Barrieren in der Systemintegration erneuerbarer Energien

BERND LEISS

Geowissenschaftliches Zentrum der Universität Göttingen

Wärmewende in Göttingen und Region

- Wärmeenergiemenge kann nur über eine Kombination verschiedener regenerativer Energieformen und gleichzeitiger massiver Energieeinsparung abgedeckt werden
- Abwärmenutzung und Kühlungsbedarf muss integriert werden
- Potentiale für Wärmeangebote, Kühlung und saisonale Speicherung im geologischen Untergrund können genutzt werden

Potential geothermal systems at Göttingen

Mesozoic sedimentary cover
up to ~800 to 1000 m depth

Zechstein evaporitic successions
including salt and potash salt layers
up to ~1500 m depth

Variscan folded and thrusted
paleozoic metasediments up to >
5000 m depth

Potential geothermal systems at Göttingen

Market-ready

Innovation

Shallow Geo-thermal Systems

Research/exploration well, Pre-project: GöMith

Mesozoic sedimentary cover up to ~800 to 1000 m depth

Medium Deep Geothermal Systems

Zechstein evaporitic successions including salt and potash salt layers up to ~1500 m depth

Optimized borehole heat exchanger system

CampusGeoHub*
Heat storage in salt/ salt caverns

Heat storage in fractured crystalline rocks

Enhanced **G**eothermal **S**ystems

e.g. Eavor

or

Deep Geo-thermal Systems

MEET Multi-sites EGS Demonstration

Variscan folded and thrusted paleozoic metasediments up to > 5000 m depth

*planned

Strategy: Energy hub

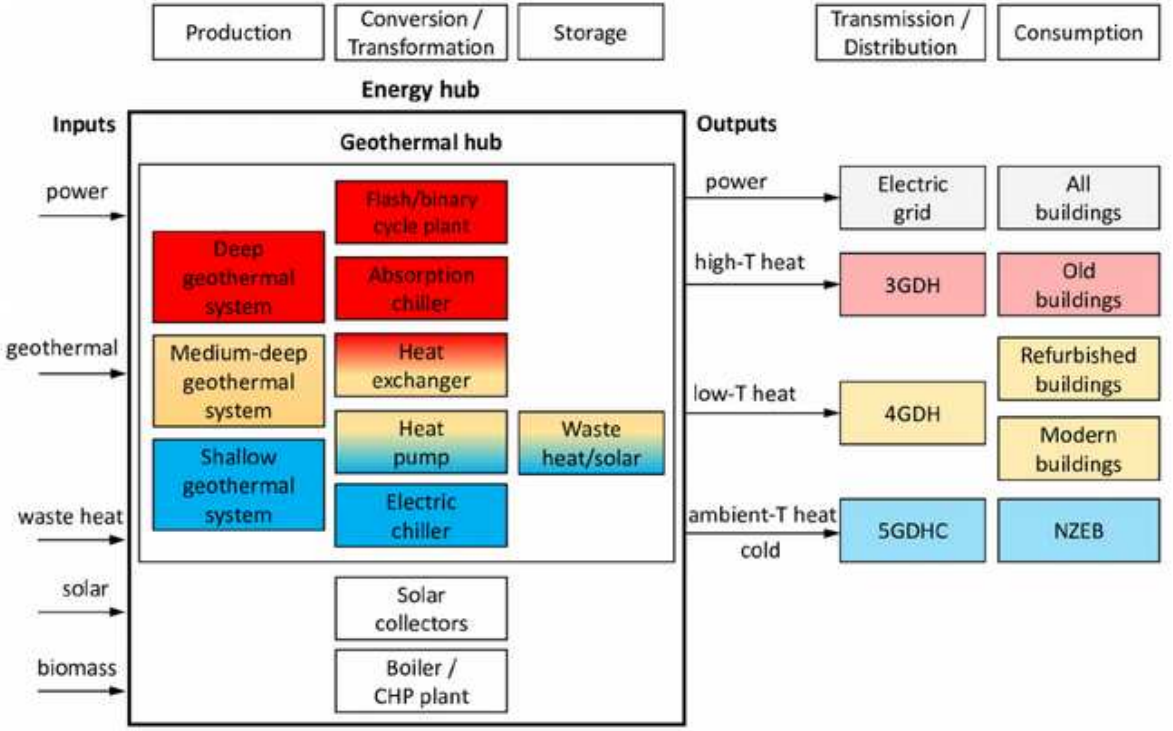


Fig. 4. Multi-faceted geothermal system as a part of energy hub.

Suggestion
for geothermal systems
being part of an energy hub
as a driver for the
energy transition.

Romanov, R. & Leiss, B. (2022):
Geothermal energy at different depths for district heating and cooling of existing and future building stock.
Renewable and Sustainable Energy Reviews, Volume 167,112727.
https://doi.org/10.1016/j.rser.2022.112727.

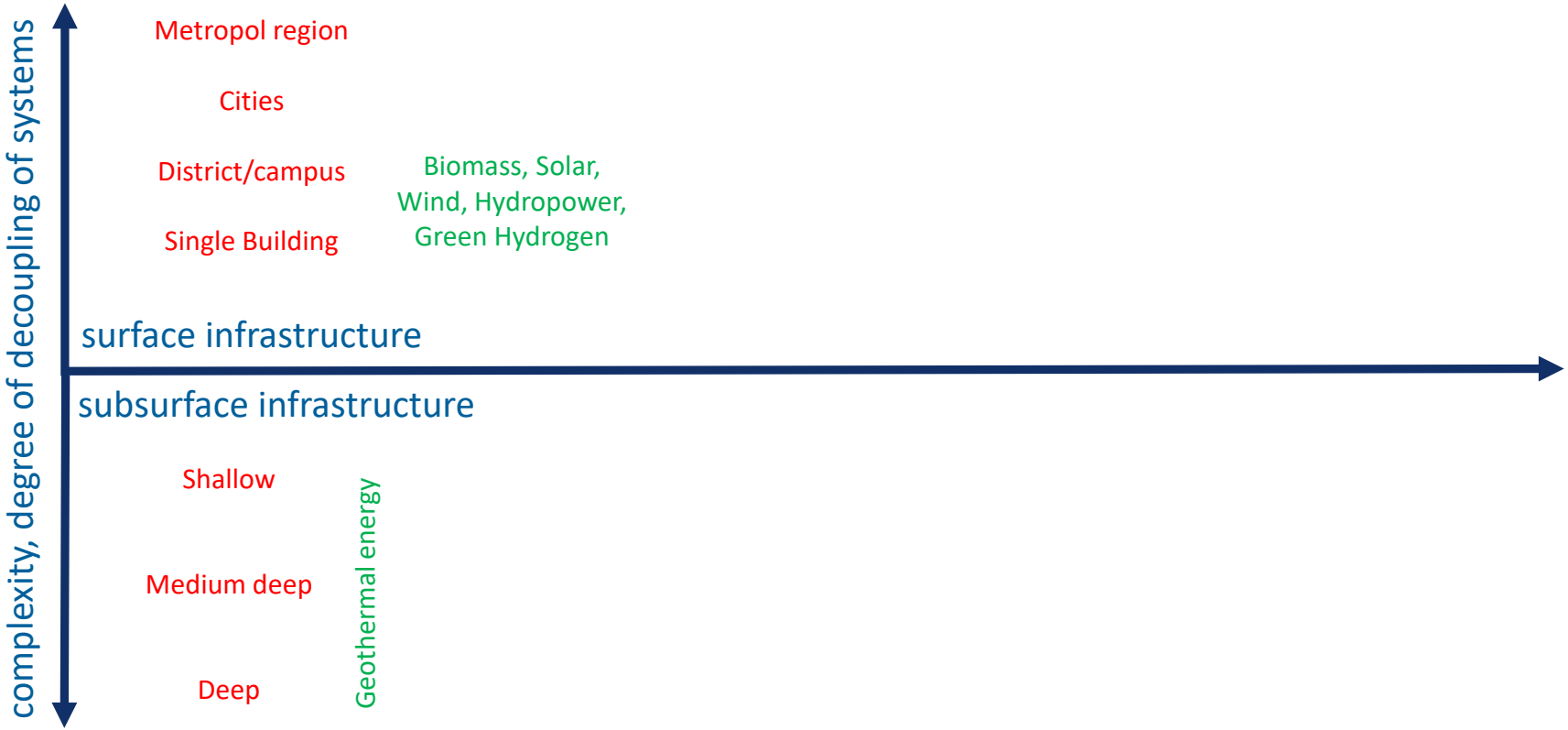
What are the barriers?

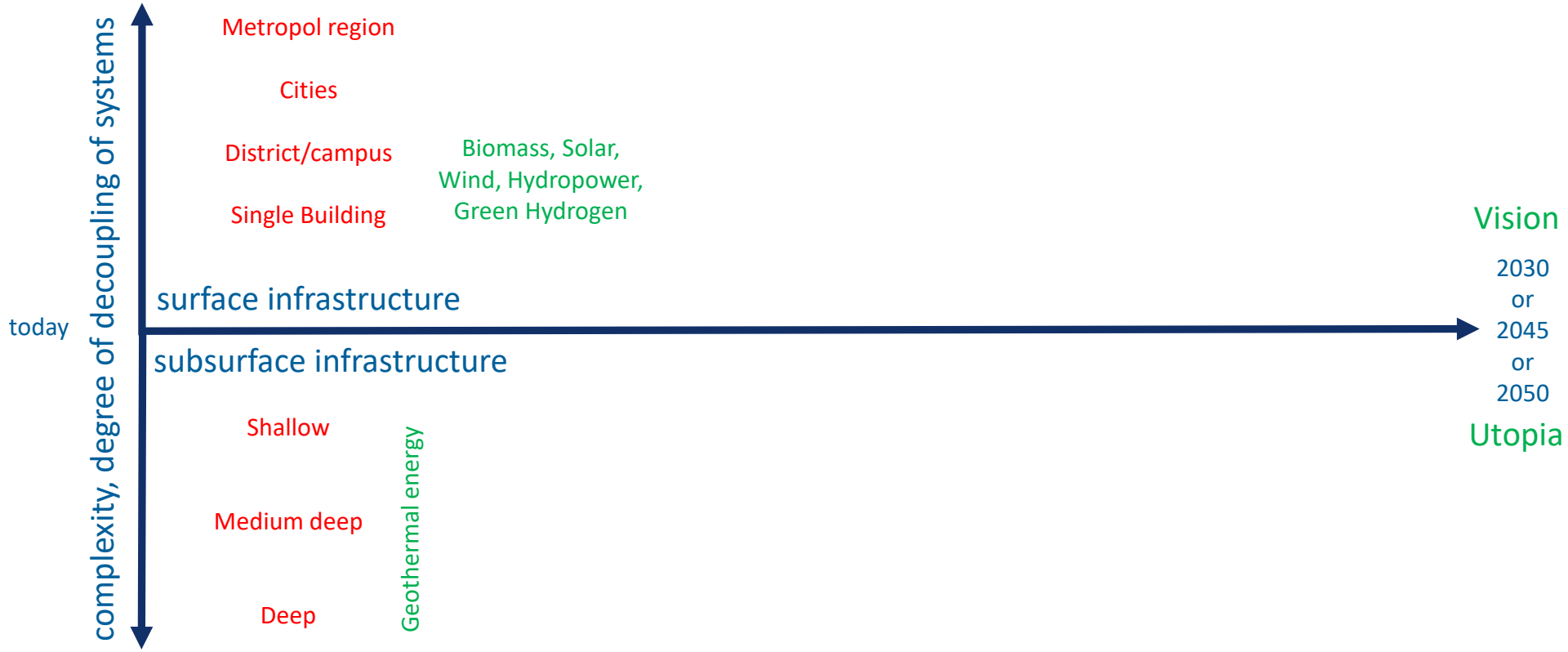
Systemintegration

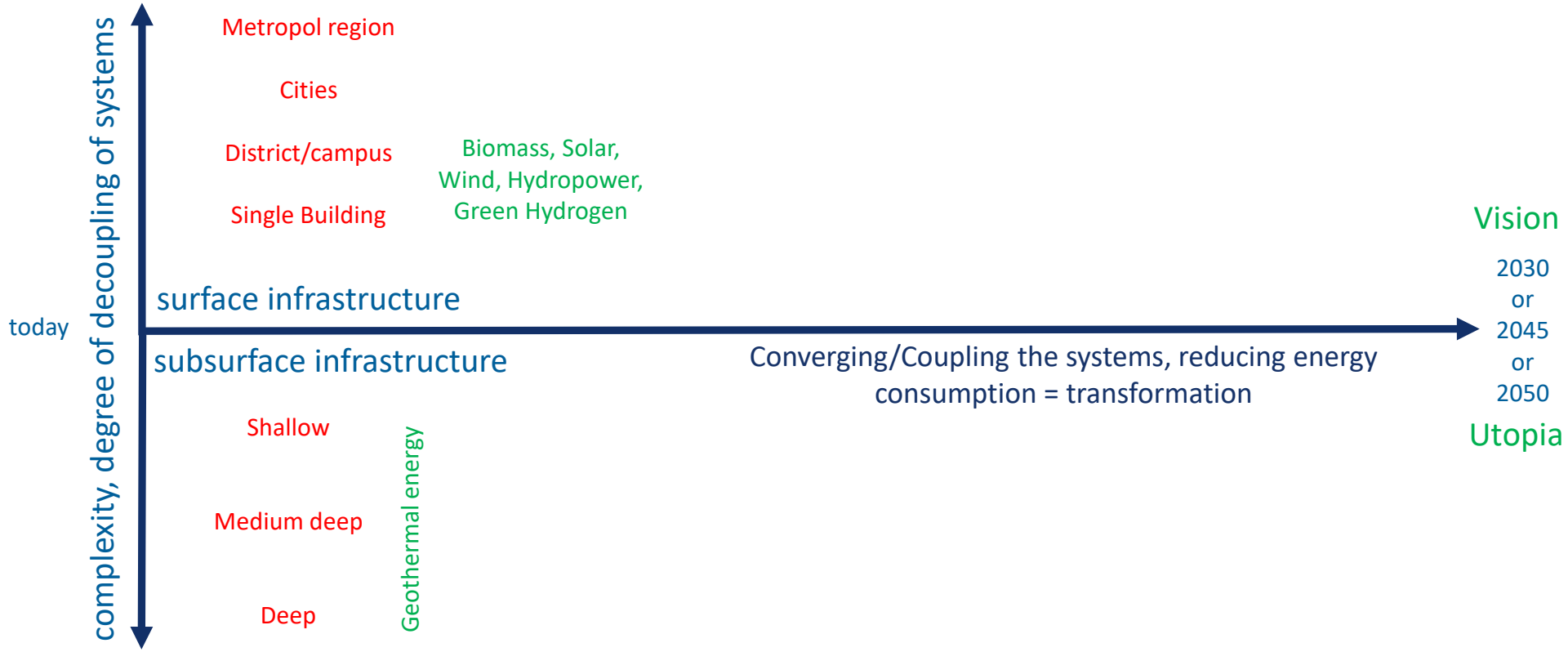
Was sind die Barrieren?

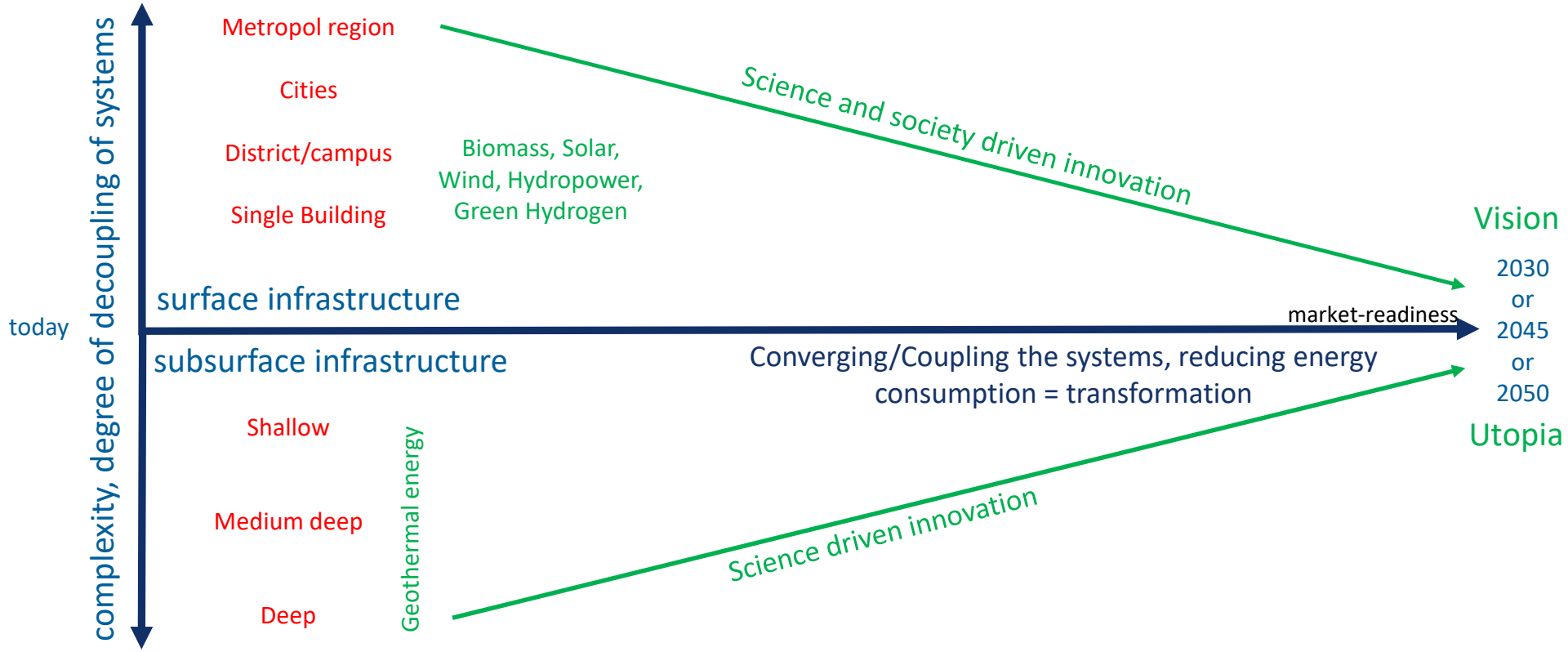
What are the barriers for the energy hub implementation?

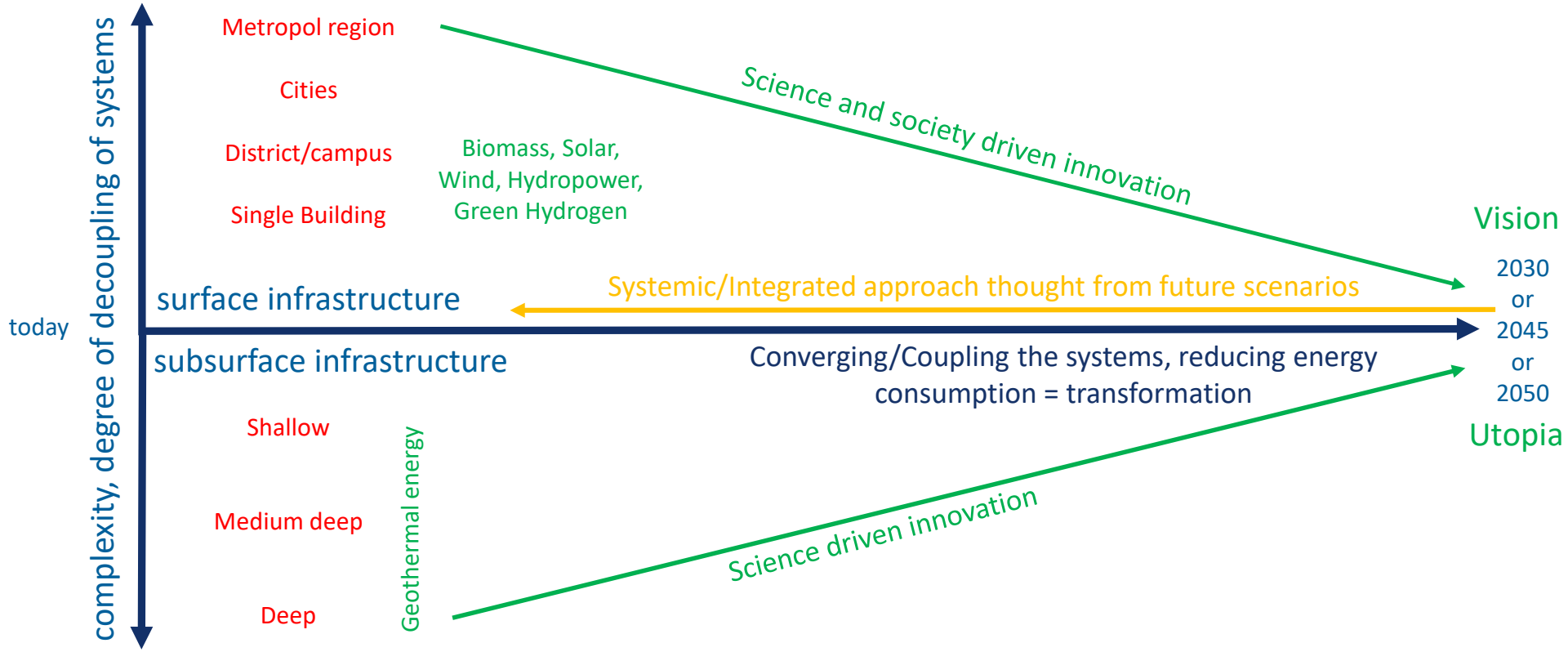
What are the barriers for the energy hub implementation?

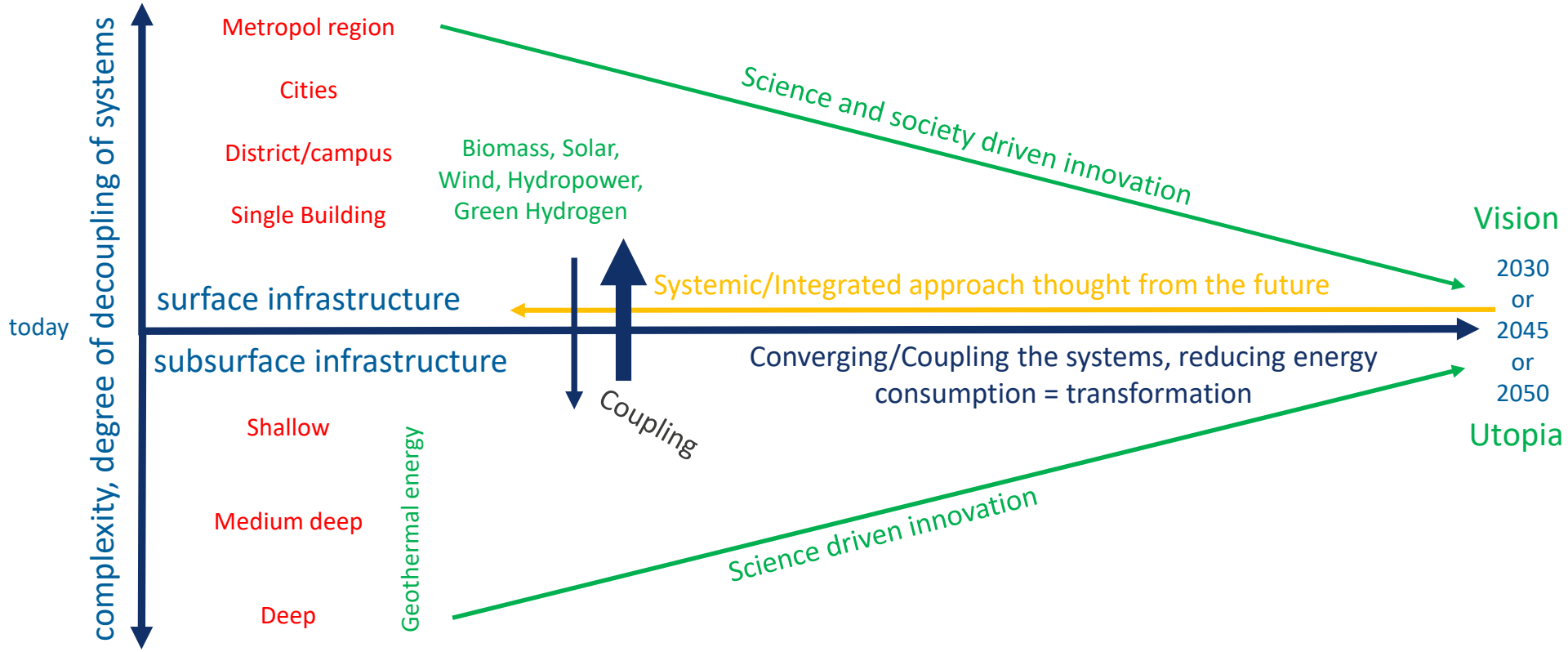

complexity, degree of decoupling of systems
Metropol region
Cities
District/campus
Single Building
Biomass, Solar,
Wind, Hydropower,
Green Hydrogen
surface infrastructure
subsurface infrastructure
Shallow
Medium deep
Deep
Geothermal energy


complexity, degree of decoupling of systems
Metropol region
Cities
District/campus
Single Building
Biomass, Solar,
Wind, Hydropower,
Green Hydrogen
surface infrastructure
today
subsurface infrastructure
Vision
2030
or
2045
or
2050
Utopia
Shallow
Medium deep
Deep
Geothermal energy

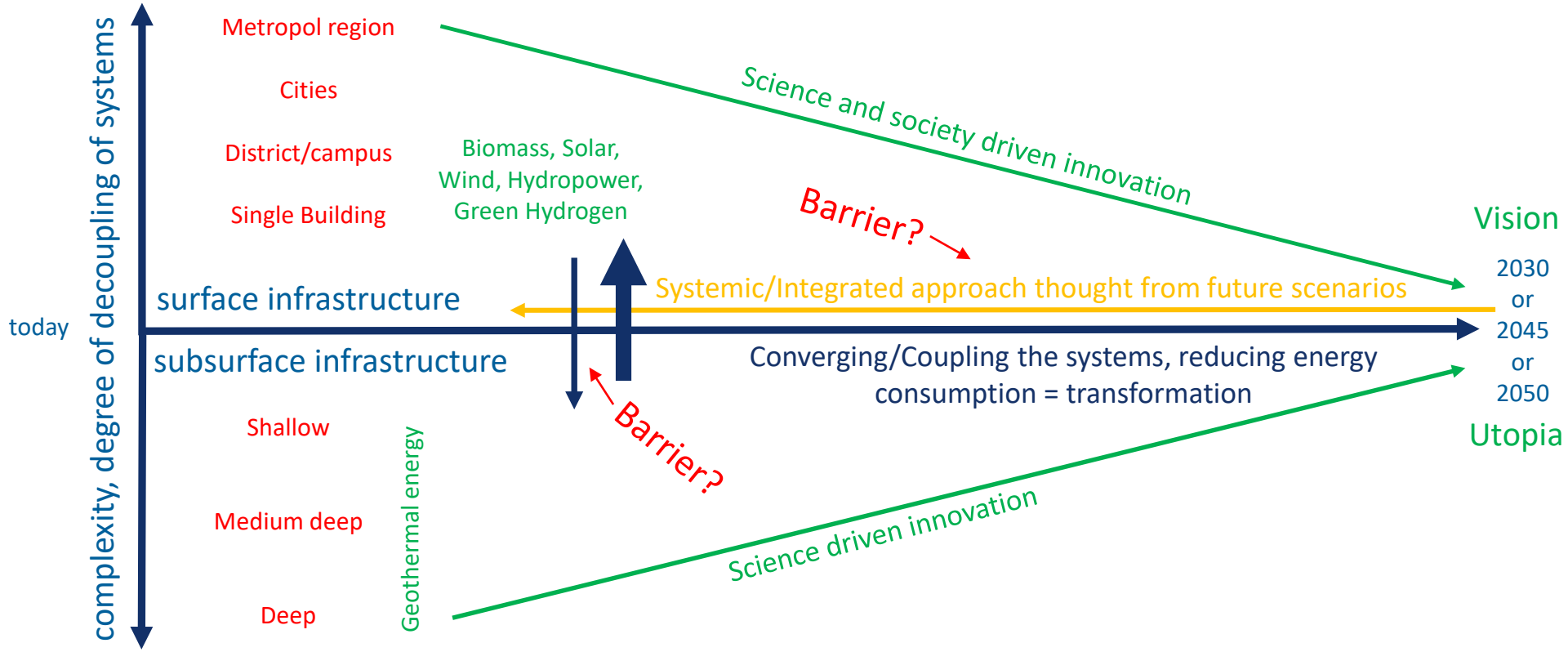

complexity, degree of decoupling of systems
Metropol region
Cities
District/campus
Single Building
Biomass, Solar, Wind, Hydropower, Green Hydrogen
surface infrastructure
today
subsurface infrastructure
Converging/Coupling the systems, reducing energy consumption = transformation
Vision
2030 or 2045 or 2050
Utopia
Shallow
Medium deep
Deep
Geothermal energy


complexity, degree of decoupling of systems
Metropol region
Cities
District/campus
Single Building
Biomass, Solar, Wind, Hydropower, Green Hydrogen
Science and society driven innovation
Vision
2030 or 2045 or 2050
Utopia
today
surface infrastructure
market-readiness
subsurface infrastructure
Converging/Coupling the systems, reducing energy consumption = transformation
Shallow
Medium deep
Deep
Geothermal energy
Science driven innovation

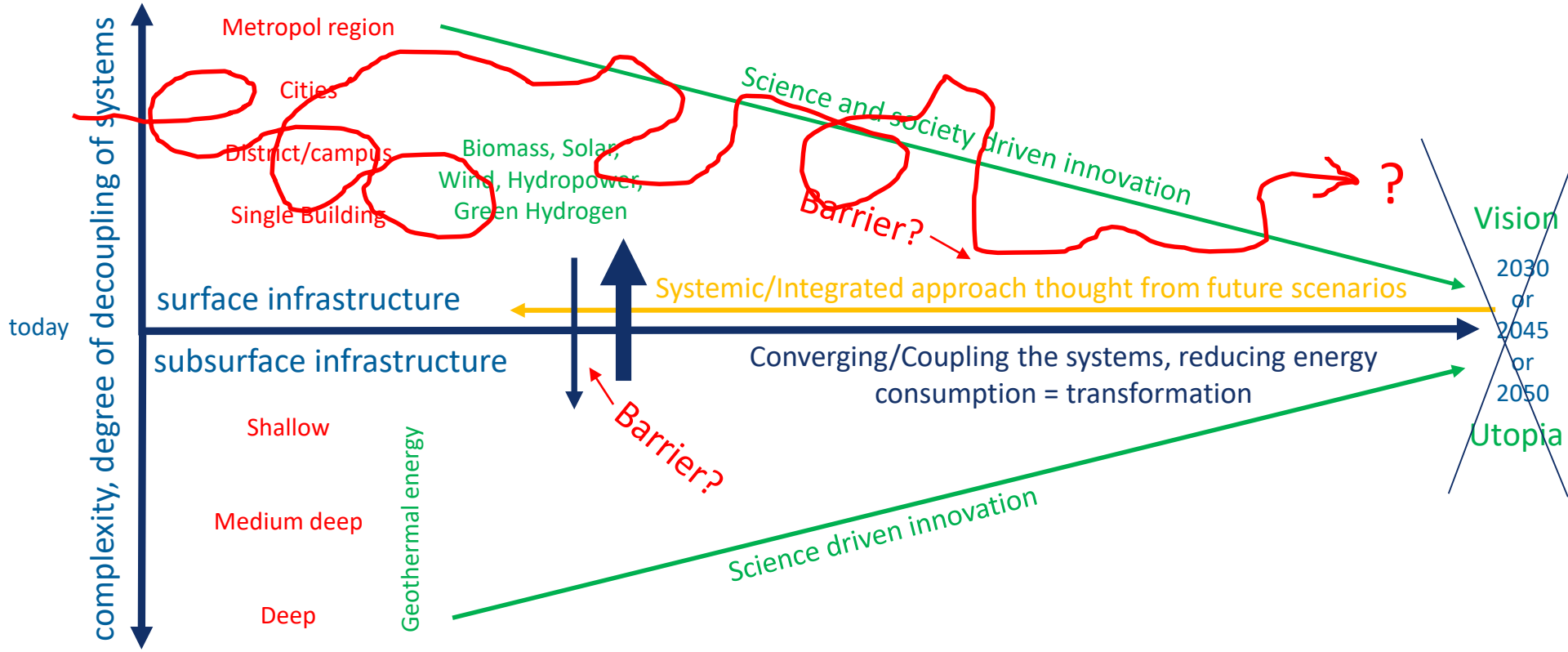

complexity, degree of decoupling of systems
Metropol region
Cities
District/campus
Single Building
Biomass, Solar, Wind, Hydropower, Green Hydrogen
Science and society driven innovation
Vision
2030 or 2045 or 2050
Utopia
Systemic/Integrated approach thought from future scenarios
today
surface infrastructure
subsurface infrastructure
Converging/Coupling the systems, reducing energy consumption = transformation
Shallow
Medium deep
Deep
Geothermal energy
Science driven innovation



What are the barriers for the energy hub implementation?



What are the barriers for the energy hub implementation?



What are the barriers for the energy hub implementation?

Wärmewende in Göttingen und Region

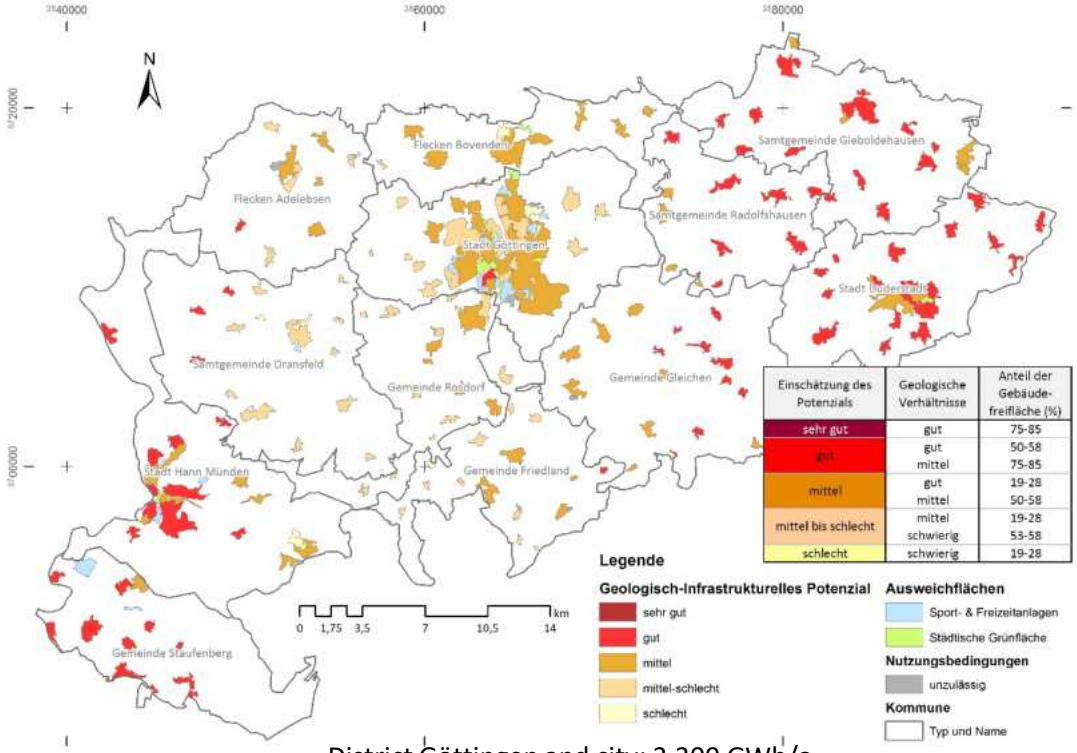
- Transformationspfad vom Ende her denken (was wird wichtig sein)
- Systeme nicht parallel, sondern gekoppelt entwickeln
- Ökonomische Szenarien weitsichtiger und -sinniger denken
- Jede Nutzung von Energie hat Folgen
- Kommunikation entwickeln

Ludovic Marin / EPA

Patrick Pouyanné, Unternehmenschef von Total Energies hatte im vergangenen August erklärt:

»Ich bin entschlossen, meine Öl- und Gasinvestitionen fortzusetzen, weil die Nachfrage steigt. Ich respektiere die Meinung von Wissenschaftlern, aber es gibt das wirkliche Leben«.

Exploration: Shallow geothermal systems (< 200 m)



Einschätzung des Potenzials	Geologische Verhältnisse	Anteil der Gebäude-freifläche (%)
sehr gut	gut	75-85
gut	gut	50-58
	mittel	75-85
mittel	gut	19-28
	mittel	50-58
mittel bis schlecht	mittel	19-28
	schwierig	53-58
schlecht	schwierig	19-28

District Göttingen and city: 3.300 GWh/a
City of Göttingen: 1.500 GWh/a

Shallow geohermal systems are marketable, but the enourmes potential in combination with heat pumps is not appreciated.

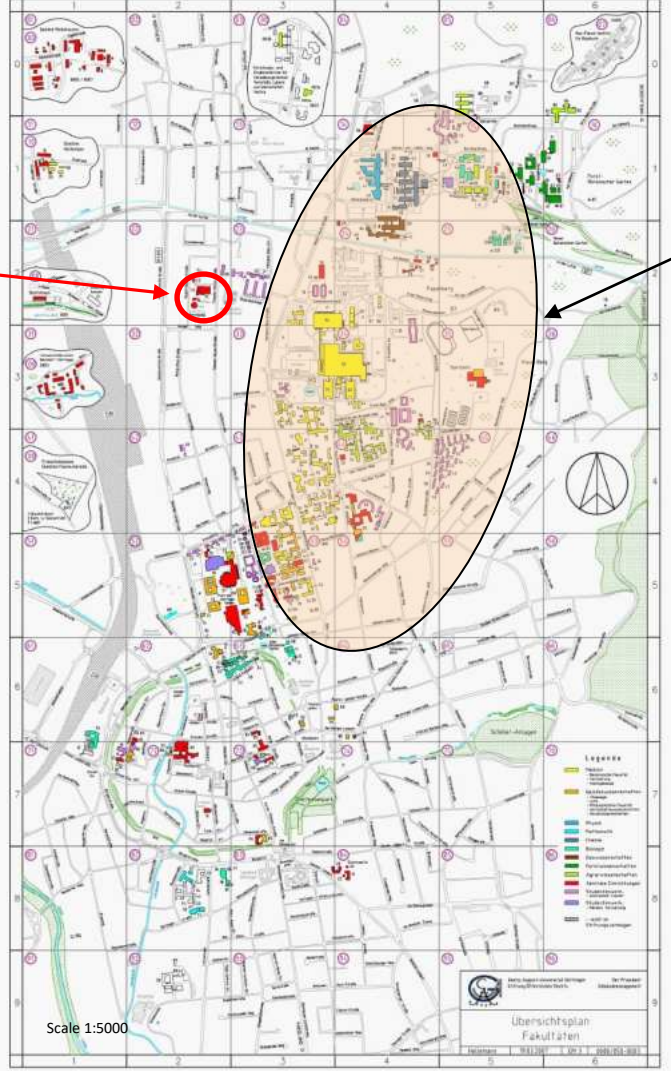
An analysis of the technical potential indicates around 80% coverage of Göttingen and the district of Göttingen!

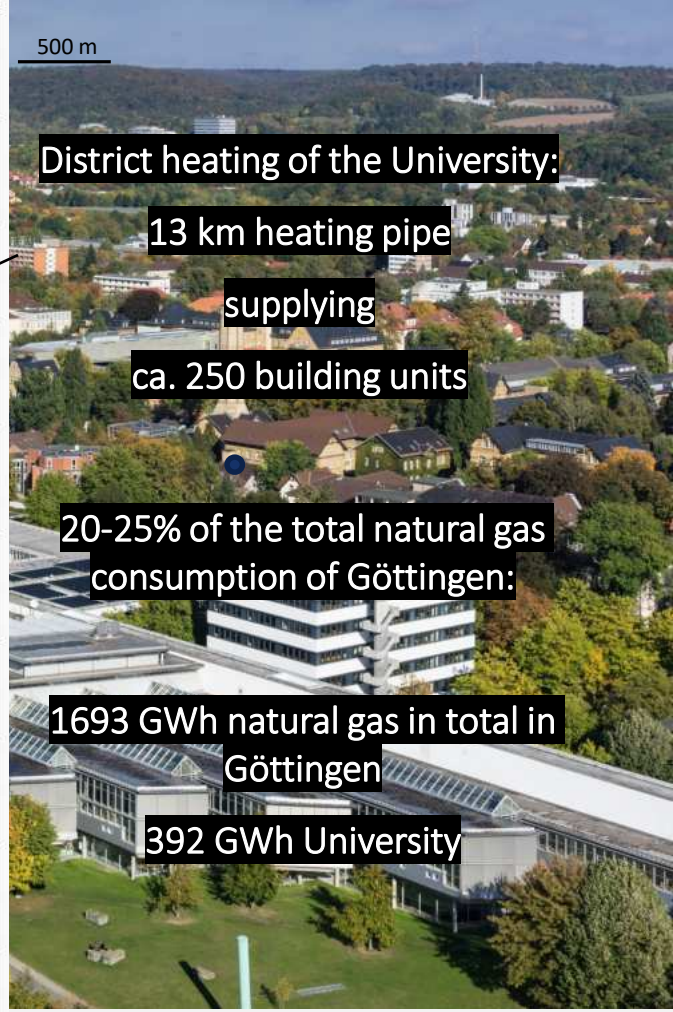
Stefanak, M.; Wagner, B.; Jensen, H. & Leiss, B. (2019): Oberflächennahe Erdwärme als Beitrag zur Wärmewende: Ein Ansatz zur Abschätzung des erschließbaren Potentials im Kreis Göttingen *Geothermische Energie*, *92* pp. 18-21

Energy infrastructure setting

Natural gas based Combined Heat and Power Generation

23 MW_{el}, 60 $MW_{heat\ input}$





District heating of the University:

13 km heating pipe

supplying

ca. 250 building units

20-25% of the total natural gas consumption of Göttingen:

1693 GWh natural gas in total in Göttingen

392 GWh University

The Göttingen Campus