Impact of electric mobility on the electricity grid

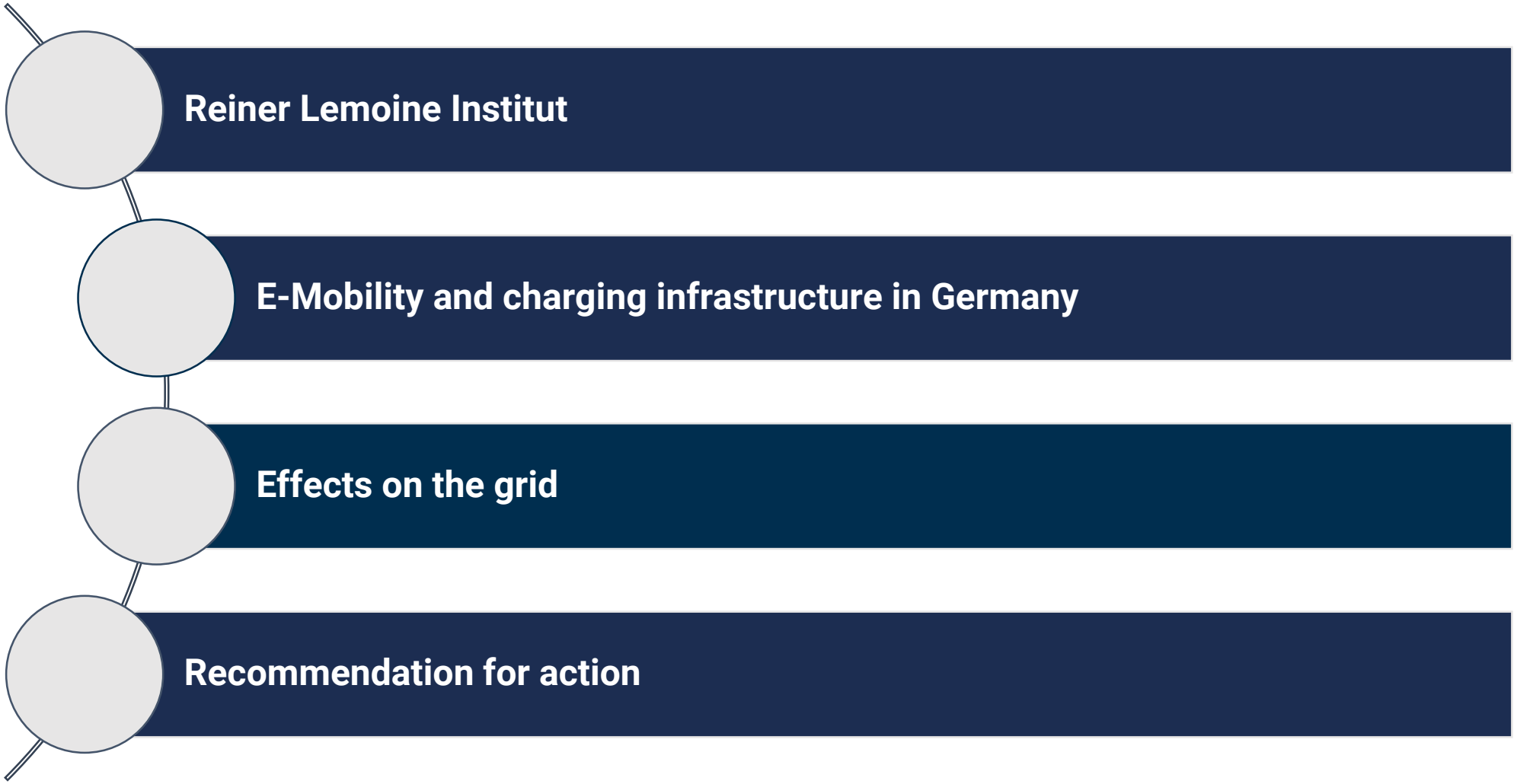
Charging infrastructure and e-mobility in Germany

Jakob Gemassmer

Reiner Lemoine Institut

Kap Verden, 17. November 2020

Agenda


Reiner Lemoine Institut
E-Mobility and charging infrastructure in Germany
Effects on the grid
Recommendation for action

Reiner Lemoine Institut – History

Objective of the RLI
Applied research for 100% renewable energies

Employees:inside
Today over 40 employees, organised in three areas

1978 EE pioneer

1996 Founding of Solon

1999 Founding of Q.CELLS

2006 Founding of RLS

2010 Founding of RLI

2017 Relocation to Adlershof

2018 Founding of LocaLISer RLI GmbH

Areas of business

Mobility with renewable energies

Research and development

- Funding projects
- Commissioned projects
- Open Science

Transformation of energy systems

Advice

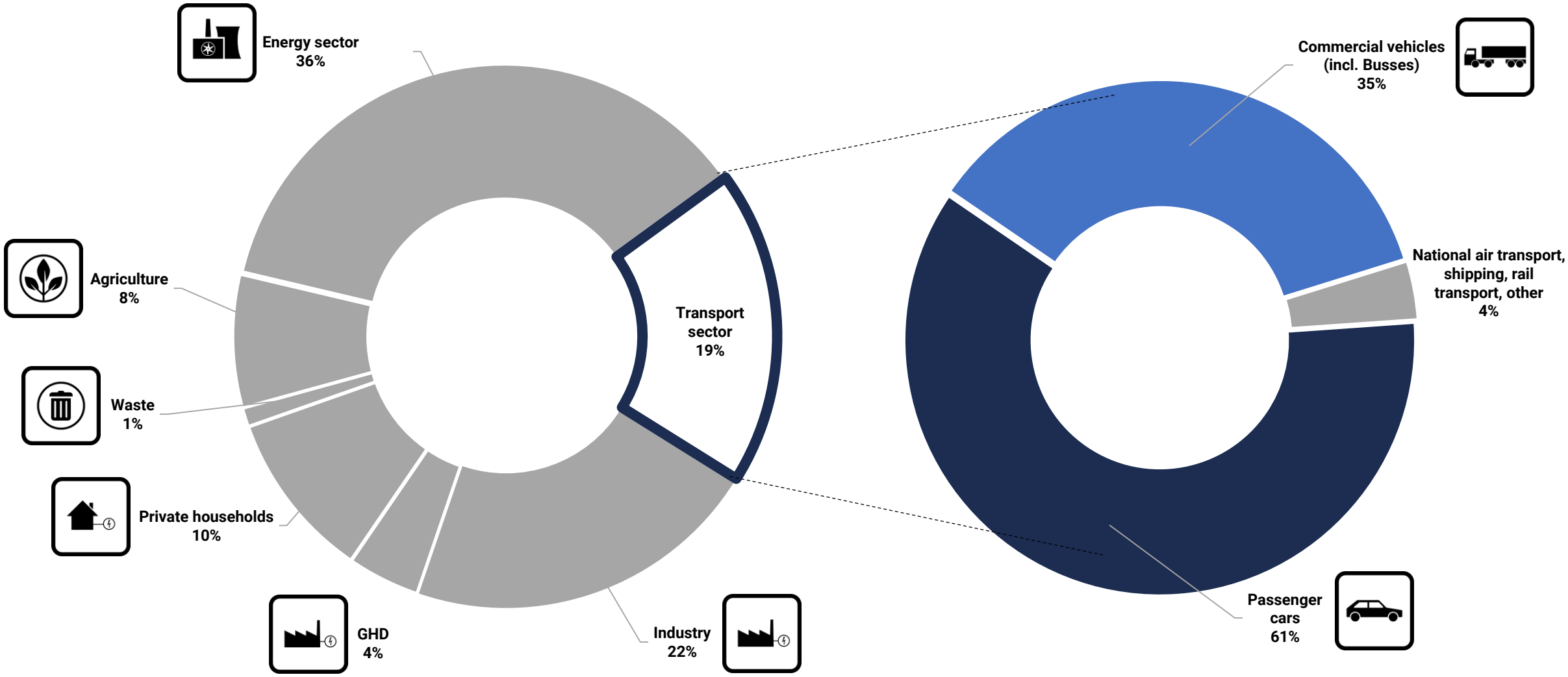
- Feasibility studies
- Workshops
- Corporate Development

Networking

- Membership in associations such as Hypos and eMO Berlin
- Advisory board activities

Off-grid systems

Green house gas emissions in Germany



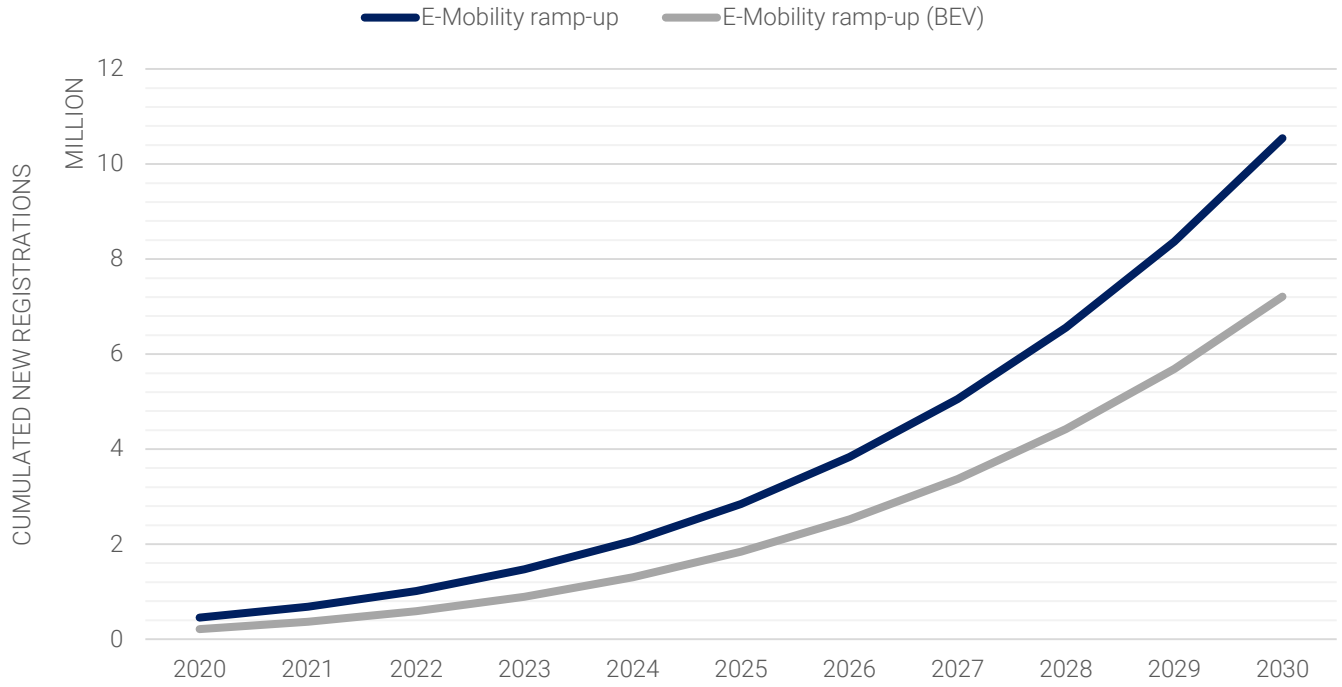
Source: BMU, Klimaschutz in Zahlen 2018/2019

E-Mobility in Germany

Currently:

- ~48 million vehicles (population: 83 million)
- 317.242 electric vehicles (BEV & PHEV) → 0,66 %

Projected stock of electric passenger vehicles up to 2030

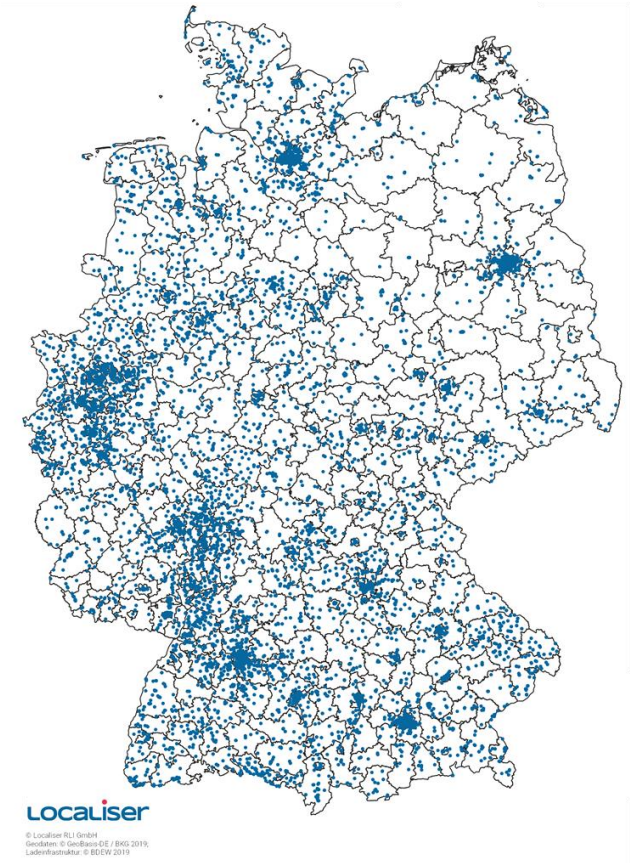


- EU directive AFID recommends a **ratio of electric vehicles to charging points of 10:1** in publicly accessible areas
- Aims for 2030 in publicly accessible areas (10,5 million electric vehicles):
  - Federal Government: **1 million charging points**
  - BDEW comes to the conclusion that **350.000 charging points** will be sufficient

Charging infrastructure in Germany

Currently:

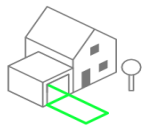
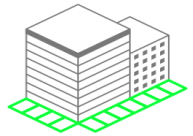
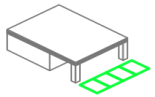
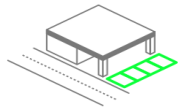
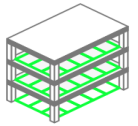
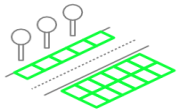
- ~30.000 charging points



- EU directive AFID recommends a **ratio of electric vehicles to charging points of 10:1** in publicly accessible areas
- Aims for 2030 in publicly accessible areas (10,5 million electric vehicles):
  - Federal Government: **1 million charging points**
  - BDEW comes to the conclusion that **350.000 charging points** will be sufficient

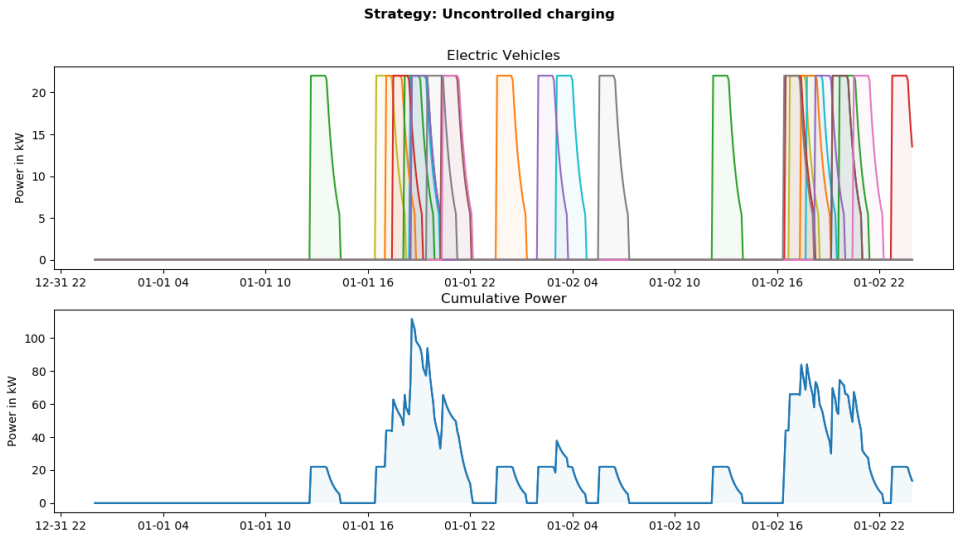
Charging Use Cases

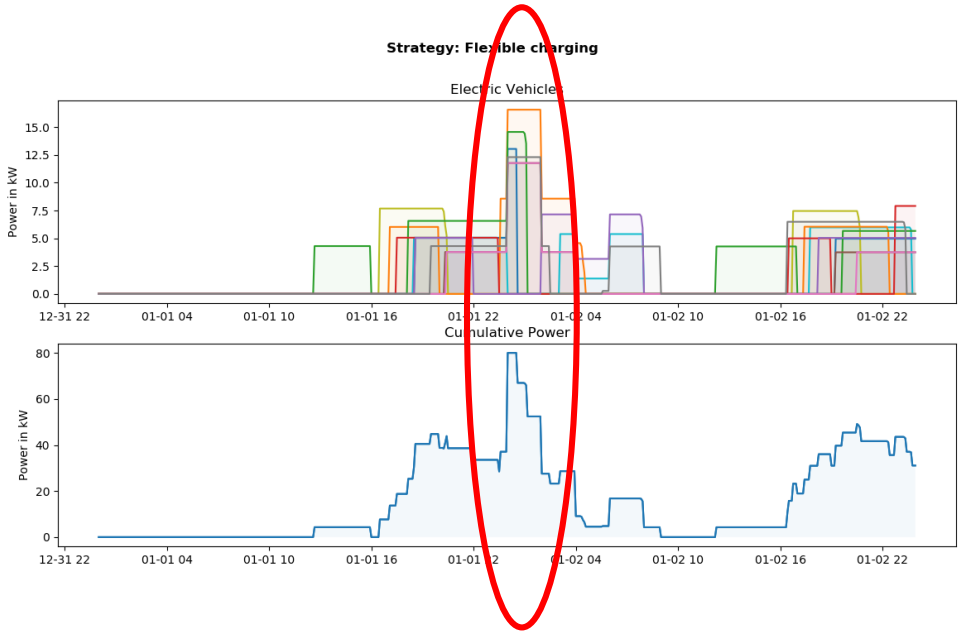
- **Attractiveness of the charging locations** depends on the availability of a private parking space
- High **uncertainty of charging behavior**

Installation location	Private space			Publicly accessible space			
	Charging use case 1	Charging use case 2	Charging use case 3	Charging use case 4	Charging use case 5	Charging use case 6	Charging use case 7
Typical locations for charging infrastructure	 Garage or private parking space at home	 Parking spaces (e.g. underground car park in residential areas, multi-family houses, apartment blocks)	 Company parking on own site	 Charging station/ charging hub in town	 Charging station/ charging hub on road axes (e.g. trunk roads, highways, federal highways)	 Customer parking spaces or multi-storey car parks (e.g. shopping malls)	 Road side, public parking spaces
Typical charging capacity (kW)	2.3 – 11 (AC)	2.3 – 11 (AC)	7.3 – 22 (AC)	Up to 150 (DC)	Up to 350 (DC)	7.3 – 22 (AC) Up to 50 (DC)	7.3 – 22 (AC)
Average standing time	Overnight	Overnight	7 h	10 – 20 minutes	15 – 30 minutes	30 – 90 minutes	< 15 minutes up to 14 h

Effects on the grid – Charging strategies

- Various strategies offer different **flexibility potential**
- Most interesting for grid operators is a **flexible charging strategy**, that takes the **local grid situation** into account

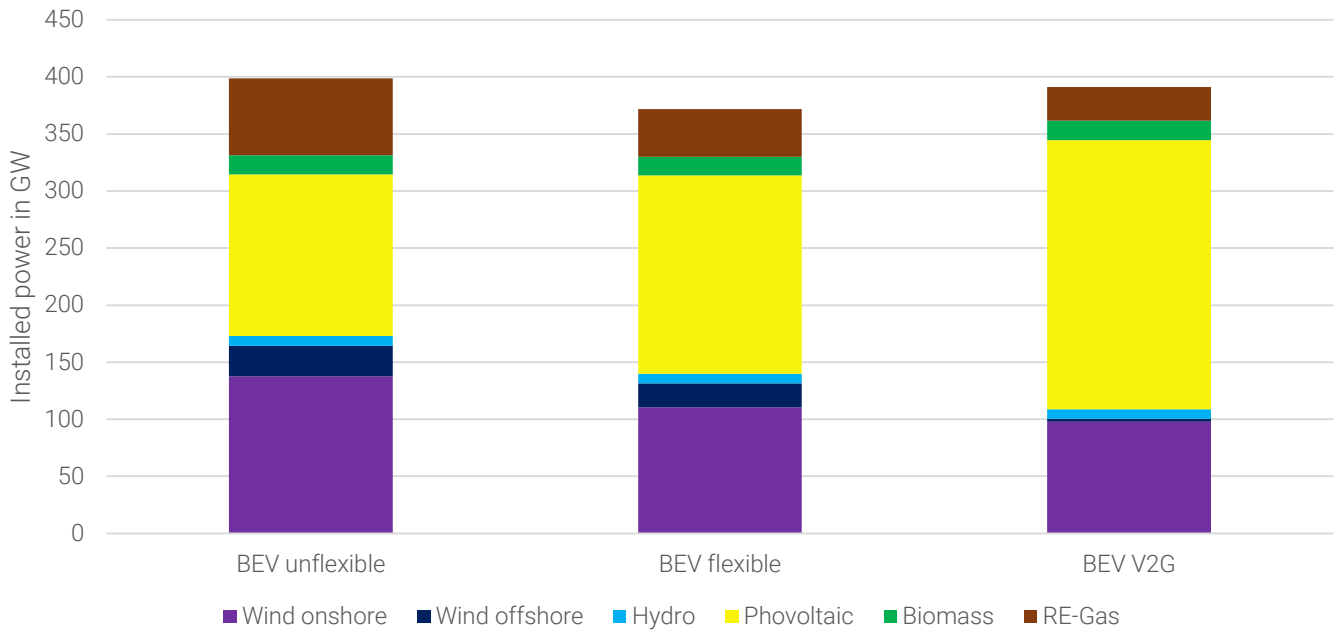




Effects on the grid – Installed Renewables

- New load: **More renewable energies needed** due to vehicle electrification
  - With full electrification of road transport, electricity demand will increase by around 136 TWh

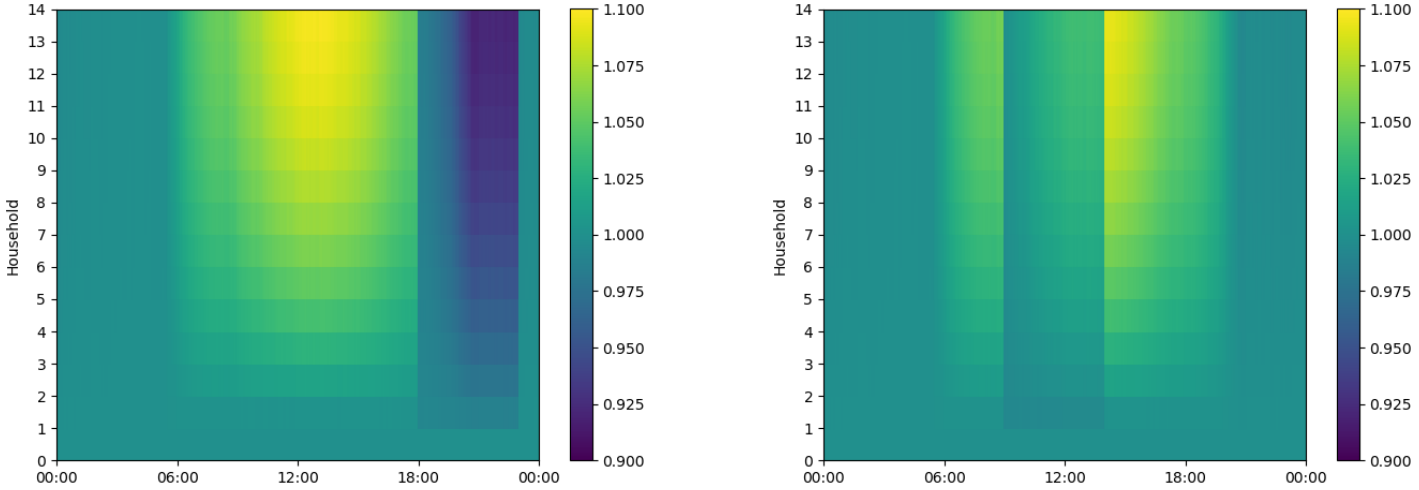
- **High flexibility enables the use of inexpensive technologies** such as photovoltaics
  → Avoidance of expensive technologies such as offshore wind turbines



Effects on the grid – Voltage range

- In Germany the grid is usually oversized
- The **challenge are peak loads**, not the overall additional energy demand

- Mobility ramp-up can lead to **existing operating equipment reaching their capacity limits**
  → e.g. **voltage range deviation**
  → grid-suitable charging can prevent this



Voltage range deviations in a power line with 14 households (1,2-4,5 MWh/a) due to phovoltaic systems (18 kW) and electric vehicles charging with 11 kW. Left: charging at midday, right: charging in the evening

Recommendations for action

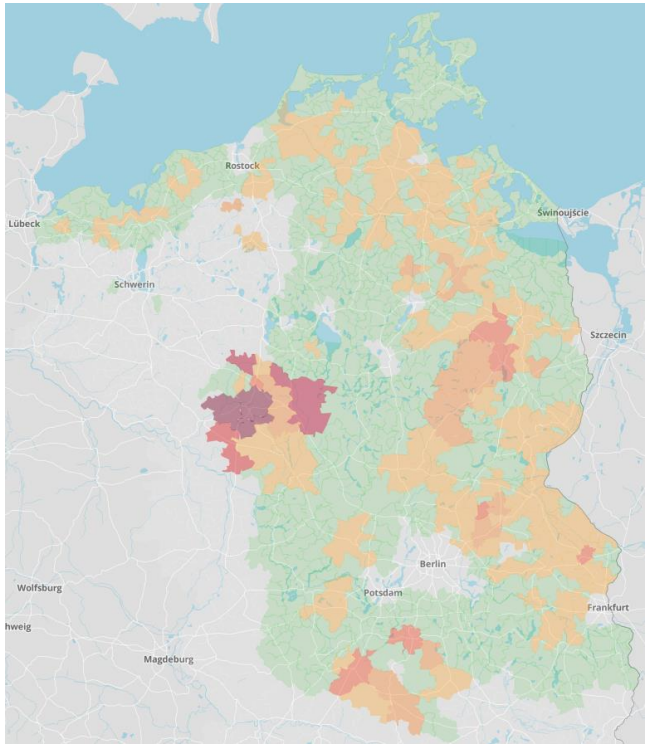
- Local research to know about mobility behaviour and the e-mobility ramp-up

- Establish demand side management
- Digitalisation

- Financial incentives
  - Encourage grid-suitable behavior
  - Dynamic grid fees

- Include e-mobility ramp-up in long-term grid planning

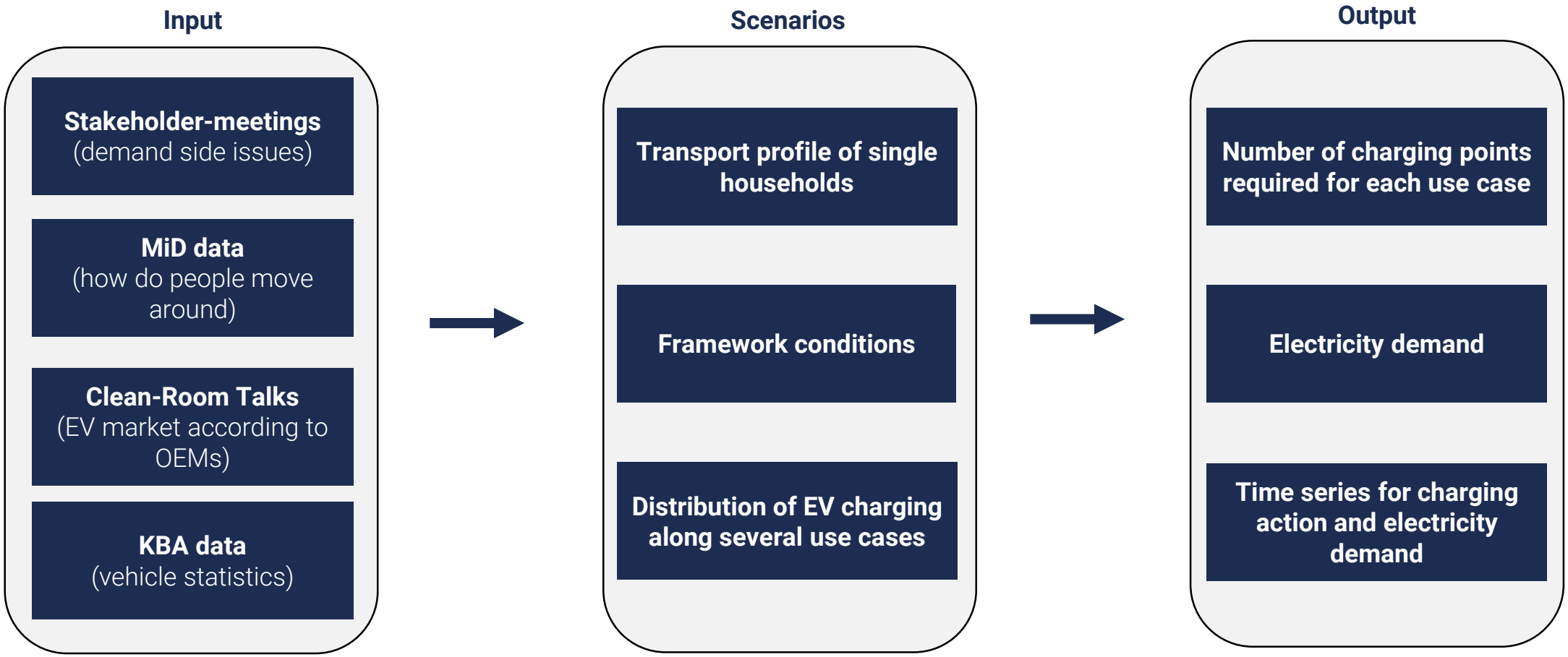
→ **Synchronisation of generation and load**



https://netzampel.energy

New study on future charging infrastructure in Germany

- Bottom-up study, funded by NOW (National Organization for e-mobility, linked to Transportation Ministry)



Thank you for your attention!

M.Sc.
Jakob Gemassmer

Scientific Reseacher
Reiner Lemoine Institut gGmbH
Rudower Chaussee 12 D
12489 Berlin

+49 (0)30 1208 434 85
jakob.gemassmer@rl-institut.de
@JGemassmer, @RL_Institut
www.reiner-lemoine-institut.de