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Deutsche Energie-Agentur

Integrierte Energiewende

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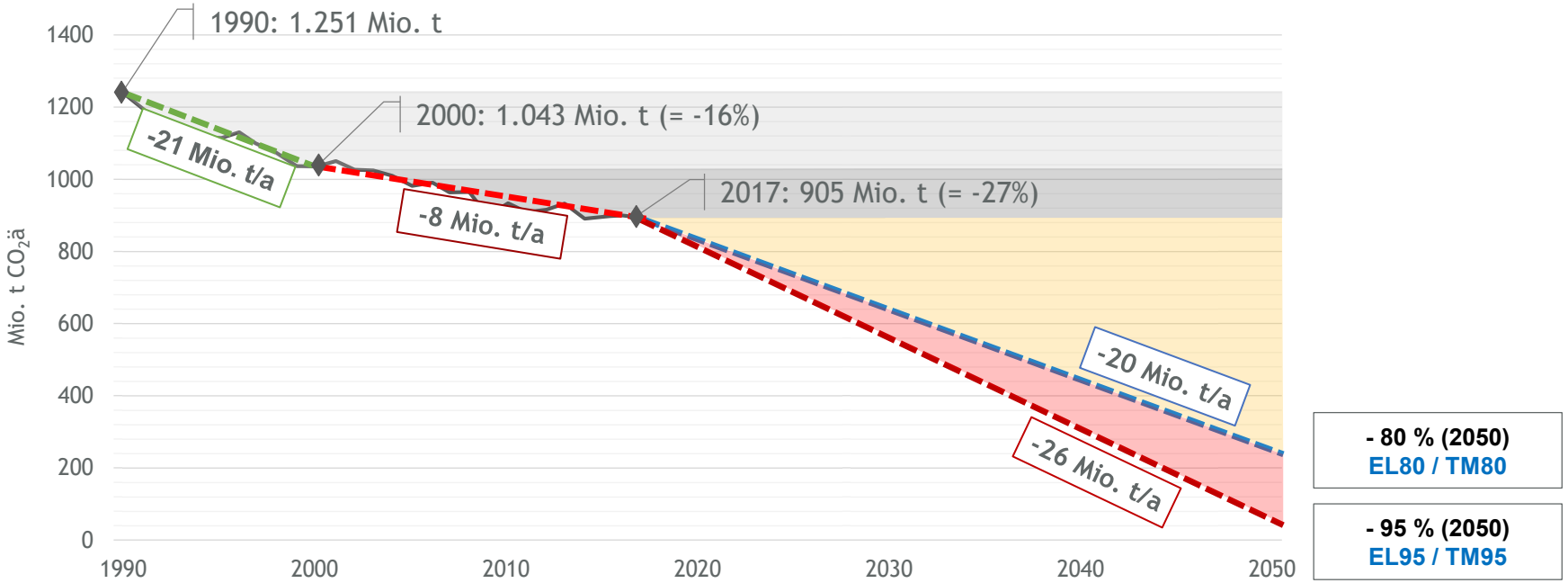
DENA STUDY
INTEGRATED ENERGY TRANSITION

Brussels, October 16th 2018

THE CHALLENGE OF CLIMATE PROTECTION

Development of greenhouse gas emissions in Germany



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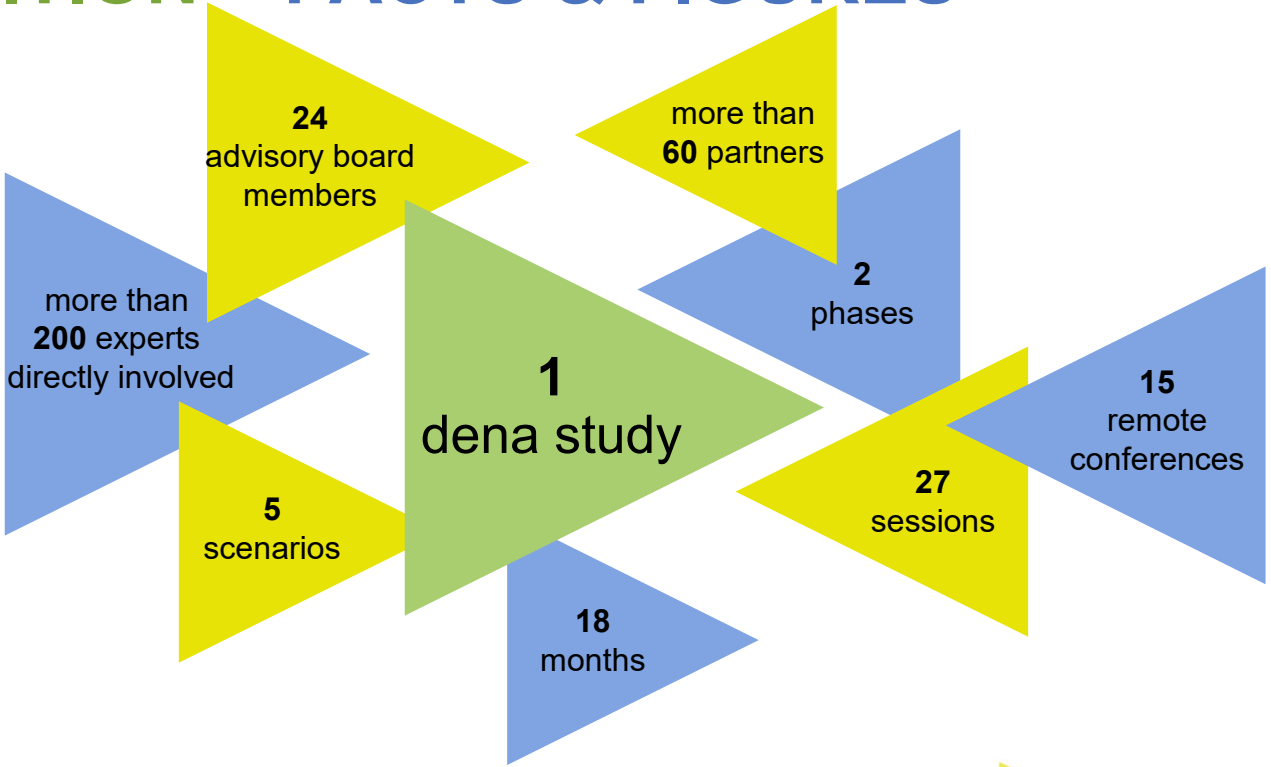
THE DENA STUDY INTEGRATED ENERGY TRANSITION – FACTS & FIGURES



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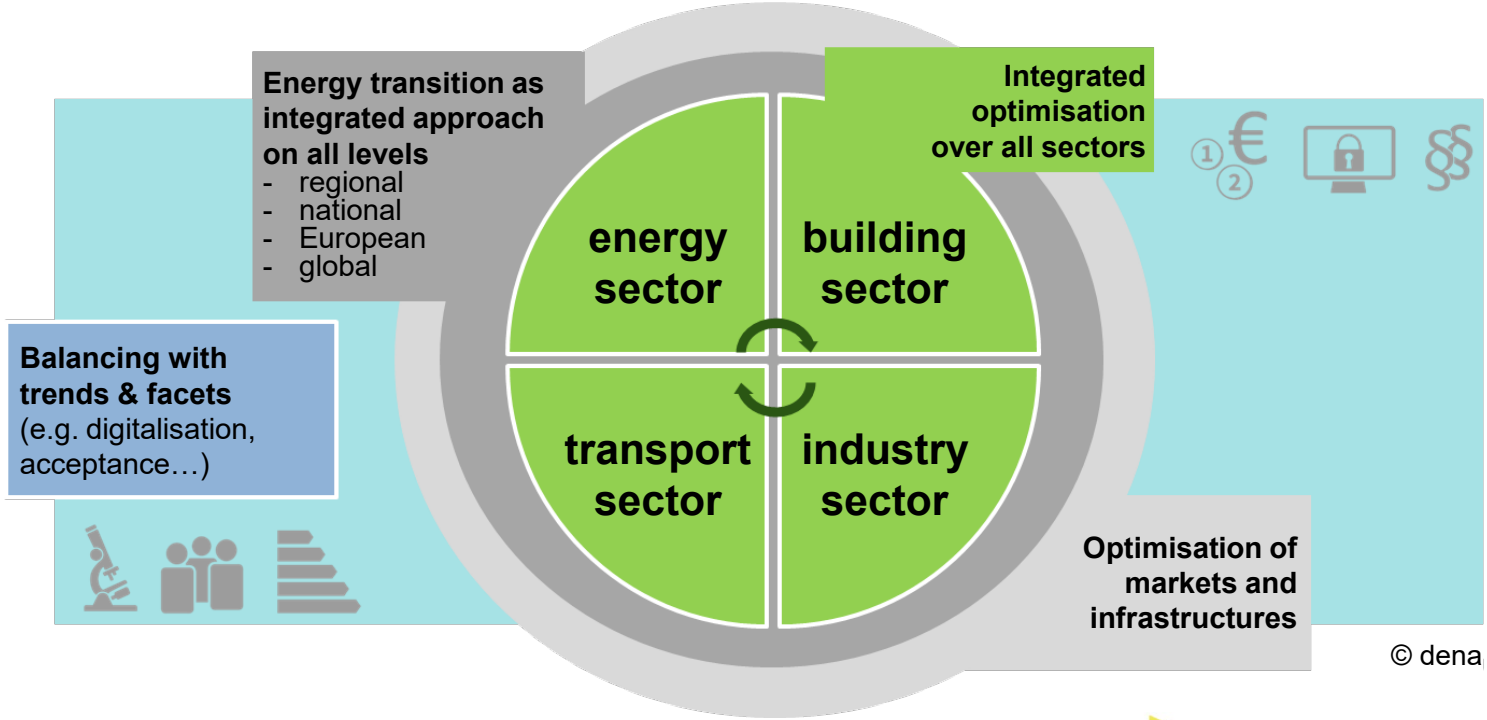
THE INTEGRATED ENERGY TRANSITION
A HOLISTIC APPROACH



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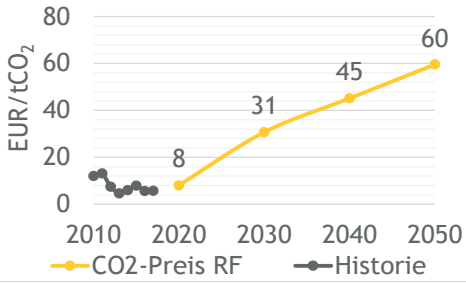
DENA STUDY INTEGRATED ENERGY
FIVE SCENARIOS MODELLED

Reference (RF)

~~Climate Targets~~

- Ambitious projection of past and current trends in politics an technology
- no binding climate goals (but CO_2 price in all sectors)



Electrification (EL)

80 % | 95 %

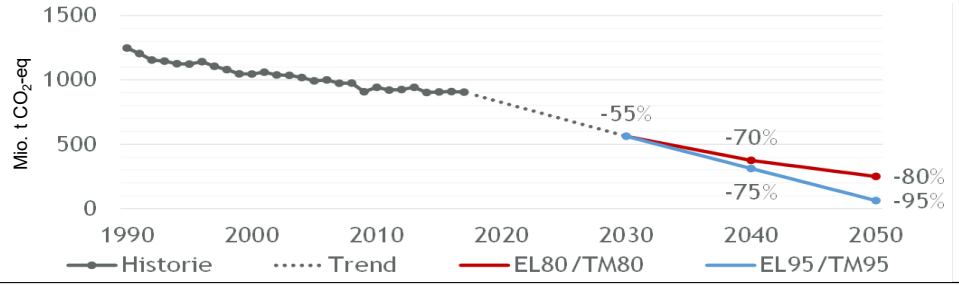
- Quick and extensive electrification of most energy uses in buildings, industry and mobility

Technology Mix (TM)

80 % | 95 %

- Broad variation of energy carriers, infrastructures and applications in all sectors

- Climate paths with two ambition levels (80 and 95 percent)



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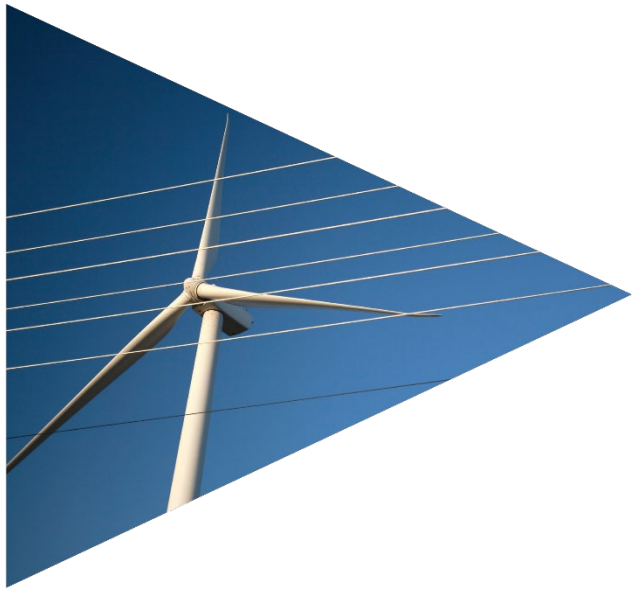
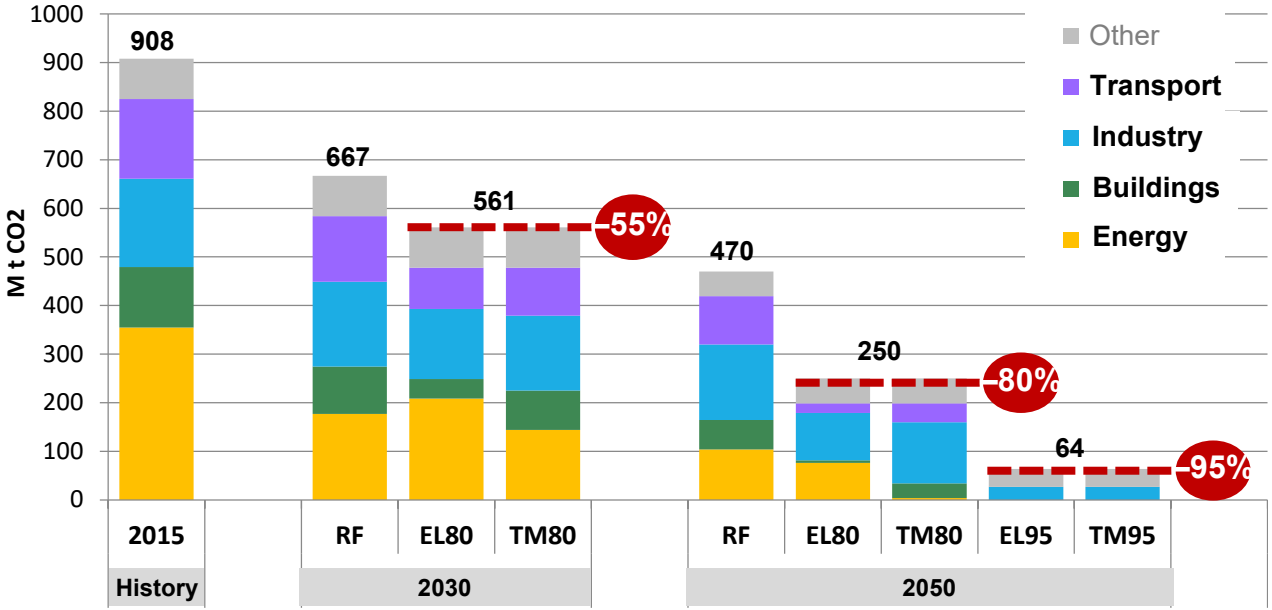


RESULTS & RECOMMENDATIONS

Our key findings

REGULATORY FRAMEWORK
NEED TO DEFINE THE 2050 TARGET

Greenhouse gas emissions by sector



- The transformation paths to achieve the climate protection targets **differ significantly** between 80 or 95 percent.
- We have to **decide today**, whether we allow remaining emissions for 2050 of 250 m t CO_2 (80 % target) or 64 m t CO_2 (95 % target).
- Climate protection goals require **immediate activation** of all actors. Intermediate goals are important to meet the overall budget for carbon emissions.

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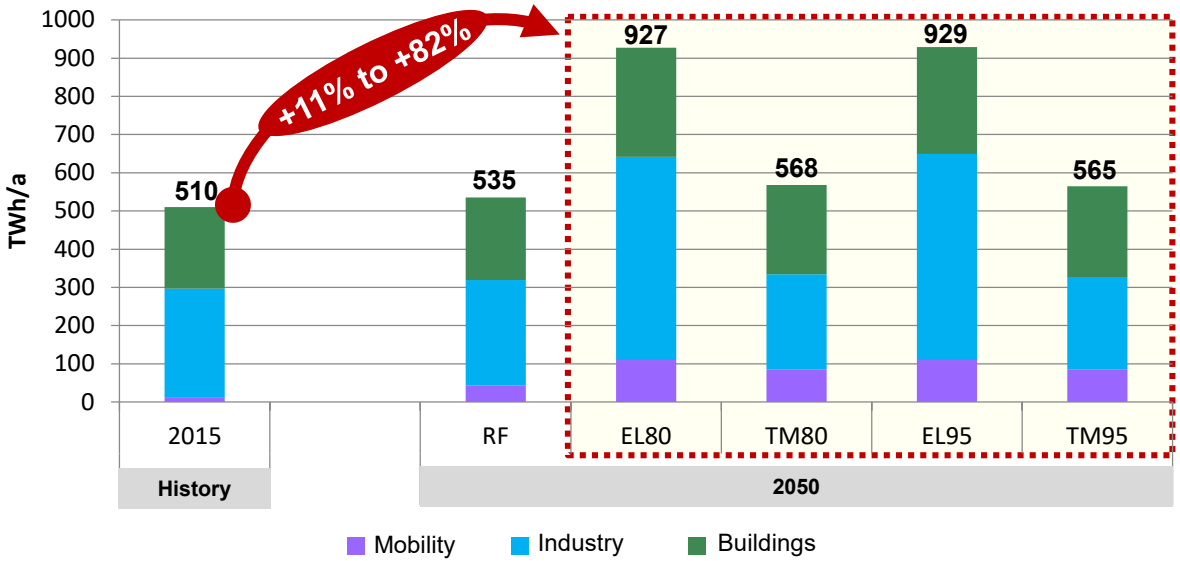
ENERGY DEMAND
STRONG ELECTRIFICATION IN ALL SECTORS

End energy demand of electricity by sectors



- All consumption sectors have an **increasing demand for electricity** (around 360 TWh higher in EL scenarios than in the TM scenarios).
- Increasing final e**nergy efficiency** and the complementary use of **power fuels** prevent even higher power requirements.

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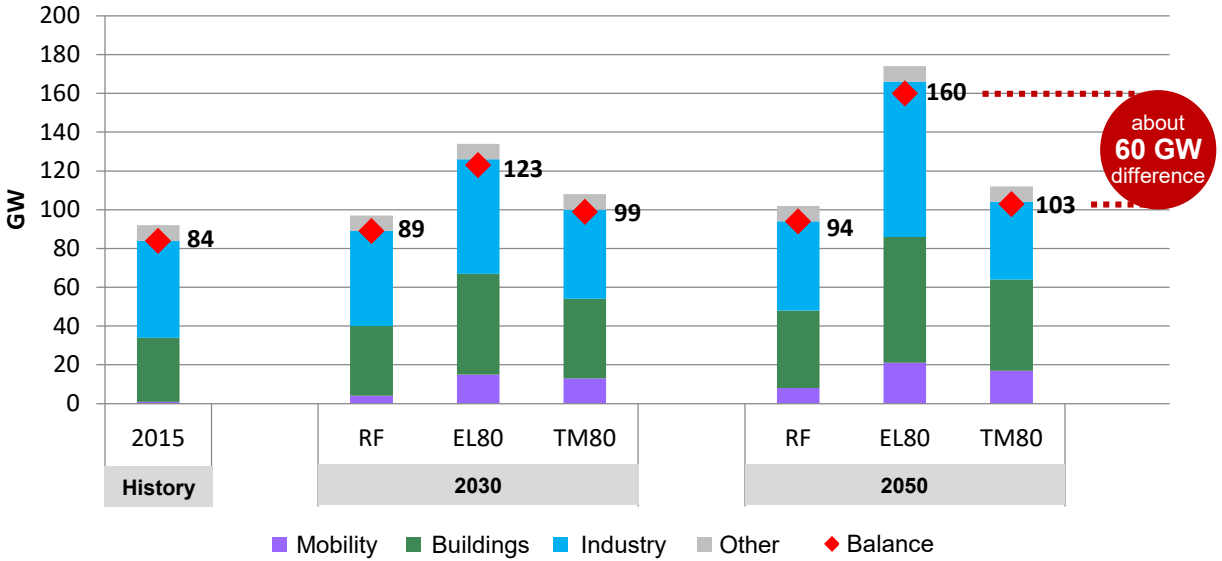
SECURITY OF SUPPLY
BROADEN THE INSTRUMENT BASE

Demand for secured power generation capacities



- The need for secured power will grow in all scenarios by 2050, as electricity demand increases.
- Compared with TM scenarios, EL scenarios have significantly higher demand for secured power (around + 60 GW!).
- The secured power is provided by **storage, demand side management and gas power plants**.

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THE 3 PILLARS OF THE ENERGY TRANSITION
EFFICIENCY & REN. POWER & POWERFUELS

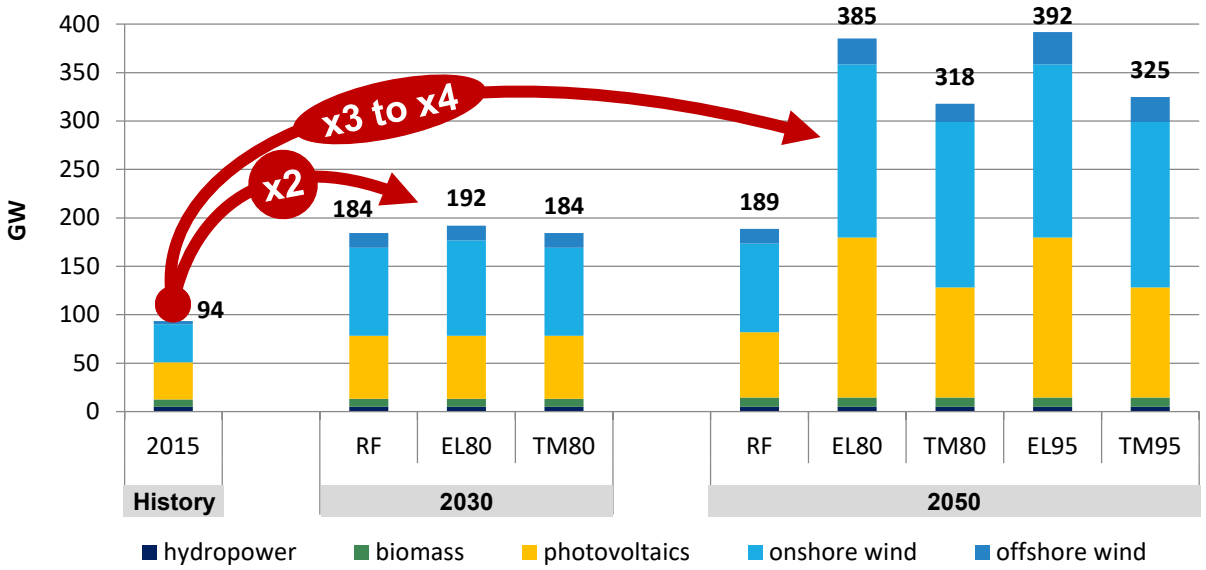
- **An ambitious energy efficiency strategy and a reduction of final energy consumption are absolutely necessary**
  to achieve the energy transition targets and the economic policy goals for reduced dependence on imports and energy prices

- **Energy efficiency is a prerequisite for climate protection and economic growth**
  Energy and resource efficiency as well as a strengthening of the circular economy can counteract the trends to increase energy consumption through economic growth and increased consumption.

- **Energy efficiency needs to be assessed more systemically**

THE 3 PILLARS OF THE ENERGY TRANSITION
EFFICIENCY & REN. POWER & POWERFUELS

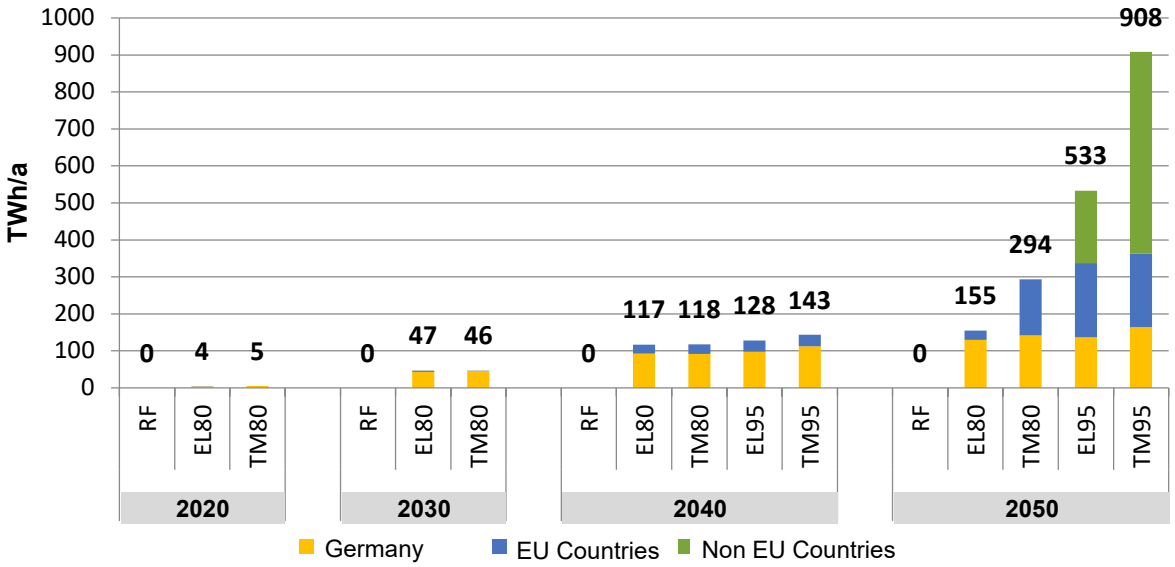
Installed capacity of renewable power generation



- In each target scenario, more than 300 GW of RES capacity will be installed in 2050.
  EL scenarios nearly 400 GW.
- The largest contribution is by onshore wind energy (at least 170 GW in all scenarios) and photovoltaics (at least 114 GW).

THE 3 PILLARS OF THE ENERGY TRANSITION
EFFICIENCY & REN. POWER & POWERFUELS

Growing demand for renewable synthetic energy carriers



- A successful energy transition requires not only „energy efficiency“ and „renewable power“ but also **„power fuels“ as a third pillar**.
- **In all target scenarios,** there will be a significant need for climate-neutral synthetic fuels (power fuels) from 2030 onwards
- Power Fuels are also produced in Germany, but mostly **imported** from European and non-European countries.

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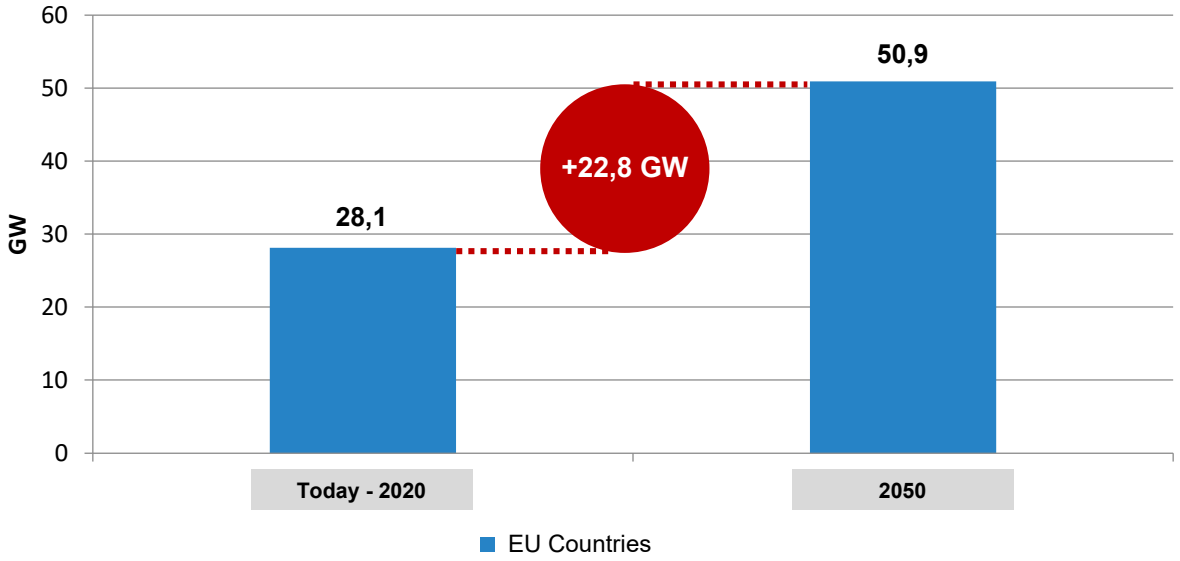
INFRASTRUCTURES
CONTINUE EUROPEAN GRID INTEGRATION

Cross-border Net Transfer Capacities (NTC)



- The German energy system continues to be integrated into the European internal energy market and closely linked international energy markets.
- All scenarios show an intensive exchange of power with neighbour states.
- The TM scenarios show net electricity exports (20-30 TWh/a) in 2050, while the EL scenarios show considerable net electricity imports (136 TWh/a by EL95).

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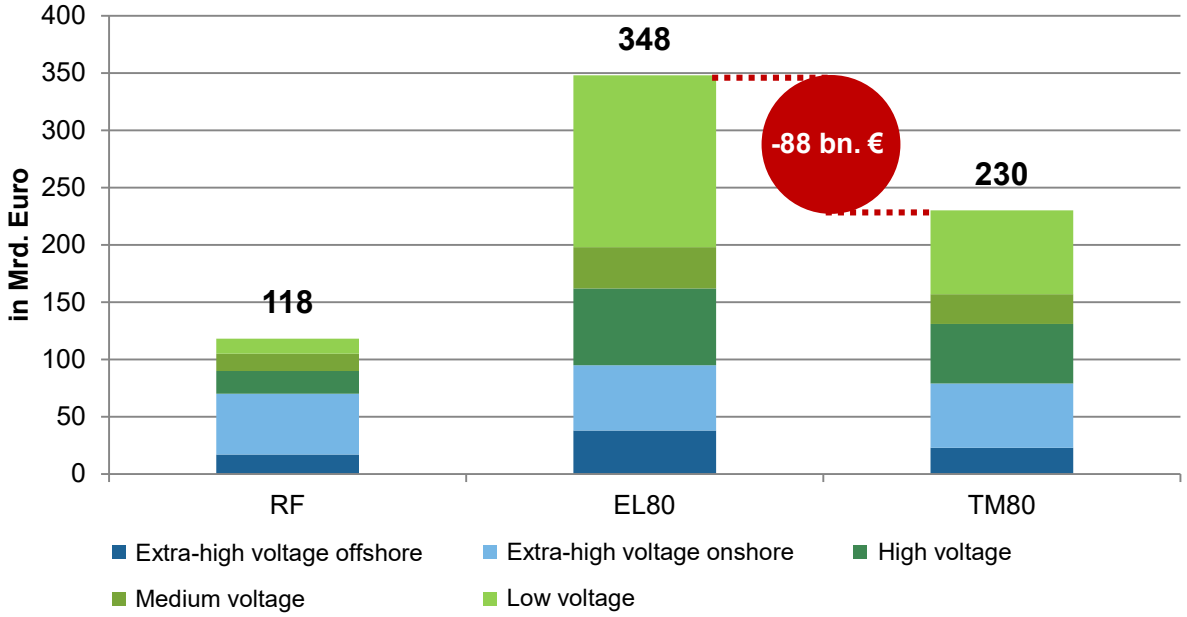
INFRASTRUCTURES: TECHNOLOGY MIX SHOWS LOWER COSTS OF POWER GRID EXPANSION

Accumulated investment costs in electricity grids 2018-2050



- Further development and **expansion of power grids** is „no regret“ measure.
- **Investment needs** in power grids significantly lower in technology mix scenarios

(Investment needs for energy infrastructures for gas and liquid fuels remain stable).

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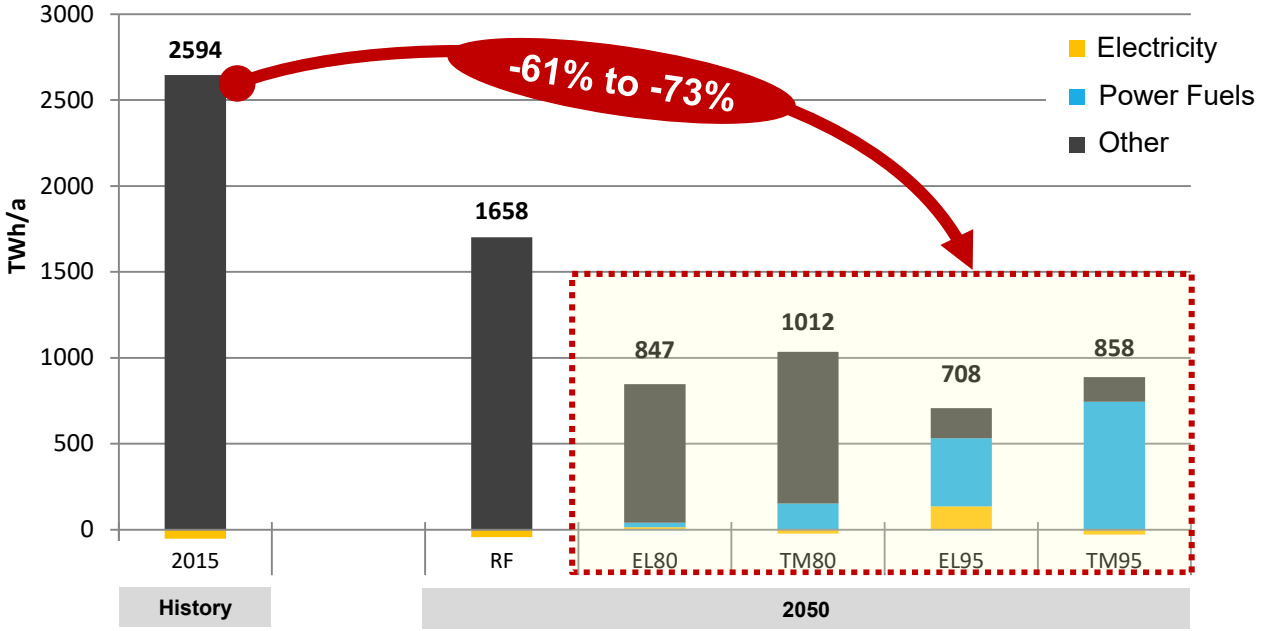
INFRASTRUCTURES & ENERGY CARRIERS CONTINUE INTERNATIONAL INTEGRATION

Net energy imports in 2050



- **Energy imports** are reduced by almost 3/4, especially of fossil fuels.
- In the 95%-scenarios, **fossil fuels** are used only as raw stock (182 TWh).
- **Energy autonomy** is not achieved (also *not* goal of the energy transition).

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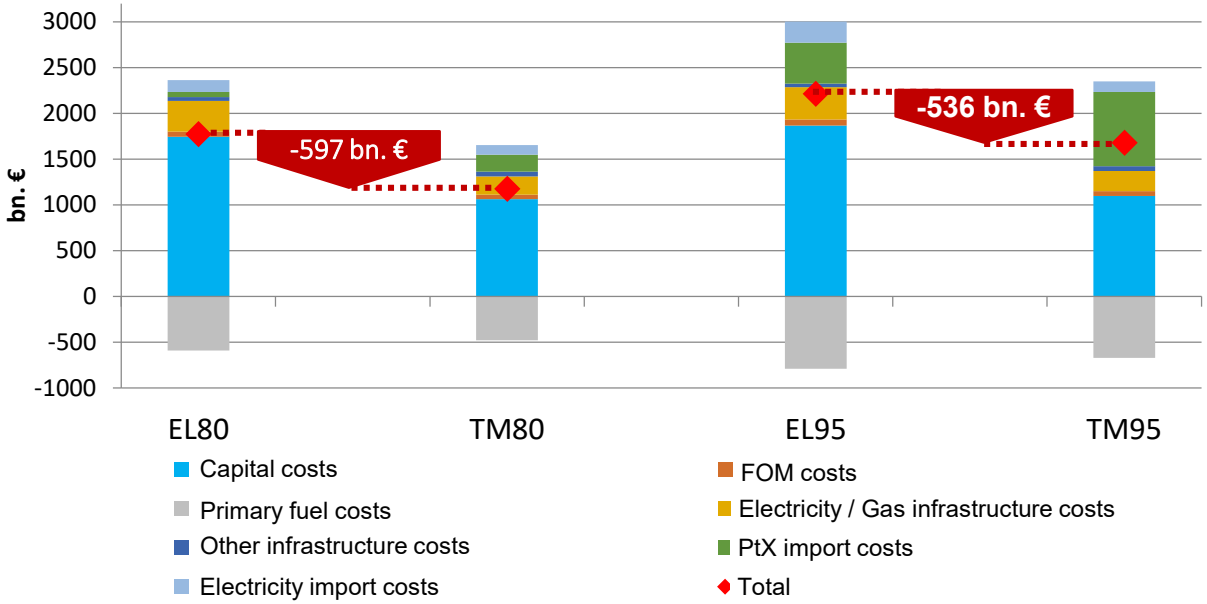
KEY FINDINGS
TECHNOLOGICAL BIAS INCREASES COSTS

Accumulated total additional costs 2018-2050 compared to reference



- Scenarios with a broad mix of energy sources, infrastructures and applications are significantly less expensive and more robust than forcing electricity as a priority energy source.
- The largest cost block includes **investments** in generation plants and infrastructures as well as efficient applications – these are also **economic opportunities**.

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KEY FINDINGS BRIEFLY

- **Paths open to a range of technologies are more robust and cost-effective**
  Transformation paths that are more broadly based on existing structures are more socially accepted and require less total investment.

- **Paving the way early on**
  As early as 2030, the paths of transformation differ significantly, therefore define targets and instruments in this legislative period of the German Government.

- **Take advantage of the opportunities and potential for Germany**
  The energy transition and climate protection are global trends; the structural change will take place in any case. As a driver of innovation, Germany can benefit fully from the opportunities.

KEY FINDINGS: SEE BOTH CHALLENGES AND OPPORTUNITIES OF THE ENERGY TRANSITION

- With increased efforts in all sectors, the Paris targets can be achieved.
- A broad mix of energy sources enables more cost-effective and robust transformation paths.
- The expansion and integration of renewable energies must be accelerated.
- Power Fuels complement energy efficiency and the expansion of renewable energies.
- A reliable planning horizon turns the necessary structural change into a modernization opportunity.
- The building stock and energy sector require the highest investment, the transport transition needs multiple pillars.
- A successful energy transition is embedded in international developments.
- Social acceptance and freedom of choice are crucial for success of this transition.

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THANK YOU!

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