



*Dr. Harry Lehmann*

*Archetypen einer 100% EE Versorgung*

A photograph of Earth and the Moon in space against a black background. The Earth is on the left, showing its blue oceans and white clouds. The Moon is on the right, showing its brownish surface. The text is overlaid on the right side of the image.

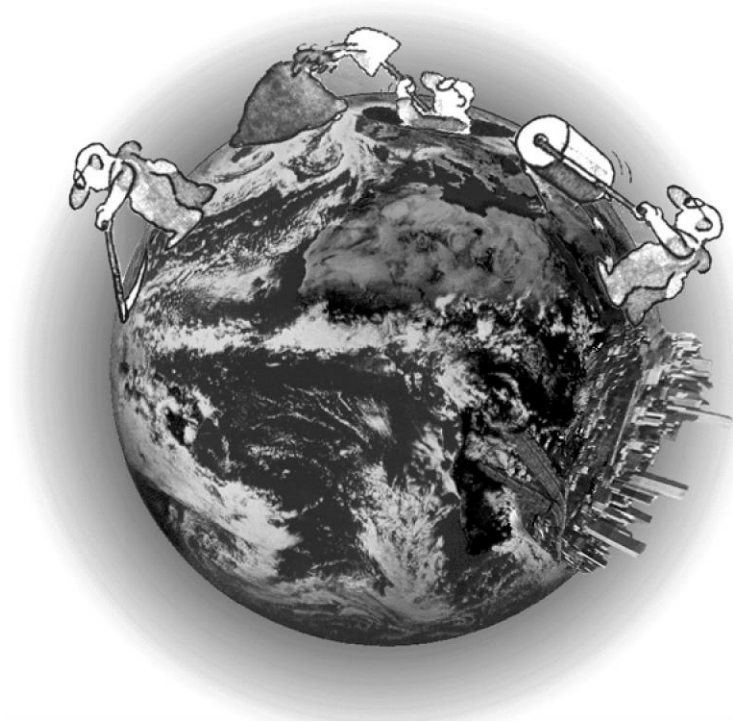
*Umweltbundesamt*

*Dr. Harry Lehmann*

*CERN  
Selbstständig  
WI  
ES-GPI  
ISuSI  
Kommissionen*

*WCRE  
Faktor 10/X*

# Szenarien einer 100% Regenerativen Energieversorgung in D



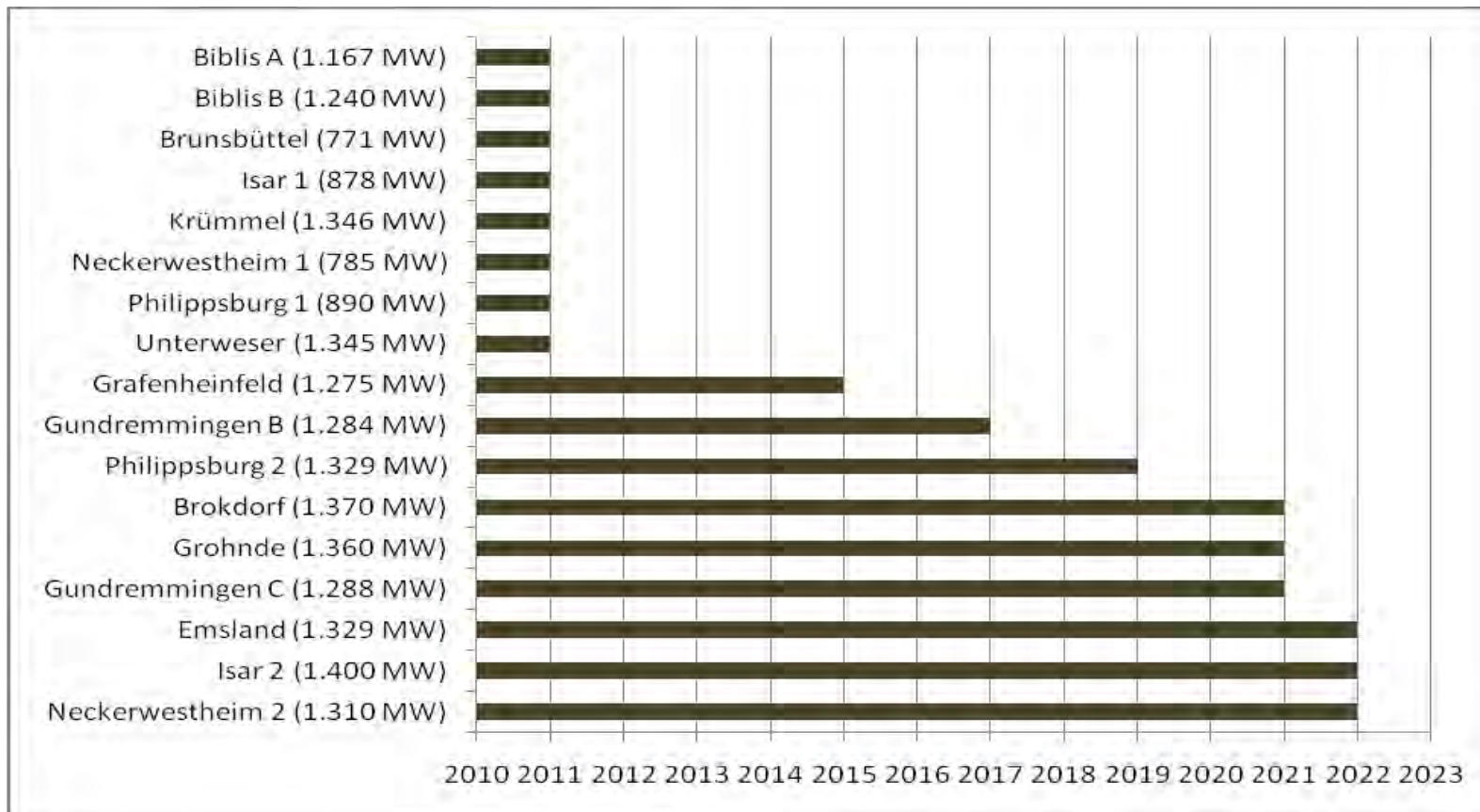
Limits to growth

Source: Harry Lehmann, 1994

## Energy- und GHG reduction Goals of Germany

	Climate	Renewable Energies		Efficiency		
	GHG (vs. 1990)	Elec.	Total	PE	E-productivity	Retrofitting Buildings
2020	- 40 %	35%	18%	- 20%	increase to 2,1%/a	doubling Rate 1% -> 2%
2030	- 55 %	50%	30%	⋮		
2040	- 70 %	65%	45%	▼		
2050	- 80-95 %	80%	60%	- 50%		

## Phase out of the individual nuclear power plants

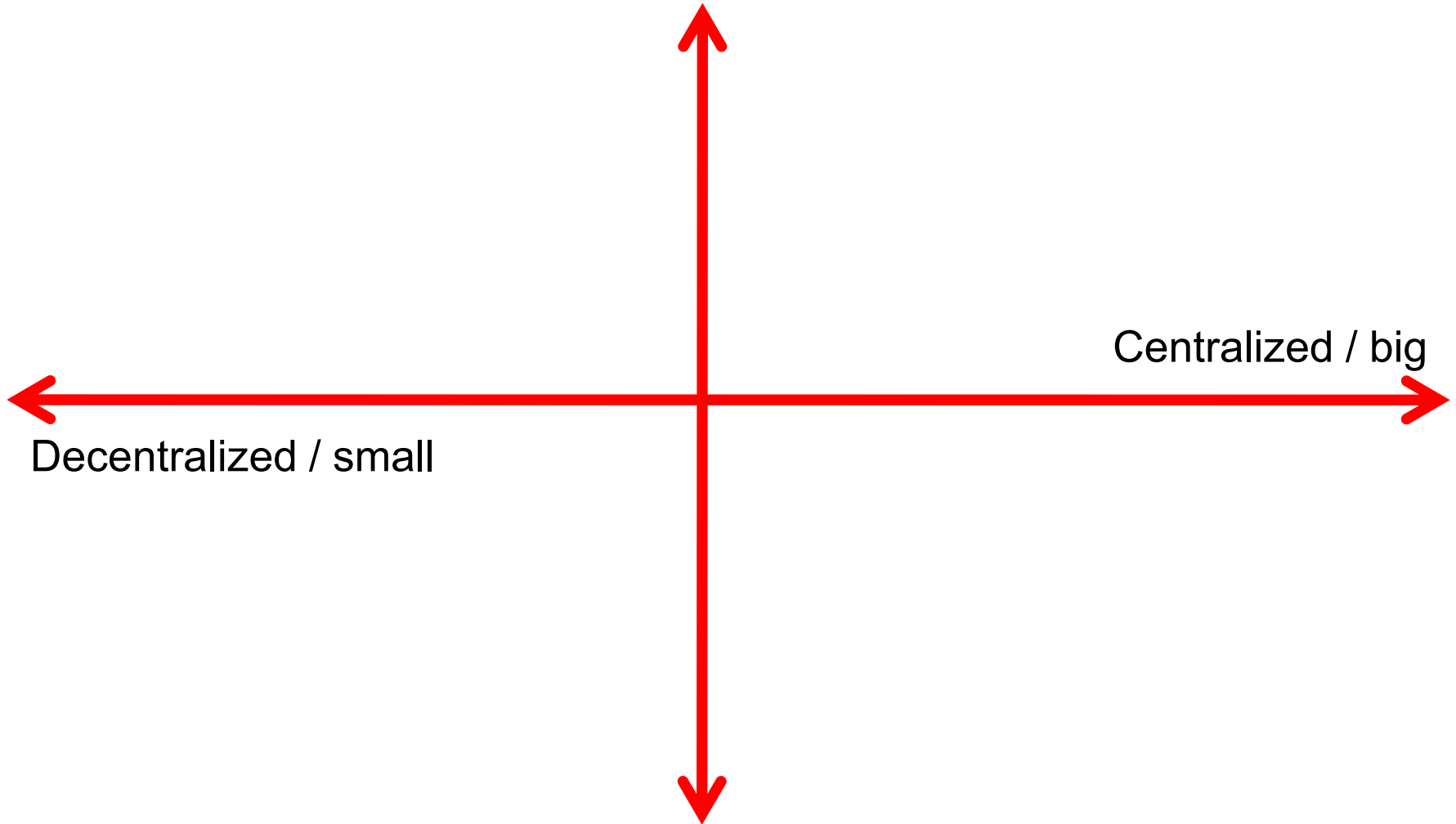


	2011	2015	2017	2019	2021	2022	total
cut-off in MW	8.422*	1.275	1.284	1.329	4.018	4.039	20.367

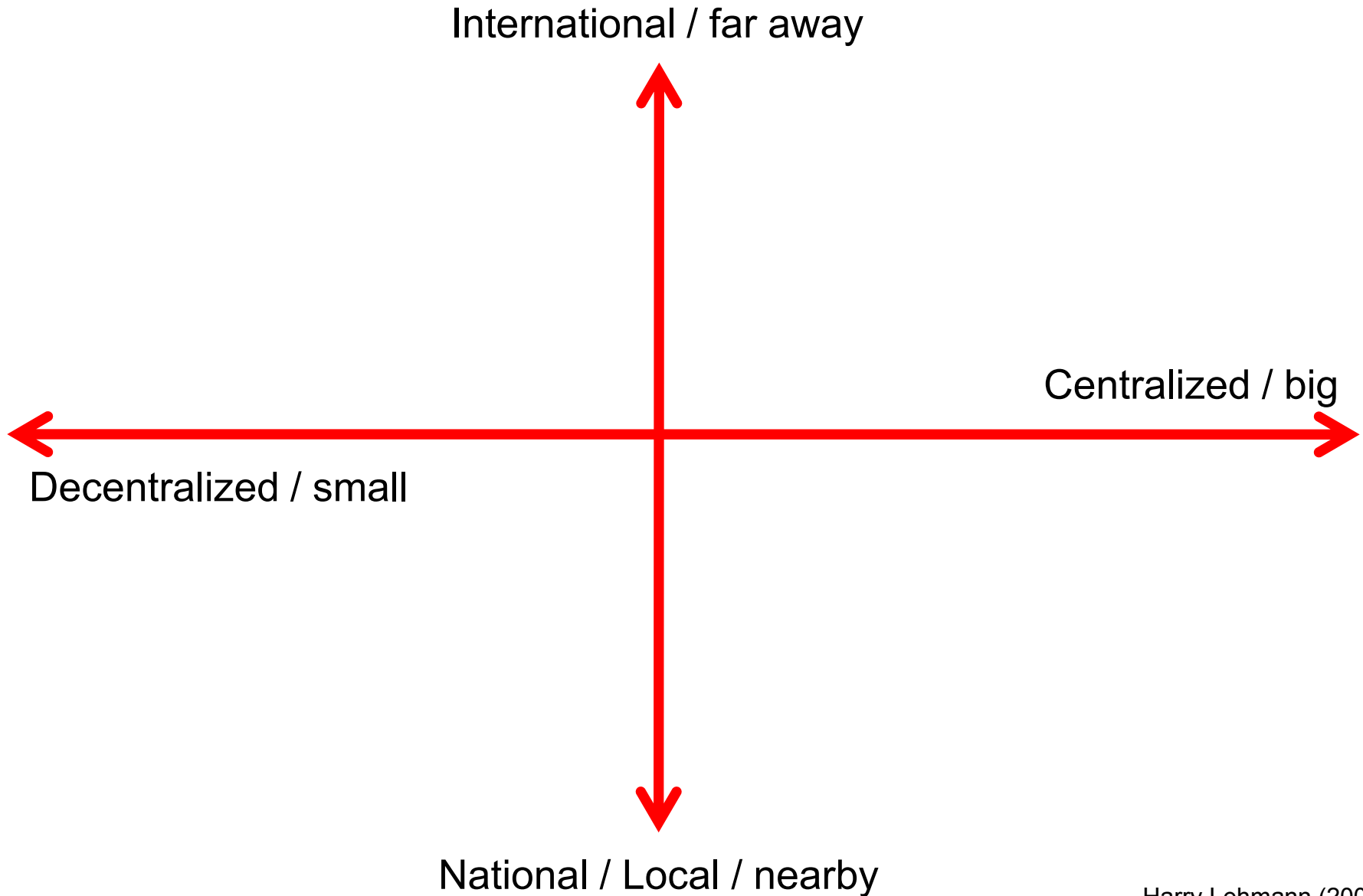
Power in net output

\*2,1 GW nuclear power out of service since 2008

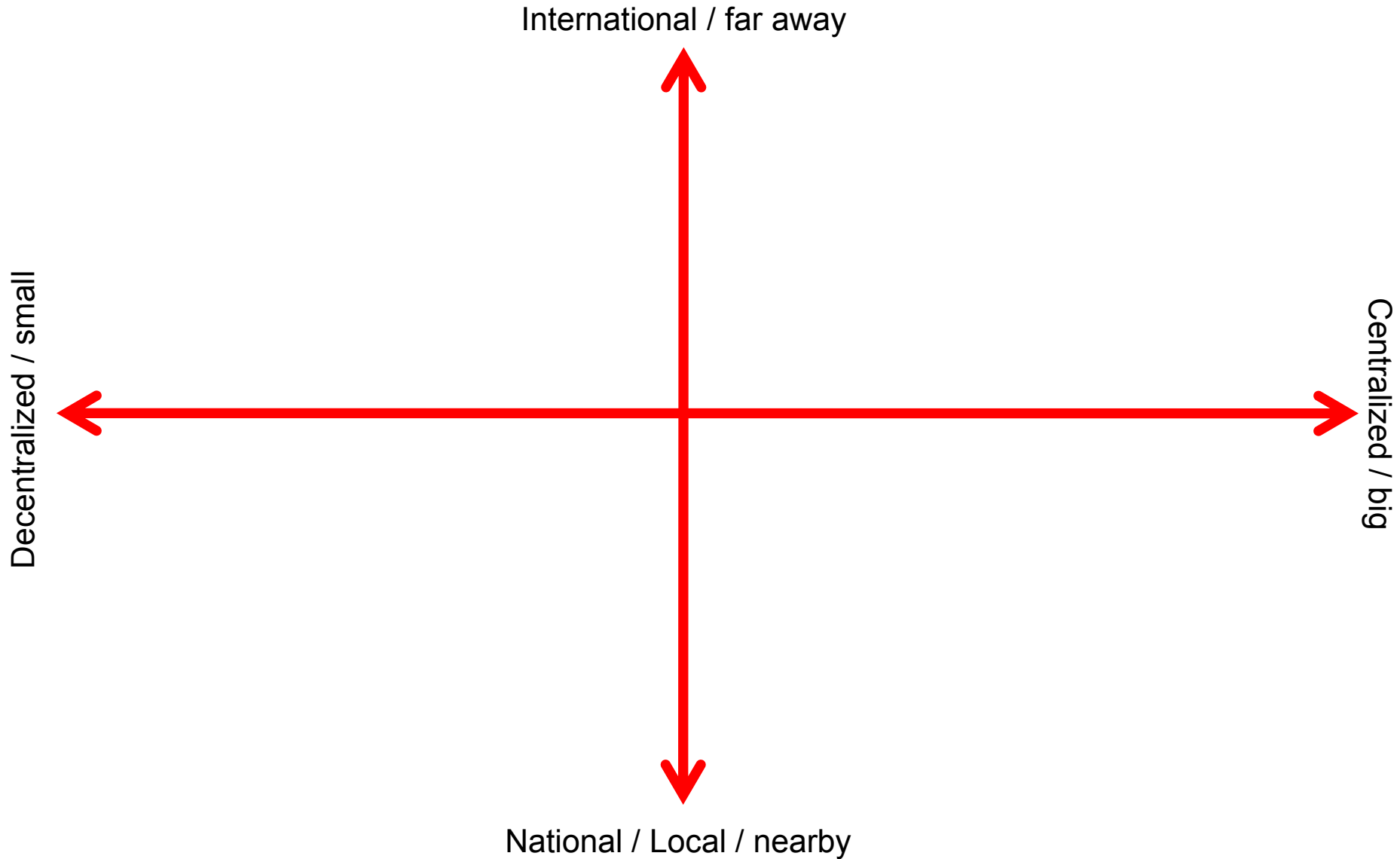
# Archetypen einer EE Versorgung



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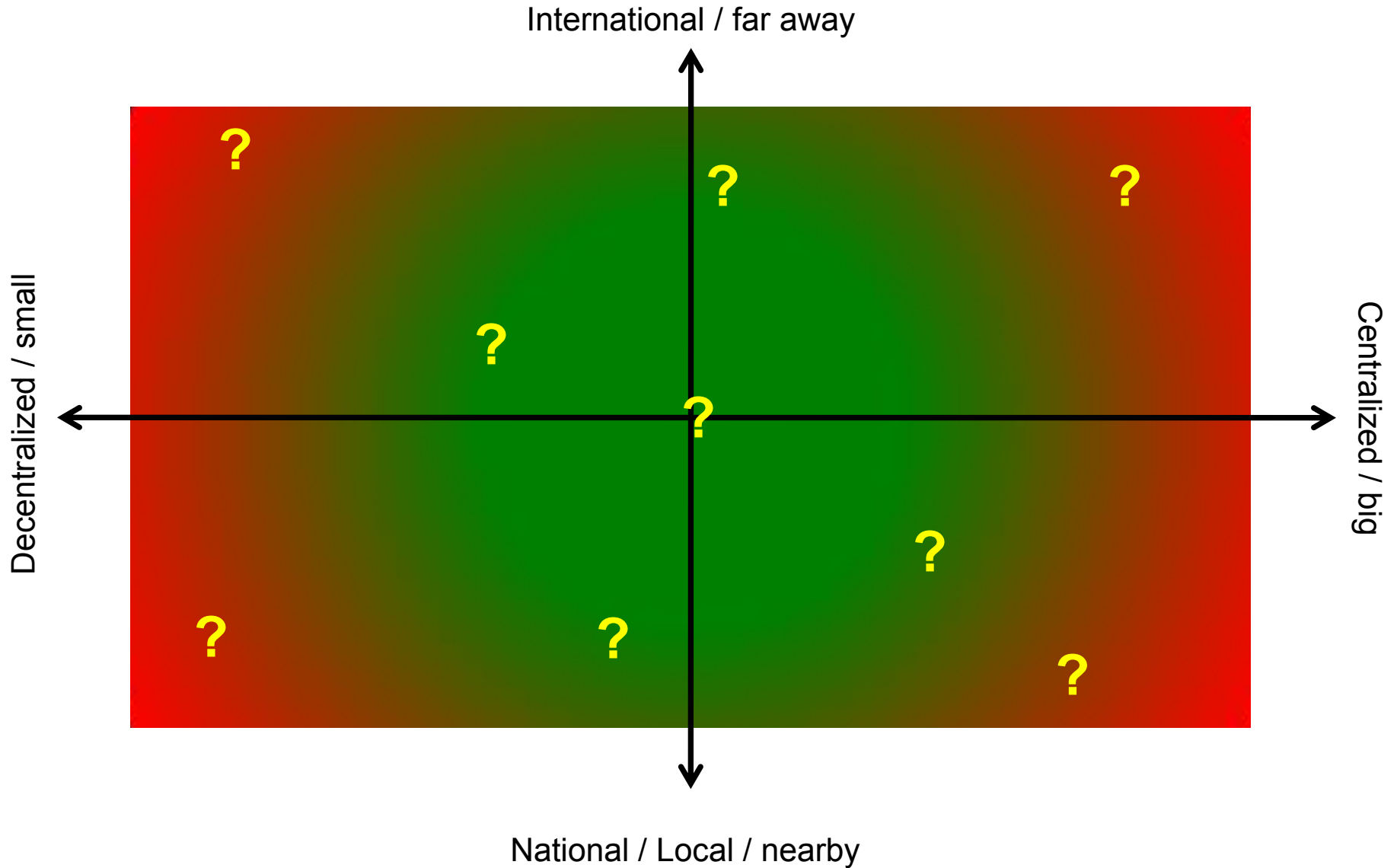


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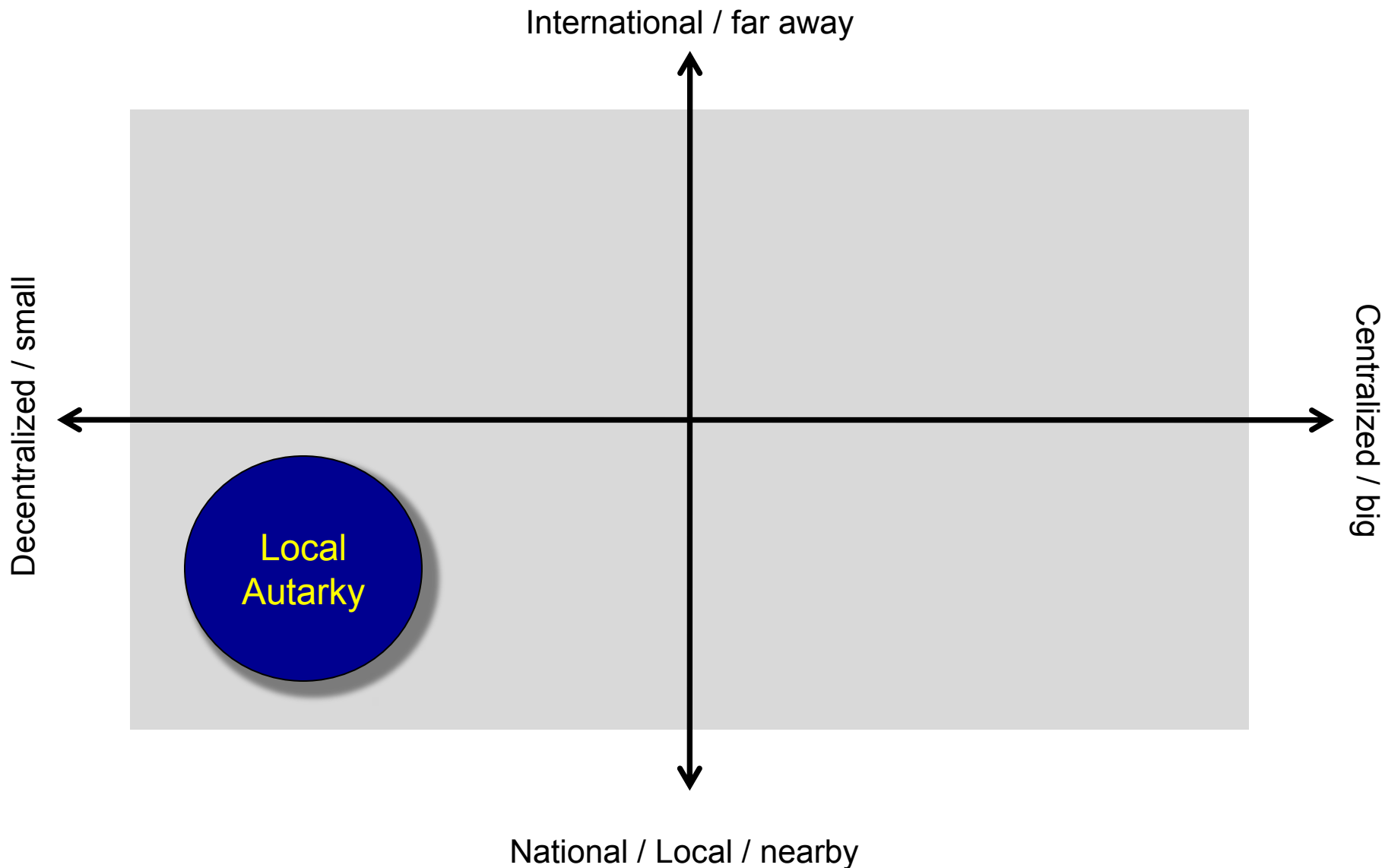




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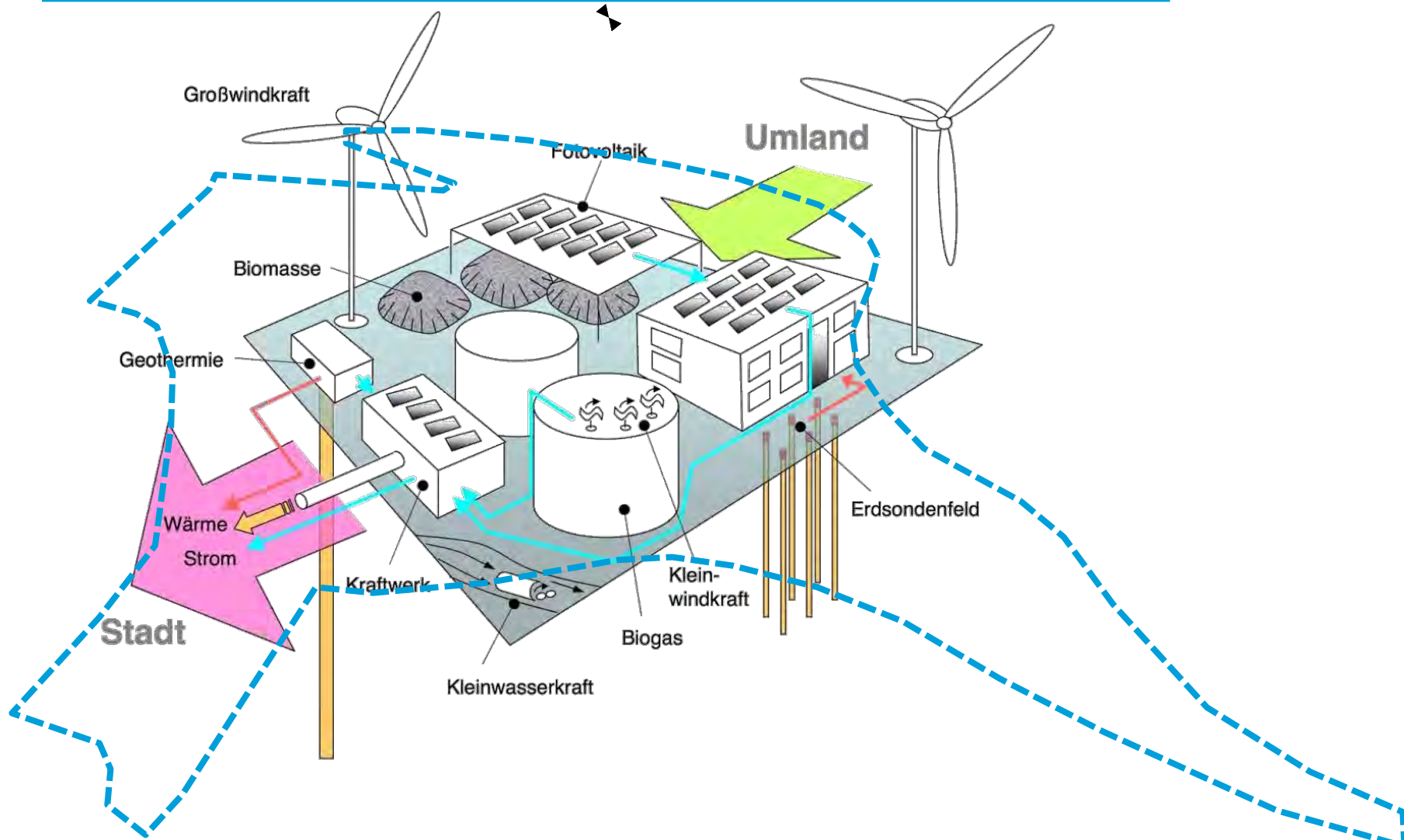


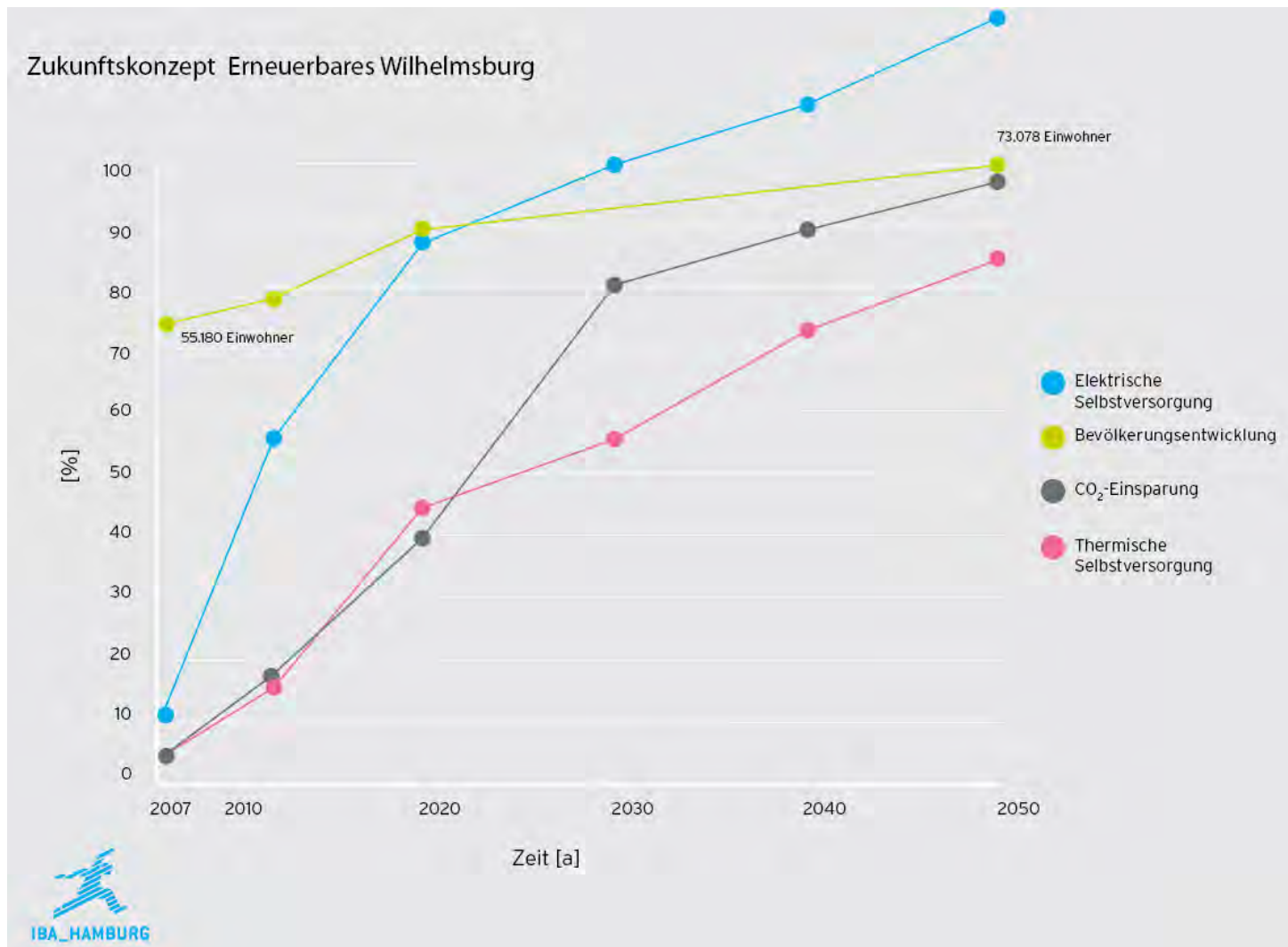
„Plusenergybuildings“

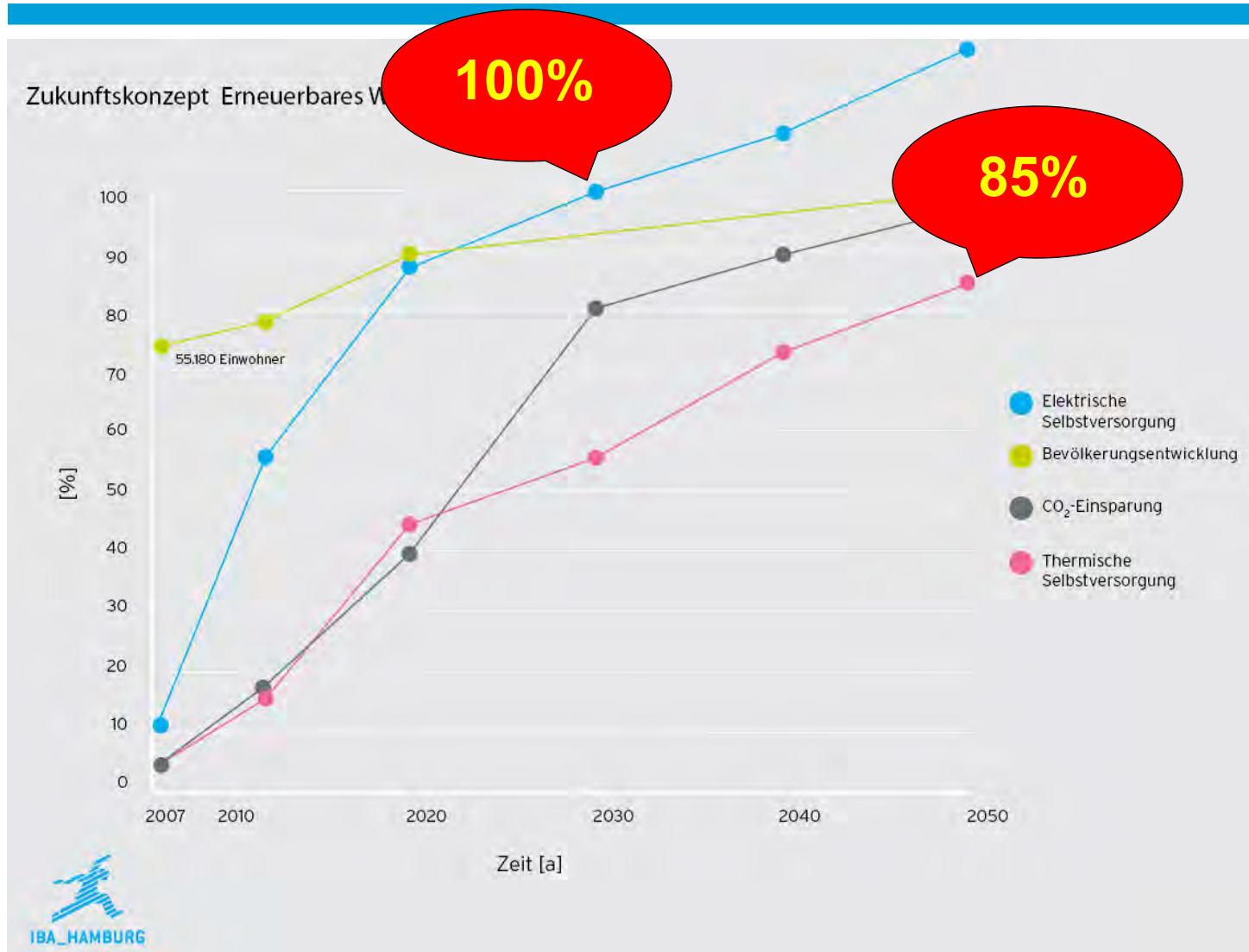
Rolf Disch



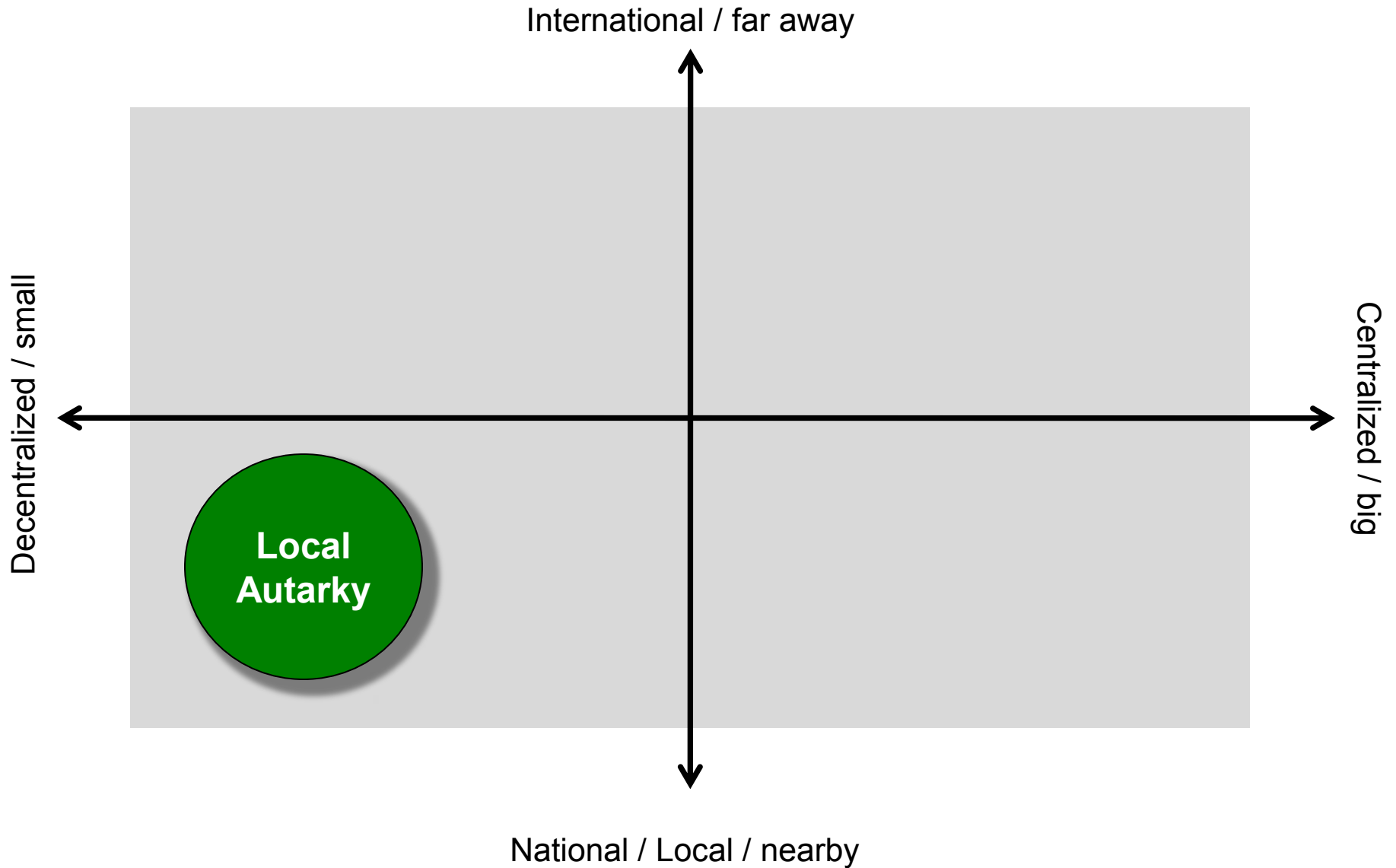






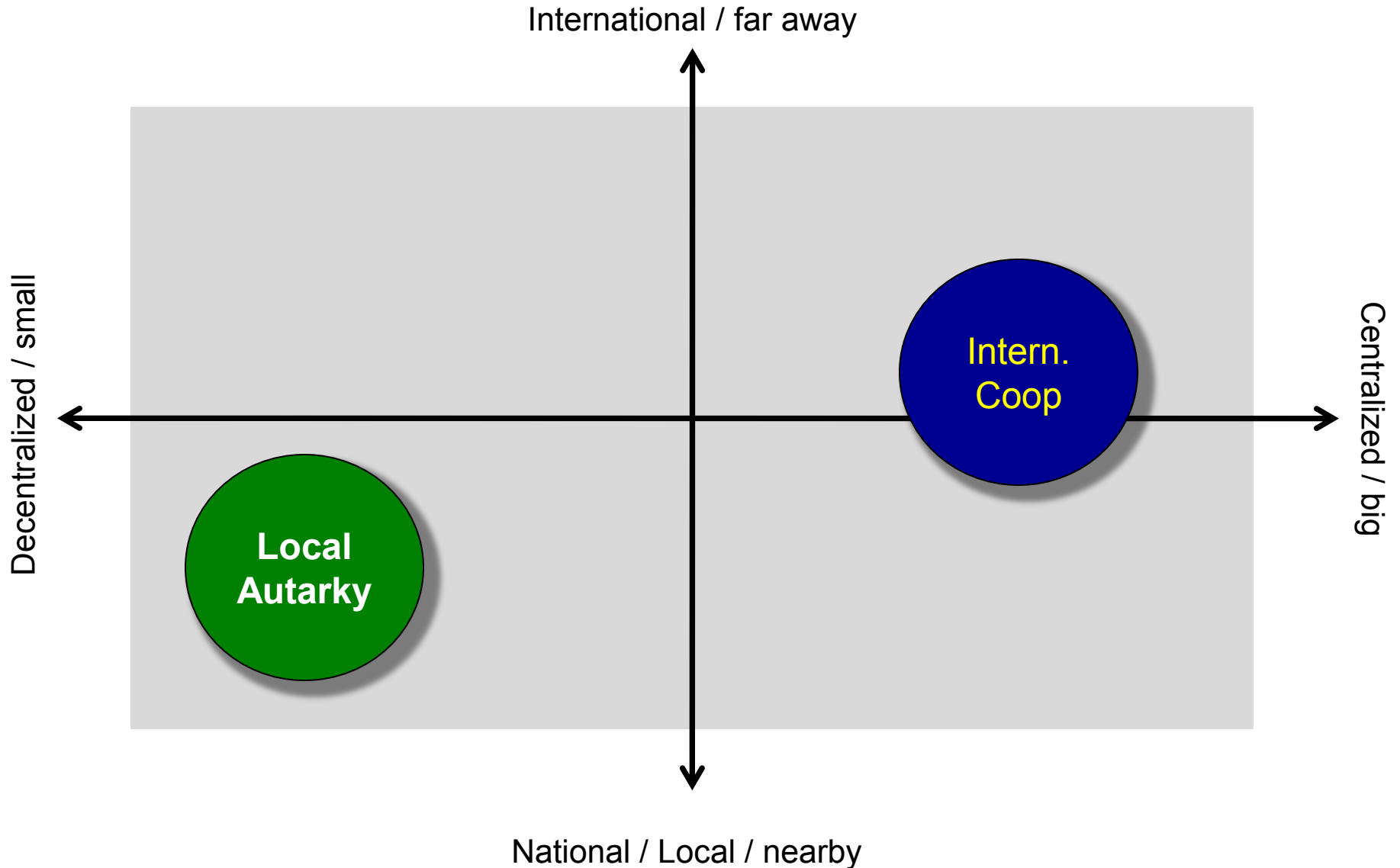


# Archetypen einer EE Versorgung





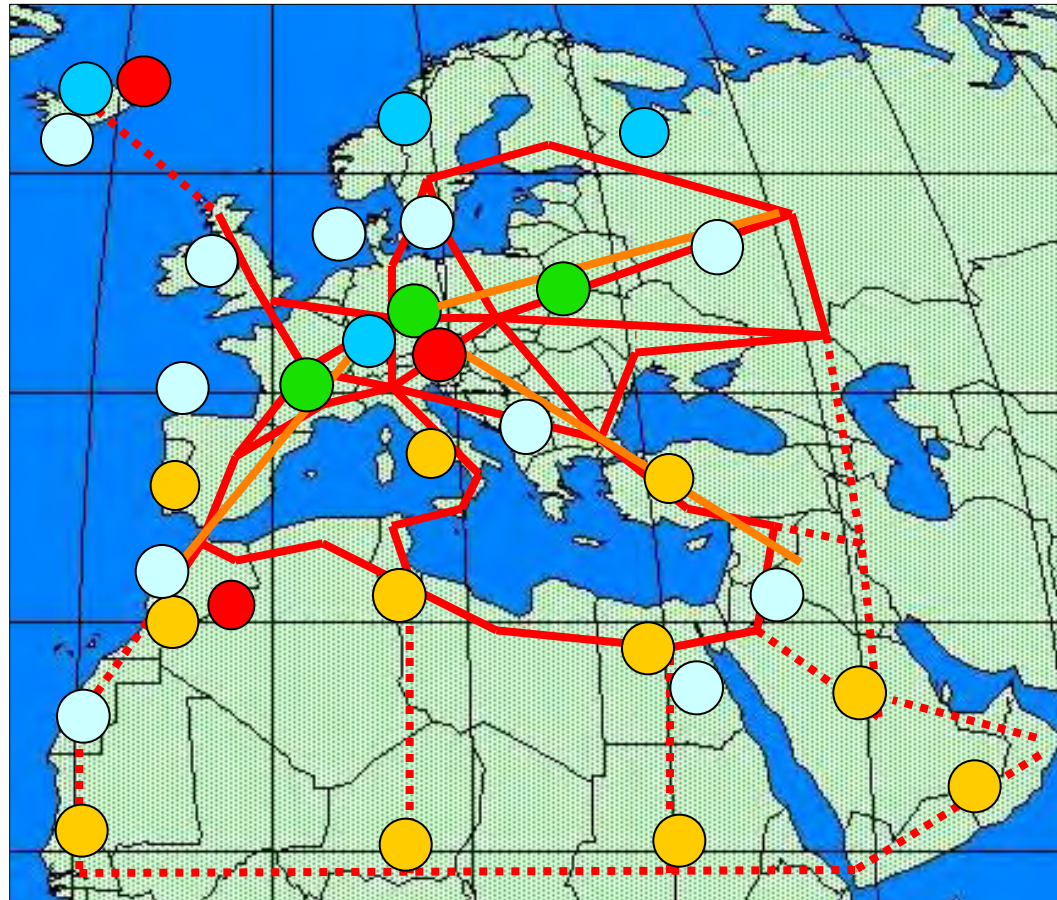
# Archetypen einer EE Versorgung





ISuSI

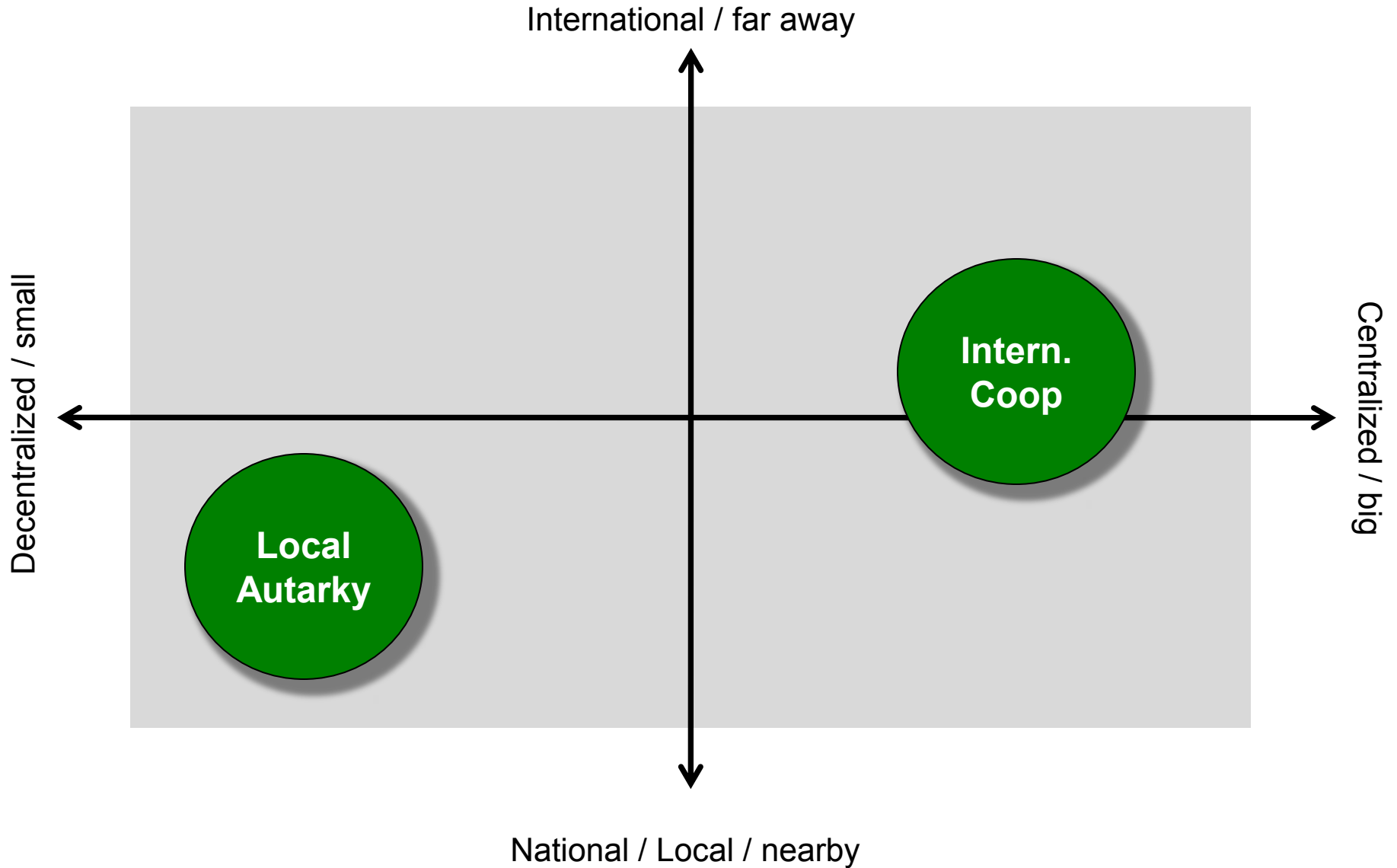
# Trans Med Renewable Energy Collaboration - TREC



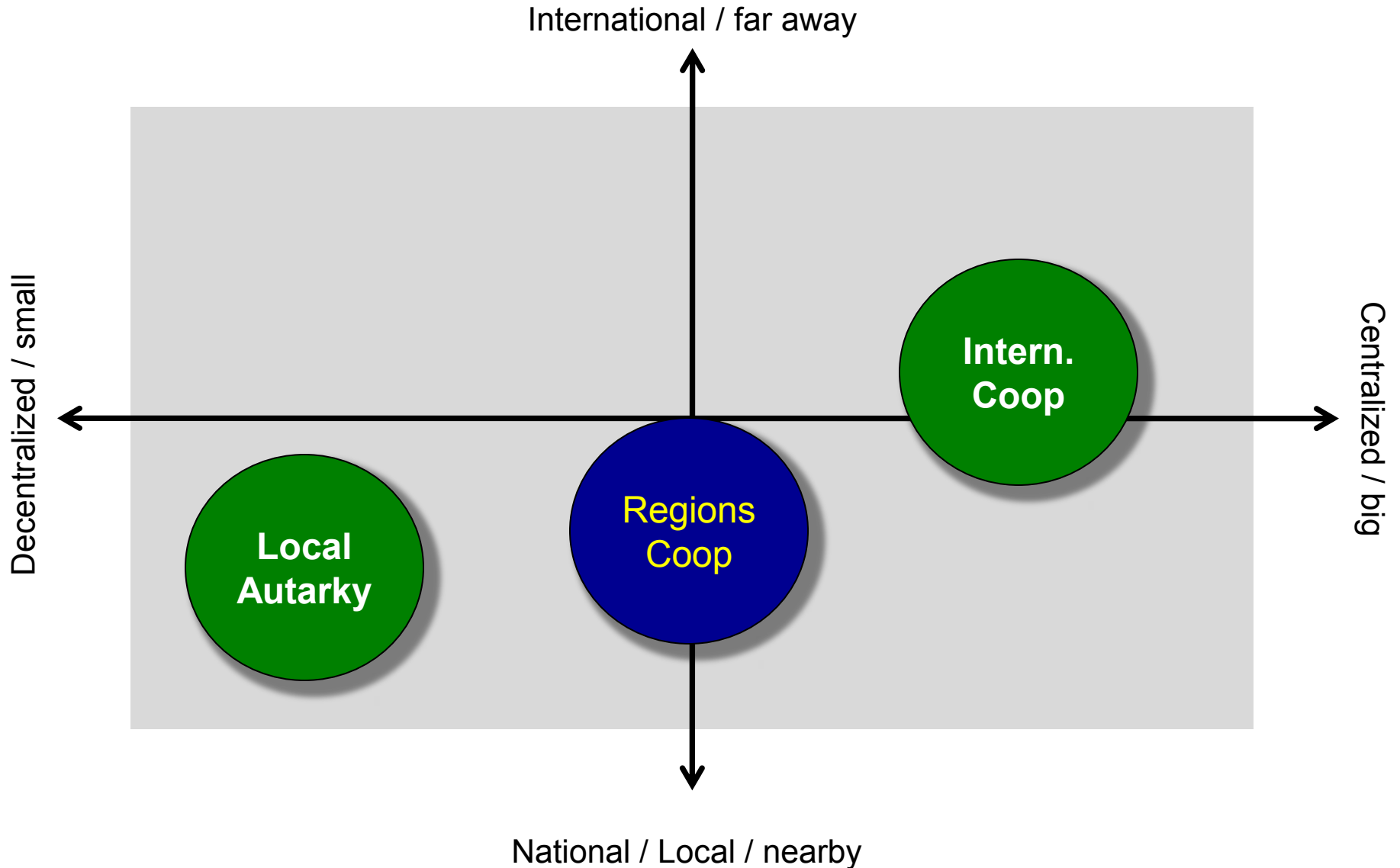
- Solar
- Wind
- Hydro
- Geothermal
- Biomass
- EURO-MED
- possible further interconnections
- Gas pipelines used for Hydrogen

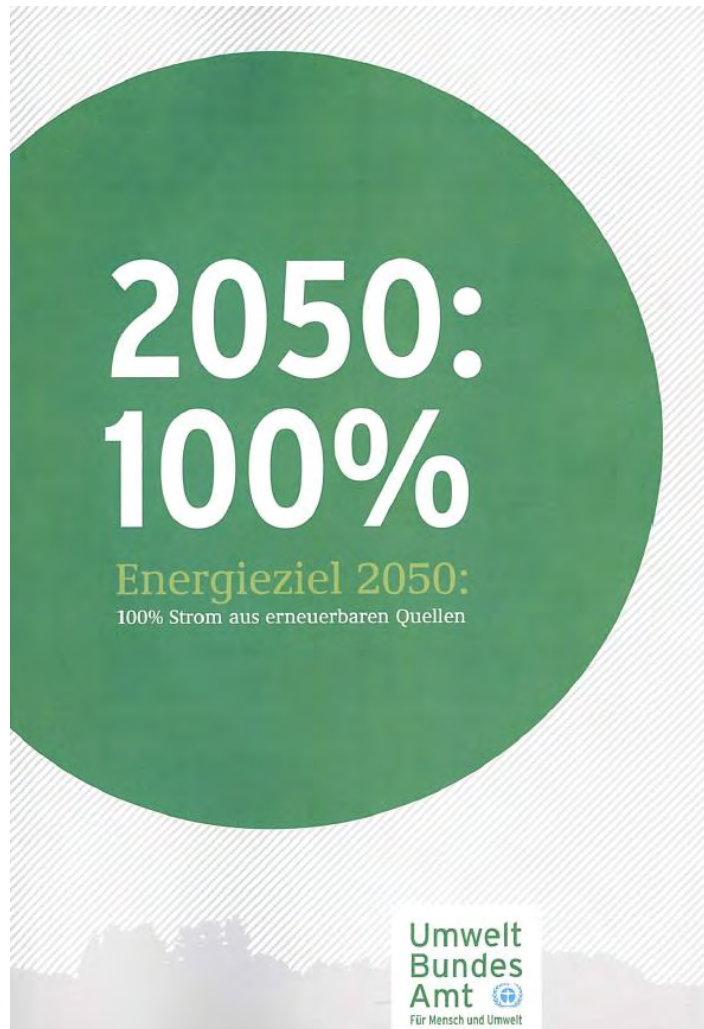
Source: TREC Collaboration und Harry Lehmann, 2004

# Archetypen einer EE Versorgung



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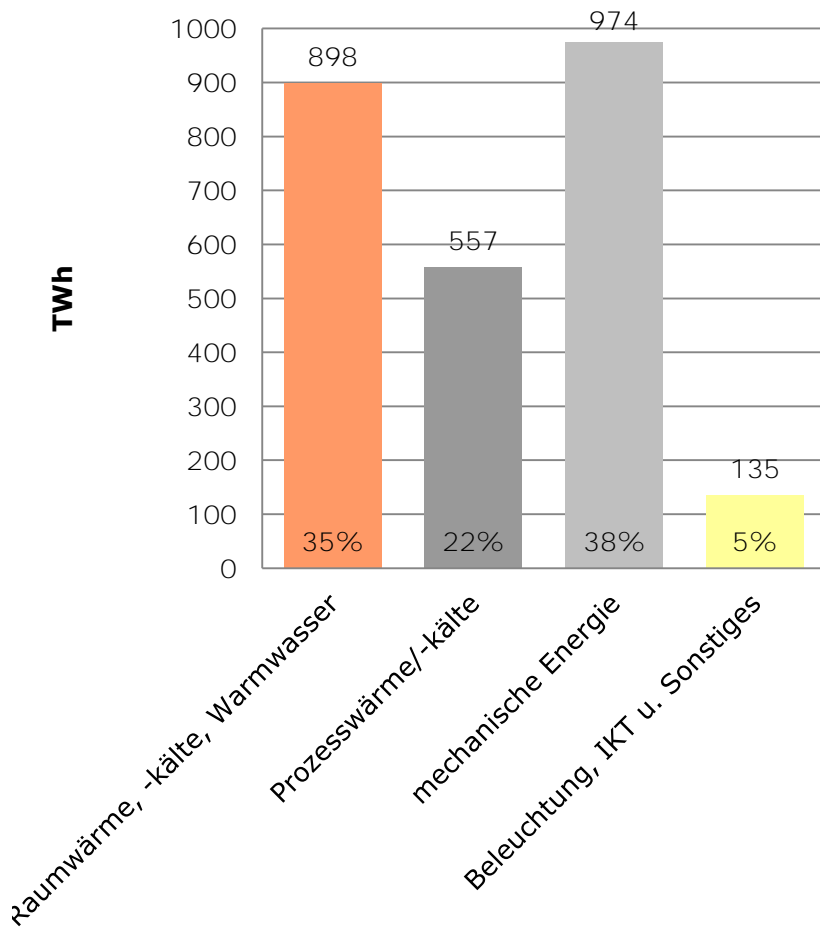




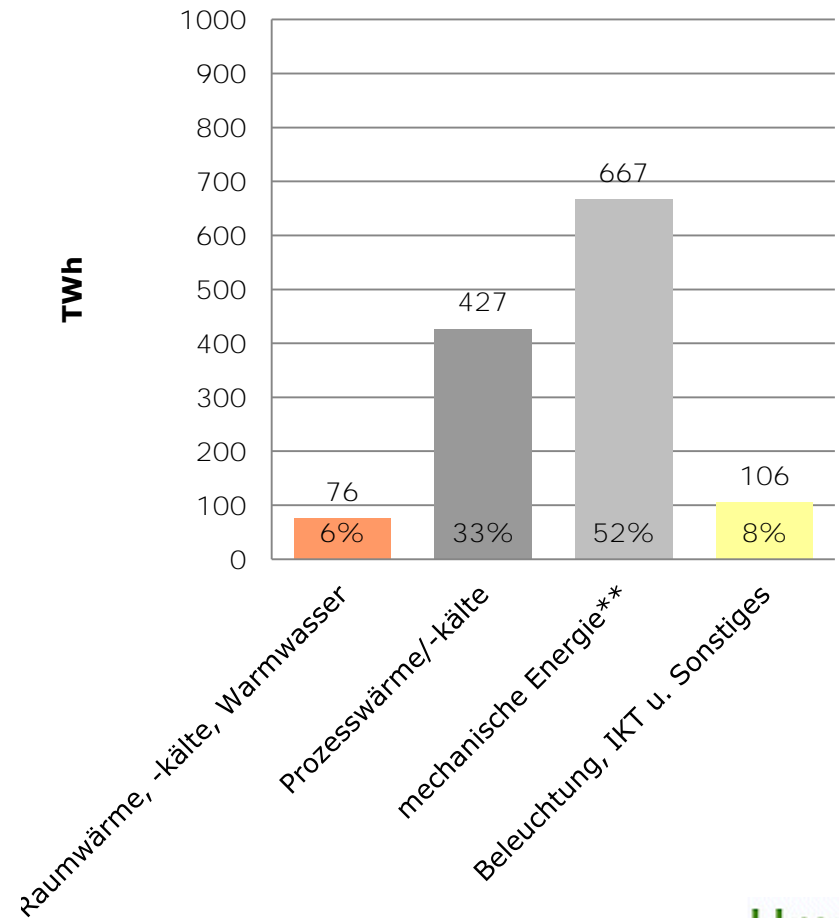
Juni 2010

# Energy Demand in diff. sectors

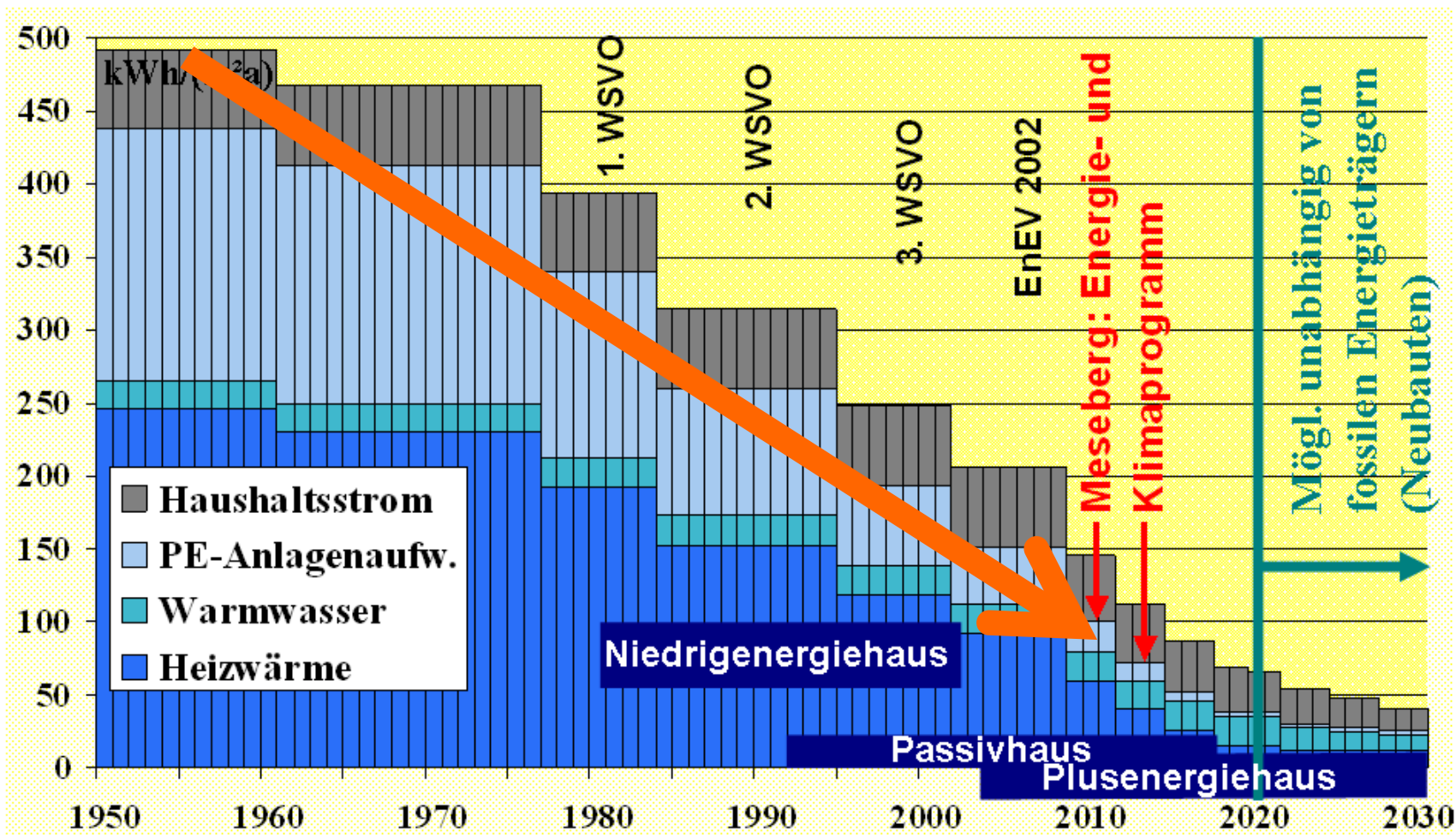
## Germany 2008 and 2050



2008

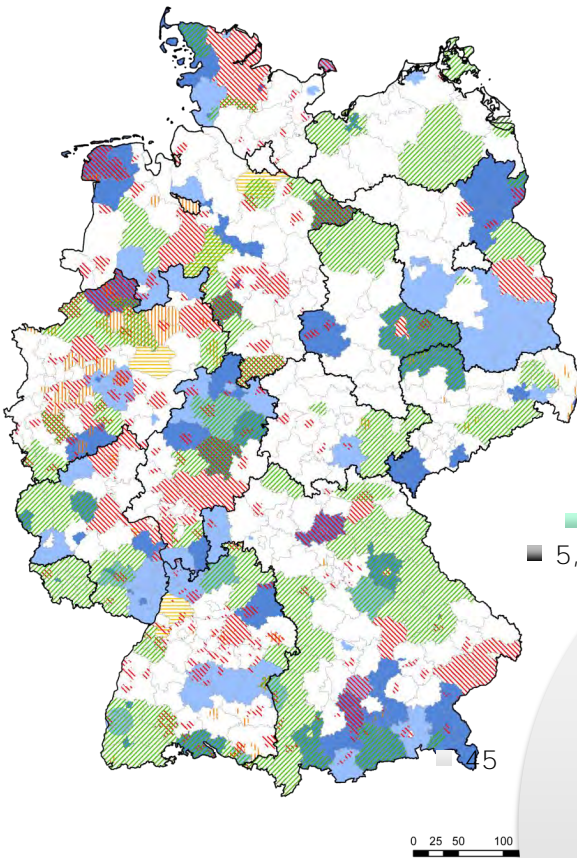


2050

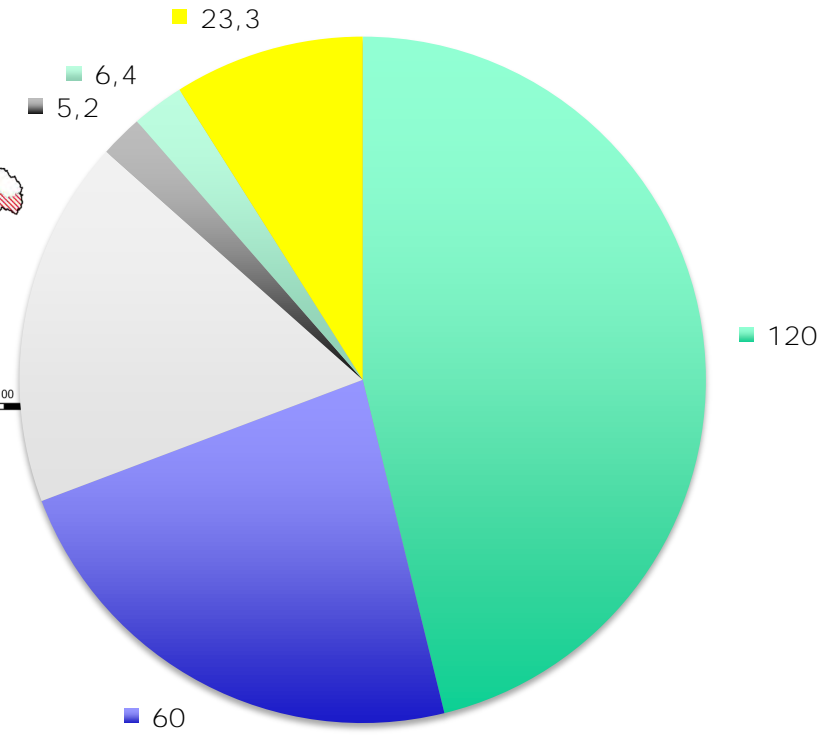


Quelle: Schulze-Darup

# Scenario „Regionen Verbund D – 2050“



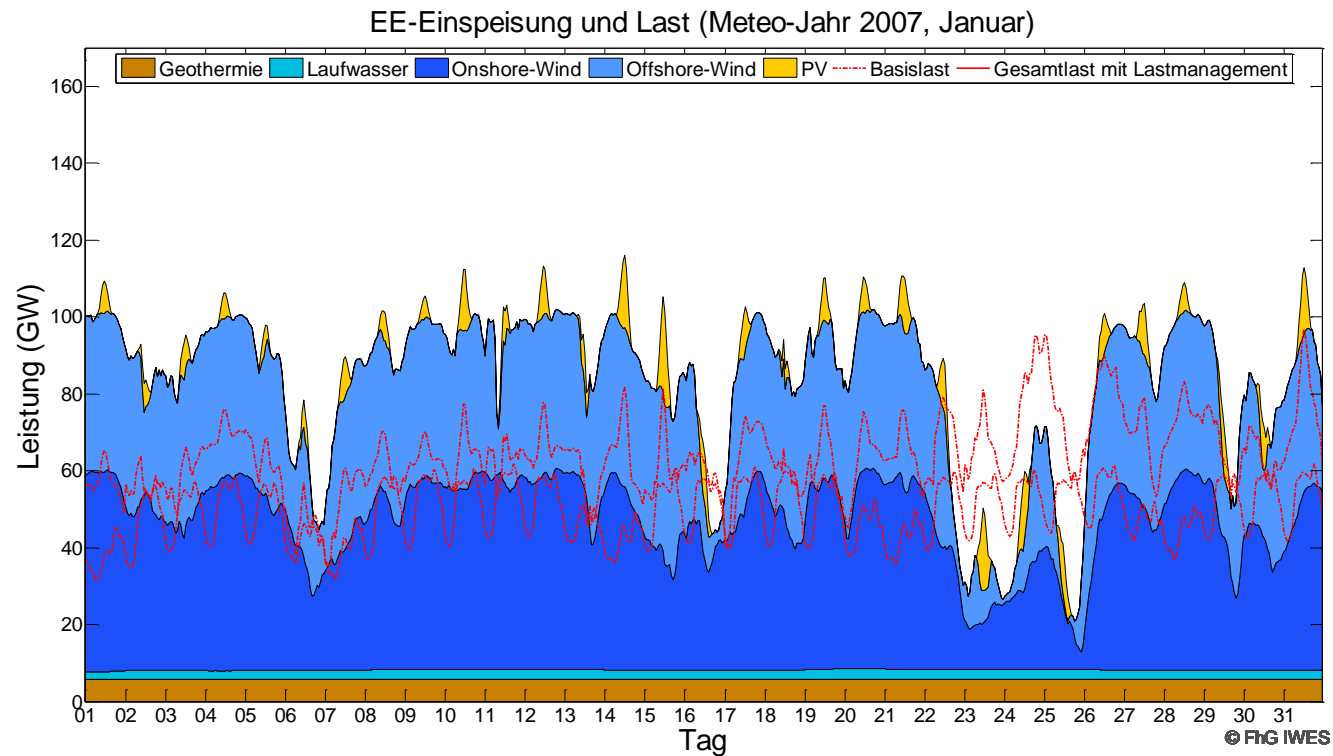
## Installed Capacity GW



- Photovoltaic
- Wind energy onshore
- Wind energy offshore
- Hydropower
- Geothermal energy
- Waste biomass (biogas)



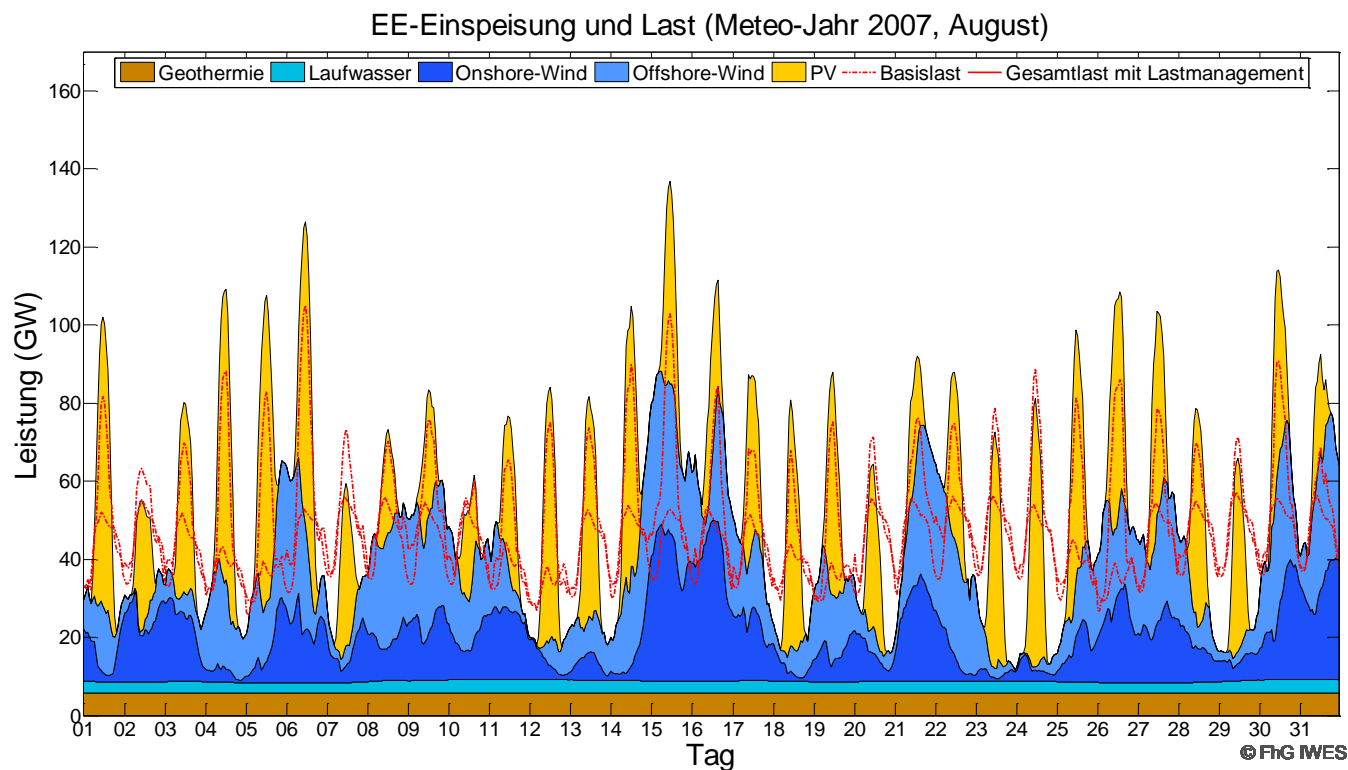
# Feed-in of renewable energy and load – per month (winter)



## Feed-in [GW] of all RE and the load curve

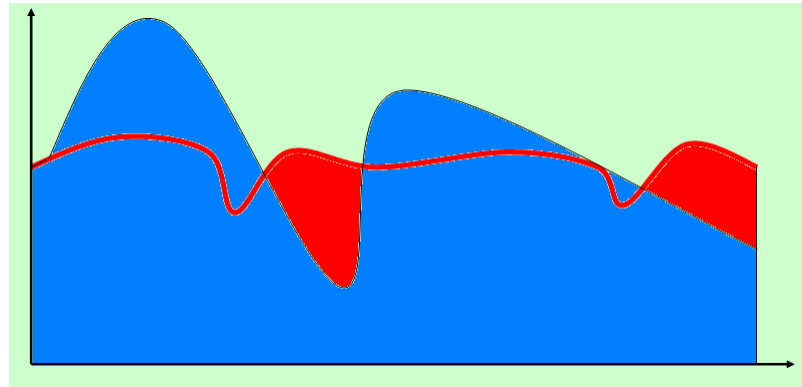
Example „Winter day“ (December) for the feed-in of renewable energies in 2050, based on the meteorological year 2007

# Feed-in of renewable energies and load – per month (summer)



## Feed-in [GW] of all RE and load

Example „Summer day“ (August) for the feed-in of renewable energies in 2050, based on the meteorological year 2007



*Speicher werden gebraucht*

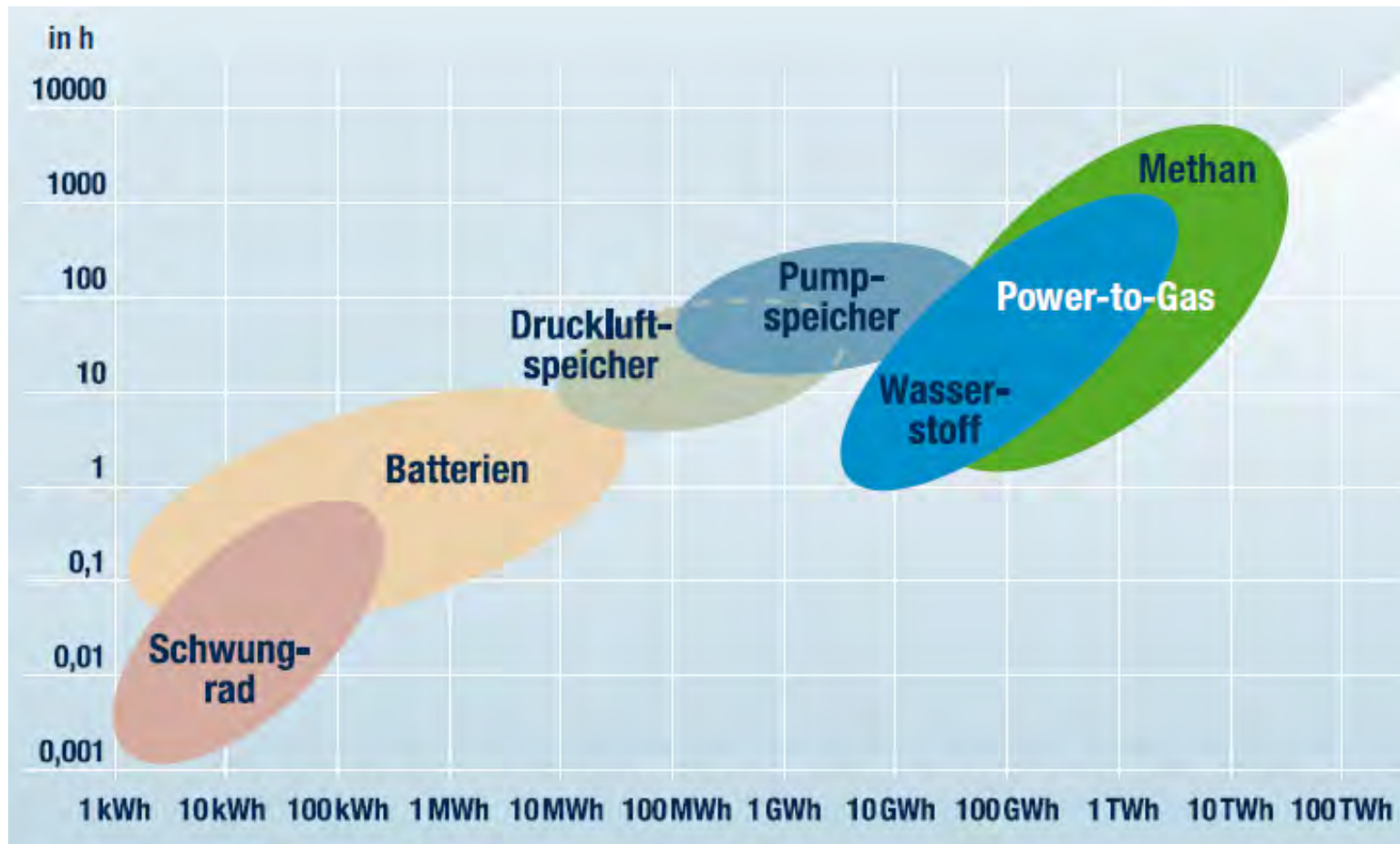
*Gravitativer Speicher*

*z.B. Wasserkraft*

*Chemischer Speicher*

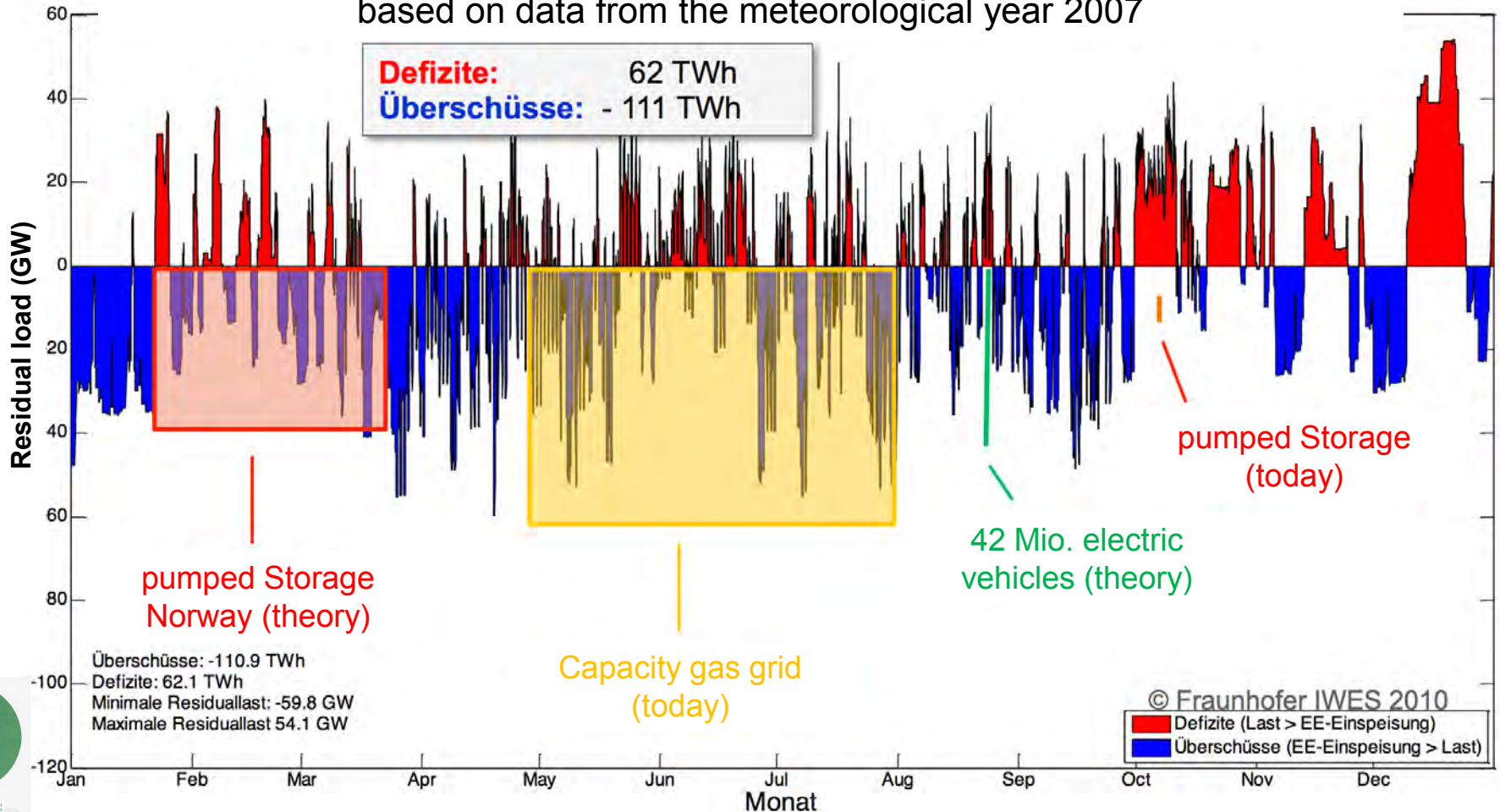
*H<sub>2</sub> or eMethan*

*Elektrischer Speicher*

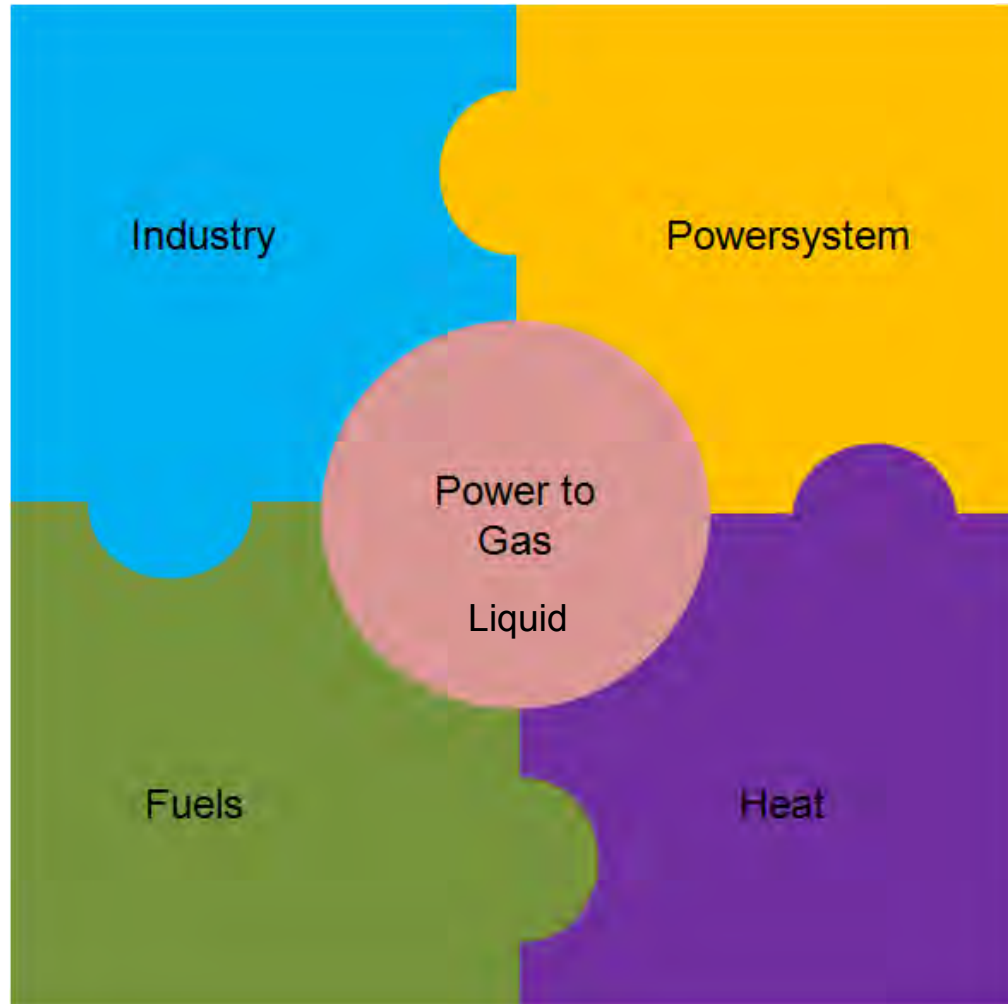


# Speicher im Größenvergleich

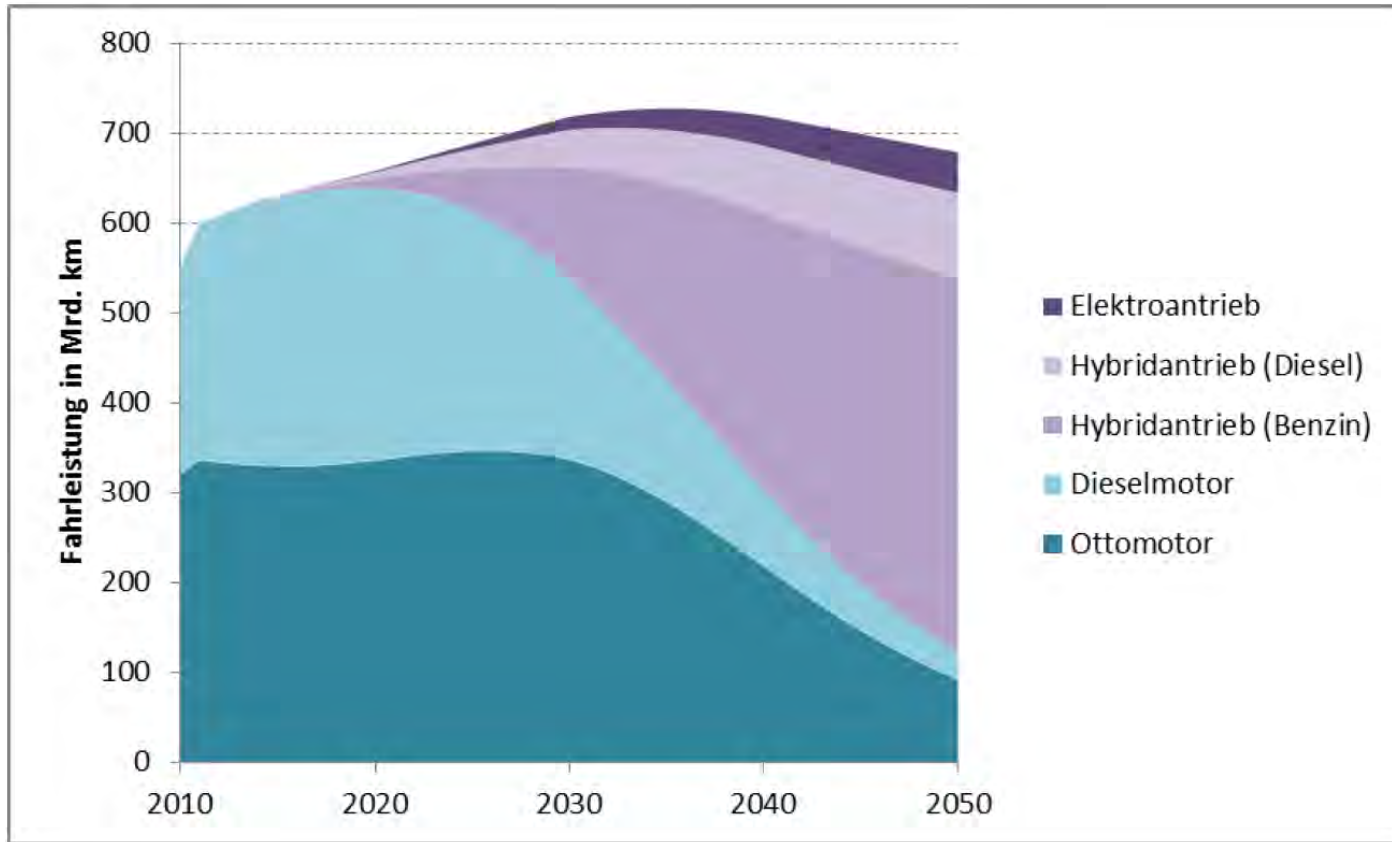
Total residual load (with load management and pump storage) in the year 2050, based on data from the meteorological year 2007



## Rolle in einem zukünftigen Energiesystem

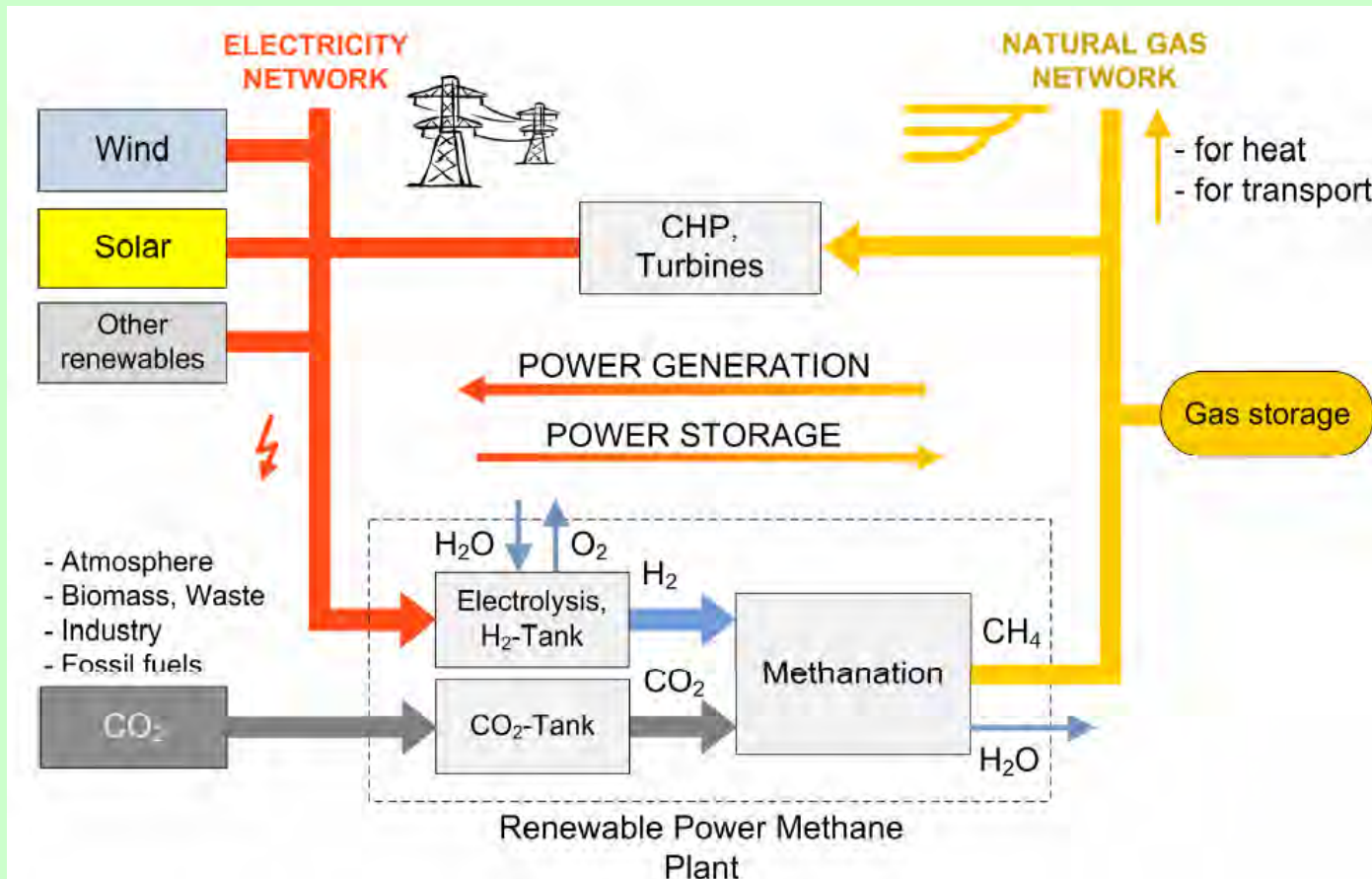


# Verkehr



PKW Fahrleistung nach Antriebstyp

# energy storage by linking the power grid with natural gas grid



[Specht et al, 2010, Sterner, 2009]



# Heutige Technologie



► Entscheidung zum Kauf von vier Offshore-Windkraftträdern

- Vorstandsfreigabe im Dezember 2010
- Vier 3,6 MW OWKA mit 53 GWh Strom Gesamtleistung p.a.

► Entscheidung des e-gas-Projekts

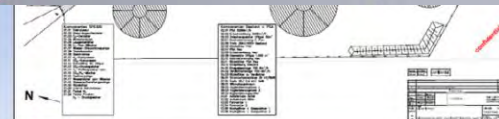
- Bau einer 6,3 MW e-gas Anlage mit 1.000t e-gas p.a.
- Kooperationspartner:



Als geeigneter Standort für ur Deutschlands ausgewählt



Audi balanced mobility

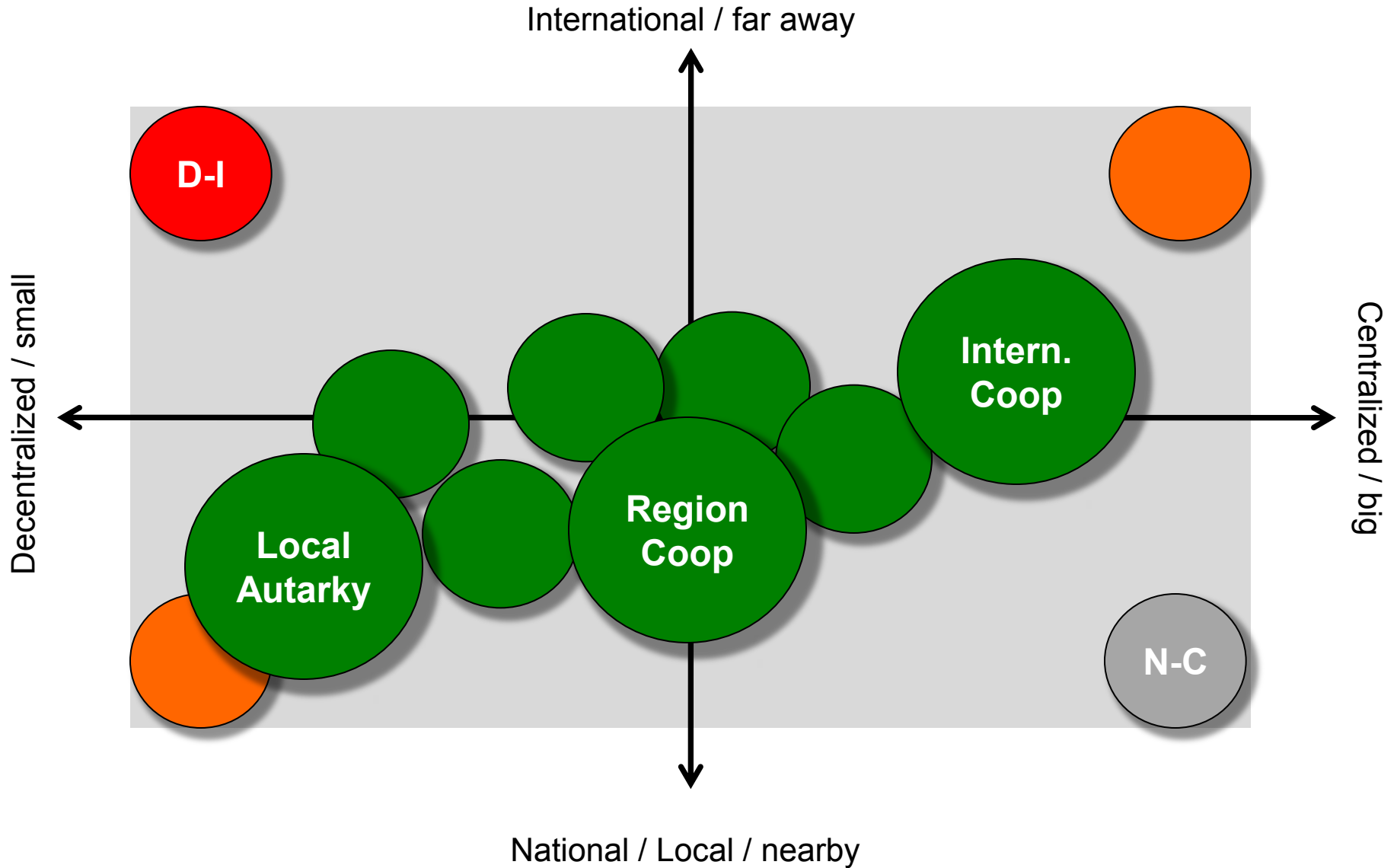


Entscheidung für Werlte wegen:

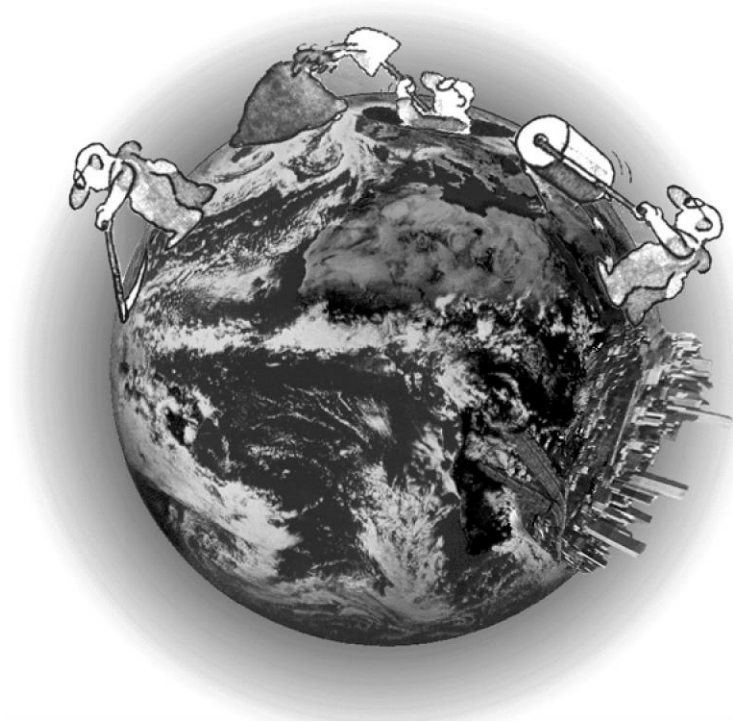
- Räumlicher Nähe zu Offshore-Windpark
- Nähe zur CO<sub>2</sub>-Quelle (Biogasanlage der Fa. EWE)
- Infrastruktur



# Archetypen einer EE Versorgung



*Von 1% über 40% zu 100%*  
*Energiewende 3.1*



Limits to growth

Source: Harry Lehmann, 1994

# 100% EE - Schritte...

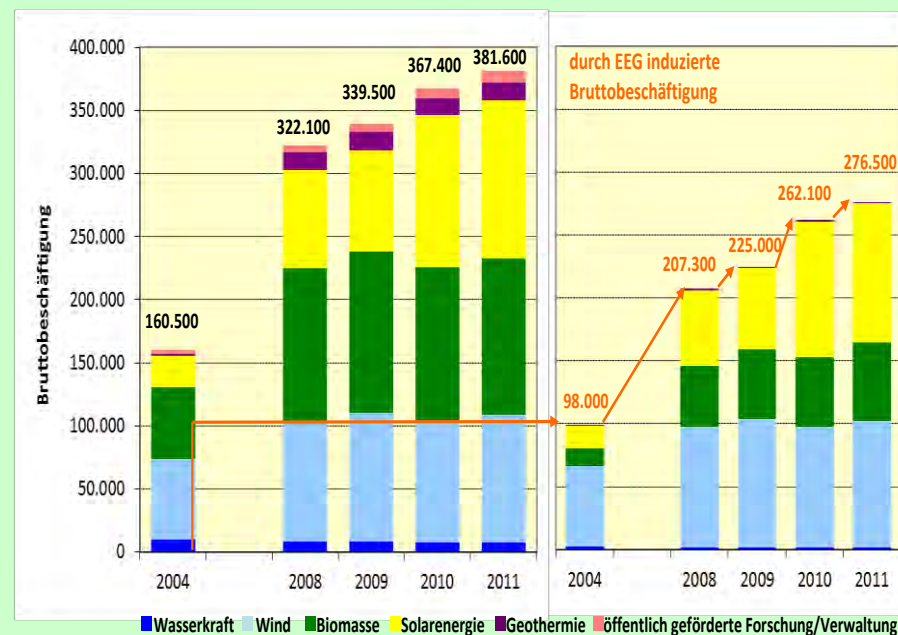
- Bindende Ziele beim Ausbau EE und Senkung THG
- Ökonomische und Gesetzliche Rahmenbedingungen (e.g. FIT, MiC)
- Effiziente und intelligente Nutzung von Energie
- Raumplanung (z.B. genug "Raum" für Wind)
- Andere Umweltziele nicht vergessen (e.g. Biodiv, Ressourcen)
- Angepasste Infrastruktur (Netz und Speicher Systeme)
- Forschung und Entwicklung und Demonstration
- Information und Weiterbildung
- Gesellschaftliche Unterstützung

# Energiewende als Chance

Die Energiewende ...

- ... sichert die Klimaschutzziele
- ... schafft Arbeitsplätze
- ... führt zu nachhaltigem Wachstum.
- ... ist *die* Chance, auf dem Weg in eine nachhaltige Moderne weltweit voranzugehen.

Entwicklung der Bruttobeschäftigung durch erneuerbare Energien

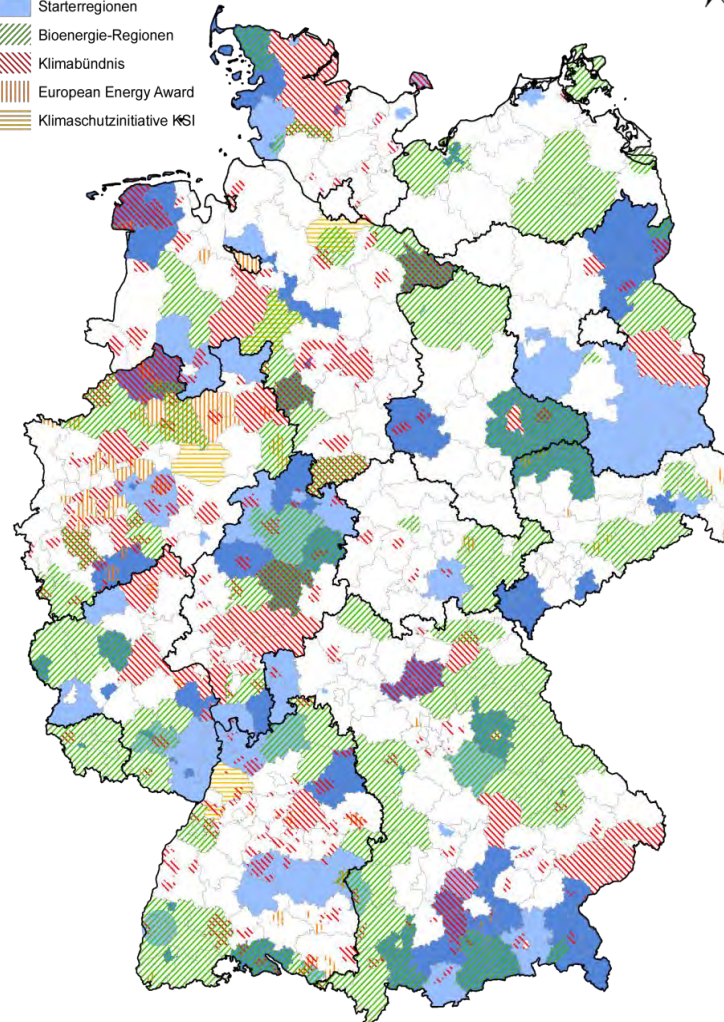
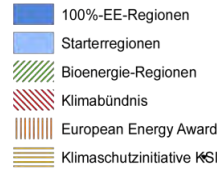




## Legende



## Legende



**50% sind gestartet**

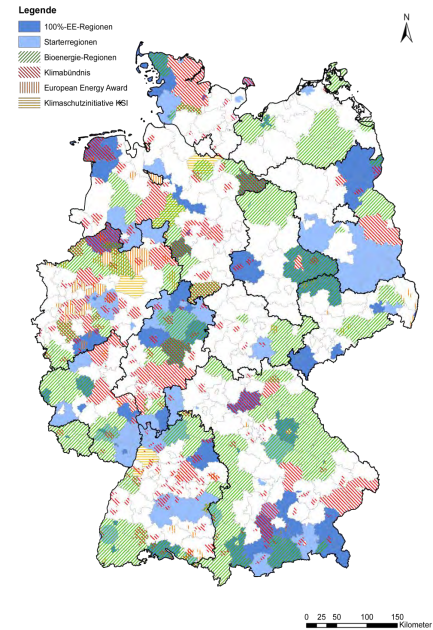
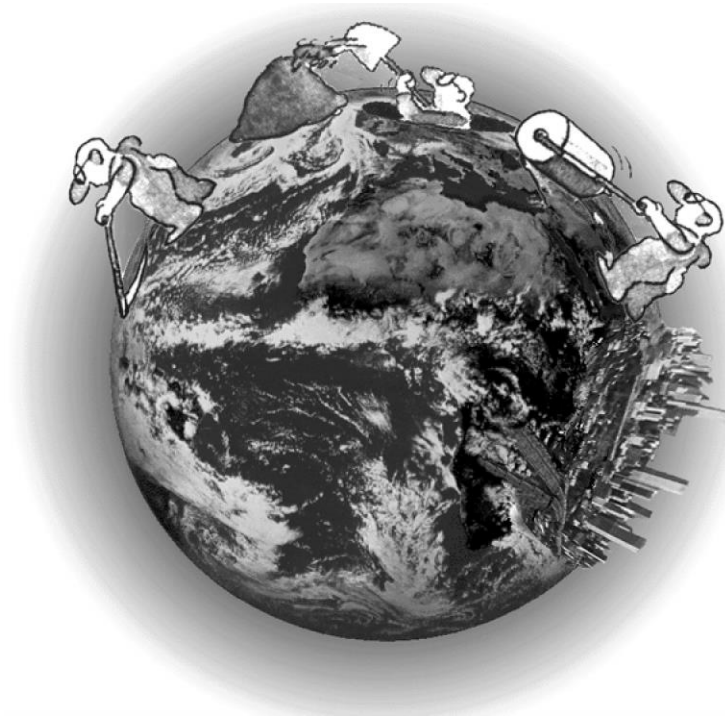
Source: P.Moser, September 2010

0 25 50 100 150  
Kilometer

Source: Peter Moser

*100% ist möglich !*

*Lasst uns die „Energiewende“  
realisieren.*



Limits to growth

<http://www.umweltbundesamt.de/energie/index.htm>

harry.lehmann @ uba.de

Source: Harry Lehmann, 1994