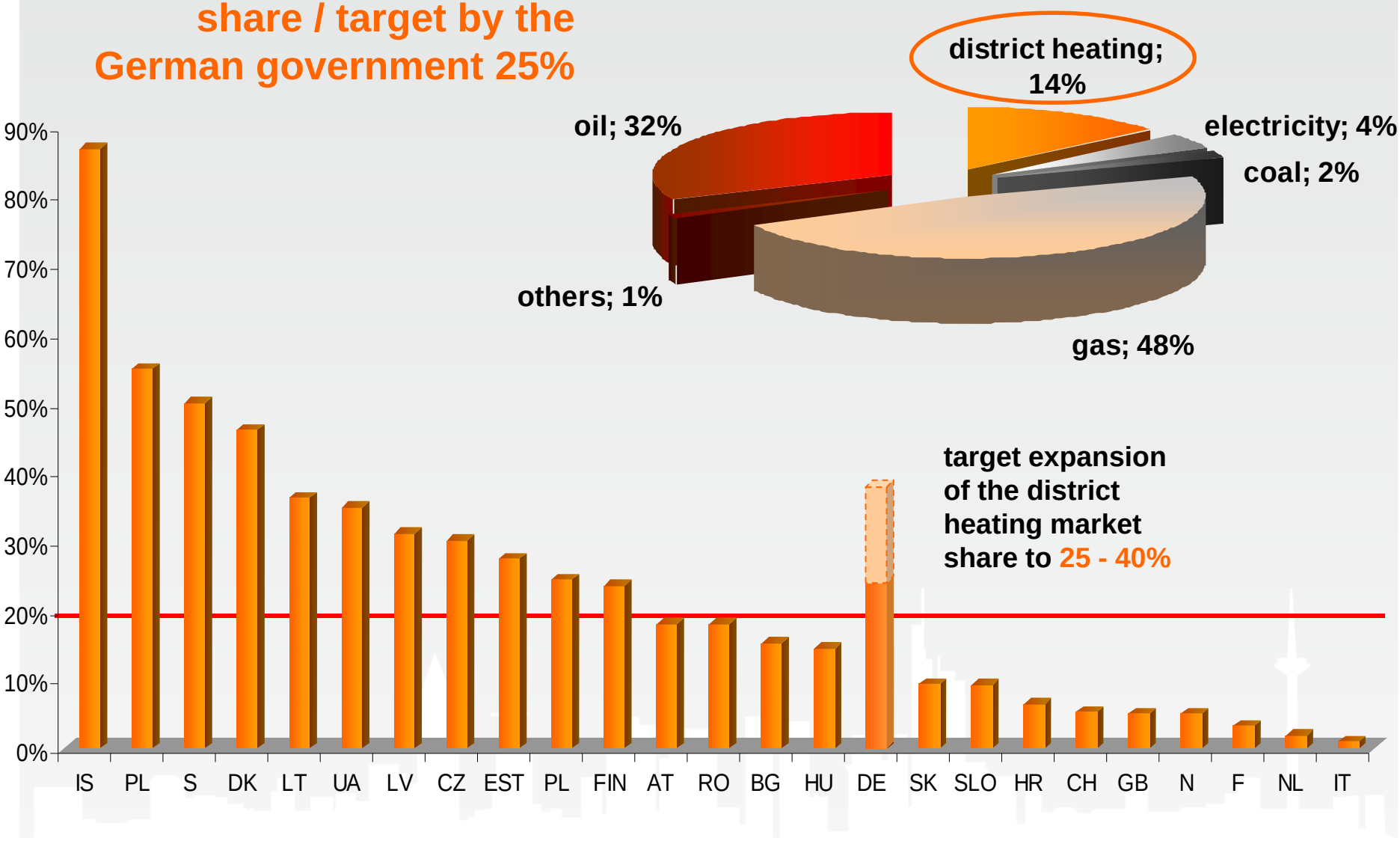


- The district heating connected load in Germany is approximately 57.000 MWth.
- 13% CHP share in electricity production
- The district heating customers are: 46% private homes, 36% public buildings, commercial and trade sector and 18% industry
- The total length of the district heating grid in Germany is approximately 100.000 km
- Over 84% of District Heating is generated in high efficient cogeneration (CHP) plants

source: AGFW

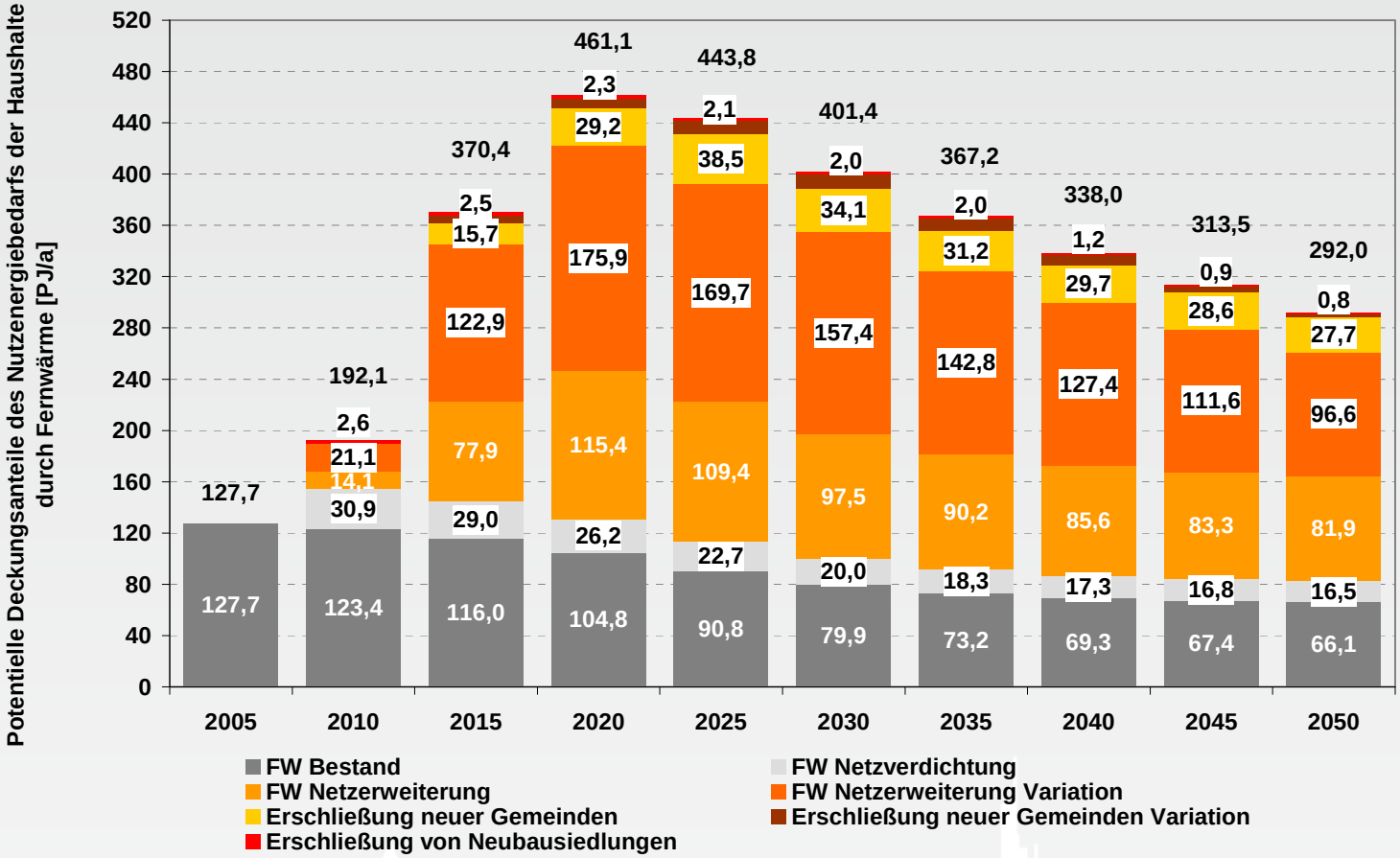
CHALLANGES FOR CHP

District heating market share / target by the German government 25%



Source: AGFW / Euroheat & Power/ BGW

CHALLANGES FOR CHP



Potential for DH by 2050 is high. It can only be used by network expansion.

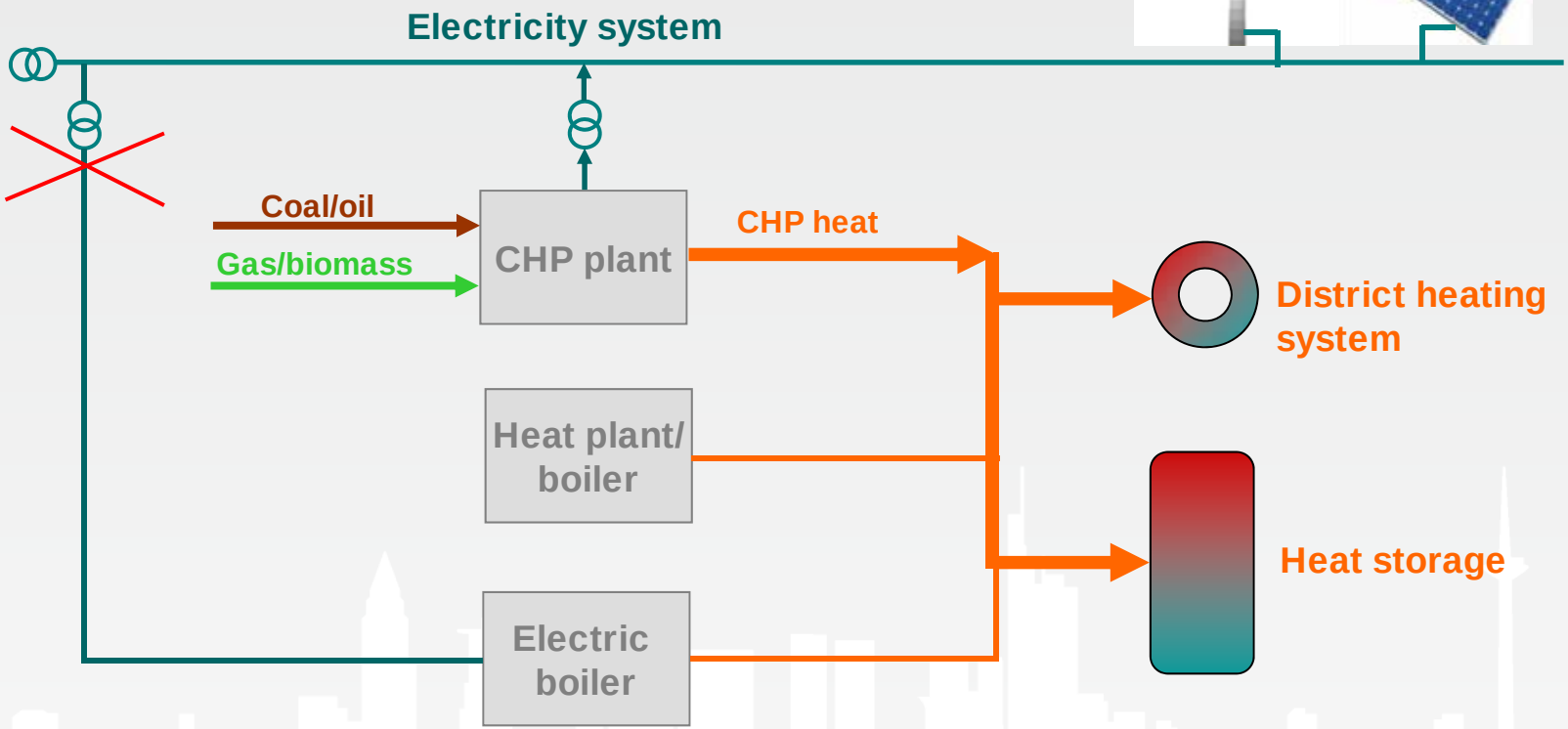
source: AGFW

Source: AGFW / Euroheat & Power/ BGW

OPPORTUNITIES FOR DISTRICT HEATING

District heating production including storage and electric boiler

Low proportion pv and/or wind

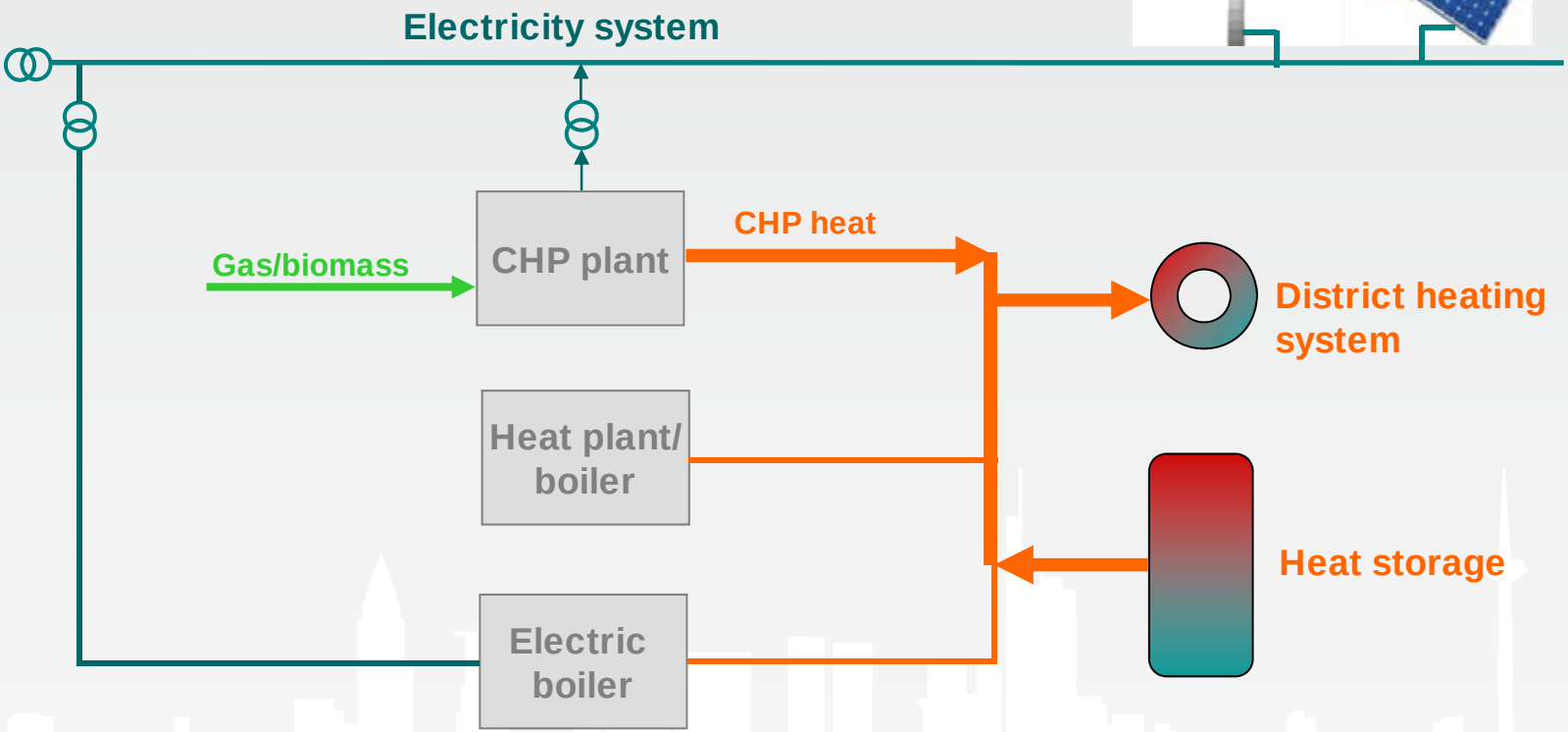


source: AGFW

OPPORTUNITIES FOR DISTRICT HEATING

District heating production including storage and electric boiler

Medium proportion pv and/or wind

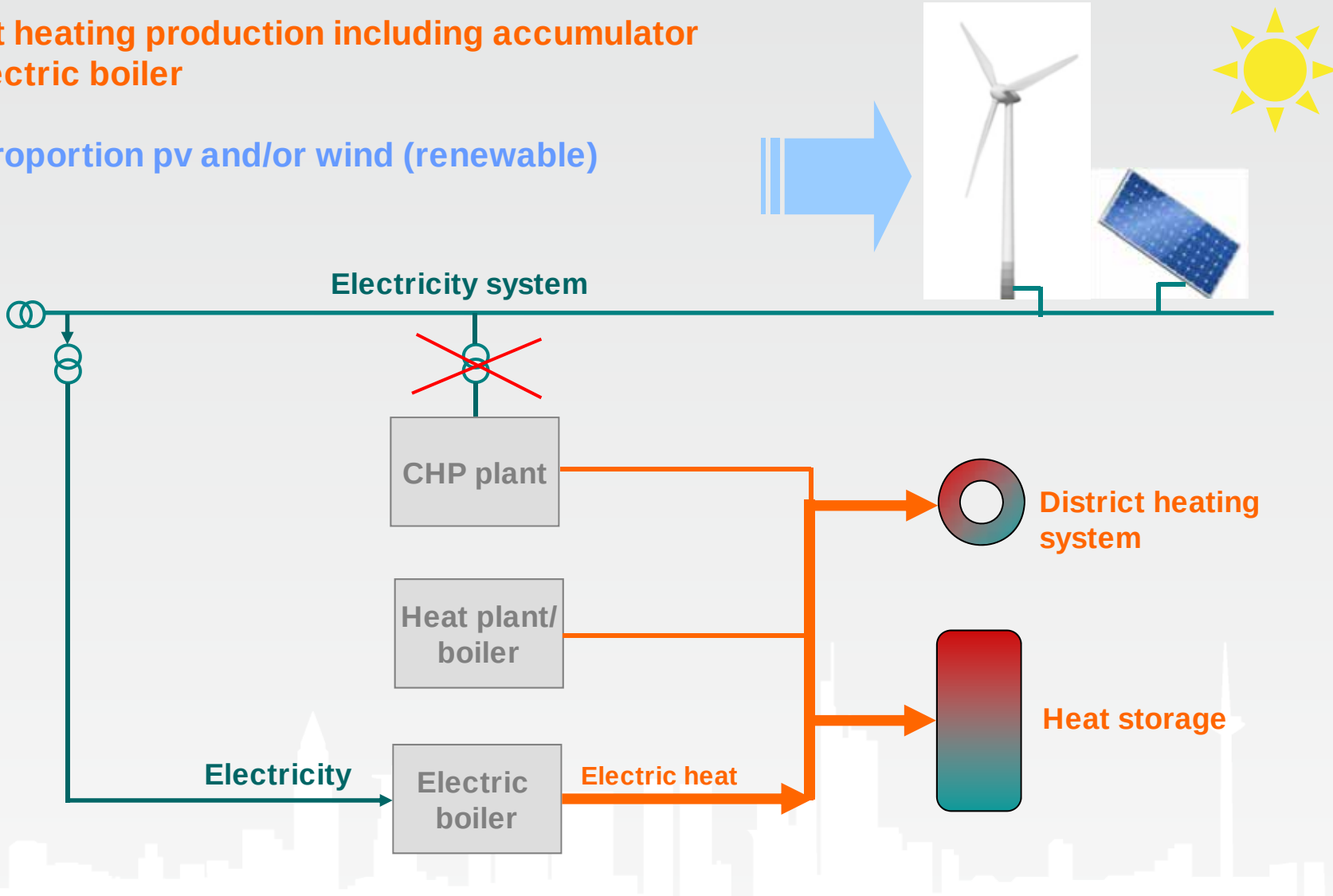


source: AGFW

OPPORTUNITIES FOR DISTRICT HEATING

District heating production including accumulator and electric boiler

High proportion pv and/or wind (renewable)



source: AGFW

OPPORTUNITIES FOR DISTRICT HEATING

Flexibility Potential of Public CHP Plants

- **Load and production management potential of CHP with thermal storage is very high**
- **A potential of 3.6 GW positive and 6.7 GW negative balancing power can be provided**
- **With auxiliary electric heating systems an additional potential of 11.7 GW renewable energy can be utilized**
- **The necessary total investment cost for heat storage facilities in public district heating ranges from 1.4 to 2.2 billion Euro**
- **The comparison with alternative options for integrating renewable energies shows significant advantages for thermal storage systems**

source: AGFW

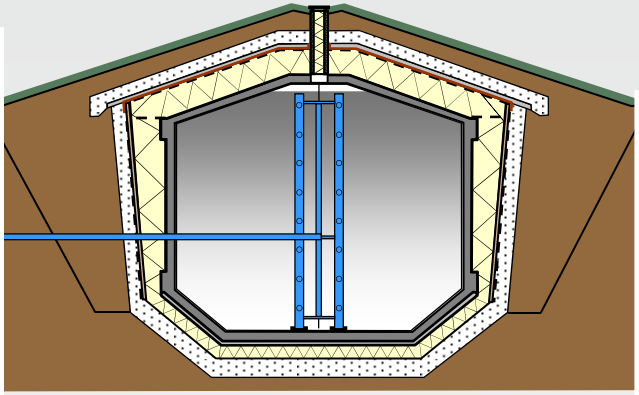
OPPORTUNITIES FOR DISTRICT HEATING

Source: AGFW/Solites

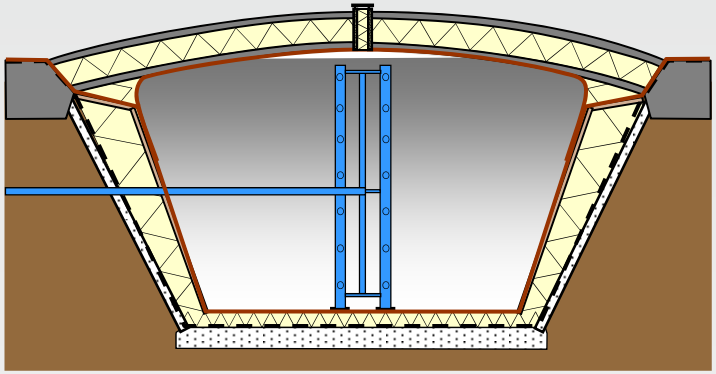
source: AGFW

OPPORTUNITIES FOR DISTRICT HEATING

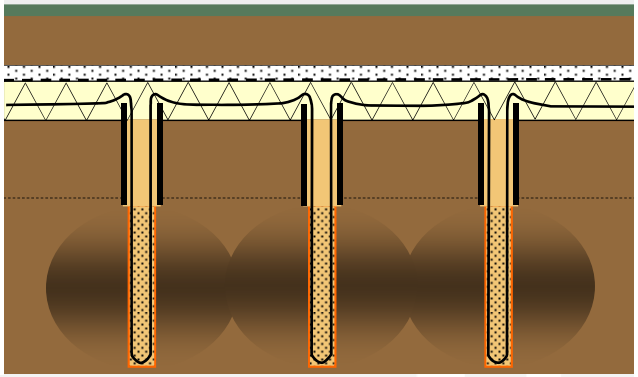
Hot water-storage
(60 - 80 kWh/m³)



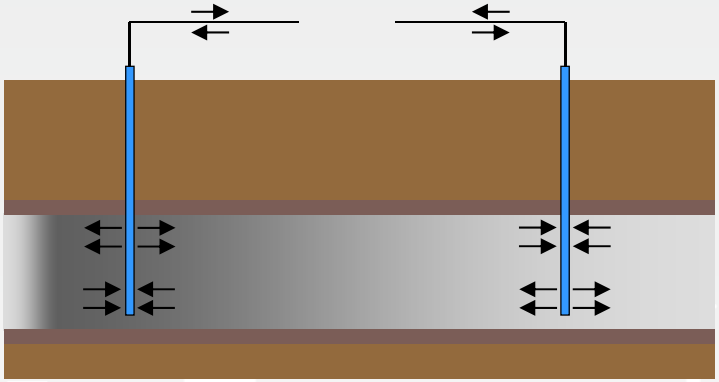
Pit storage
(60 - 80 kWh/m³)



Geothermal heat storage
(15 bis 30 kWh/m³)



Aquifer-heat storage
(30 - 40 kWh/m³)



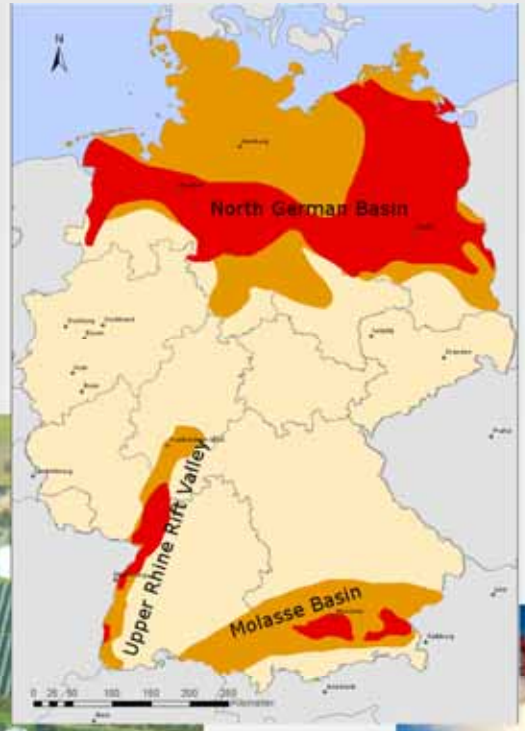
source: AGFW

Quelle: AGFW/Solites

OPPORTUNITIES FOR DISTRICT HEATING

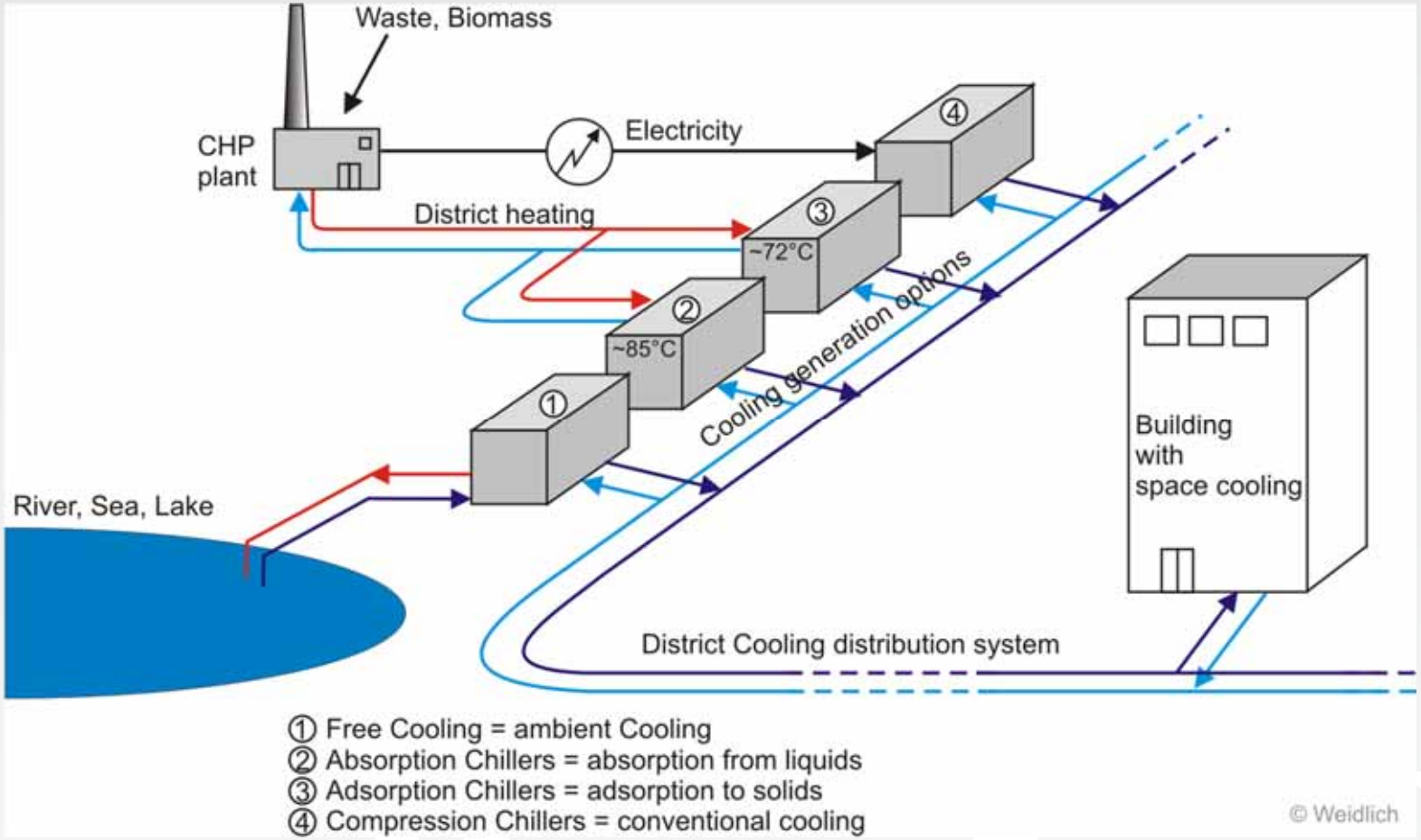
Integration of Renewable heat sources

- Biomass in CHP unit.
- Geothermal sources.
- Solarthermal sources.



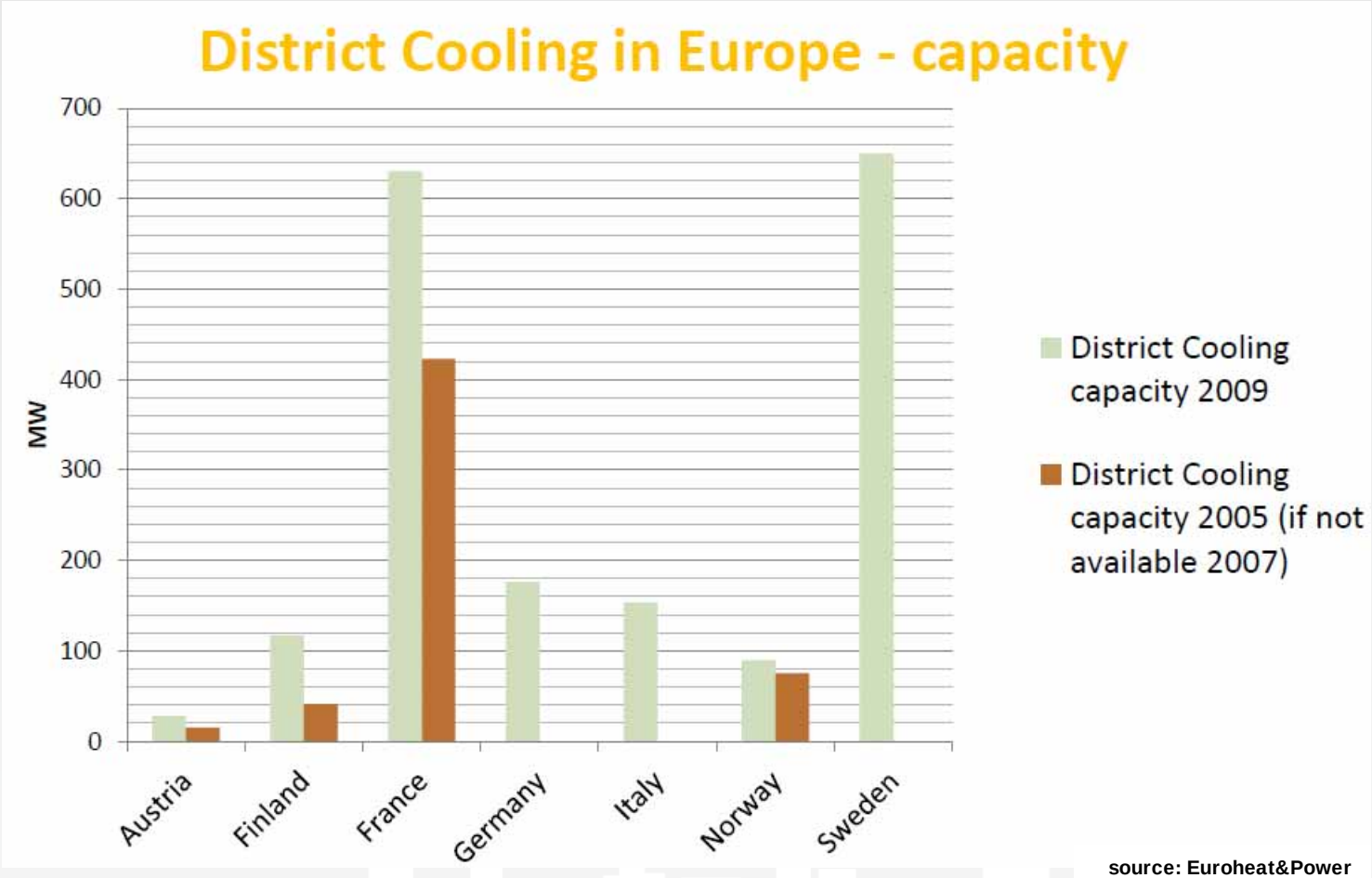
source: AGFW

COOLING



source: AGFW

OPPORTUNITIES FOR DISTRICT HEATING



source: Euroheat&Power

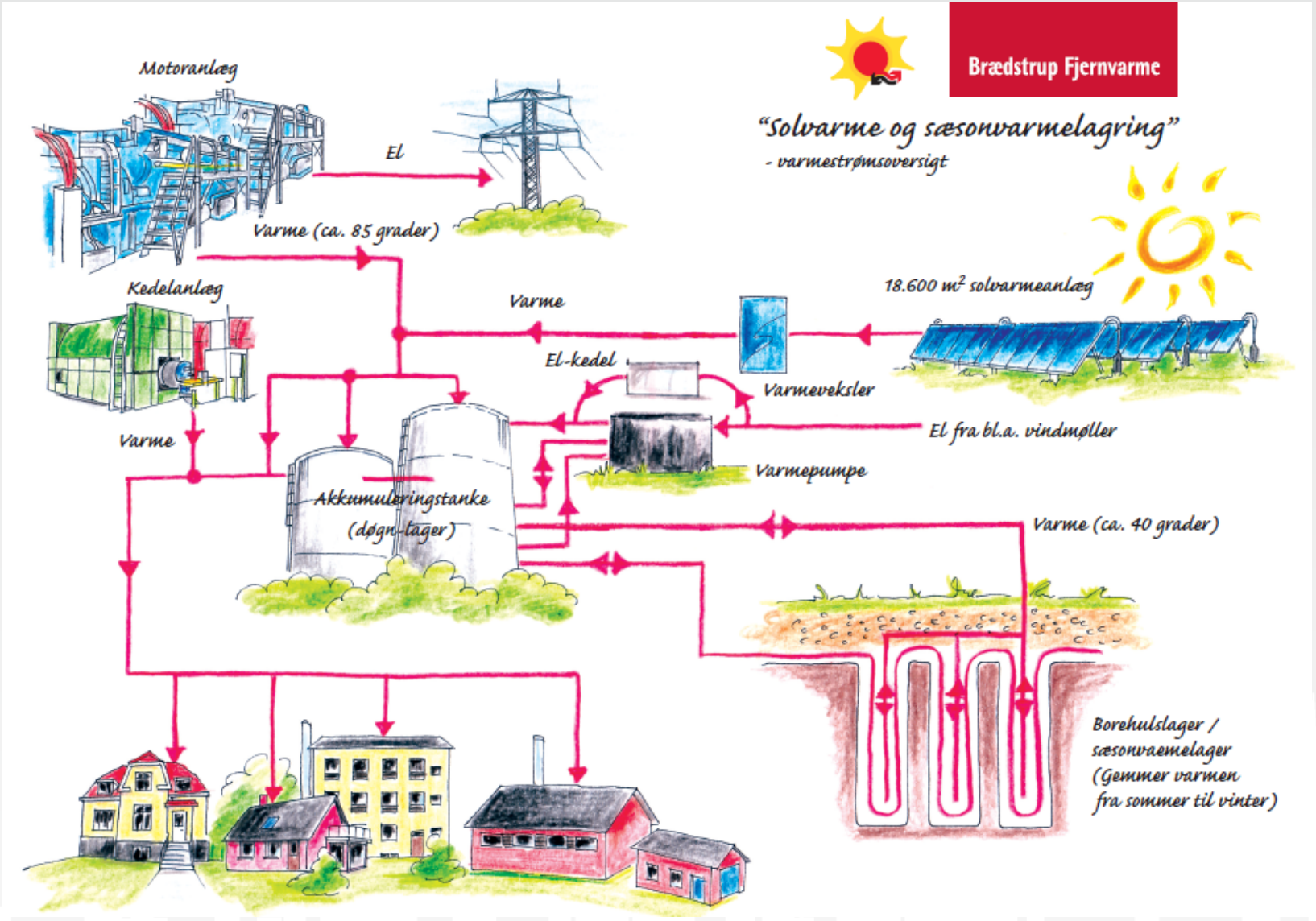
source: AGFW

CHALLANGES FOR CHP AND DH

- Make use of the great potential.
- Cost efficient network expansion.
- Combining different RE heat sources.
- Combining differen technologies.
- Heat storage and flexibility.
- Expansion of the cooling grid.

source: AGFW

MULTI TECHNOLOGICAL SOLUTIONS



source: AGFW

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Many thanks for your attention!