

Potential of integrating industrial waste heat and solar thermal energy in district heating systems in Germany

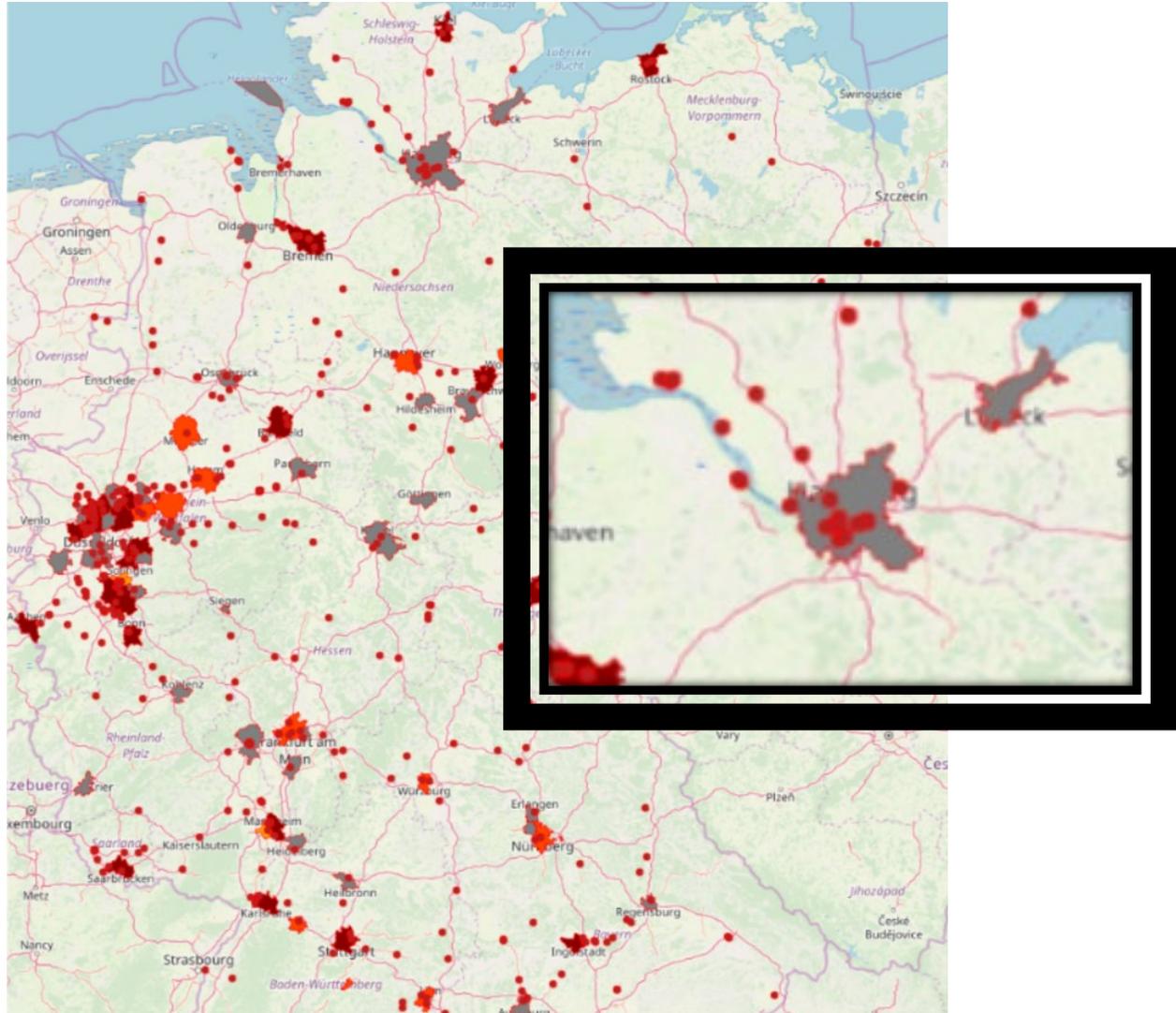
Friederike Stelter

Industrial waste heat – definition

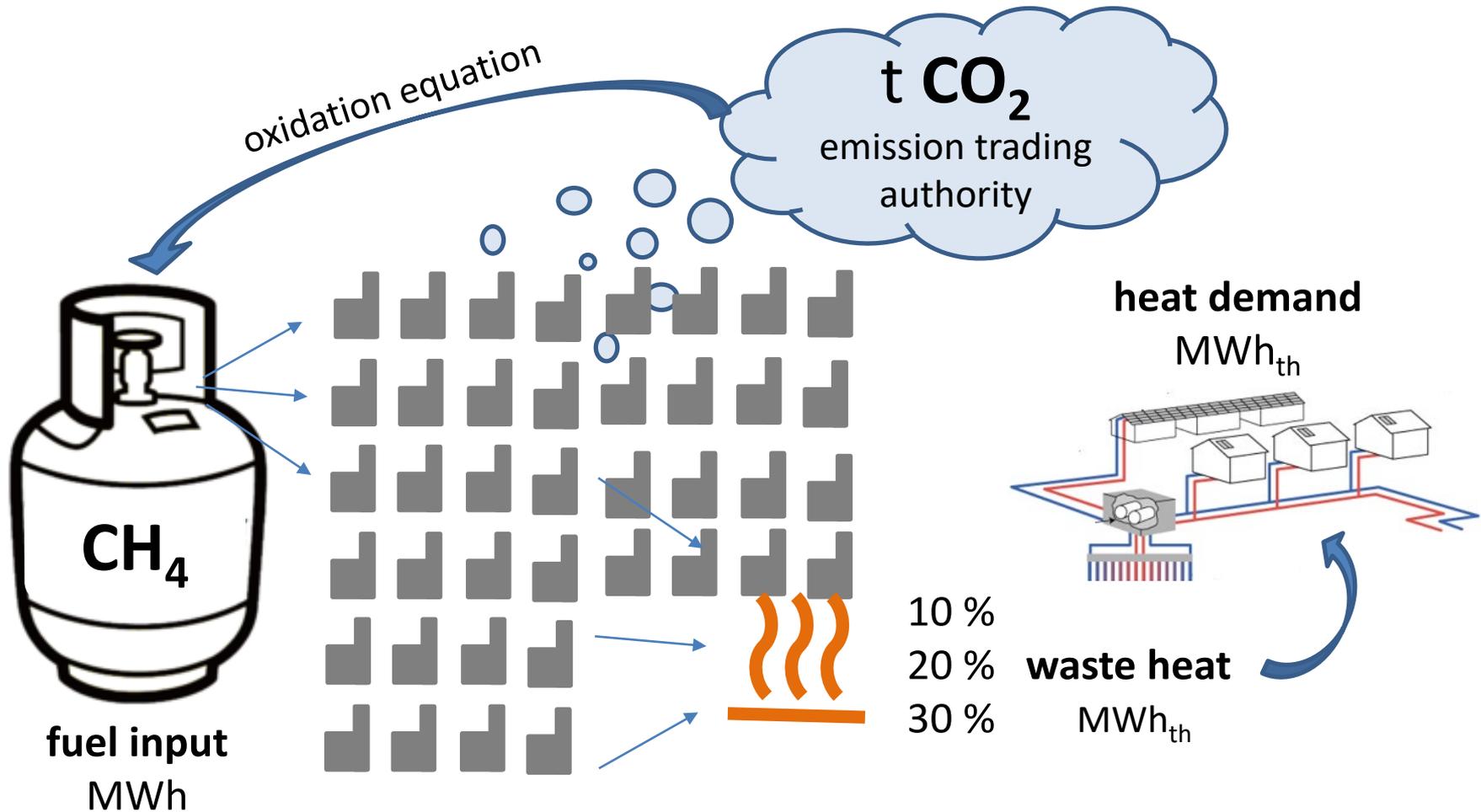
Heat that is a by-product of an industrial process and that otherwise would not be used

- X Heat from waste incineration plants are excluded from this definition
- X It is not a renewable resource
- ✓ It can be categorized as carbon-neutral

Industrial waste heat – methods

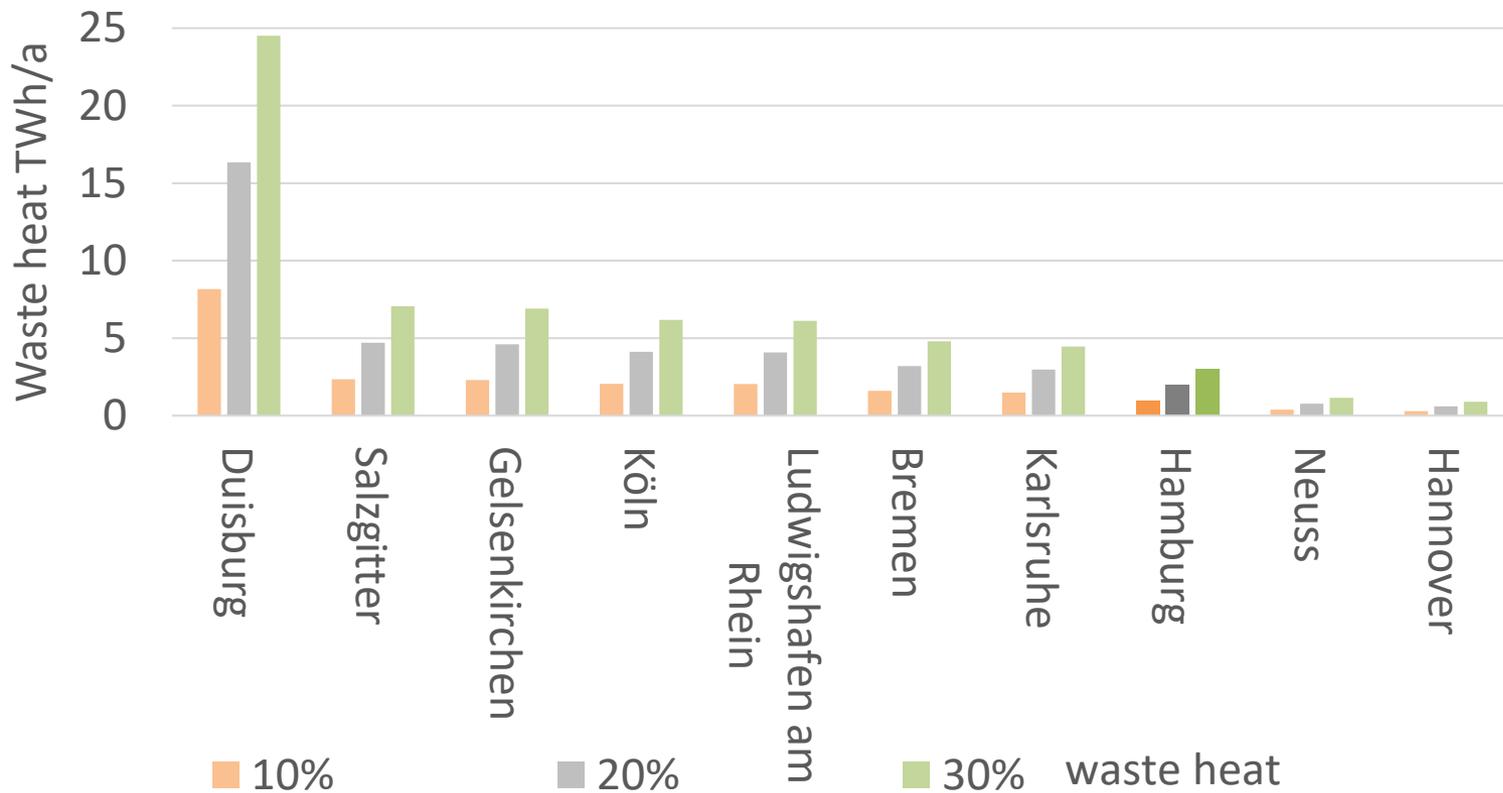


Industrial waste heat – methods

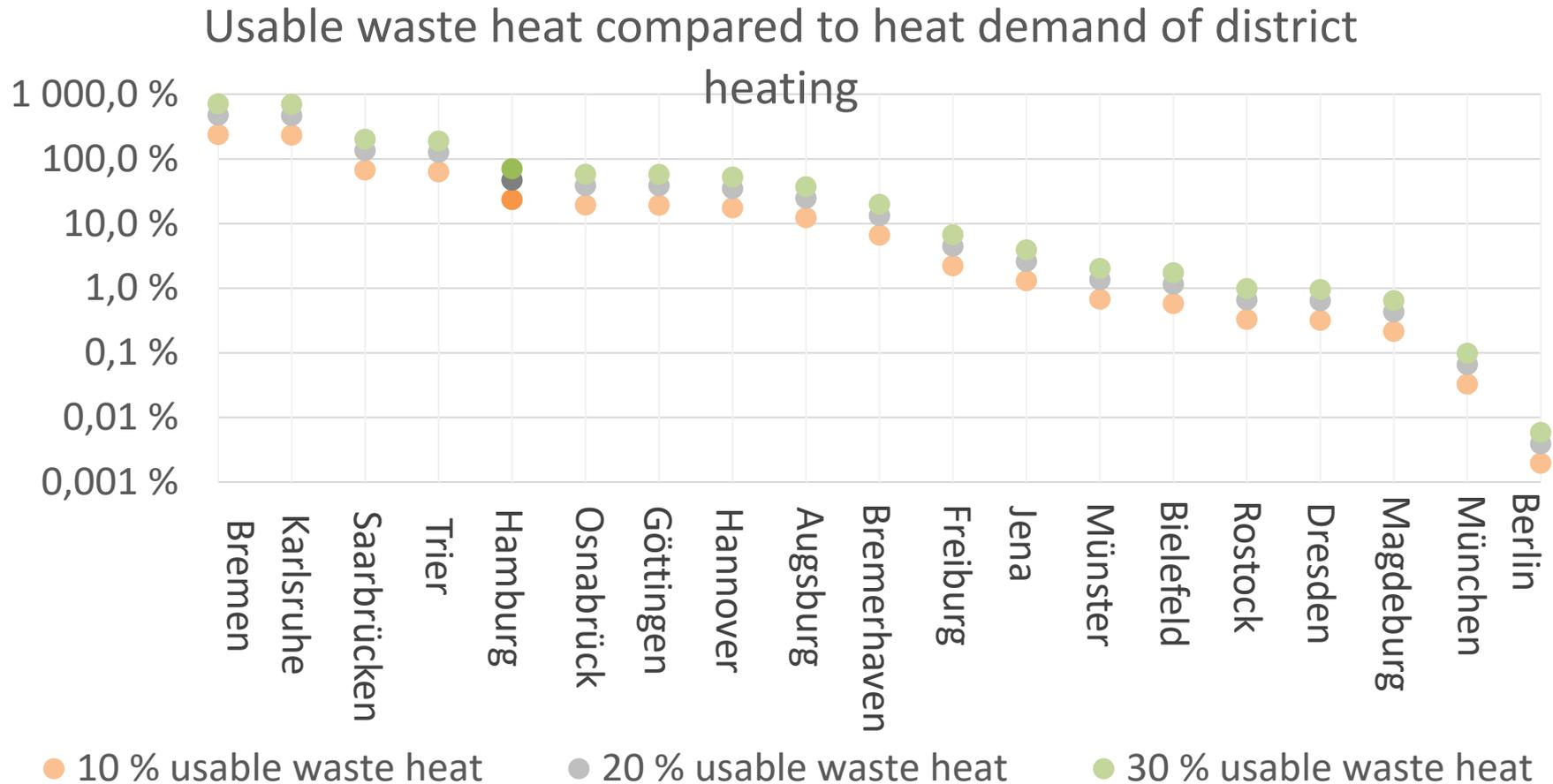


Industrial waste heat – results

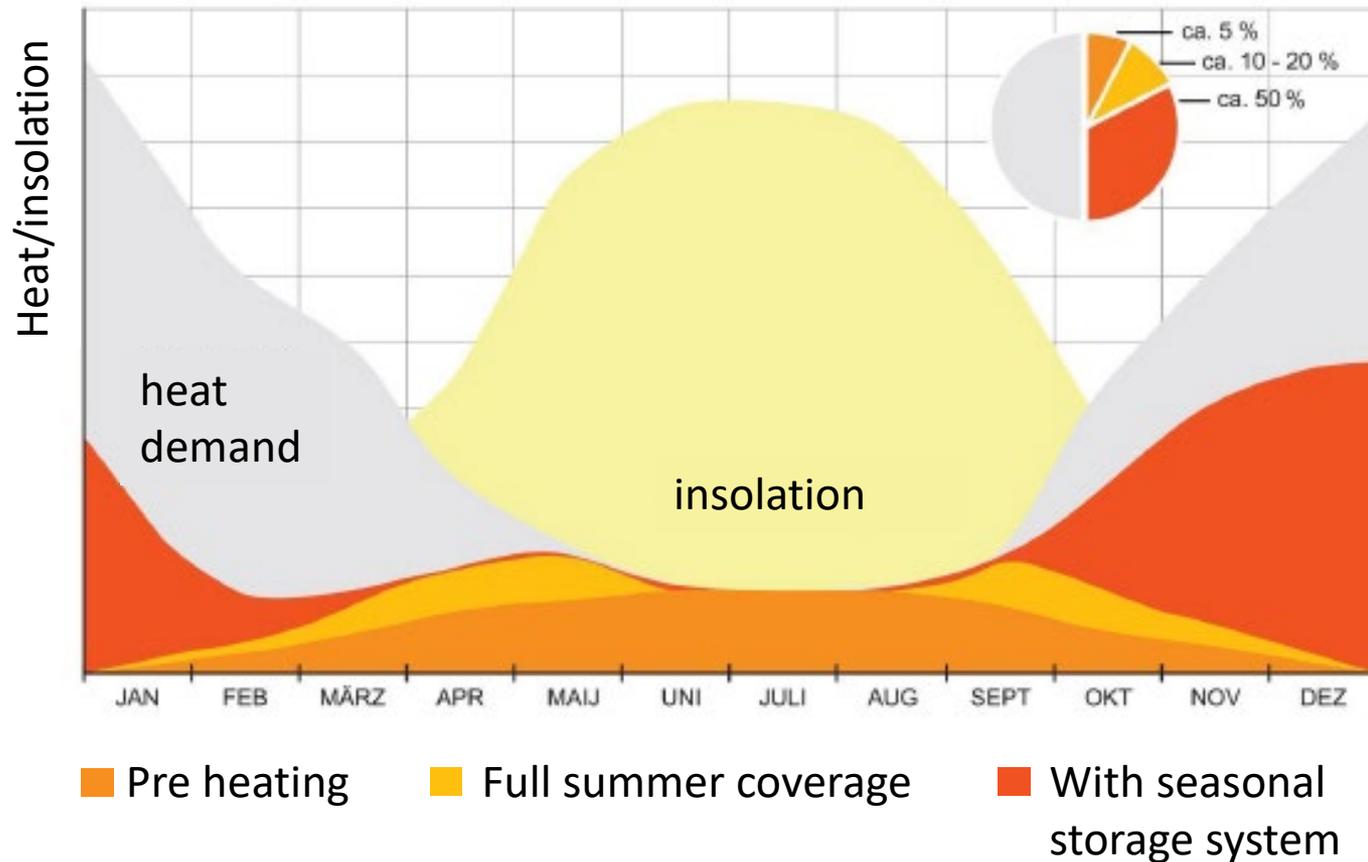
Usable waste heat in TWh/a



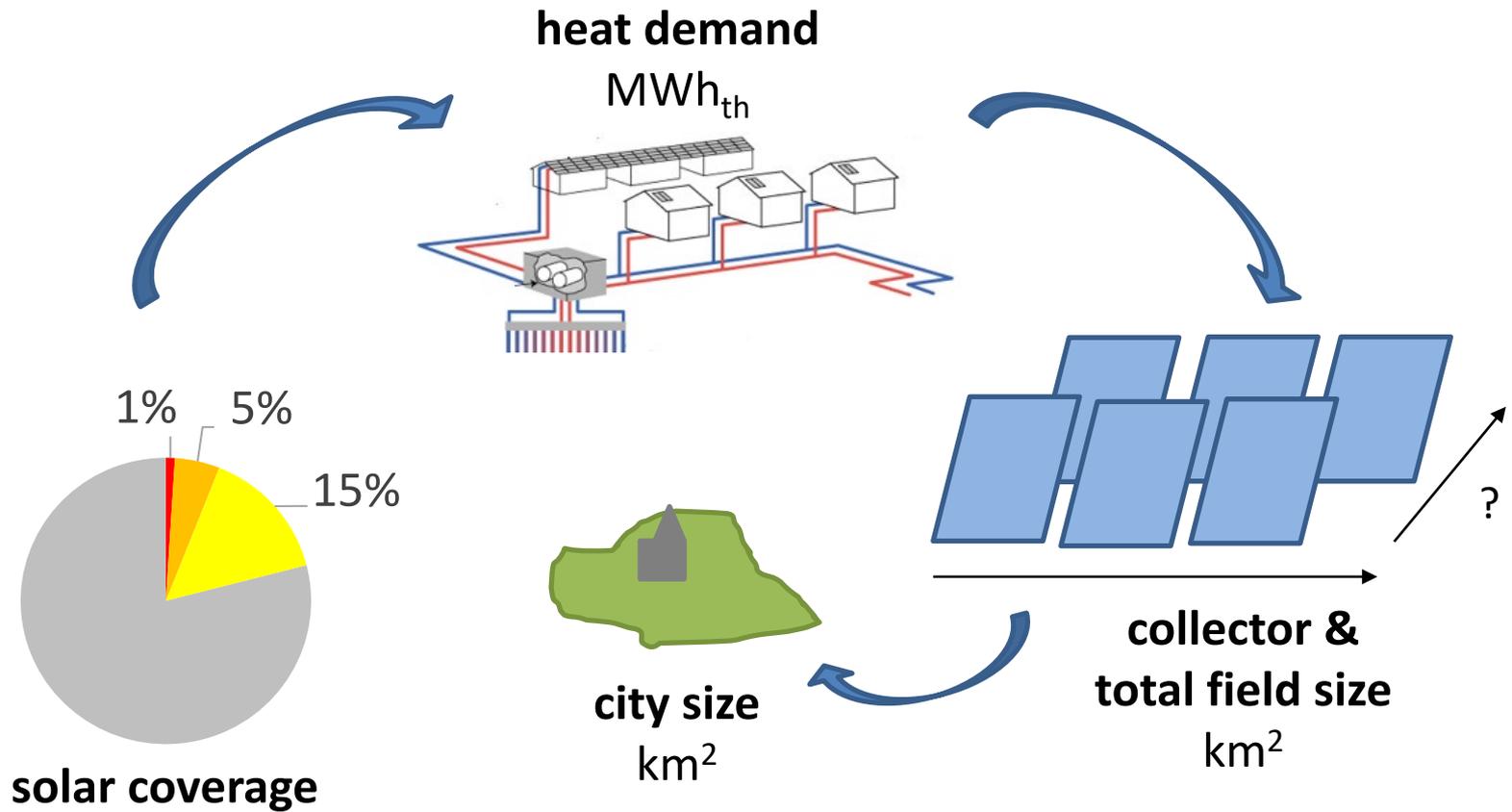
Industrial waste heat – results



Solar thermal energy

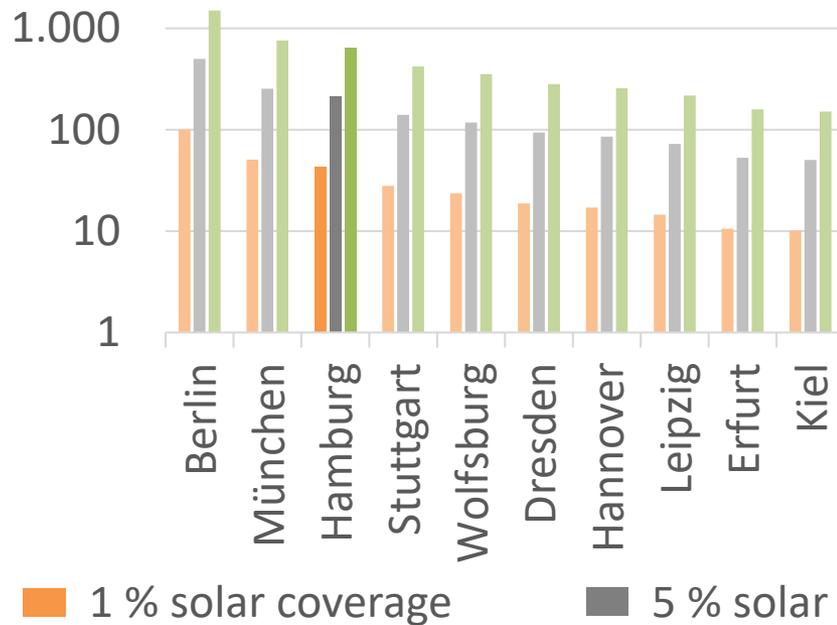


Solar thermal energy – method

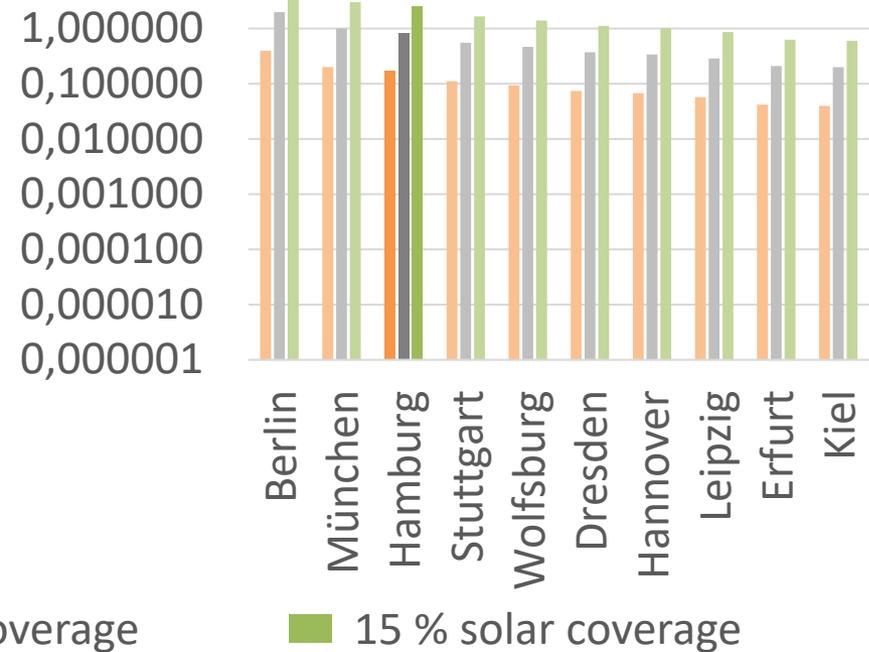


Solar thermal energy – results

Needed energy in GWh/a

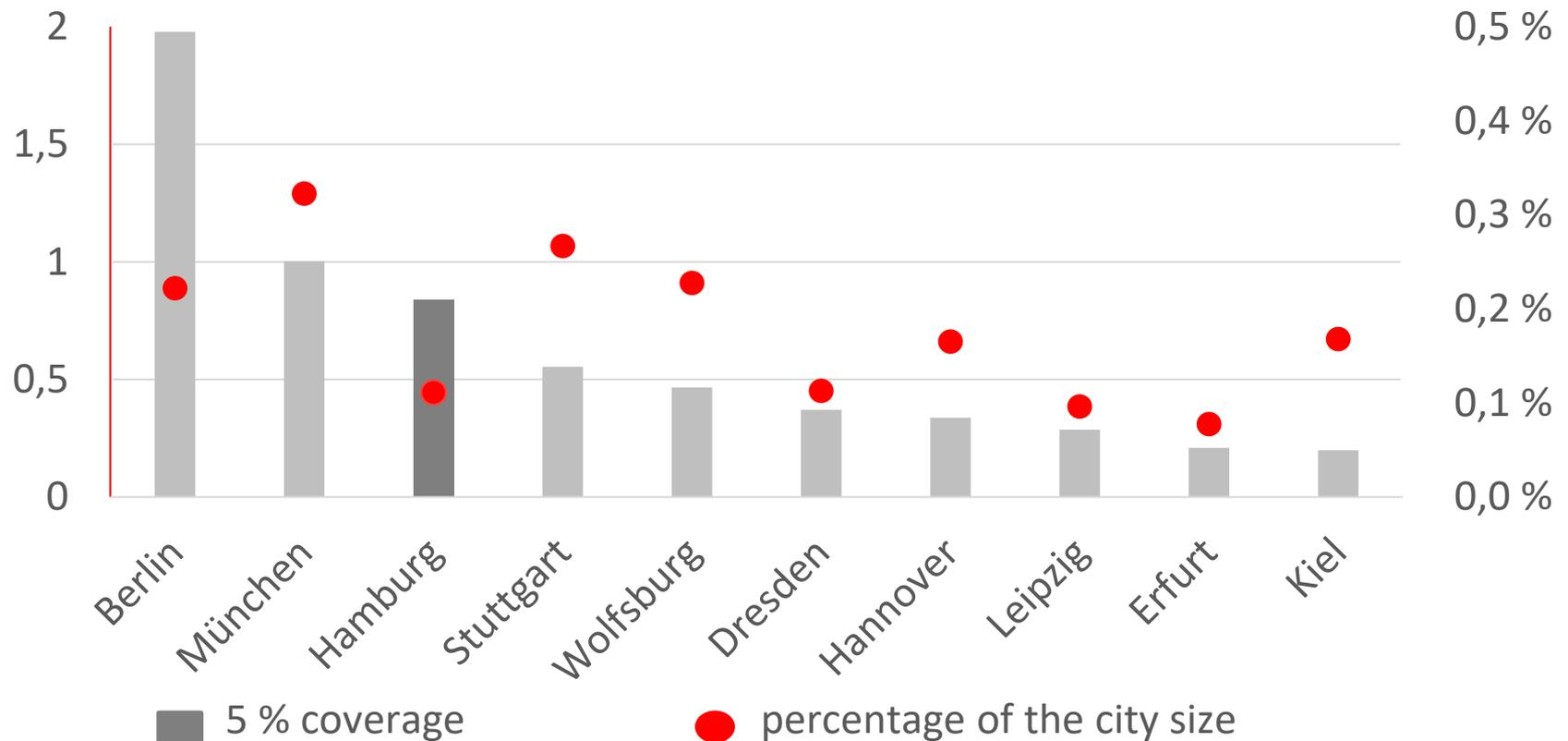


Total field size in km²



Solar thermal energy – results

Total field size in km² and percentage of city size



Conclusion

- ✓ Great theoretical potential of industrial waste heat and solar thermal energy to integrate in district heating systems in Germany
- ✓ Possible solution to enforce the decarbonisation of the heat market

Thank you for your attention!

Industrial waste heat – method

- 48 big cities with more than 100.000 inhabitants
- CO₂ Emissions in 2017 from German Emission Trading Authority (DEHSt)
- Converting CO₂ emissions in amount of input energy and usable waste heat
 - 10, 20 and 30 % usable waste heat
 - Gas as input energy source

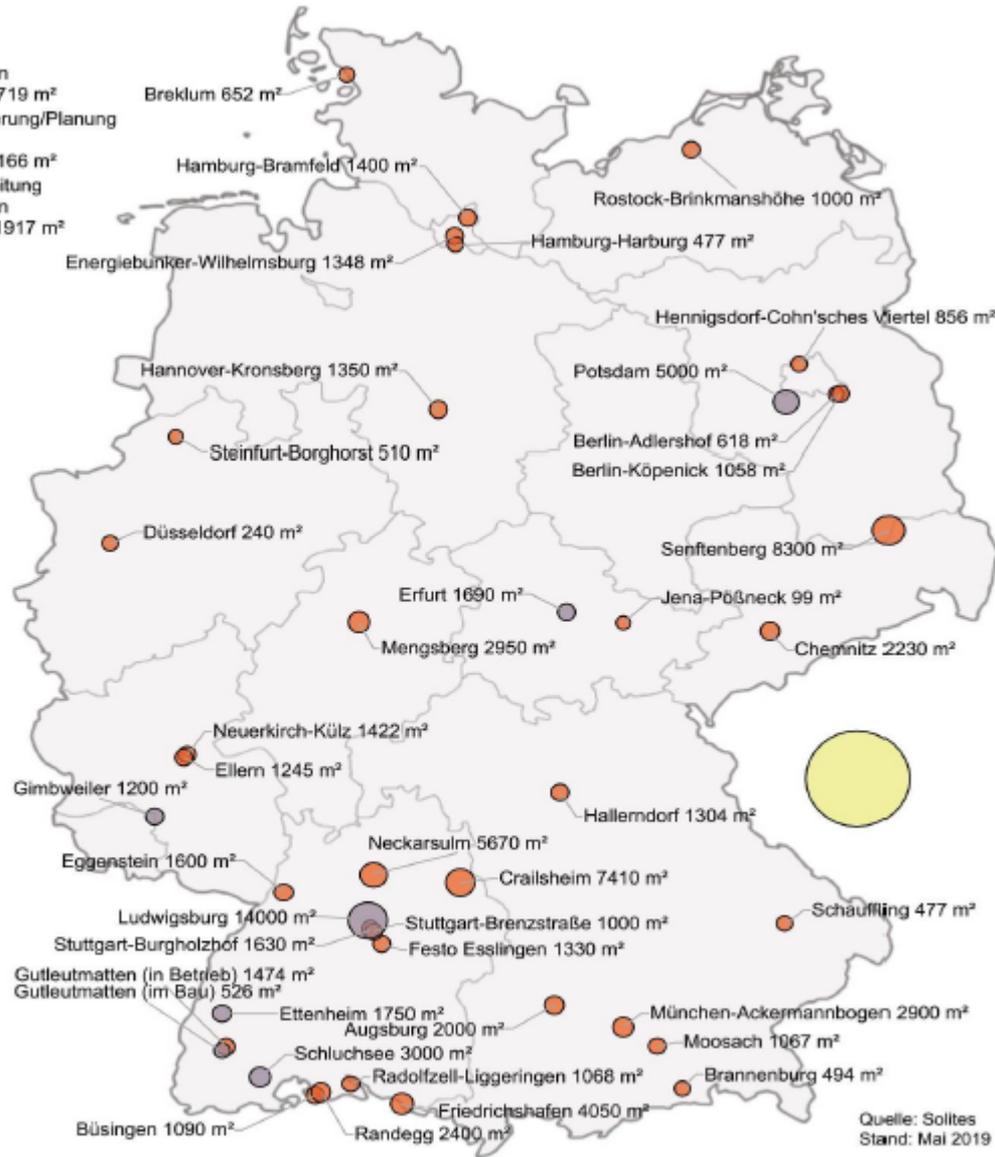
- Modelling a scenario for 2020, 2030 and 2050
 - Reaching Emission reduction goals of 2020 40%, 2030 55 % and 2050 80-95%
 - Reaching Energy efficiency goal of 35 %
 - 10, 20 and 30 % usable waste heat
 - Gas as input energy source

Solar thermal energy – methode

- Needed energy:
 - $\text{coverage}_{\text{Solar}} * \text{heat demand}_{\text{FWN}}$
- Energy need in total field size:
 - Needed energy * Solar gain
 - Solar gain: $1054 \text{ kWh/m}^2 * 0,6 = 632,4 \text{ kWh/m}^2$
- Total fieldsize in relation to city size

Solar therm

- in Betrieb
34 Anlagen
mit ca. 62719 m²
- in Realisierung/Planung
7 Anlagen
mit ca. 27166 m²
- in Vorbereitung
29 Anlagen
mit ca. 111917 m²



Quelle: Solites
Stand: Mai 2019

lata

Solar thermal energy - results

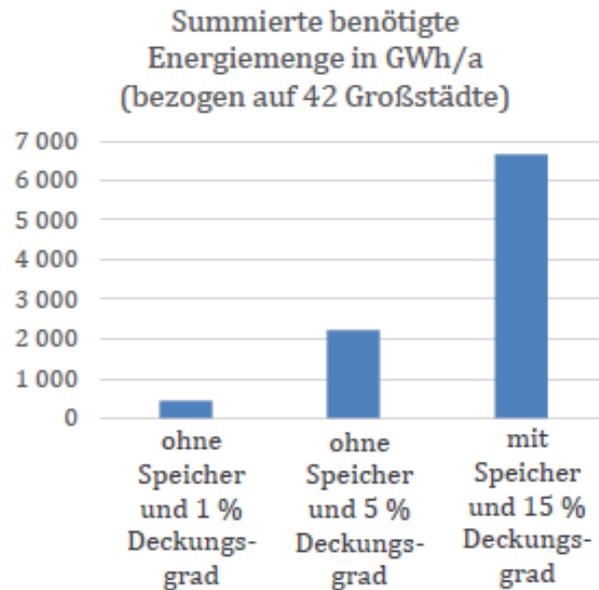


Abbildung 5-9: Summierte benötigte Energiemenge (eigene Berechnung und Darstellung)

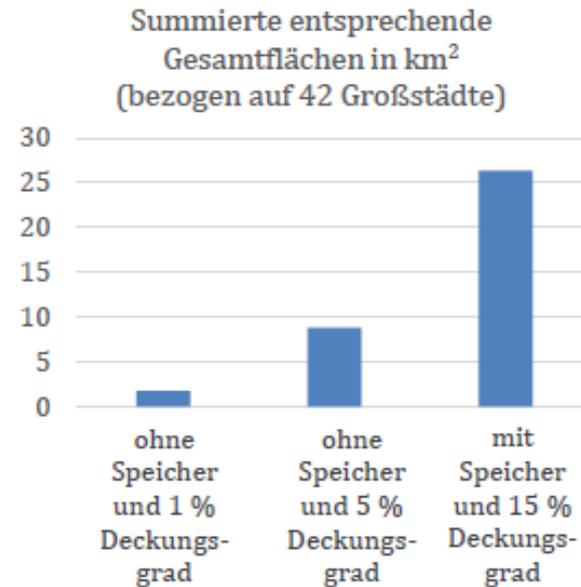
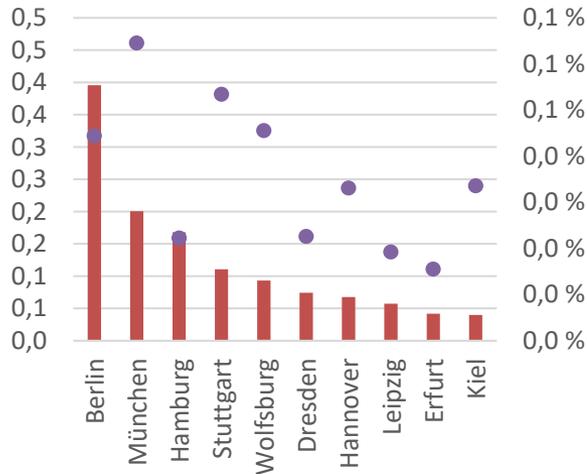


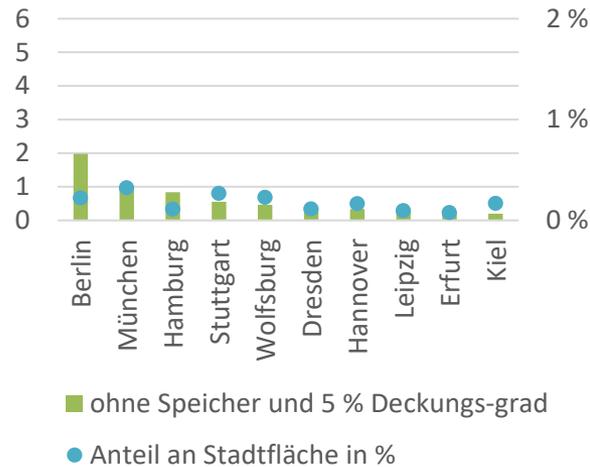
Abbildung 5-10: Summierte entsprechende Gesamtfläche (eigene Berechnung und Darstellung)

Solar thermal energy – results

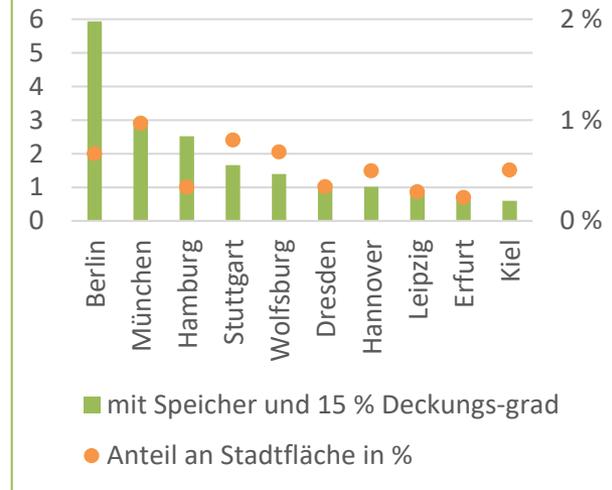
Entsprechende Gesamtfläche in km²
 und Anteil an Stadtfläche TOP 10



Entsprechende Gesamtfläche in km²
 und Anteil an Stadtfläche TOP 10



Entsprechende Gesamtfläche in km²
 und Anteil an Stadtfläche TOP 10



Solar thermal energy - results

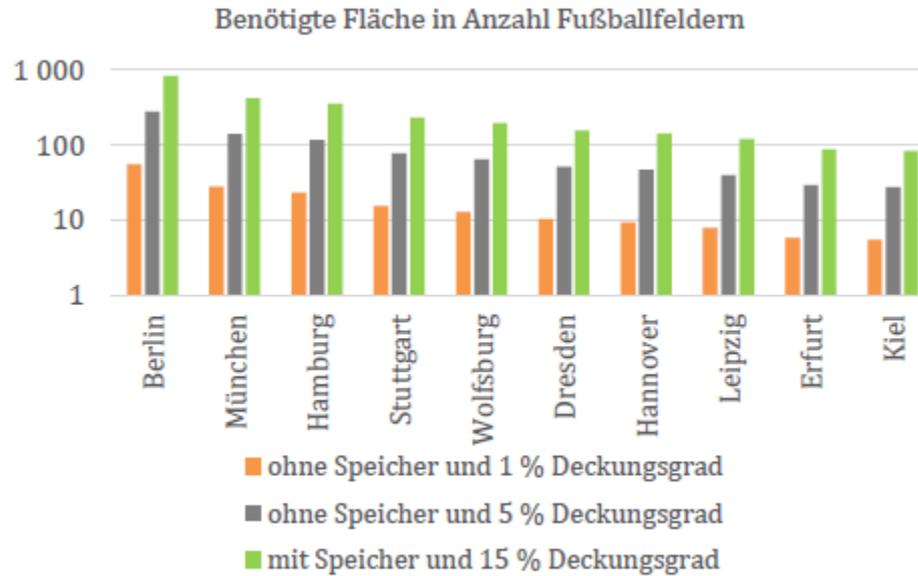


Abbildung 5-17: Benötigte Fläche in Anzahl Fußballfeldern (Eigene Berechnung und Darstellung)

Available data

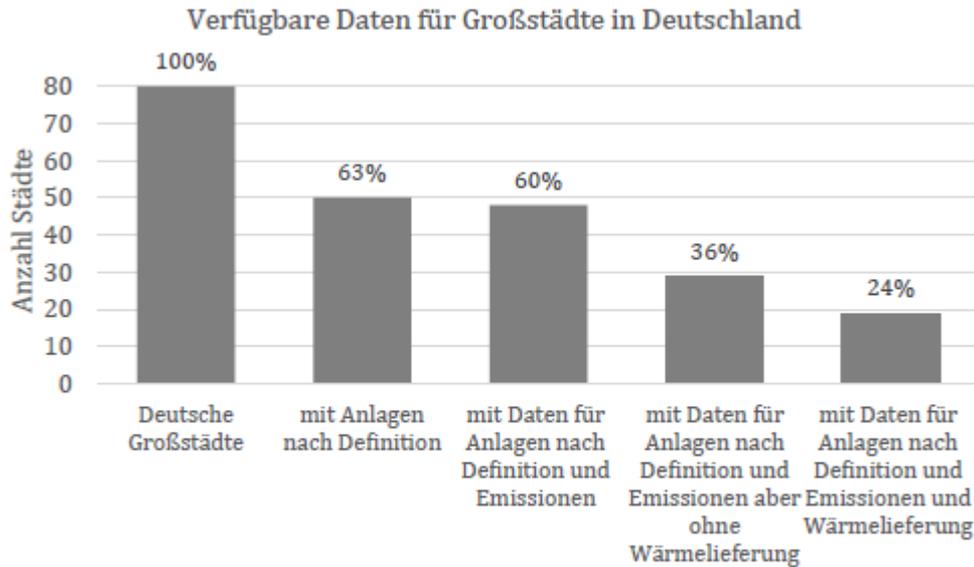


Abbildung 3-1: Verfügbare Daten für die Großstädte, bezogen auf die industrielle Abwärme

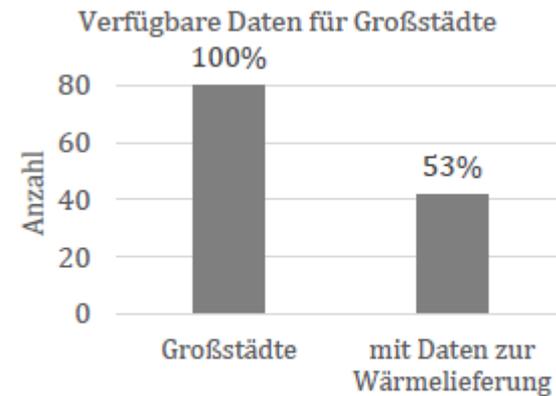


Abbildung 3-2: Verfügbare Daten für Großstädte für Solarthermie

Sources

pictures:

Gas: https://commons.wikimedia.org/wiki/File:Gas_bottle.png

District heating: <http://www.dlsc.ca/images/contentphotos/Simple-District-loop.gif>