Connecting the dots on Germany’s Energiewende

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Looking at Germany – what is the country doing?

The Energiewende did not start with Fukushima
Germany is gradually shutting down all nuclear power plants
Declining nuclear energy installed capacity in Germany, 2000–2022

Source: Institute of Applied Ecology, BMJ, own calculations
Renewables are Germany’s single biggest power resource
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)
- **Gross energy consumption** (compared to 2008)
- **Heat demand, buildings** (compared to 2008)
- **Final energy consumption, transport** (compared to 2005)
- **Greenhouse gases** (compared to 1990)

**German Energy Transition**

<table>
<thead>
<tr>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
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<tr>
<td>-21%</td>
<td>-55%</td>
<td>-70%</td>
<td>-95%</td>
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Target in %
Share of renewables in %
Trend
In terms of primary energy

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The Green Political Foundation
Why is Germany undergoing the energy transition?
More renewables strengthen Germany's energy security
Share of imports of conventional energy sources in Germany 2012

Source: BMWi

- Hard coal: 81%
- Petroleum: 98%
- Natural gas: 86.0%
- Uranium: 100.0%
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

Increase in renewables since 1991

7x

GDP per capita (1991 = 100)

Share of renewables in electricity mix
Germany: growing economy, declining emissions
Change of Gross Domestic Product (GDP) and Greenhouse Gas (GHG) emissions in Germany, 1991-2012
Source: BMU, BMWi, Destatis

GDP per capita (1991 = 100)
GHG emissions in CO₂-equivalent (1991 = 100)
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 WEC

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

Source: AEE, www.unendlich-viel-energie.de

- 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
Citizens form cooperatives to drive the energy transition

Number of energy cooperatives in Germany, 2001-2013

Source: www.unendlich-viel-energie.de
92 percent of Germans support further growth of renewables
“The use and growth of renewable energy is …”, survey from October 2014

Source: VZBV
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*
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 solar installation in euros per kilowatt

2006 2007 2008 2009 2010 2011 2012

5,000 4,000 3,000 2,000 1,000 0

DECREASE IN PRICE
-66%

1,700 €
Renewables need flexible backup, not baseload

Estimated power demand over a week in 2012 and 2020, Germany

*Source: Volker Quaschning, HTW Berlin*
German power exports continue to rise

Net power exports from 2000-2014 in TWh.

Source: Agora Energiewende, AGEB
Central steering of the Energiewende

Federal and state coordination
- Chancellor
- Prime ministers of the Länder

In charge of the Energiewende
Federal Ministry for Economic Affairs and Energy

Electricity Market Platform
Energy Efficiency Platform
Energy Grids Platform
Buildings Platform
Research and Innovation Platform

Stakeholder Dialogue

Monitoring report “Energy of the Future”

Source: BMWi 2014
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.
Thank you!

German Energy Transition
Arguments for a renewable energy future.

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@EnergiewendeGER
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
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*
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/atomreaktoren

- 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

Solar covers one third of demand when demand peaks.

Total power consumption
Solar power production
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

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<th>2023</th>
<th>2013 future</th>
<th>2014</th>
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<td><strong>UK New nuclear</strong></td>
<td>155.00</td>
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<tr>
<td><strong>Solar</strong></td>
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<tr>
<td><strong>DE Wind offshore</strong></td>
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<td>97.00</td>
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<tr>
<td><strong>Wind onshore</strong></td>
<td>58.23</td>
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<td>51.53</td>
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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