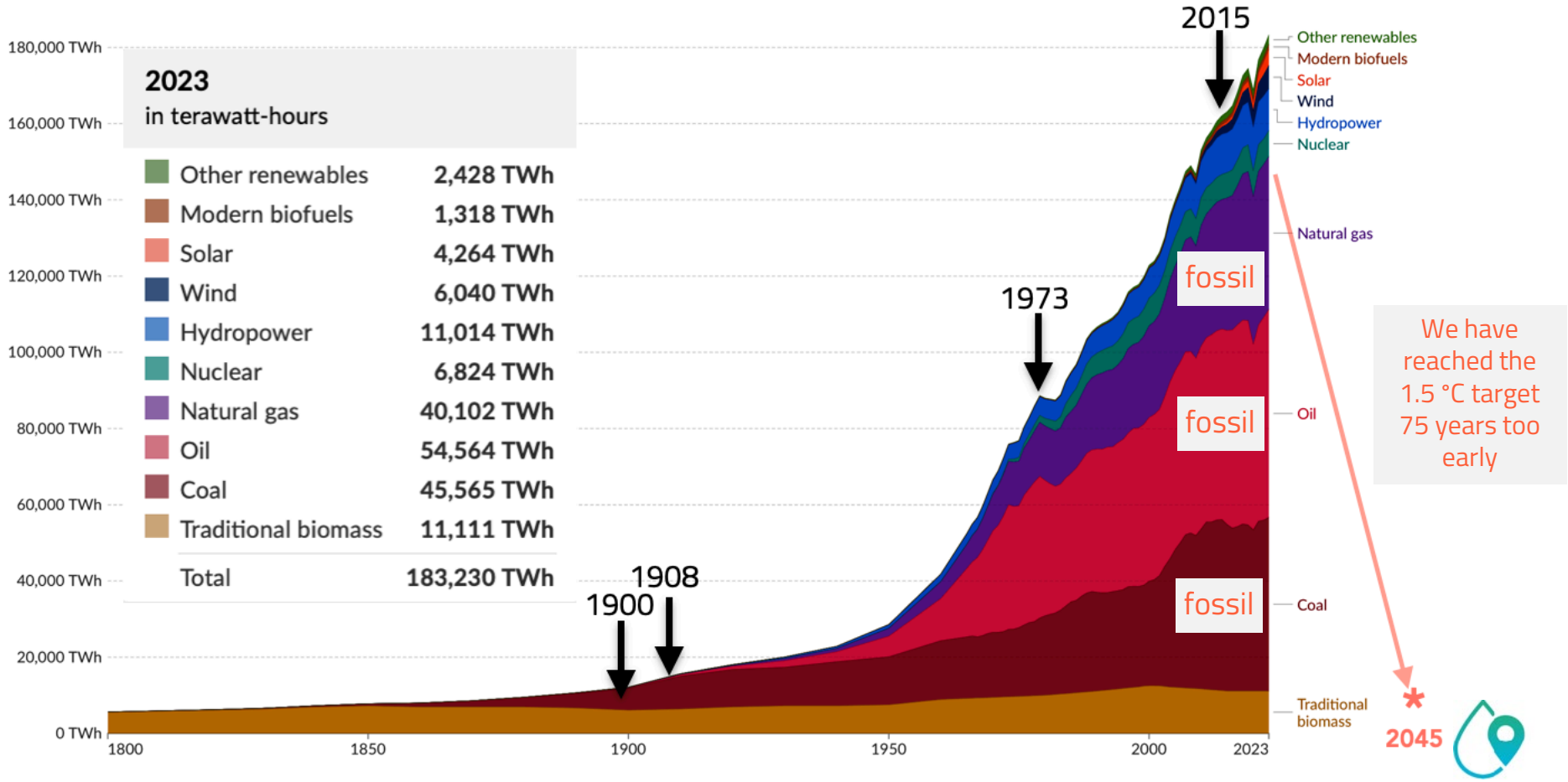
Energy Transition in Transportation

Clean power comes out of the grid at any time and as much as we need – right?

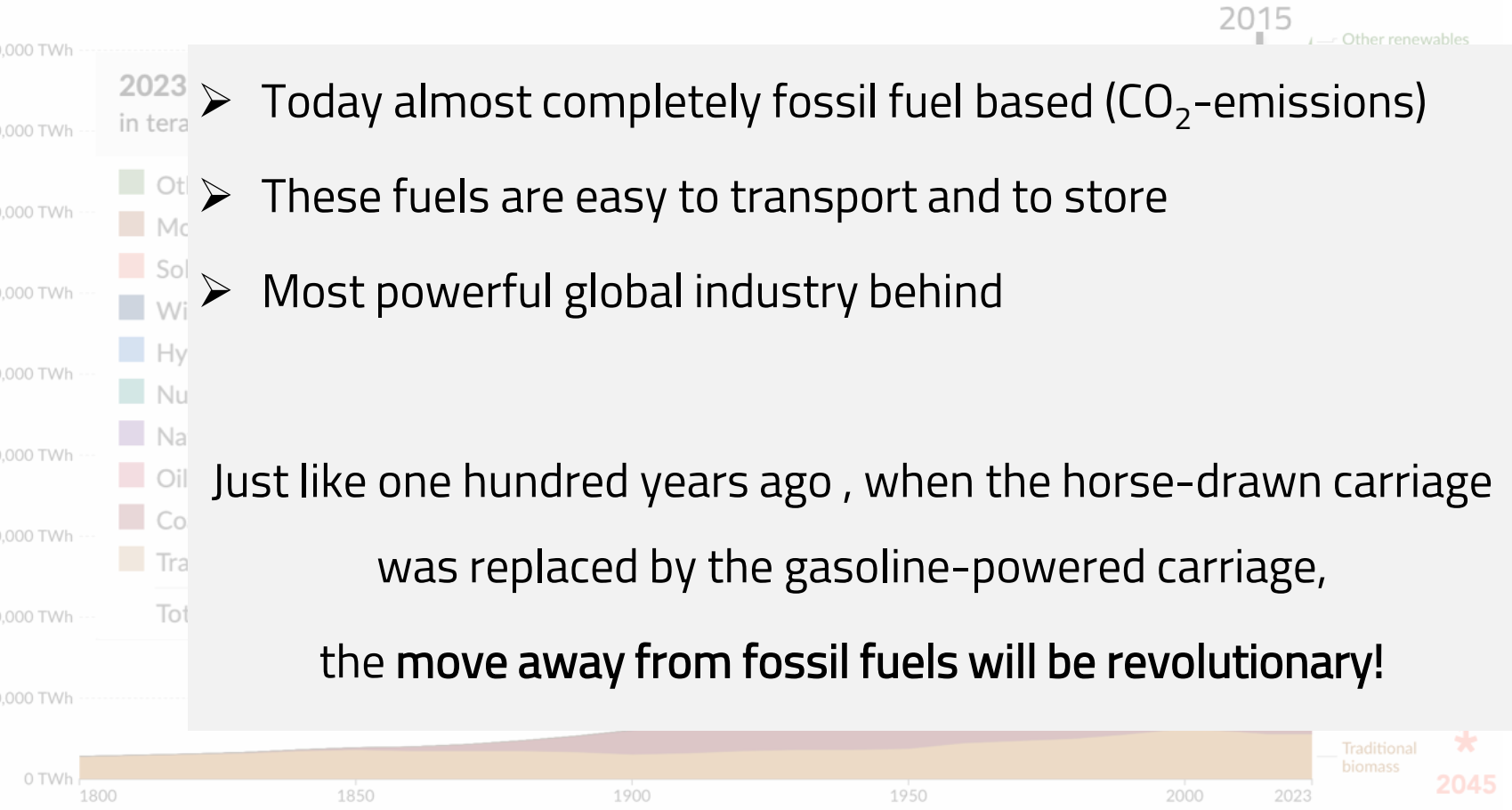
46. Internationales Wiener Motorensymposium 2025
15.Mai 2025

Werner Tillmetz & Eberhard Jacob

Global Primary Energy Consumption



Energy for Transportation



- Today almost completely fossil fuel based (CO_2-emissions)
- These fuels are easy to transport and to store
- Most powerful global industry behind

Just like one hundred years ago , when the horse-drawn carriage was replaced by the gasoline-powered carriage,

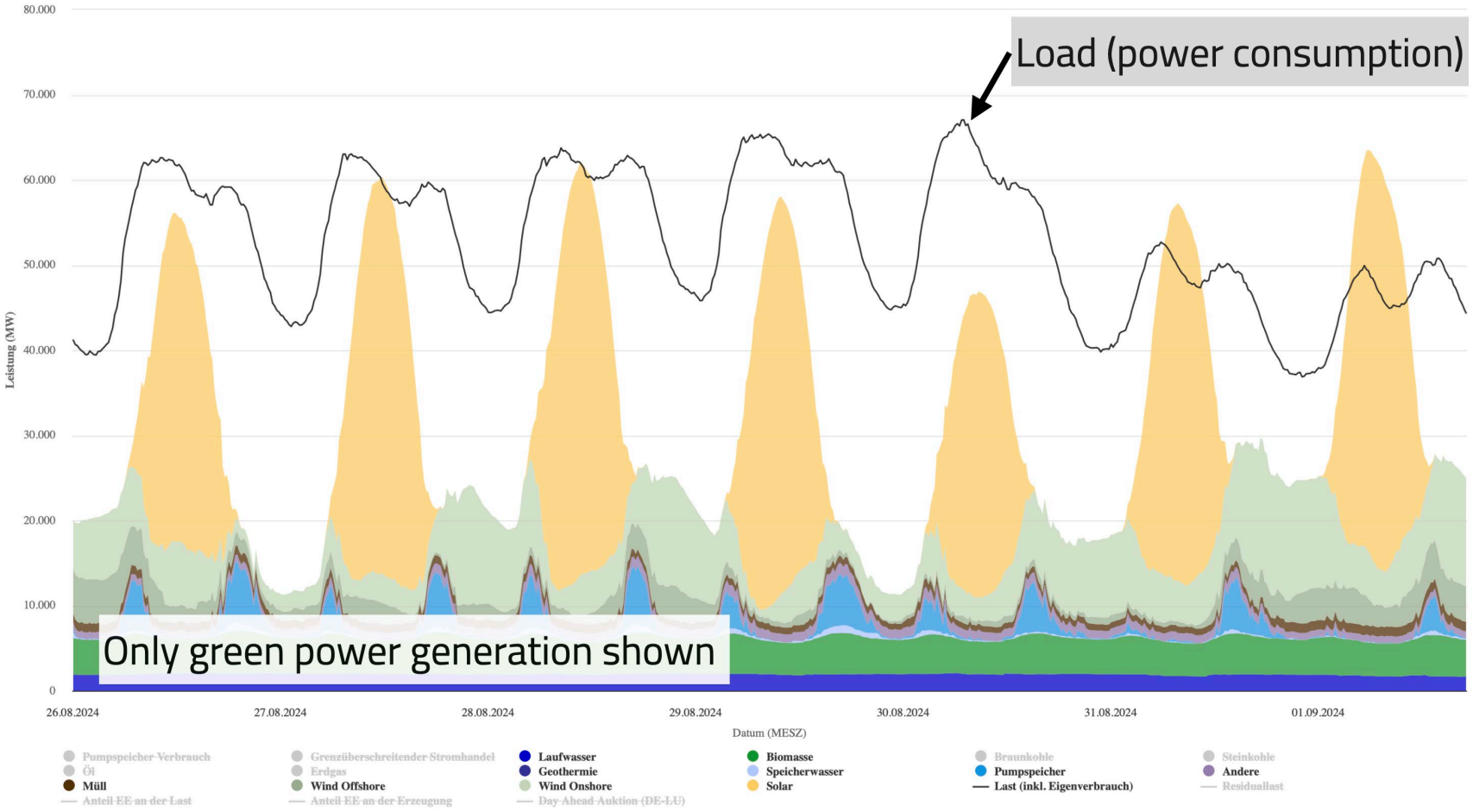
the **move away from fossil fuels will be revolutionary!**

Energy Transition for Transportation

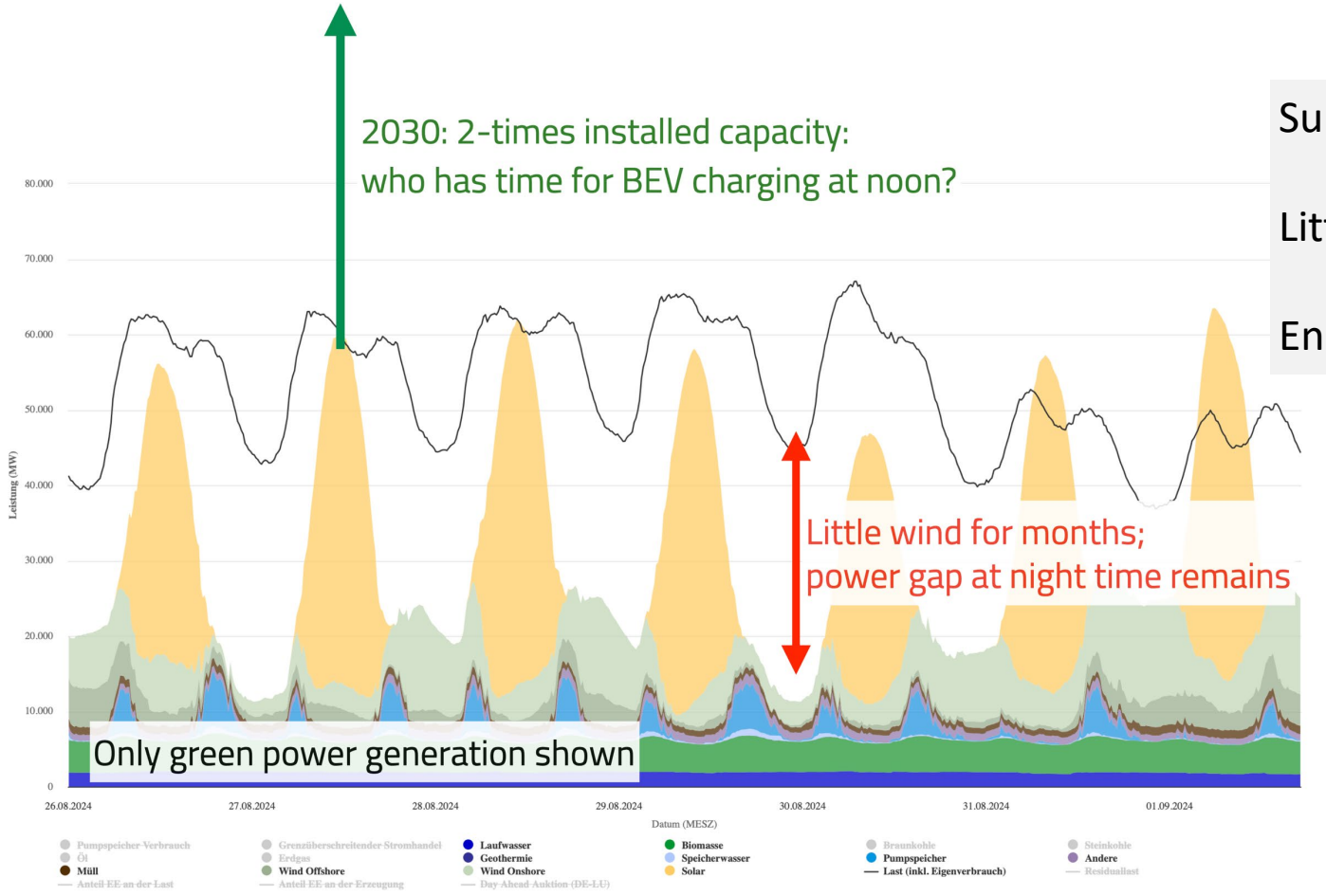
The energy system of the future will based on solar & wind power.

What does this mean for our energy supply?

Availability of Green Electricity (Germany, Summer 2024)



Availability of Green Electricity (Germany Summer 2030)

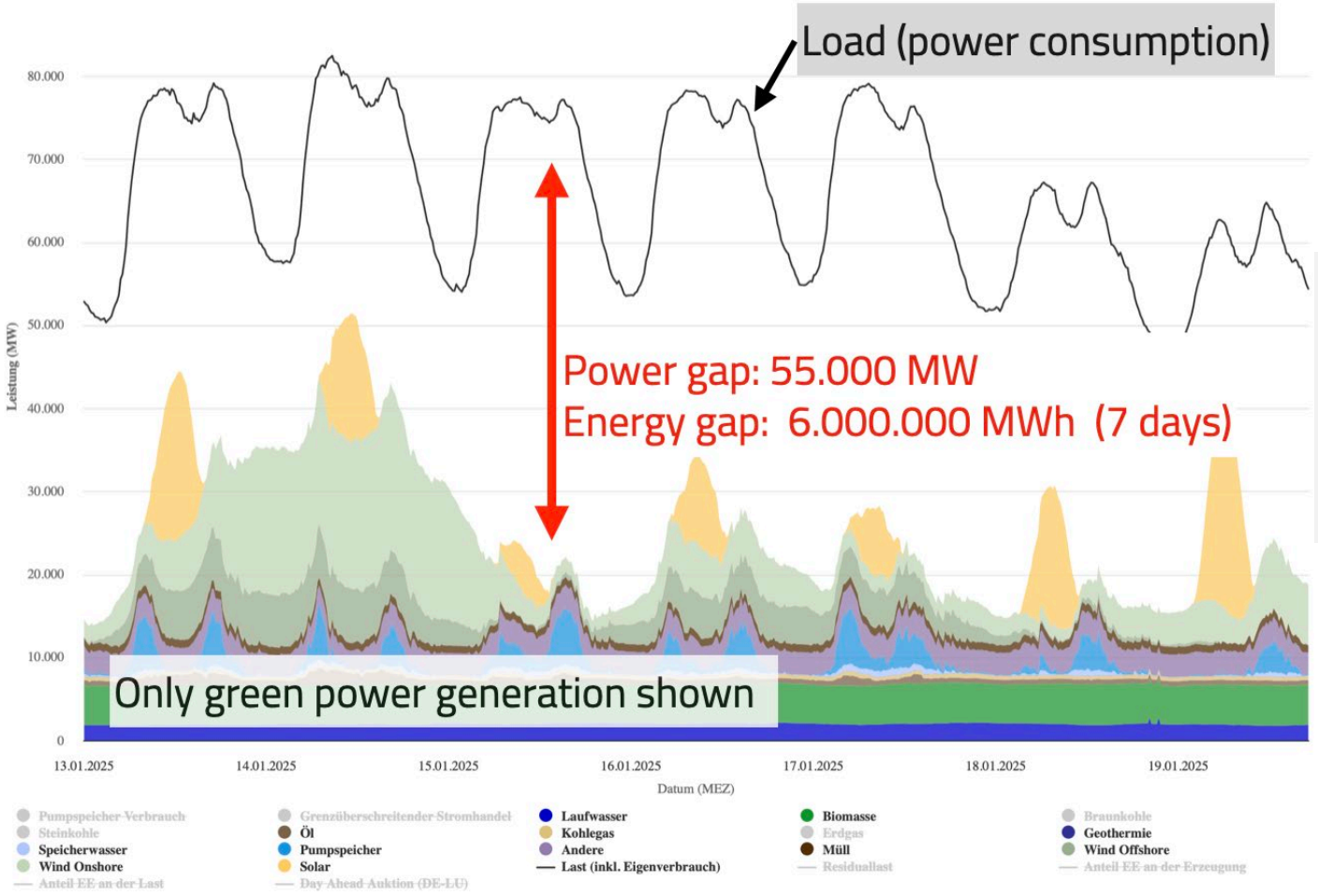


Surplus sun power

Little wind power

Energy storage needed

Availability of Green Electricity (Winter, CW 3/25)

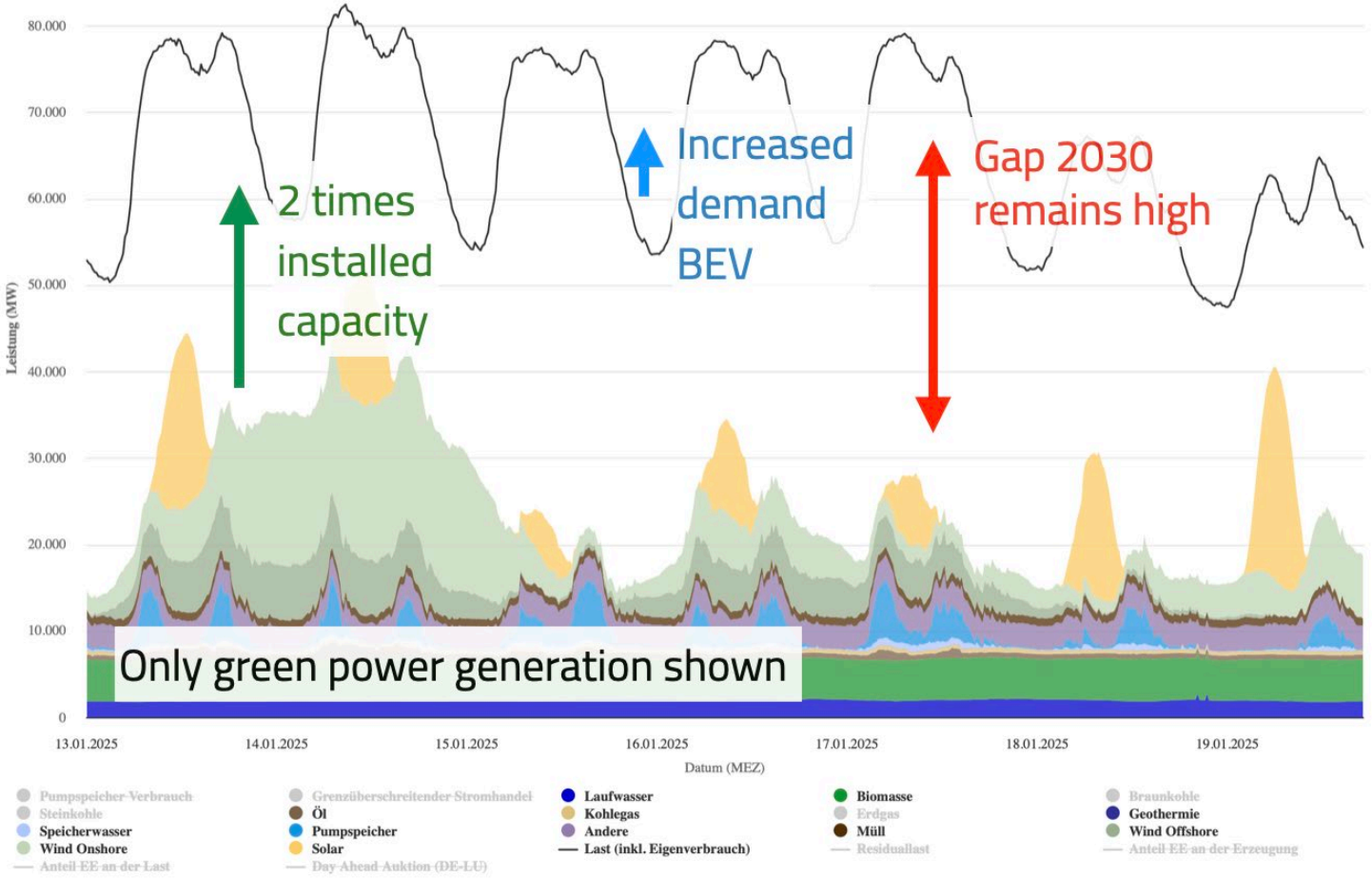


No wind

No sun

No power

Availability of Green Electricity (Winter 2030)



some wind
and
little sun
for months

Import of Energy

- Huge areas along **remote coast lines** & in the **sunbelt** can harvest solar and wind power at very **low cost** & no local electricity demand
  → many times of today`s global energy demand available
- Energy transport as **Hydrogen** via existing **gas grid** (including storage),
- or as **e-fuels** shipped by vessels, trucks, railroad – **existing fuelling infrastructure**
- Costs below **10 cent/kWh** (hydrogen & e-fuel) feasable

Winter
in Germany
←
in Namibia
→

Is the „BEV-only“ Strategy Realistic?

Today`s share of BEVs in the vehicle fleet (%):

	EU	D	A
Car	1,8	2,9	3
LDV	1,1	2,4	1,9
HDV	0,1	0,3	0,3
Bus	2,5	3,1	2,3

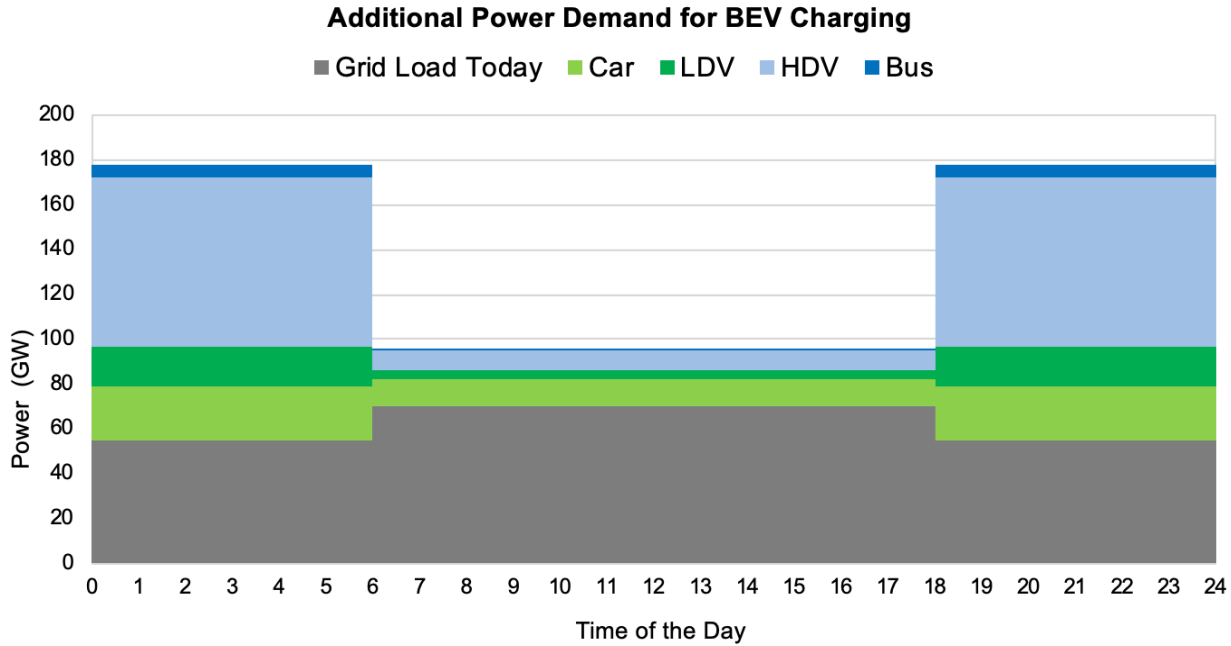
These numbers determine:

CO_2-emission level, costs for **infrastructure** & **green power demand.**

Which technologies will participate in the future market?

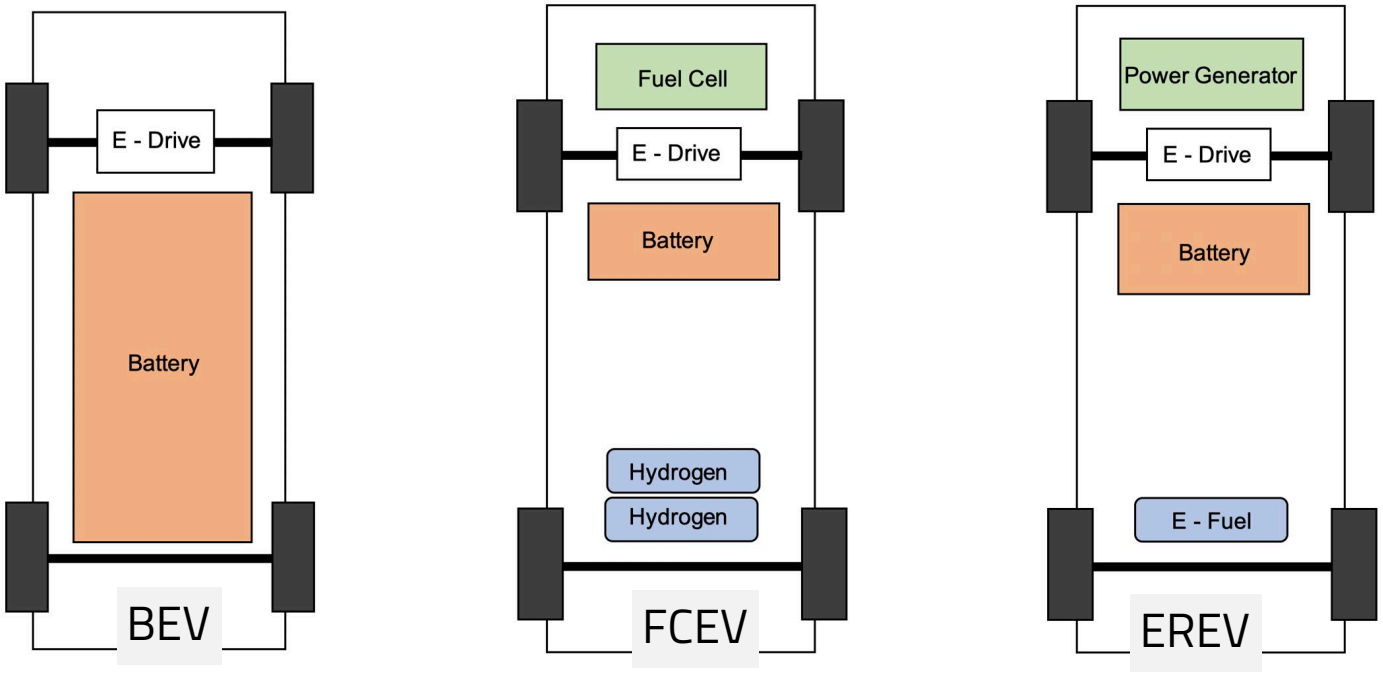
Power Demand for „BEV-only“ Strategy

A rough estimation on the power demand for 100% BEV in Germany



120+ GW of additional power needed for charging – infrastructure & renewable power generation would be **unaffordable!**

The Variety of Electric Drives



These are **all attractive solutions** in different applications.

The **availability** of **CO_2-free electricity**, **hydrogen** or **e-fuels** resp., is **the rate determinig step** for climate protection

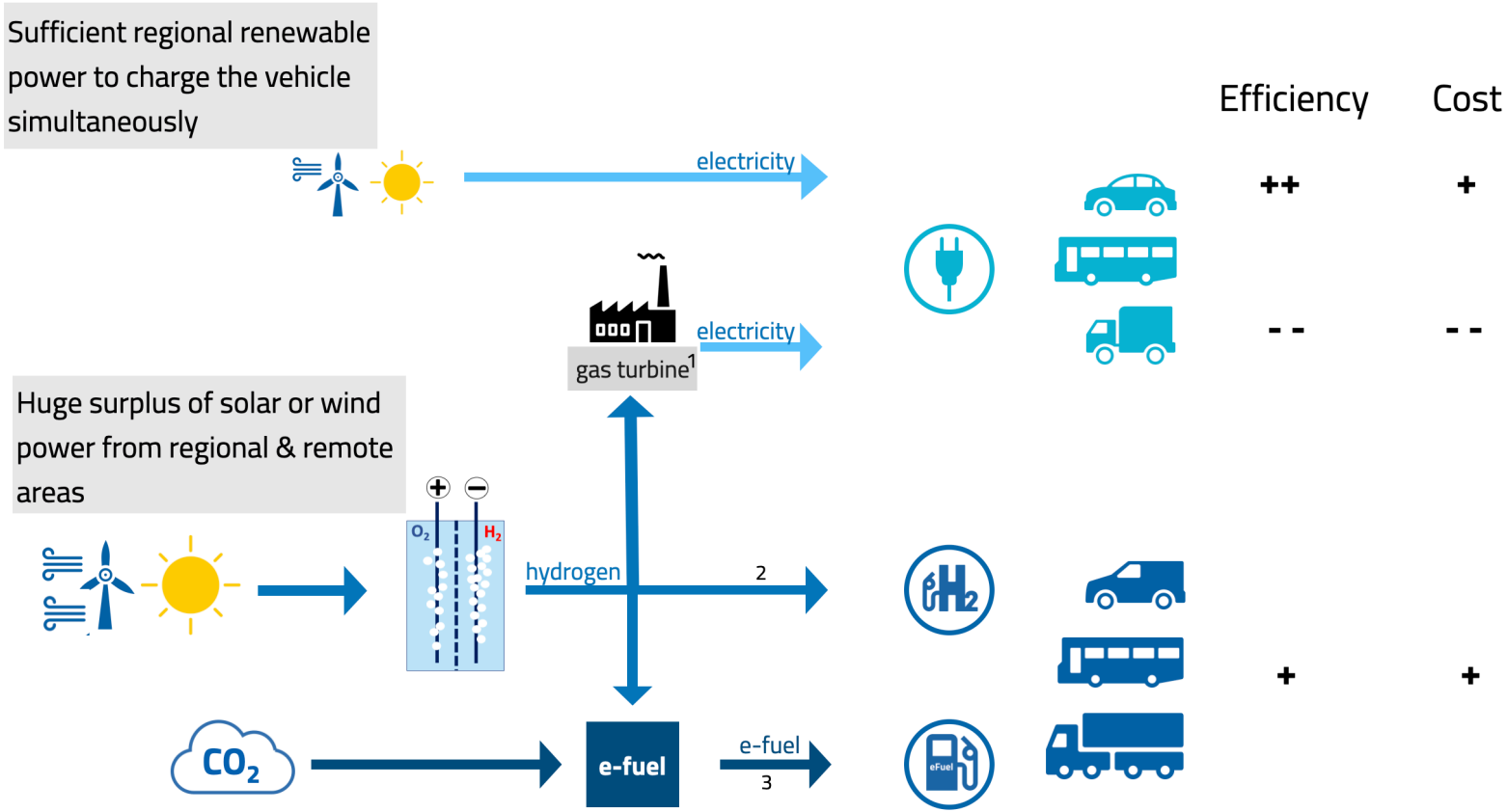
E-Fuels at a Glance

- Attractive for efficient **EREV:** low fuel consumption & simple exhaust treatment
- **Methanol** as platform chemical → easy to produce & many applications
- Today > 100 Mt/a (fossil based) → established global infrastructure
- **e-Methanol**: green Hydrogen + CO_2 from various sources:

$$CO_2 + 3\,H_2 \rightleftharpoons CH_3OH + H_2O$$

- Methanol as **maritime fuel**: approved & **huge off-taker** (dual fuel strategy)
- **Direct use** in **CI engines** with $OME_{3\text{-}5}$ as pilot fuel & **SI engines** → simple ET
- Most environment friendly: e-DMC/MF, $OME_{3\text{-}5}$
- **Drop-in fuels:** e-Gasoline, e-Kerosene, e-Diesel (via MtO or FT process)

Today`s Misleading Efficiency Discussion vs. Real World



1 Efficiency Open Cycle Gas Turbine: 40%

2 Hydrogen transport via pipeline or trucks from regional production

3 Use existing infrastructure (vessel, truck, train, fueling station…) & extended range e-vehicle (EREV)

Today`s Misleading Efficiency Discussion vs. Real World

- **Limited availability of green power** for direct (simultaneous) **BEV-charging**
- Cheap, green **surplus power** from regional and remote areas:

  store and transport as hydrogen & e-fuel
- **Electricity from gas turbines**:

  at least **3-times more expensive** than gas (hydrogen)

1 Efficiency Open Cycle Gas Turbine: 40%
2 Hydrogen transport via pipeline or trucks from regional production
3 Use existing infrastructure (vessel, truck, train, fueling station…) & extended range e-vehicle (EREV)

Energy Transition in Transportation

- The **availability** of sufficient **green energy** (electricity, hydrogen, e-fuel) at any time is the **rate determining step** of the transition

- A **holistic strategy** across the entire value chain (from fuel, infrastructure to vehicles) is **mandatory for success**

Thank You for Your Attention