

HIER STEHT EINE KOPFZEILE

Energy Transition in Germany

Dr. Severin Beucker
November 19, 2025



BORDERSTEP INSTITUT
für Innovation und Nachhaltigkeit

18.11.2025

Energy Transition: Efficiency, Renewables, Sector Coupling

1 Increasing
energy efficiency



© Zbynek Burival - unsplash

2 Increasing
renewable capacity



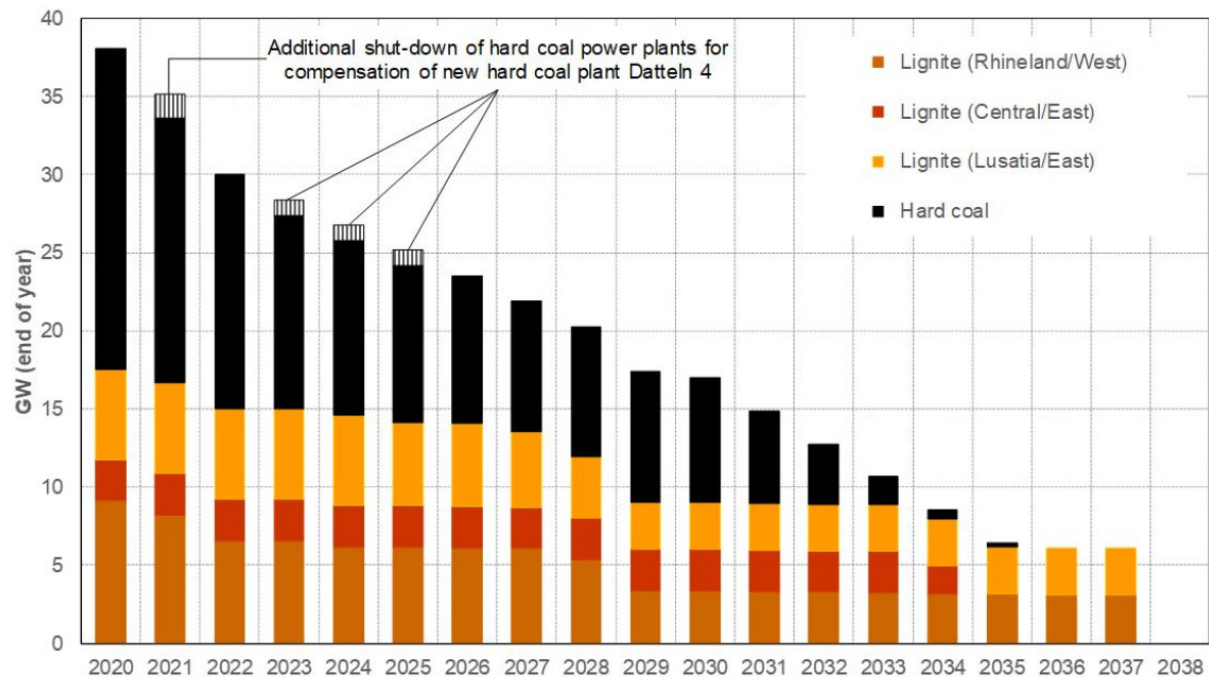
© Fabian - Adobe Stock

3 Sector coupling
electrification and
green hydrogen



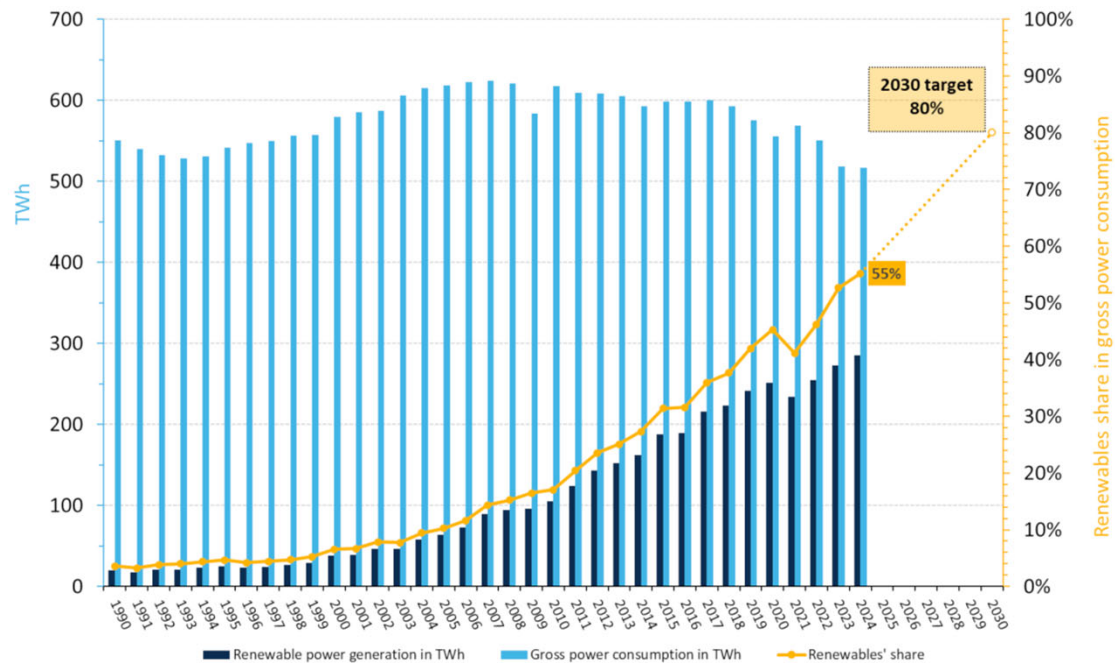
© PhotoGranary - Adobe Stock

Phase Out of Coal (and Nuclear)



Source: Felix Chr. Matthes/Öko-Institut

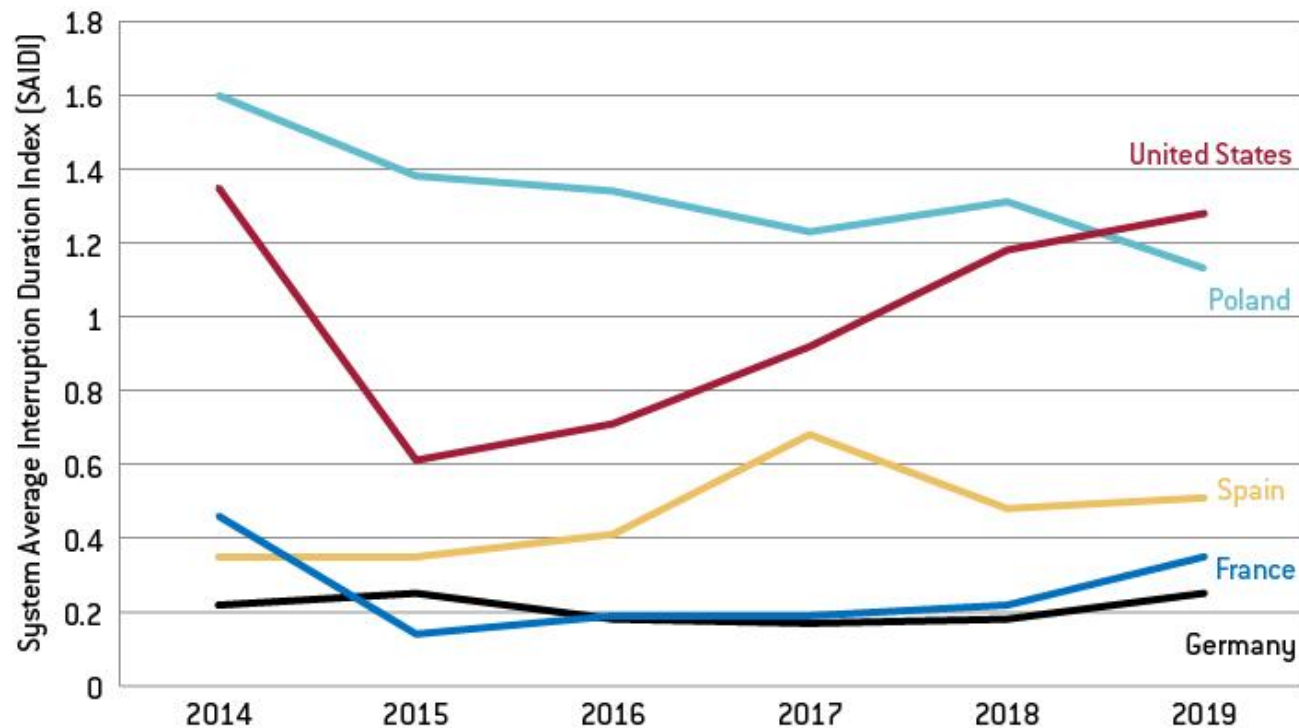
Share of Renewables in Gross Electricity Consumption



© BY SA 4.0

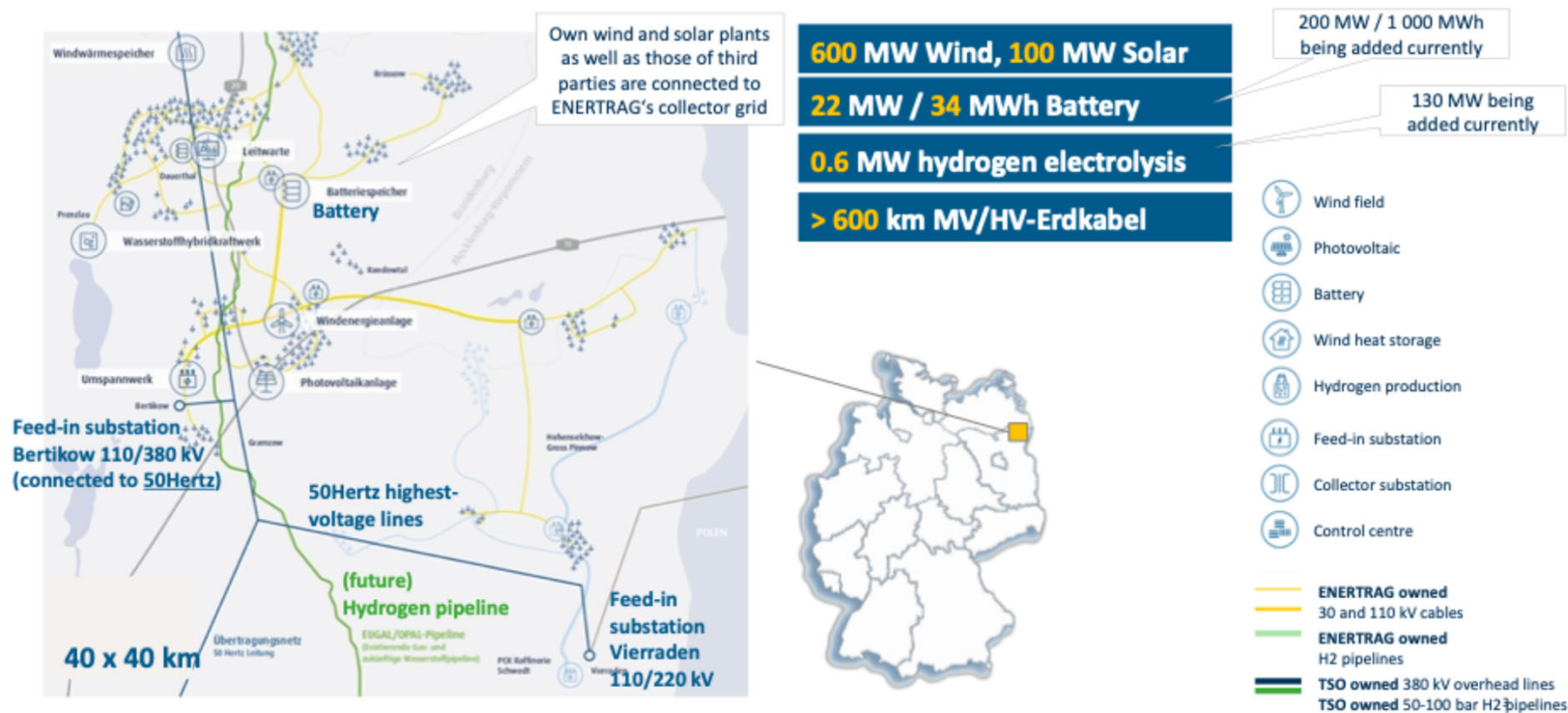
Source: Clean Energy Wire (2025)

Power Outages/ Year Based on SAIDI Index



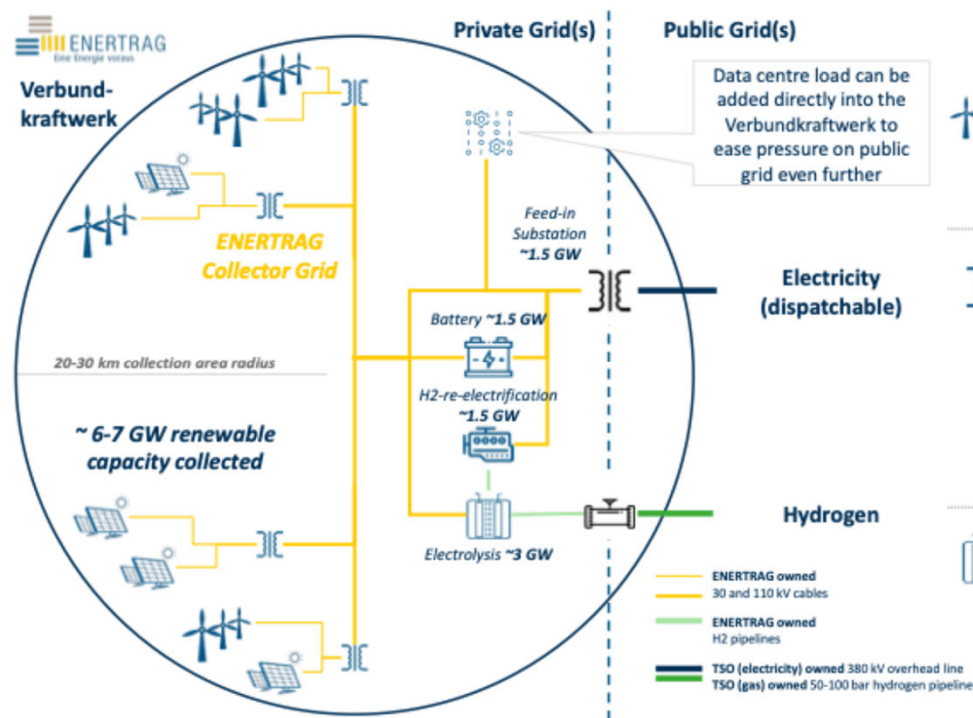
Source: Bruegel based on World Bank. Note: SAIDI is a reliability index measuring the average total duration of outages (in hours) experienced by a consumer in a year. SAIDI of 1 should be interpreted as an average of one hour of electricity outage across an entire year. A lower score indicates greater reliability.

Micro and Collector Grids for the Transition



Source: Enertrag, Bischof-Niemz (2025)

Combined Hydrogen and Electricity Production



Lower Grid Costs and Faster Deployment

In such an integrated power plant architecture, **> 12 GW of plant capacity** (wind, solar, battery, electrolysis, H2 re-electrification) require only 1.5 GW of TSO electrical grid connection capacity

Electricity on Demand: 10 TWh/a

Battery & hydrogen re-electrification combination supplies reliable, dispatchable electricity, even during periods of prolonged 'dark doldrums'

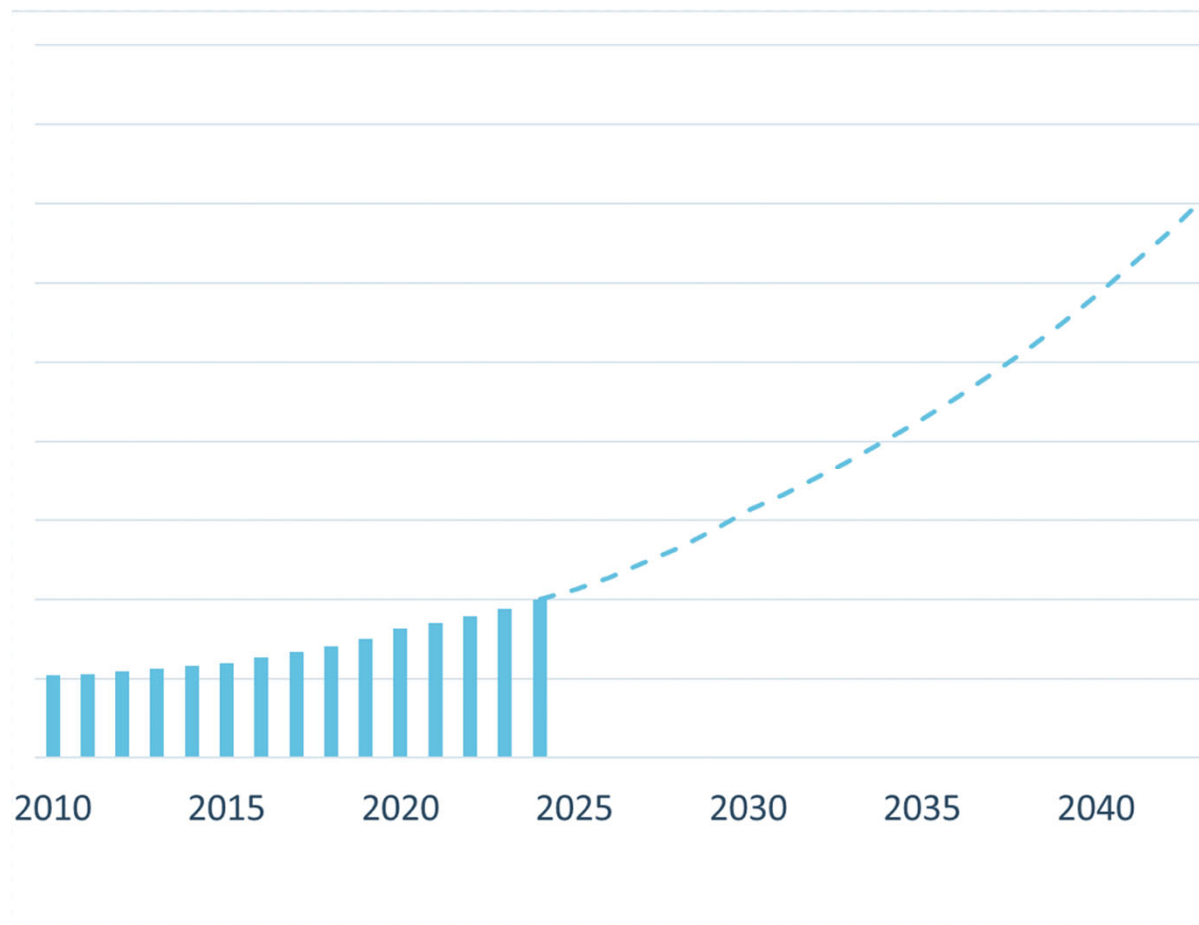
- When too much primary electricity is generated, it gets stored in batteries and H2
- When too little primary electricity is generated, batteries discharge & hydrogen is re-electrified

Competitive Domestic Hydrogen: 200 kt/a

3 GW Electrolysis are powered with surplus wind and solar electricity and hence produce competitively priced **200 kt/a green hydrogen** for feed-in into the German hydrogen core pipeline grid

4

Source: Enertrag, Bischof-Niemz (2025)



Power Demand of Data Centers in Germany

- ▶ Development of the electricity needs of data centers and smaller IT installations in Germany in the years 2010 through 2024, and long-term prediction through 2045
- ▶ Demand scenarios indicate a strong increase in energy consumption
- ▶ Useable waste heat will increase by 10 TWh until 2045

Grid Integration and Heat Reuse from Data Centers

- ▶ Data center boom: rising number of centers, sites, and power demand create challenges for grid integration
- ▶ Data centers compete with compounds of energy transition (large batteries, electrolyzers, industrial sites, etc.)

Nevertheless, data centers can be part of the solution by:

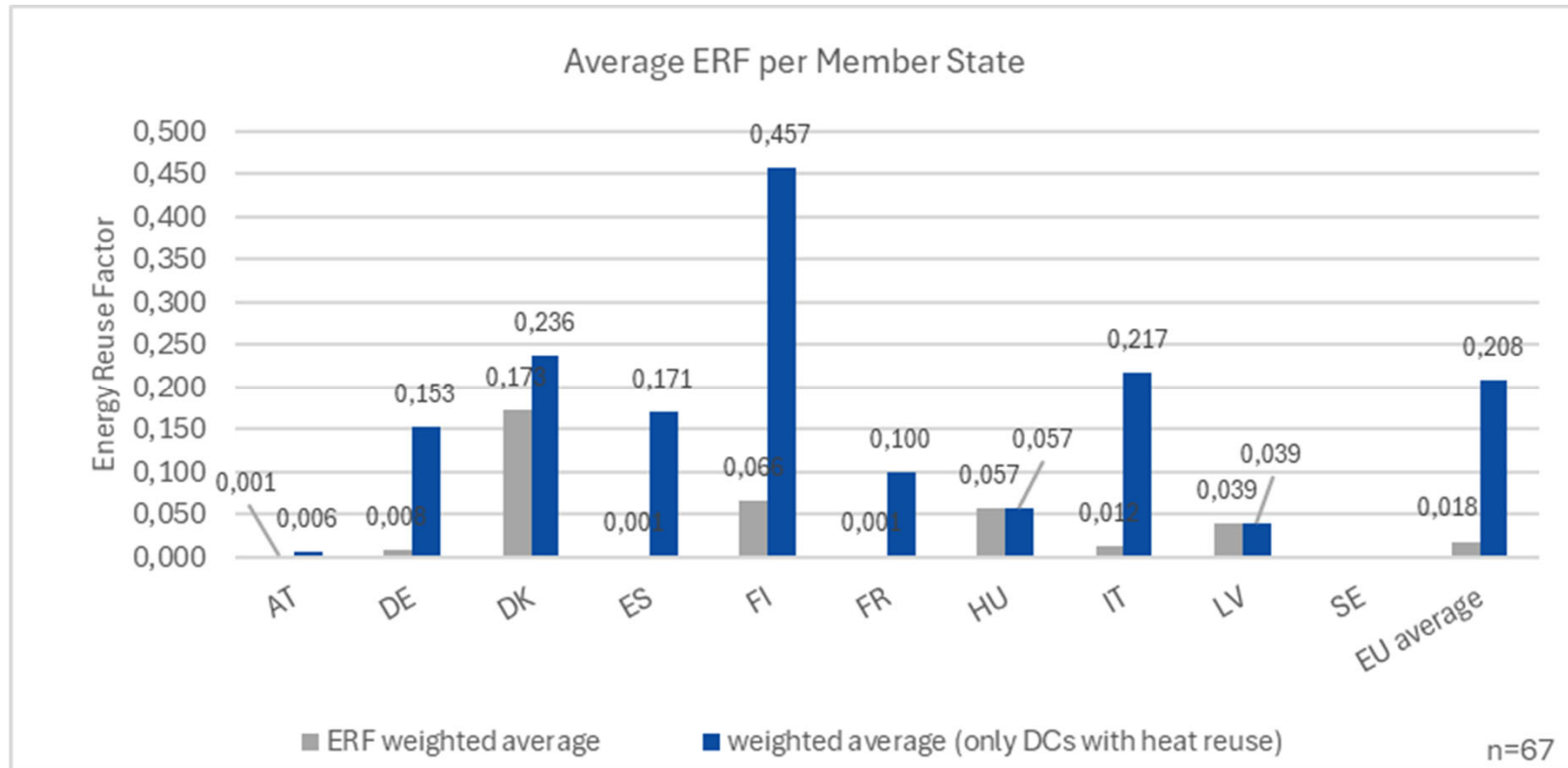
- ▶ Sharing connection to the (transmission) grid with other users
- ▶ Providing flexibility (e.g., from load management, supply/backup systems, batteries)
- ▶ Onsite power generation

Source: IER (2025) www.ier.uni-stuttgart.de/dokumente/nachhaltige_rechenzentren/2020-06_Nachhaltige-Rechenzentren_Leitfaden_BF.pdf



BORDERSTEP INSTITUT
für Innovation und Nachhaltigkeit

Potential Waste Heat Utilization EU



Source: Borderstep (2024)

Thank you!

Dr. Severin Beucker

M beucker@borderstep.de

W www.borderstep.de



BORDERSTEP INSTITUT
für Innovation und Nachhaltigkeit