Connecting the dots on Germany’s *Energiewende* and its impact on European energy policy

Rebecca Bertram
Heinrich Böll Foundation
EU Energy Policy: 20-20-20

- **Climate**: A reduction in EU greenhouse gas emissions of at least 20% below 1990 levels (e.g. Germany minus 40%)

- **Renewables**: 20% of EU energy consumption to come from renewable resources (e.g. Germany 18%)

- **Efficiency**: A 20% reduction in primary energy use compared with projected levels

*Principle: effort sharing*
EU Energy Policy: 2030 Goals

- **Climate**: A reduction in EU greenhouse gas emissions of at least 40% below 1990 levels
- **Renewables**: 27% of EU energy consumption to come from renewable resources
- **Efficiency**: No target yet
Germany is gradually shutting down all nuclear power plants
Declining nuclear energy installed capacity in Germany, 2000–2022

Source: Institute of Applied Ecology, BMU, own calculations
Renewables are Germany’s single biggest power resource

2015 power mix (2014 values in brackets)

- Gas: 8.8% (9.7%)
- Oil and other: 4.9% (5.2%)
- Hard coal: 18.2% (18.9%)
- Nuclear: 14.1% (15.5%)
- Lignite: 24.0% (24.8%)
- Renewables: 30.0% (25.9%)
- Wind Onshore: 12.0% (8.9%)
- Wind Offshore: 1.3% (0.2%)
- Photovoltaics: 5.9% (5.8%)
- Biomass (incl. biogenic waste): 7.7% (7.9%)
- Hydropower: 3.0% (3.1%)
German energy transition: high certainty with long-term targets

Long-term, comprehensive energy and climate targets set by the German government in 2010

Source: BMU

- Power consumption (compared to 2008): 80% (2020), 35% (2030), 50% (2040), 65% (2050), 75% (2050), 80% (2050)
- Gross energy consumption (compared to 2008): 100% (2020), 80% (2030), 18% (2040), 30% (2050), 45% (2050), 50% (2050), 60% (2050)
- Heat demand, buildings (compared to 2008): 100% (2020), 80% (2030), 14% (2040), 20%* (2050), 20%* (2050), 20%* (2050)
- Final energy consumption, transport (compared to 2005): 100% (2020), 90% (2030), 10% (2040), 60% (2050)
- Greenhouse gases (compared to 1990): -21% (2020), -55% (2030), -70% (2040), -80% (2050), -95% (2050)

Legend:
- Target in %
- Share of renewables in %
- Trend
- In terms of primary energy

German Energy Transition energytransition.de CC BY-SA
More renewables strengthen Germany’s energy security
Share of imports of conventional energy sources in Germany 2012

Source: BMWi
Renewables do not hurt Germany’s economy
Gross Domestic Product and share of renewables in power generation from 1991-2014, Germany

Source: BMWI, AG Energiebilanzen, Destatis

Die grüne politische Stiftung
Germany: growing economy, declining emissions
Change of Gross Domestic Product (GDP) and Greenhouse Gas (GHG) emissions in Germany, 1991-2012

Source: BMU, BMWi, Destatis

Die grüne politische Stiftung
Germany continues to produce more GDP with less energy

Energy intensity (=energy use per unit of GDP) of different world regions, 1990–2013

*Source: Enerdata Yearbook*
How? Feed-in Tariffs (FIT) – High investment certainty for renewable energy (first phase)

1. Fixed payments for 20 years (depending on technology and size) eliminate risks to investors and banks

2. Guaranteed grid access
   Rewarding renewable electricity production, not investment; open for all citizens; not a government subsidy

- > This has provided market access for all renewables, giving them a fair share to enter the market and become competitive.
Feed-in tariffs provide investment certainty and drive costs down

Simplified generalization of feed-in tariff with 20 year duration

Source: Own estimates based on WFC

Rate level

Rate is set for 20 years when system is installed...

...but rates for new systems drop each year.
German energy transition is a democratic movement
Ownership of renewables in 2012

- > 1 out of 60 Germans is now an energy producer ("prosumers")

Energy suppliers
12%

Institutional and strategic investors
41%

Total installed capacity 2013
73 GW*

Citizens and coops
47%

* excluding PSW, offshore wind, geothermal and bio-mass

Source: AEE, www.unendlich-viel-energie.de
Grid reliability and renewable growth seem to go hand in hand

Minutes of power outages per year (excl. exceptional events), based on Saidi

Source: CEER and own calculations

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Price of solar down in Germany by 66% since 2006

Average system price for installed rooftop solar of up to 100 kilowatts

Source: EUPD Research and BSW-Solar
Price of new nuclear already higher than solar and wind
FITs for current and future solar and wind in Germany with strike price for nuclear at Hinkley

Source: Thomas Gerke, DECC, Agora Energiewende
What are the main characteristics of the German energy transition?

1. ...there is an all-party agreement that climate change is real and needs to be addressed;

2. ...there is broad support to switch to a renewable energy economy (priority for RE, no nuclear power);

3. ...the energy policies are geared not towards large corporations, but SME and citizens which are driving the energy transition.
...yet some challenges remain (second phase):

1. How to build new infrastructure in form of smart new power grids (north-south) and storage systems;
2. How to coordinate the expansion of renewables while controlling the costs (from feed-in tariffs to auctions);
3. How to coordinate renewable power production and distributive generation with the rest of the power system, particularly fossil fuels;
4. How to continue limiting national CO2 emissions effectively (coal);
5. How to think beyond just electricity (energy efficiency, transportation, heating);
6. How to coordinate the Energiewende with European neighbors and into the Energy Union.
Germany’s Energiewende – European Impacts

1. Germany’s geographical location at the center of Europe puts it in a unique position;

2. Energy Transition constructed as national policy regardless of its impact on European neighbors, esp. Poland;

3. Some changes have been made in recent years (key word: regional cooperation and integration):
   - “Baake Prozess” and Electricity Neighbors
   - Pentaforum (electricity markets)
   - European Network of Transmission System Operators (infrastructure and grid operation)
     → increasing regional flexibility
Hot topics in Brussels – The Energy Union and “Winter Package”

1. Security of supply;
2. Completion of the international energy market,
3. Energy efficiency;
4. Climate protection and emissions reductions,
5. Research and Innovation

→ no shared common energy vision among EU Member States
Thank you!
Renewables need flexible backup, not baseload
Estimated power demand over a week in 2012 and 2020, Germany

Source: Volker Quaschning, HTW Berlin
Recognizing the danger of nuclear power
30/80 km zones around nuclear reactors in Germany and nearby reactors of neighbouring countries

Source: http://opendata.zeit.de/atomareaktoren

30 km evacuation zone around Fukushima
POPULATION AFFECTED 12%

80 km evacuation zone recommended by US for Fukushima
POPULATION AFFECTED 51%
Germany’s plan: drive down energy demand
Primary energy demand in Germany, 2000–2020

Source: AGEB, BMWi
Renewables create more jobs than conventional energy does

Employment in Germany in renewable and conventional energy sectors, 2005–2011

Source: BMU, BMWi
Solar PV can already cover a third of peak power demand

Power demand and solar power production in Germany. Estimate based on actual data from May 2012

Source: Fraunhofer ISE, EEX

Diagram shows a comparison of total power consumption and solar power production throughout the day. The diagram indicates that solar power production covers one third of the demand when demand peaks.
Fossil and nuclear have received by far more subsidies than renewables
Energy subsidies in Germany, 1970-2014

Source: Was Strom wirklich kostet, FÖS, 2015
Renewable energy offsets expenses for fossil fuel imports

Benefits of renewables in energy use, Germany

Source: AEE