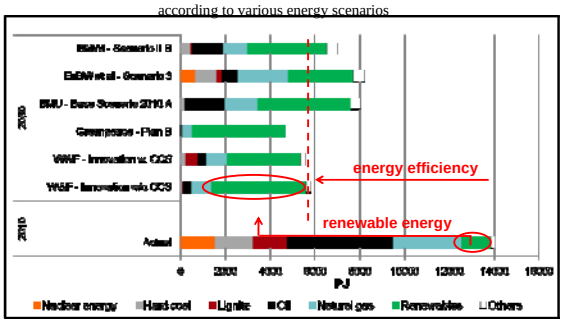
Germany on the way to sustainable energy and decoupling?

The Integration of renewables and efficiency is the key to sustainable energy!

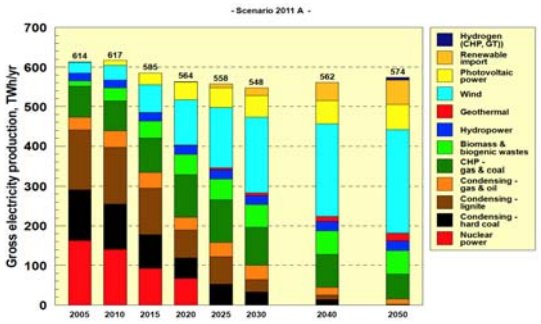
Primary energy supply and mix in Germany in 2010 (actual) and in 2050 according to various energy scenarios



Source: Samadi 2011, based on data from AG Energiebilanzen 2011 and scenario studies cited

Renewables in the Electricity Sector

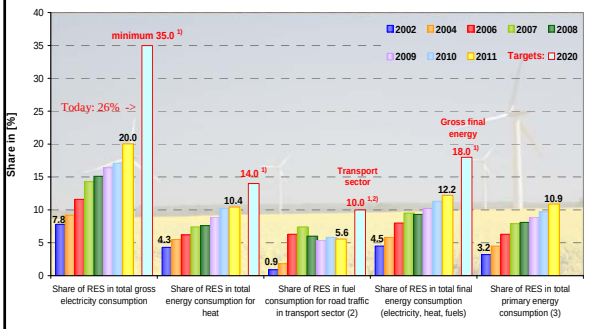
Structure of gross electricity generation in „BMU-Lead study 2011“ (TWh/a)



Quelle: BMU 2012

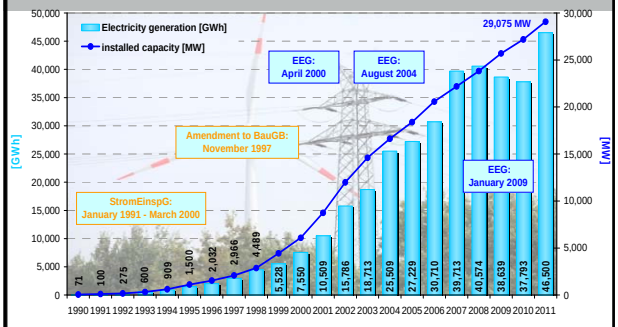
Status of renewable electricity production in Germany

Renewable energy sources as a share of energy supply in Germany



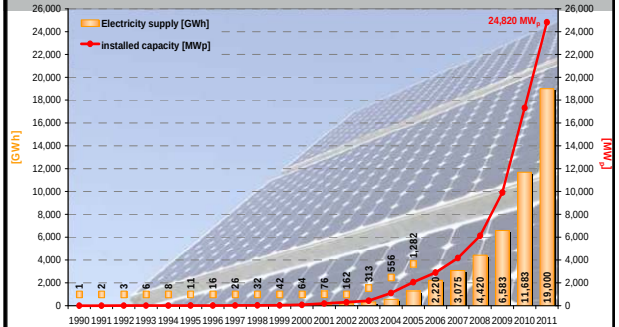
1) Sources: Targets of the German Government, Renewable Energy Sources Act (EEG); Renewable Energy Sources Heat Act (EEWärmeG), EU-Directive 2009/28/EC;
2) total consumption of engine fuels, excluding fuel in air traffic; 3) calculated using efficiency method; source: Working Group on Energy Balances e.V. (AGEB); RES: Renewable Energy Sources; source: BMU-KI III 1 according to Working Group on Renewable Energy-Statistics (AGEE-Stat); image: BMU / Brigitte Hiss; as at: March 2012; all figures provisional

Development of electricity production and installed capacity of wind energy plants in Germany



StromEinspG: Act on the Sale of Electricity to the Grid; BauGB: Construction Code; EEG: Renewable Energy Sources Act; 1 TWh = 1 Bill. kWh; 1 MW = 1 Mill. Watt; sources: electricity supply 2011 according to 50Hertz Transmission, Amprion, TenneT TSO, EnBW Transportnetze; J.P. Molly: "Wind Energy Use in Germany - Status 31.12.2011"; Deutsches Windenergie-Institut (DEWI) and German Wind Energy Association (BWE); BMU-KI III 1 according to Working Group on Renewable Energy-Statistics (AGEE-Stat); as at: March 2012; image: BMU / Christoph Edelhoff; all figures provisional

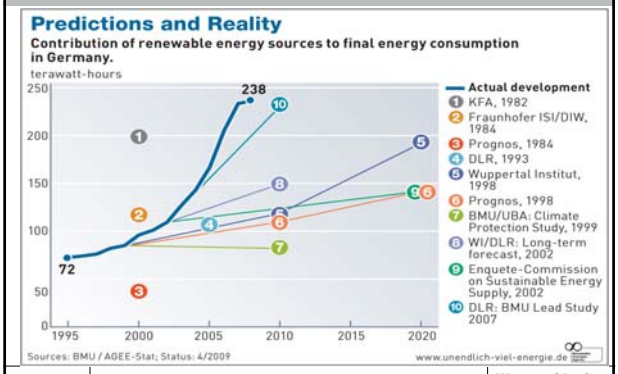
Installed capacity and energy supply from photovoltaic installations in Germany



Source: BMU-KI III 1 according to Working Group on Renewable Energy-Statistics (AGEE-Stat);
1 GWh = 1 Mill. kWh; 1 MW = 1 Mill. Watt; image: BMU / Bernd Müller; as at: March 2012; all figures provisional

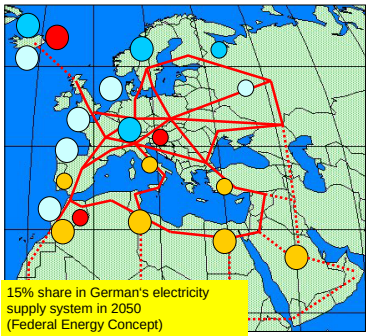
How much green energy is possible and in what time?

Smart policies and technology innovations can foster unexpected success!



Infrastructure challenge

Trans-European transmission grid based on renewable energies



15% share in German's electricity supply system in 2050 (Federal Energy Concept)

Quelle: DLR 2002

- Solar
- Wind
- Hydropower
- Geothermal
- EURO-MED
- possible further connections

Technological potential North Africa 1,360,000 TWh (ca. 100 * current global electricity demand)

Selection of German policies to foster the Energiewende
-Power
-Heat
-Transportation

Renewable energy policy in Germany

Feed-in-Tariffs (FiT) highly successful in Germany

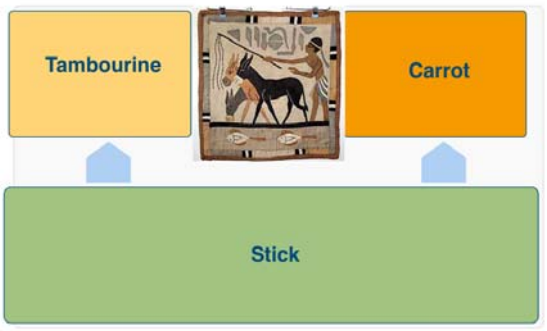
- German FiT for renewables include three key elements:
  - Guaranteed grid access
  - Long-term contracts for the electricity produced
  - Purchase prices based on the cost of generation (decrease over time)
- Long-term contracts and fixed purchase price enable high investment security (= low capital costs)
- By enabling market diffusion of different kinds of renewable technologies, costs for various technologies are driven down (learning curve effect)
- Investment structure is broad thanks to small-scale plants and high investment security → Increases acceptance of deployment of renewables
- EU (2008): "well-adapted FiT regimes are generally the most efficient and effective support schemes for promoting renewable electricity".
- Today about 60 countries have adopted Feed-in-Tariffs to support the use of renewable energy sources (plus many more states/provinces)

Low Carbon Transport Policy in Germany

including implementation of EU-Regulation

- **More efficient passenger cars**
  - **Emission performance standards** for new passenger cars (Application of EU Regulation (EC) No 443/2009): 130 g CO_2/km by 2015
  - Inclusion of CO_2-emissions into **vehicle taxation** since 2009: tax exemption for vehicles having 110 g CO_2/km or less (2012/2013)
  - **Energy labelling** since 2004 (in application of the EU Directive 99/94/EC): information about fuel/eclectricity consumption and CO_2-emissions for customers. Since 2011: including a colour scale for CO_2-emissions. However: rating of consumption/emissions in relation to weight of vehicle
- **Biofuels**
  - **Biofuels**: Reduction of greenhouse gas emissions in petrol and diesel fuels by 7% until 2020 (equivalent to a 12-13% share of biofuels). However: uncertainty about environmental effects
- **Electromobility**
  - One million **e-vehicles** in Germany until 2020: National platform for electromobility, pilot projects, financial support

How to Promote Energy Efficiency?



what's that – a Passive House? five basic elements (we need that!)

- comfortable building to be heated (cooled) easily

no thermal bridges!

Ventilation with ≥ 75 % heat recovery
Electricity demand max. 0.45 Wh/m³

Heat protection:
U ≤ 0.15 W/(m²K)
U_w ≤ 0.8 W/(m²K)

Outdoor air | Exhaust air

Triple-glazing:
U_g ≤ 0.8 W/(m²K)
g-value 50 - 55 %

Extract air | Supply air

Airtightness:
n_{50} ≤ 0.6 /h

Heating energy demand	≤ 15 kWh/(m²a)
or Building heating load	≤ 10 W/m²
Useful cooling demand	≤ 15 kWh/(m²a)
Primary energy demand	≤ 120 kWh/(m²a)
Building airtightness	≤ 0.6 /h
Excess temperature frequency	≤ 10 %

1 W/m² = 0,317074019 Btu/h/ft²
1 kWh/(m²a) = 317,0740194 Btu/(ft²a)

13th CTI workshop, Berlin 10/2012: Passive Houses in Germany – and worldwide

Promotional effects

kfw BANKENGRUPPE

	2009	2010	2011
Commitments (in millions of EUR)	8,863	8,746	6,510
housing units (in 1,000)	617	953	282
reduction of CO_2 (in 1,000 Tonnen p.a.)	1,452	1,049	567
jobs * (in 1,000)	292	342	247
investments (in millions of EUR)	18,335	21,330	18,427
federal budget (in millions of EUR)	2,033	1,337	934
leverage	9.0	16.0	19.7

* safeguarded employment for one year

Effects of promotion

- Increase of retrofitting ratio
- Sustainable reduction of CO_2-emissions
- Promotion for SMEs and creation of employment
- Substantial investments in buildings be triggered

Budget funds being recovered by additional revenues of taxes

Retrofitting existing buildings to nearly „passive houses“

passive house standard = 15 kWh/qm/a

dena

High-Performance-Retrofitting: more than 400 high efficient buildings all over Germany.

All building types and construction periods included

Multi family dwelling
Pforzheim
Year of construction 1951
before: 358 kWh/m²a
after: 31 kWh/m²a
reduction of 92% primary energy

Single-family home
Oldenburg
Year of construction 1890
before: 462 kWh/m²a
after: 21 kWh/m²a
reduction of 95% primary energy

heritage building in
Eichstetten
Year of construction 1750
before: 202 kWh/m²a
after: 22 kWh/m²a
reduction 89% primary energy

Caption: Plus energy houses are designed to produce more energy than they consume in the course of the year.

Controversial topics of the Energiewende

- **Costs: How much, how long, for whom?**
- **Security of power supply vs. system integration of intermittent power?**
- **Focus on power: system transformation of heat and transport sector?**
- **Supply side biased; low priority for energy (resource) efficiency?**
- **Decentralized („smart grids“) vs. centralized power („Desertec“)?**
- **Role of municipalities, participation and democratisation?**
- **Absolute decoupling of GDP and energy?**
- **Lifestyle changes to sustainable consumption and production?**