Positive effects of energy efficiency on the German electricity sector

Main Conclusions

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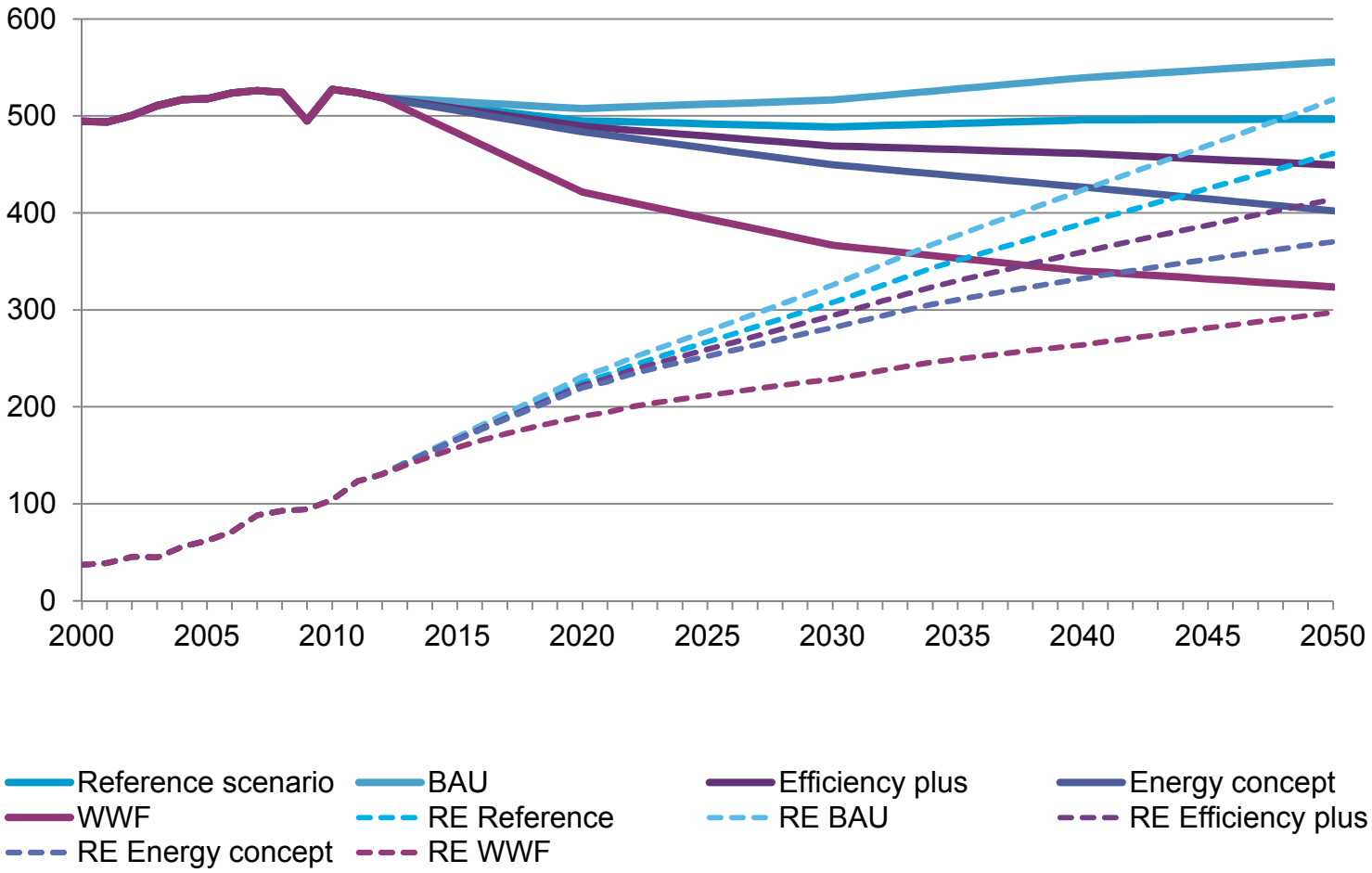
the dark side of energy efficiency…

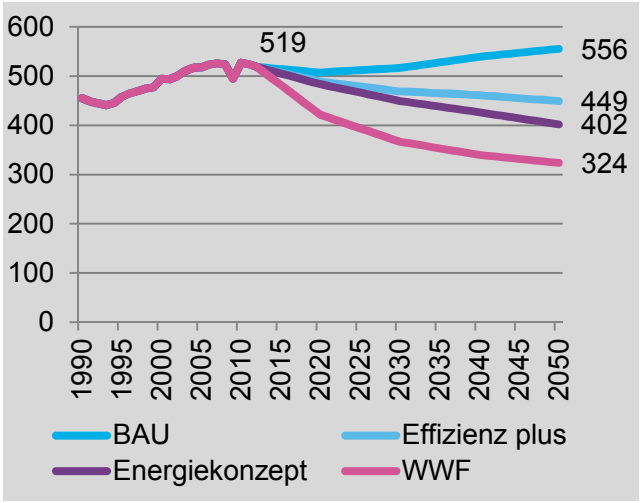
Energy Efficiency Scenarios [Electricity Consumption in TWh]



Key data of the five scenarios

	BAU	Referenz	Effizienz plus	Energie konzept	WWF
Efficiency development					
Energy productivity growth (GDP/Primary energy consumption)	1,2 - 1,3 %/a	1,7 -1,9 %/a	2,0 - 2,2 %/a	2,3 -2,5 %/a	2,6 %/a
Annual change in electricity consumption	+0,3 %/a	-0,1 %/a	-0,3 bis - 0,4 %/a	-0,6 %/a	-0,9 %/a
Total change in electricity consumption by 2050 (relative to 2011)	+7 %	-5%	-10 - 15 %	-20 bis - 25 %	-40 %
Total change in electricity consumption by 2050 (relative to 2011)	+37 TWh	-22 TWh	-69 TWh	-117 TWh	-195 TWh
E-Mobility (values 2050)					
Share of e-vehicles (passenger cars)		36 %		55 %	46 %
Number of e-vehicles		17 Mio.		25 Mio.	21 Mio.
Electricity consumption of e-vehicles (TWh)		34 TWh		53 TWh	28 TWh

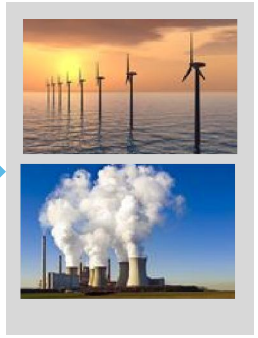
Tasks and Procedure



4 Power consumption scenarios :

> Time horizon up to 2050

> Comparison of BAU scenario with three efficiency scenarios



Calculating the costs of electricity production:

> Conventional power plants

> Renewable Energies

Calculating the costs of electricity distribution:

> Transmission networks

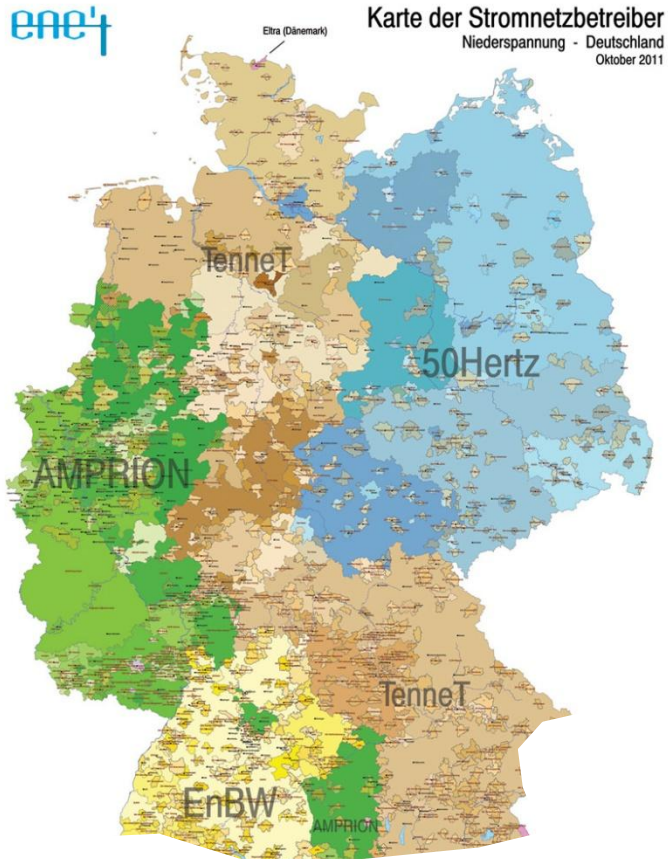
> Distribution networks

modelling the costs of the grid

- German transmission grid operated by 4 transmission system operators (TSO)
- more than 800 distribution system operators in Germany (DSO)

- circuit length of German transmission grid around 35,000 km
- aggregated circuit length in distribution grids > 1,000,000 km

- different approaches for modeling and simulating transmission and distribution grids
  - transmission grid simulations rely on explicit grid model
  - distribution grid simulations based on representative model grids



source: enet

map of German low voltage network operators

Calculation of network infrastructure costs

> Determination of grid extension requirements and network costs for all voltage levels (0.4 kV – 380 kV)

Transmission networks

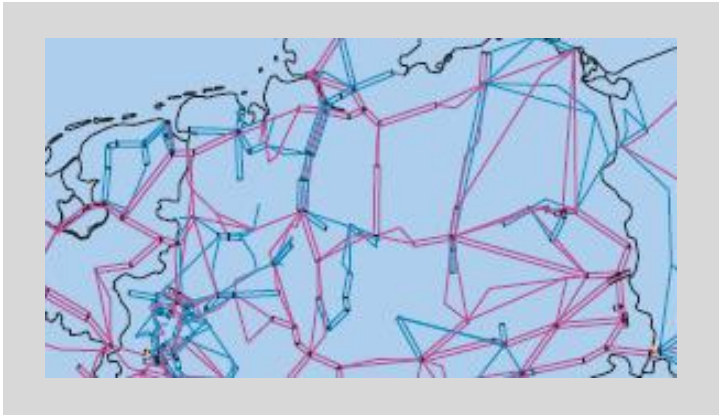
> Application of a detailed transmission' grid model

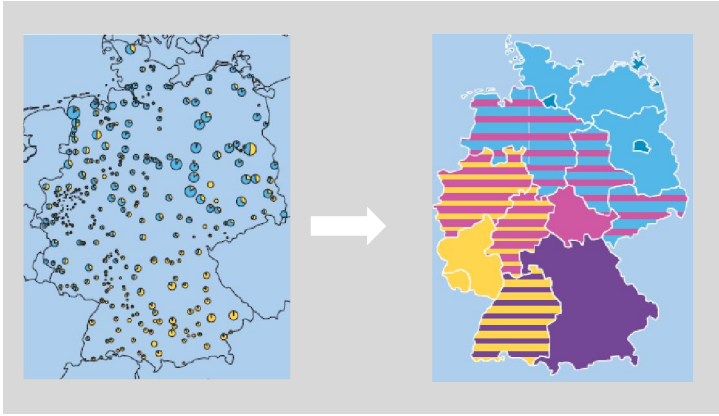
> Development of individual projects

Distribution networks

> Very large infrastructure

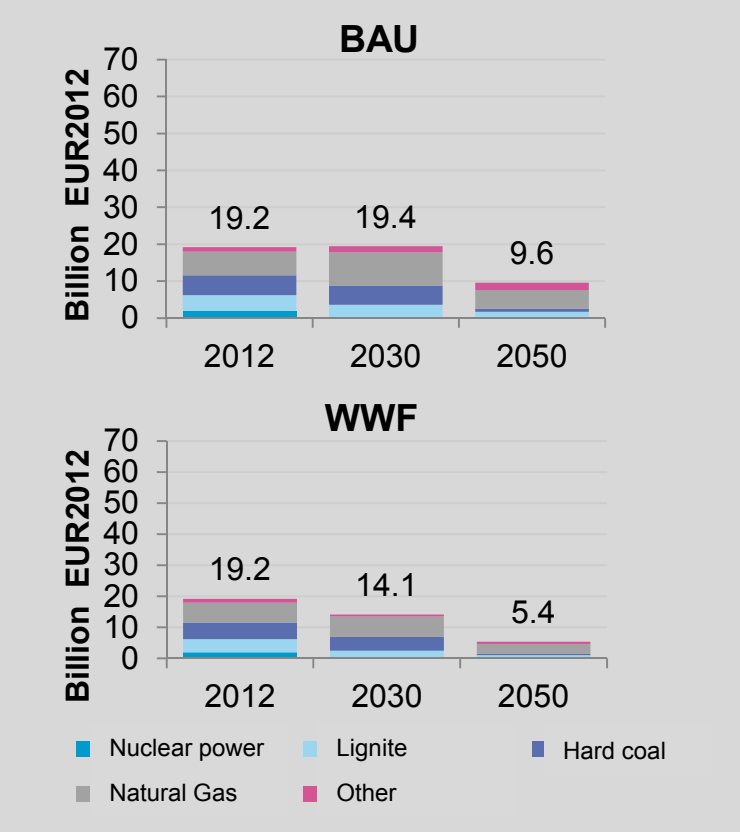
> Use of a model network approach



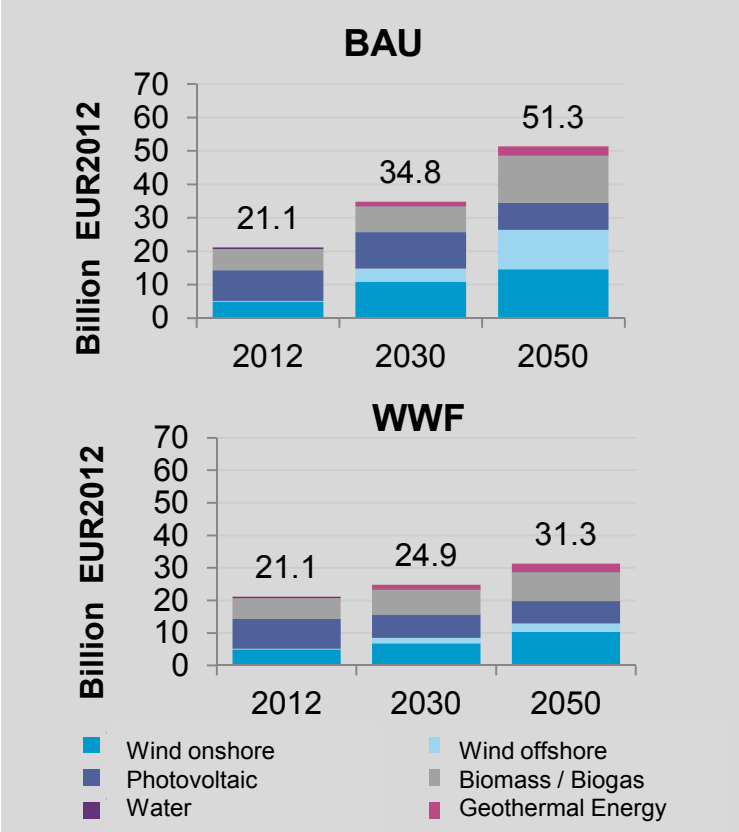


Costs of electricity production

Power generation: conventional

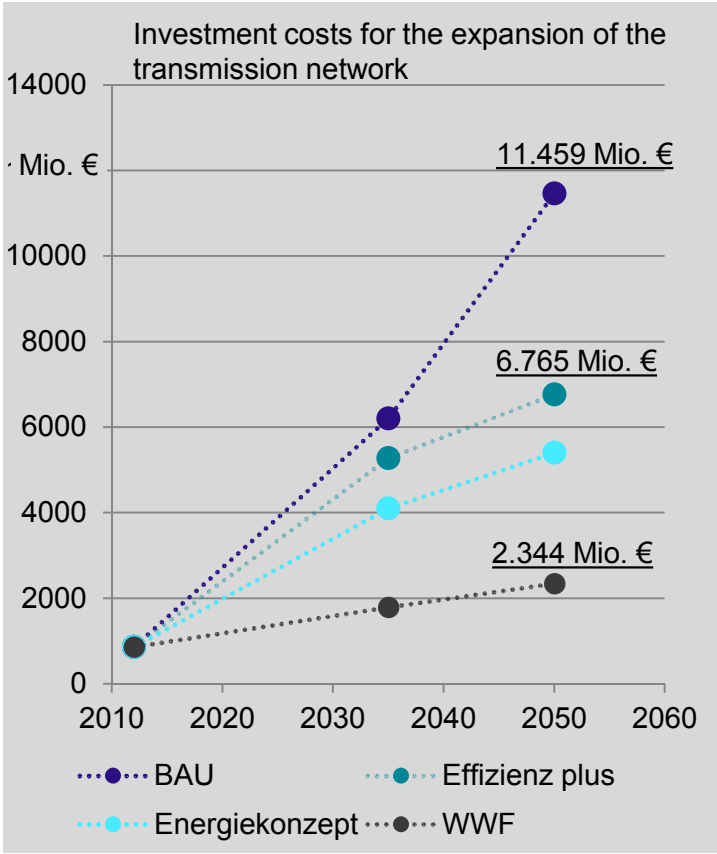


Power generation: renewables



Grid Extension requirements and their costs for the transmission network

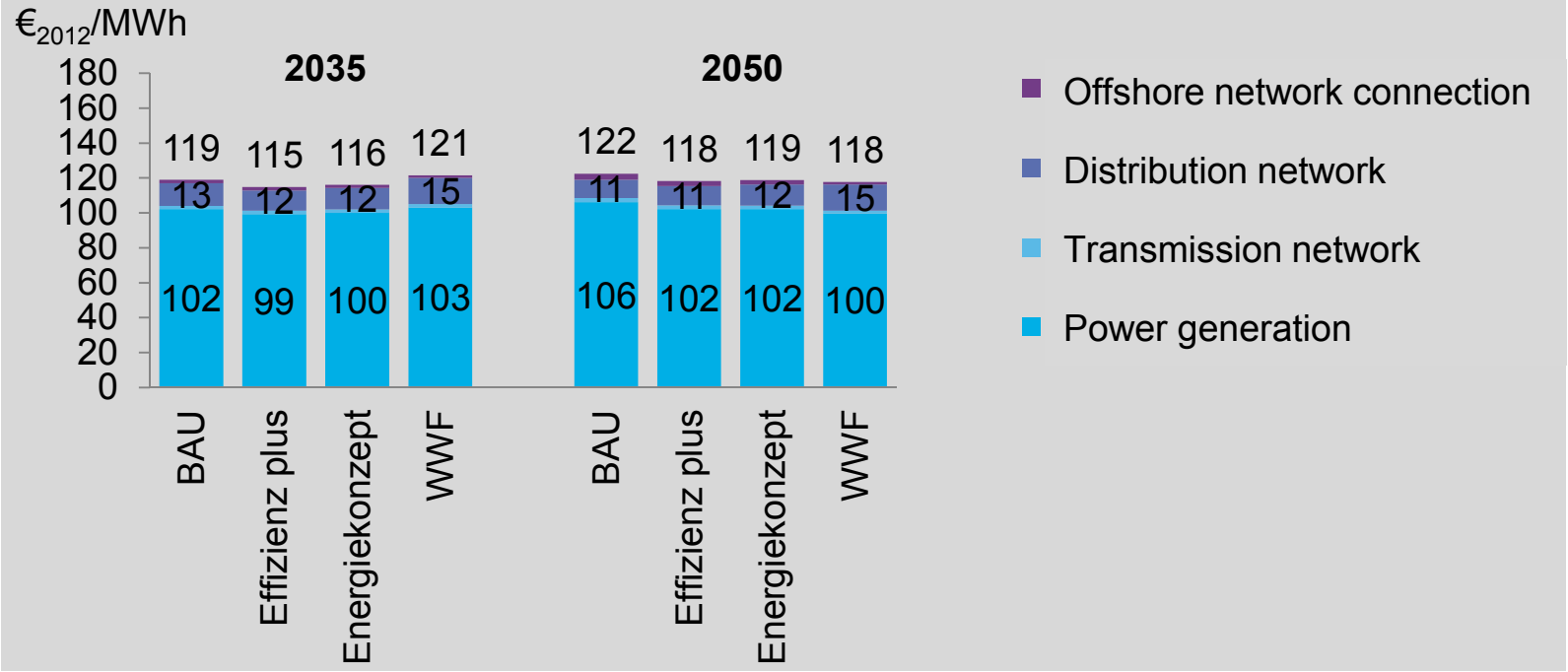
- Estimation of grid extension needs through iterative simulated power-circuit extensions in existing routes [1]
- Increase of the specific grid infrastructure costs between 15-56% by 2050 (currently € 1.4 / MWh)
- Energy efficiency measures reduce load and feed-in and reduce the required grid extension (through reduced transportation needs)



[1] The approach took into account technical constraints different from the network development plan (e.g. no study of dynamic stability).

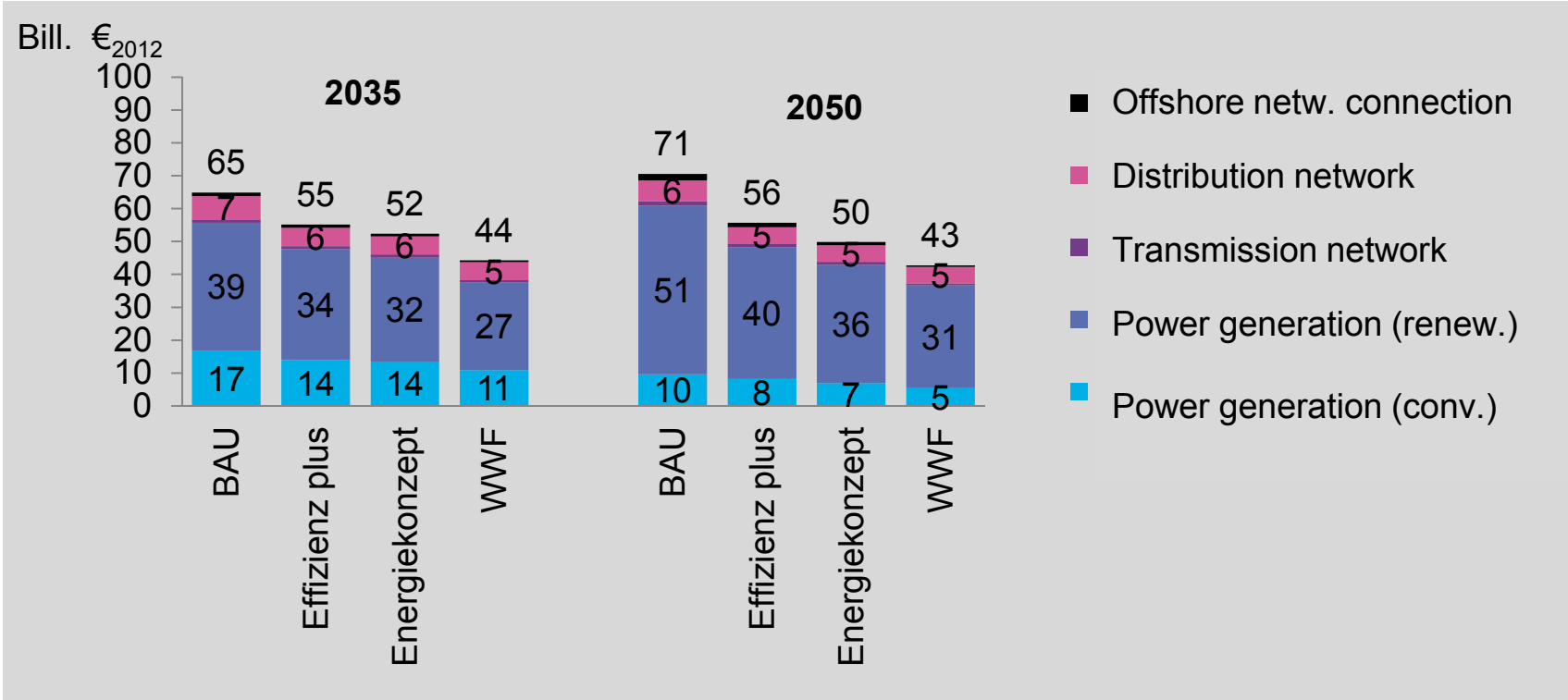
Specific costs of the power system

Even with decreasing power consumption, electricity costs per MWh remain approximately stable on a medium and long term, although the costs of the power networks must be passed on to a lower consumption.



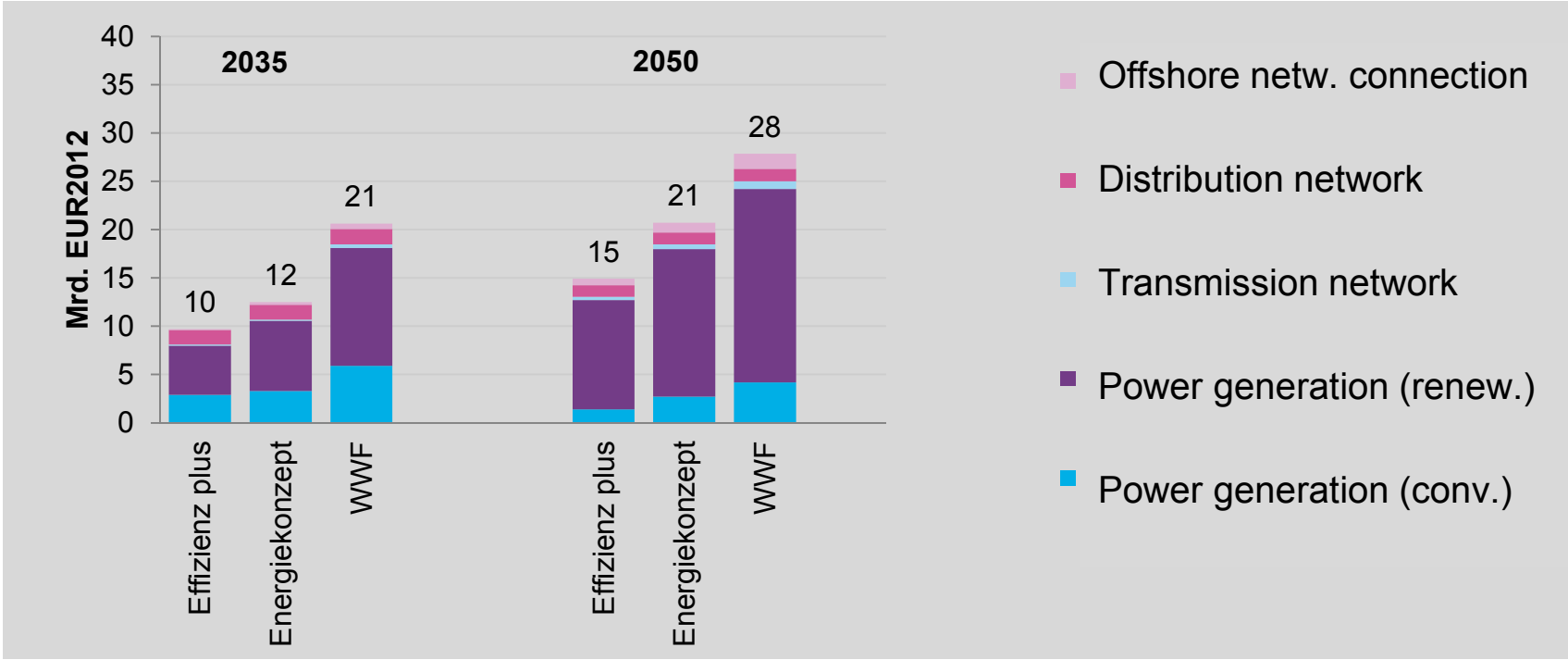
Overall costs of the power system

In 2050 the implementation of energy efficiency measures reduces annual costs throughout the whole power system by up to 28 billion euros.



Cost savings compared to the BAU scenario

By 2050 based on the WWf scenario expenses of about 28 billion Euros can be saved compared to the BAU scenario.



Main conclusion

- For **four scenarios, the total cost of the current system were calculated** (cost of electricity generation plus the cost of electricity transmission).
- **More efficient power systems require less conventional power plants**, less renewable energy and less networks.
- **The cost per energy unit will remain stable** also when the power consumption is decreasing.
- **Import dependency will be reduced**. In 2050 Germany can save expenses for coal and gas imports worth up to € 1.8 billion a year.
- **In 2050, the most efficient power system can economise 28 billion € annually compared to the BAU scenario**.