Energy storage design and integration in power systems by system-value optimization

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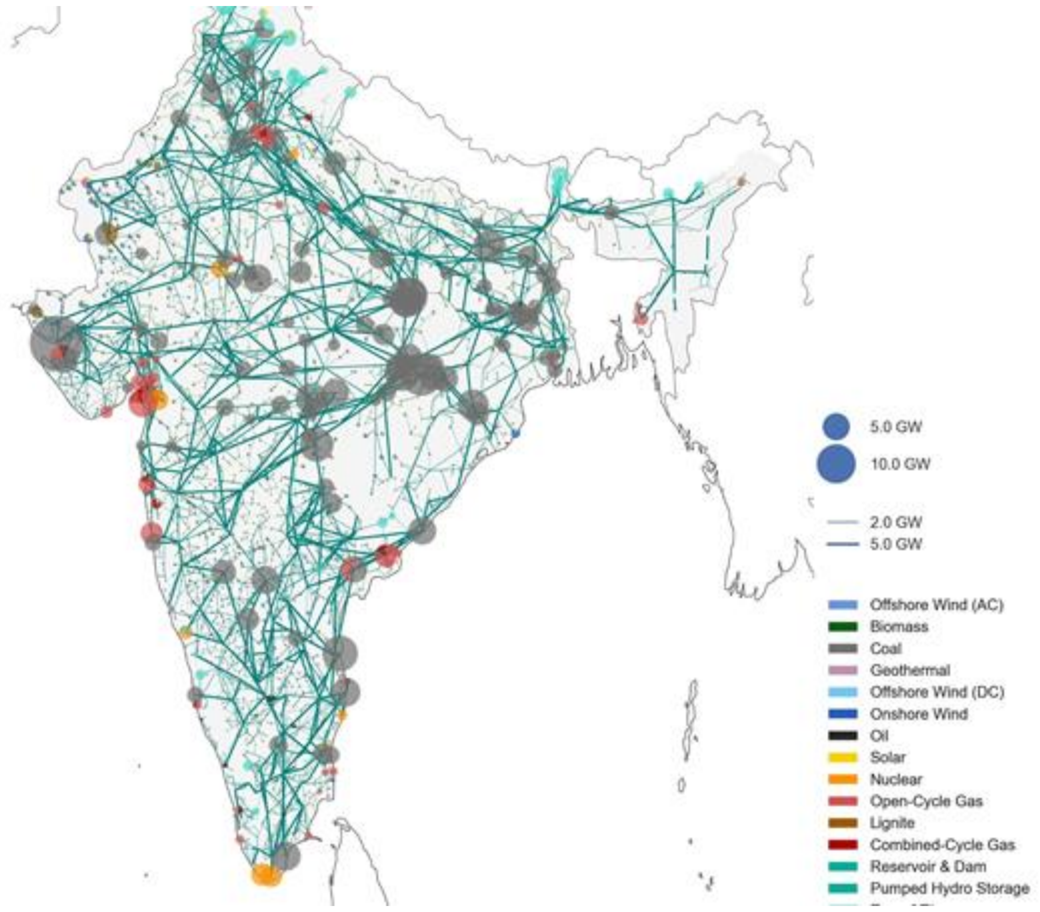
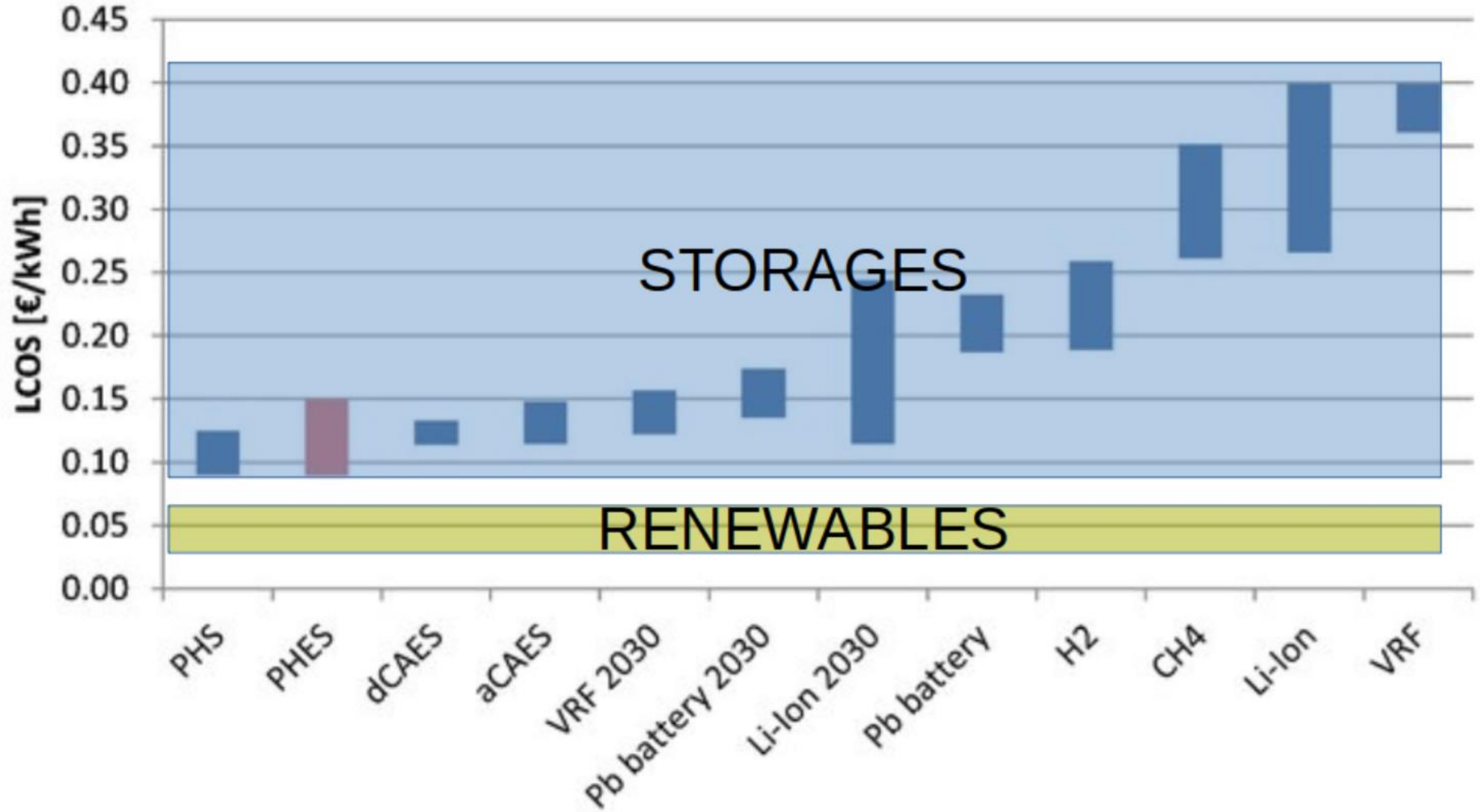
(PhD.) Maximilian Parzen -
University of Edinburgh,
CEO at Open Energy Transition



Problem: Energy storage are still expensive!



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Solution: Increase affordability of energy storage

How?

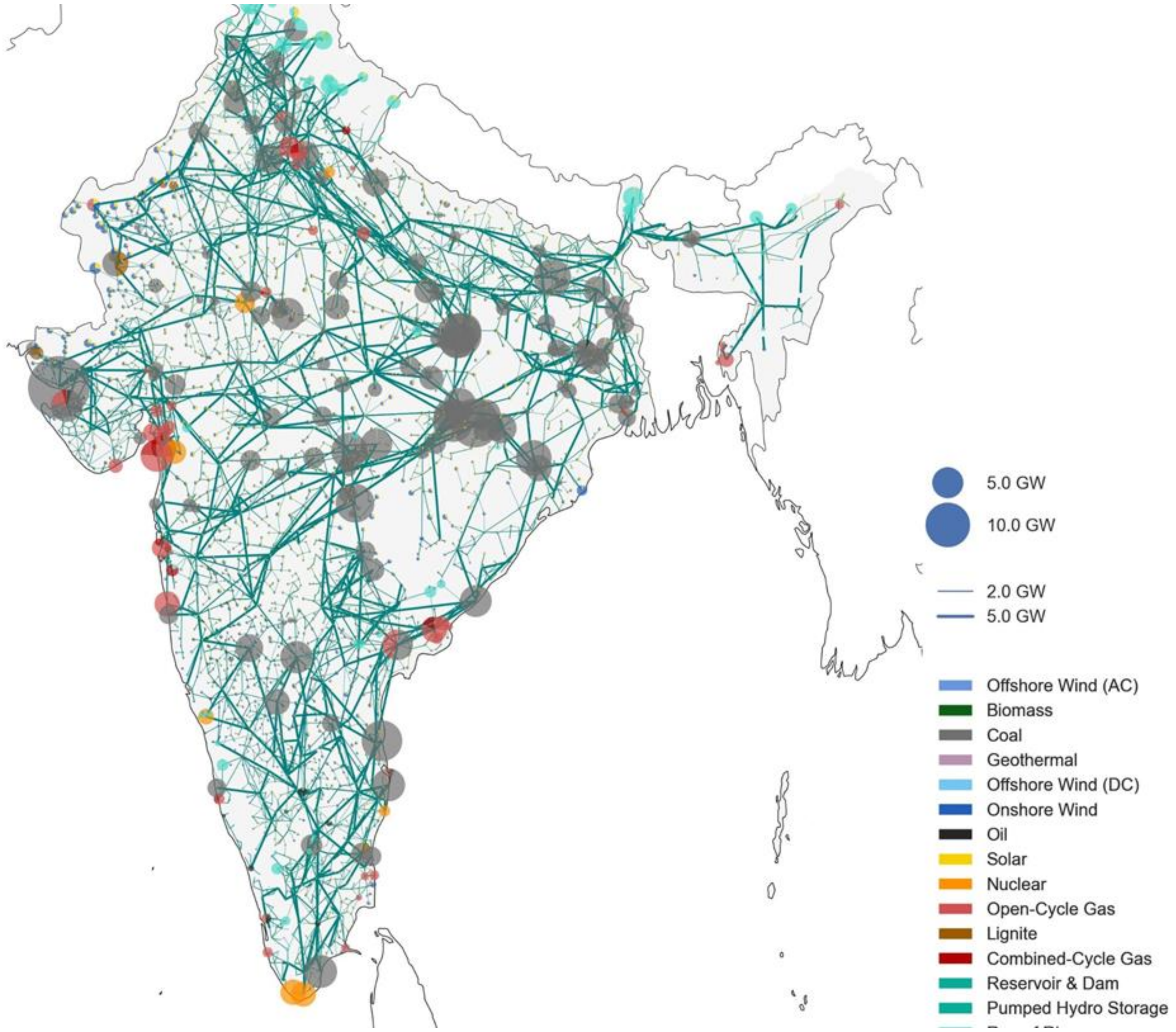
Technology optimization

reduce costs (capital, operational)
increase efficiency, lifetime etc
...

System optimization

integrate tech where & when it's needed,
design tech-friendly systems,
design system-friendly tech,
...

How does system optimization works?

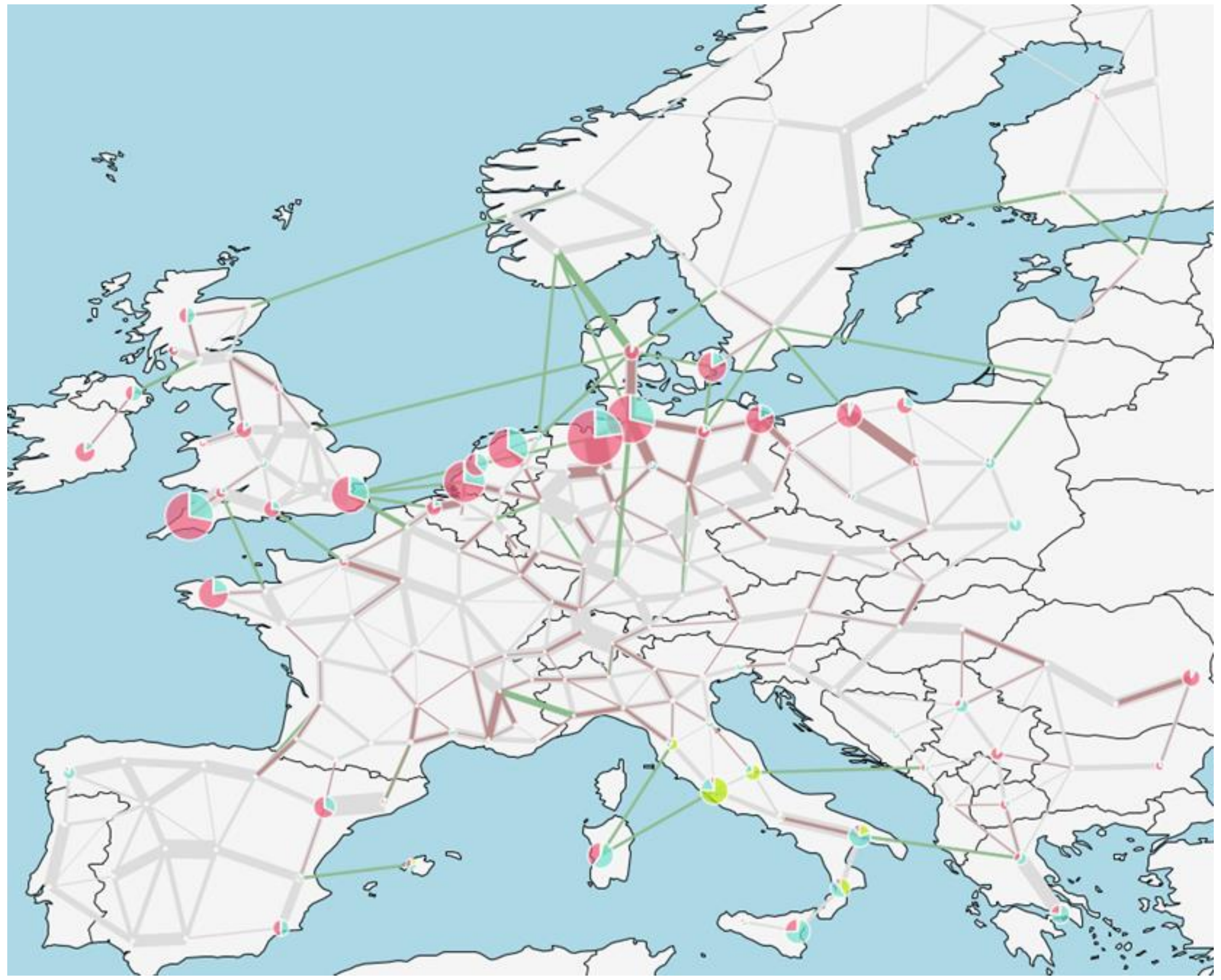


Objective: minimise the total system cost that consist of

- investment costs in new generation projects
- investment costs in new storage capacity
- investment costs in new transmission line projects
- variable costs, such as costs for fuels or maintenance

NEW. Models can be created with EASE everywhere using free and open source software!

What does system optimization tells us?



Don’t use Levelised Cost of Storage (LCOS)

- Ignores competition
- Misleading! Low LCOS does not mean good for the system

Use System Evaluation Methods

- Quantifies the market size per country (GW and GWh)
- Can consider competing technologies
- Can consider unique power systems (heterogenous world!)

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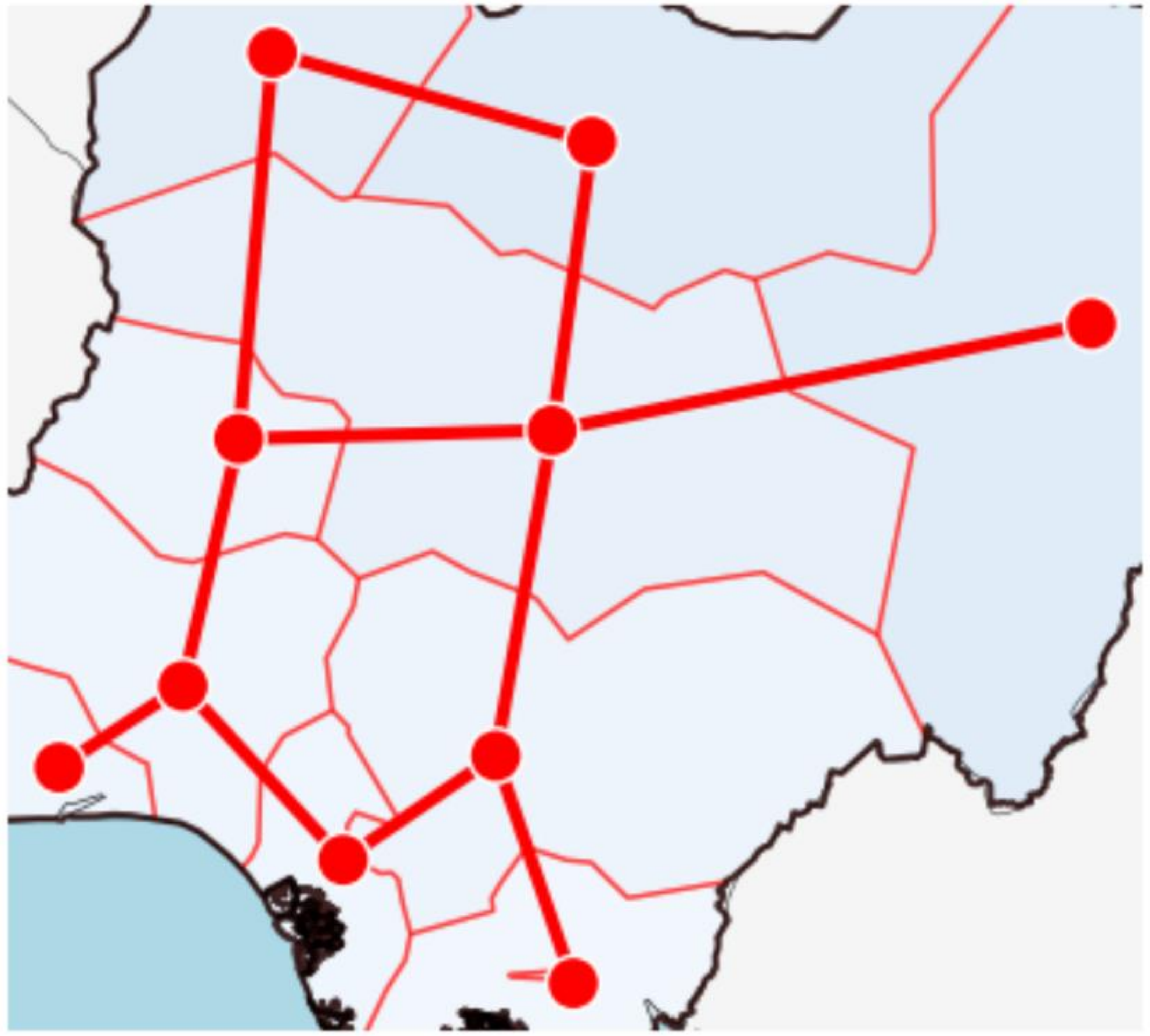
Case study: Nigeria with 100% Renewable Energy



- Added 20 energy storage to a power system
  - **1x Chemical** (Hydrogen)
  - **6x Thermal** (Concrete heat, Molten Salt, Liquid Air, Pumped heat, Sand heat, …)
  - **8x Electrochemical** (Lead Acid, Lithium FeP, Li NiMnCo, Nickel Zinc, Vanadium Redox-Flow, Zinc-Air, …)
  - **8x Mechanical** (Compressed Air, Brick Gravity, PHS, …)
- Considered deep cost uncertainty across 40 scenarios

RESULTS - Market Potentials

0-25GW
0-125GWh

Li-Ion Battery

EP ratio: 6
Tech: LFP

0-3.5GW
0-587GWh

Hydrogen

EP ratio: 8-21
Tech: Thermal

0-17GW
0-119GWh

Gravity

EP ratio: 4-7
Tech: Mech.

9-24GW
140-877GWh

Sand-based

EP ratio: 9-36
Tech: Thermal

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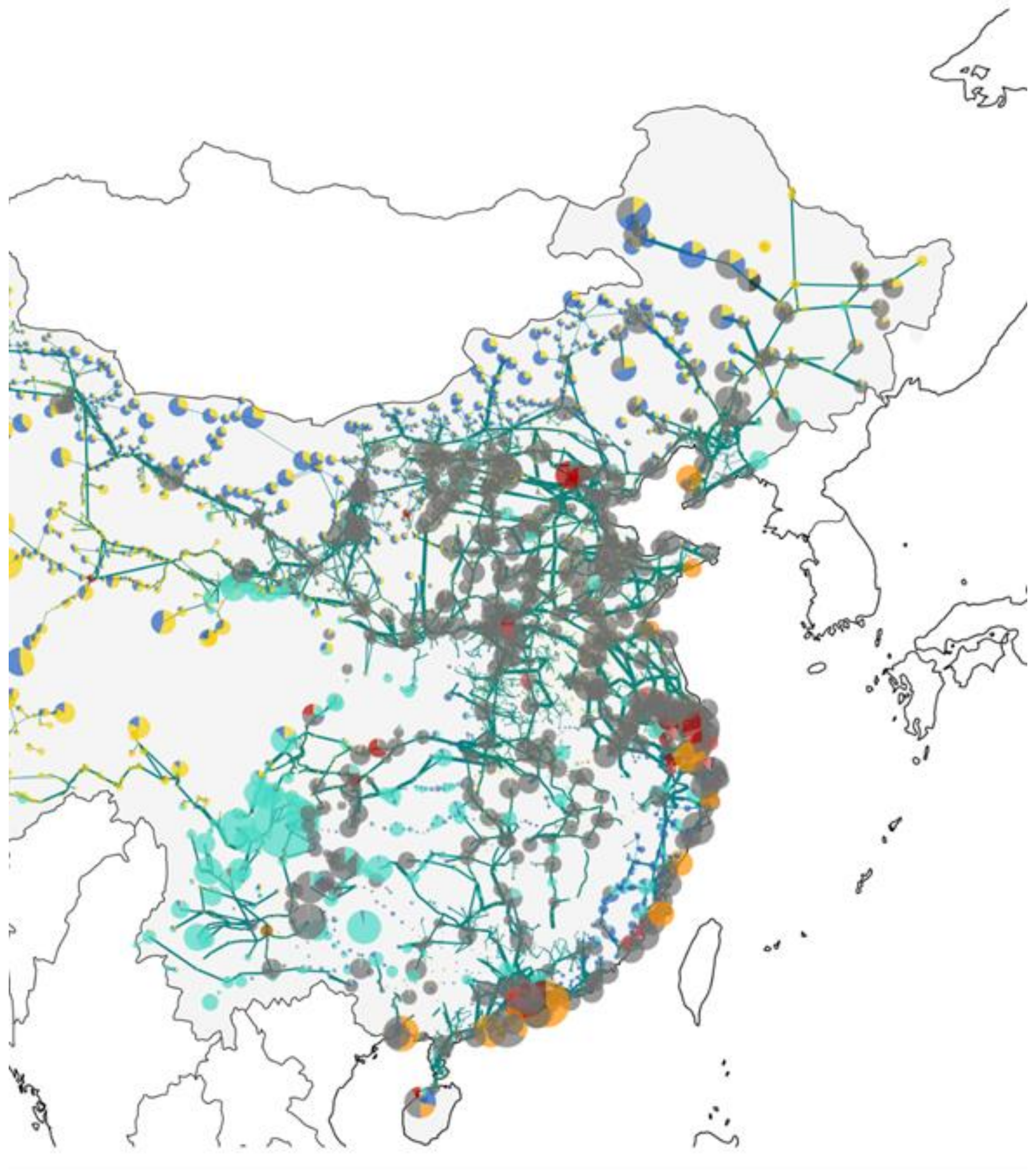
“Interestingly, this work discovers that **lithium energy storage** might not be system relevant in many cases due to competition from other technologies [...] ”

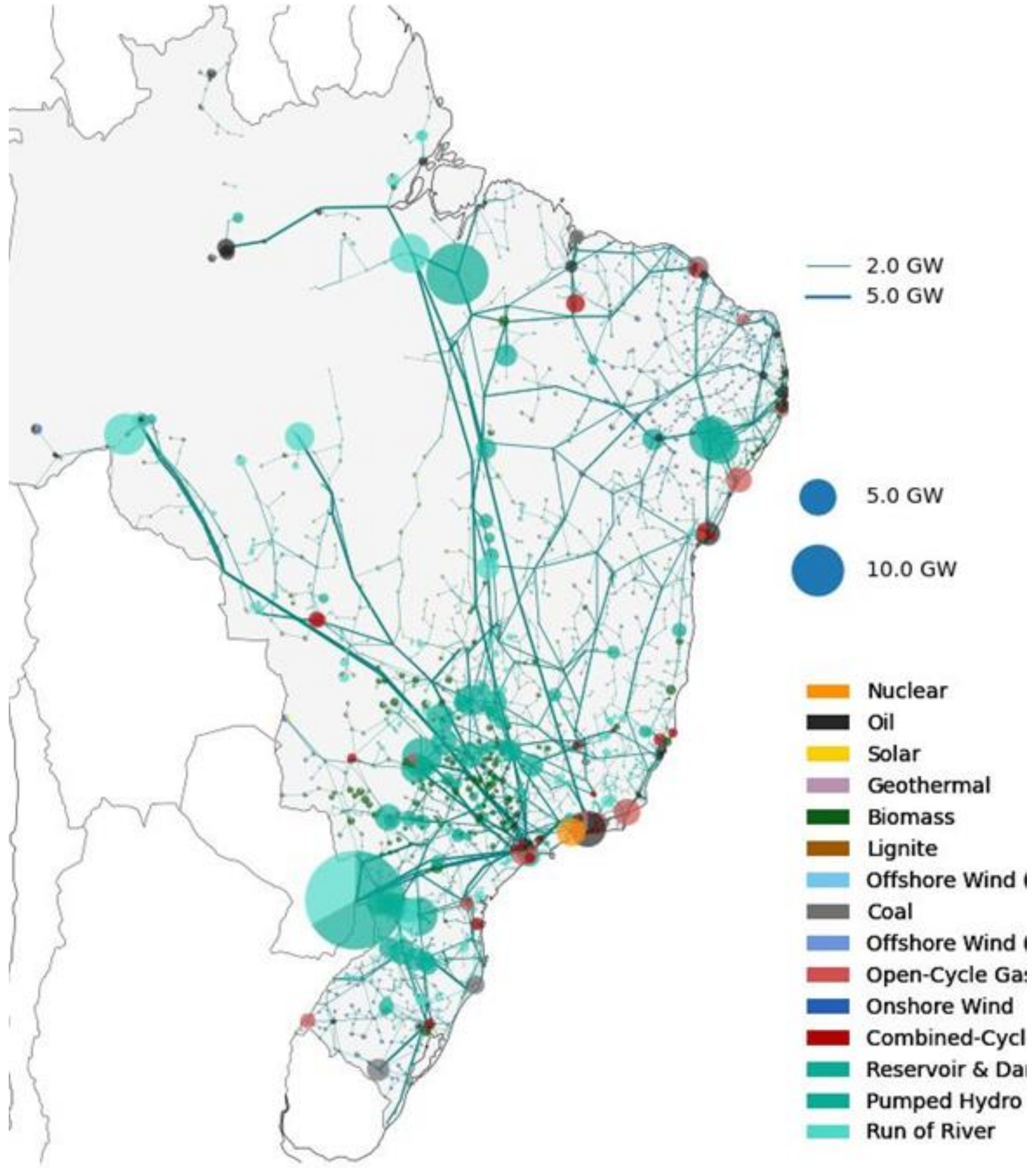
- Thesis Maximilian Parzen

Every system is different - This implies storage potentials can change

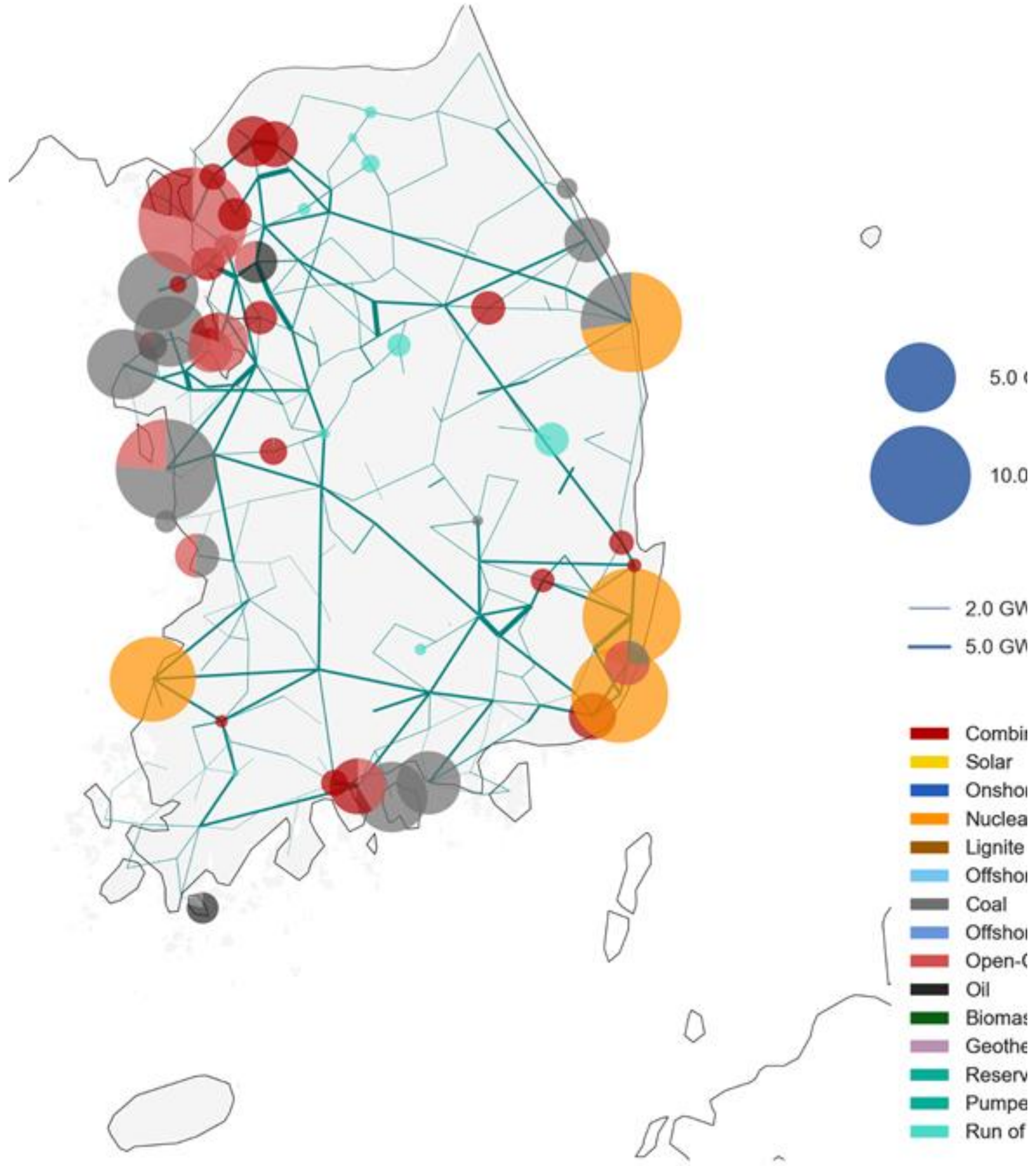
Ideally: global analysis & easy repeating analysis



CHINA



BRAZIL



SOUTH KOREA

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We started a non-profit software company and think tank to help YOU

Open Energy Transition

from the creators of PyPSA meets Earth

- We **work globally** (all-remote)
- We maintain **worldwide leading** free and open source software
- We are **battle proof** (work with TSOs, NGOs, and many others)
- We can **globally assess the storage market** potential (one-time or automated monitoring)
- We can **make methods more robust**

THANK YOU!

Maximilian Parzen

max.parzen@openenergytransition.org

www.openenergytransition.org

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