

Observations from abroad and a look at the future



CREATE's mission is to advance the field of renewable energy by championing exemplary renewable energy educational programs.

- Faculty Professional Development
- Industry and Academic Partnerships
- Promoting renewable energy careers
- Skills, competencies, and certifications
- Curriculum Development

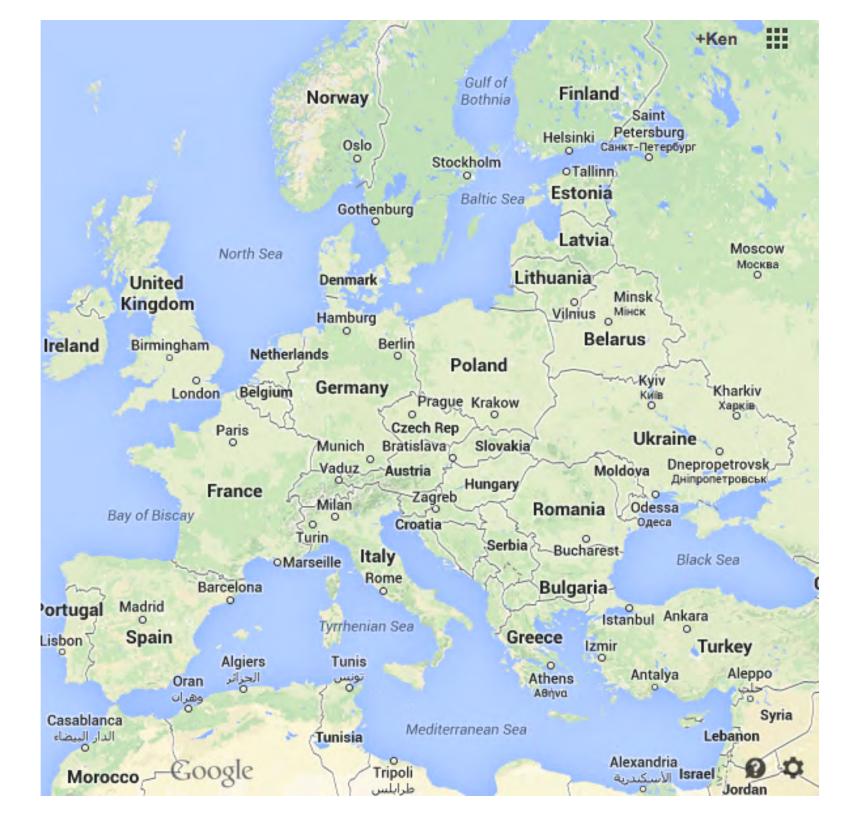


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CREATE Energy Storage Project

The goal of the CREATE Energy Storage Project is to advance the field of renewable energy by integrating energy storage technology into existing two-year college programs. This goal will be accomplished through four objectives:

- 1.Examining existing model energy storage education efforts already pioneered in European countries.
- 2. Conducting a Job Task Analysis and Curriculum Gap Analysis
- 3.Implementing pilot energy storage courses in a model teaching lab.
- 4. Providing professional development in energy storage through digital webinars, presentations, and workshops.



Germany

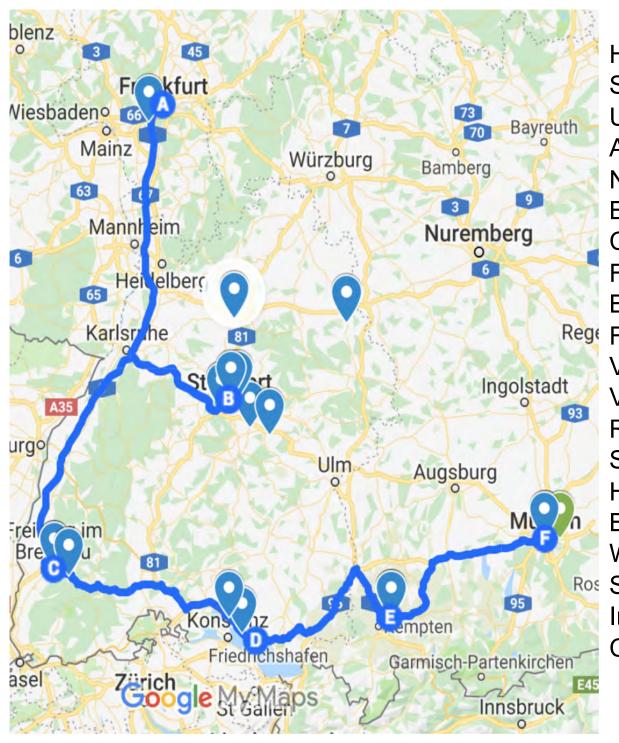
80 Million people 16 states ~138,000 sq miles ~500 miles N to S ~400 miles E to W 4th largest economy in the world (behind U.S., China, and Japan)



Germany's relative size?

Roughly twice the land area of Wisconsin, but 14X WI's population Roughly the same land area as California, but double CA's population





Heinrich Boll Foundation Solites/Crailsheim Solar Storage University of Stuttgart ADS-Tec Netze BW, Stuttgart Bosch/ EnBW battery storage City of Freiburg/ Green City Office Freiburg University Badenova AG Rege Fraunhofer Institute for Solar Energy VAG Flyweel Storage, Frieburg Vaubaun City Area Reterra Biogas Solar Settlement Helliotrope Bugginer Strasse 50 social housing Wildpoldsried

Sonnen Batterie, Wildpoldsreid Intersolar and ESS Energy Storage Conferences

Site identification/selection process

- Holistic view of the German Energy Transition
- Learn about German energy policy
- Meet with industry leaders
- See working examples of renewable energy and energy storage technology in the field
- Foster relationships for future collaboration

Three Pillars of the Energiewende



RENEWABLE ENERGY SOURCES

- Rapid, continuous expansion
- Cost-efficient and environmentally friendly



ENERGY EFFICIENCY

- Reduce energy consumption
- · Ensure efficiency



FLEXIBILITY
AND FUTURE
GRID NETWORK

- Flexible grids and high capacity
- Integration of electricity from renewable sources





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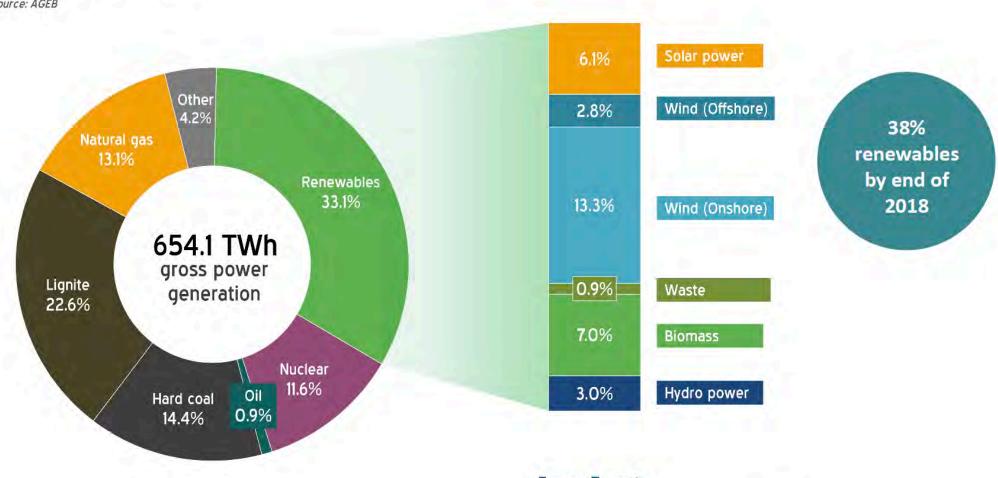






Germany reaches 33.1 percent renewable power in 2017 Gross power generation mix

Source: AGEB







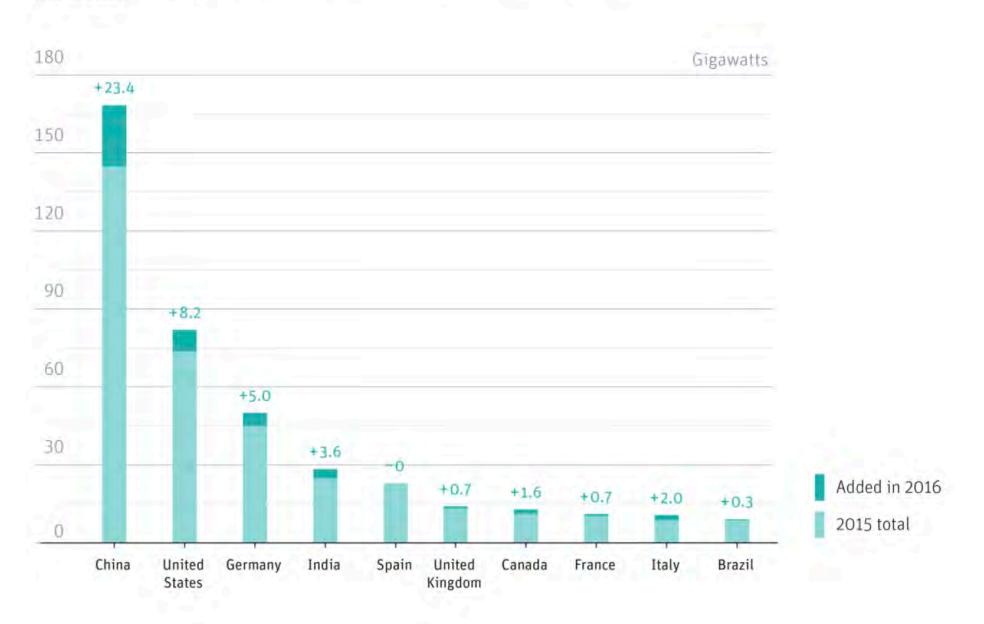


Germany is a leader in wind power



Top 10 countries for wind power in terms of total installed capacity, 2016

Source: REN21

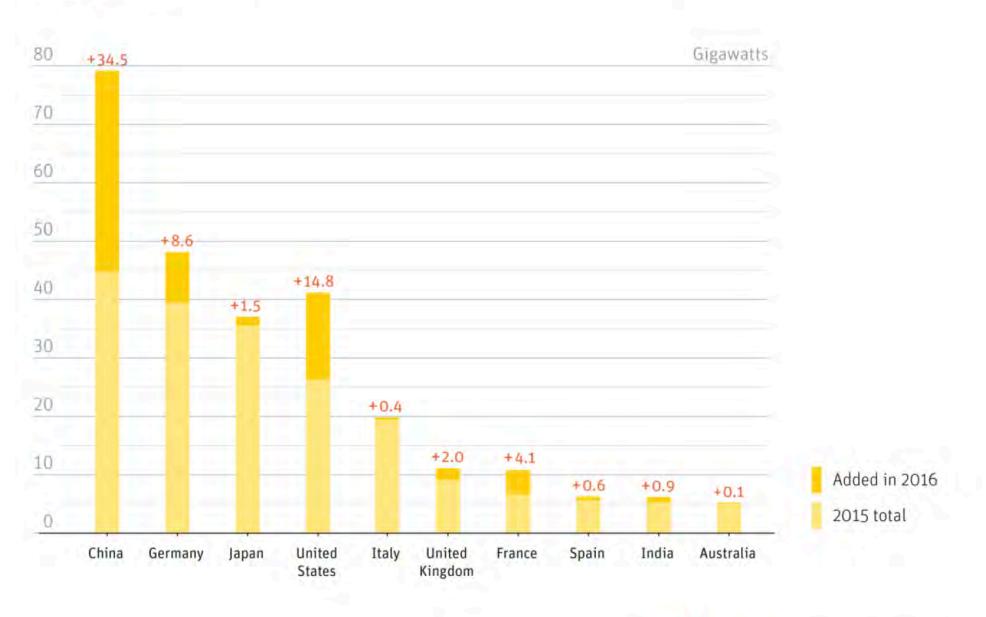


Germany is a leader in solar



Top 10 countries for solar power in terms of total installed capacity, 2016

Source: REN21, BNetzA





















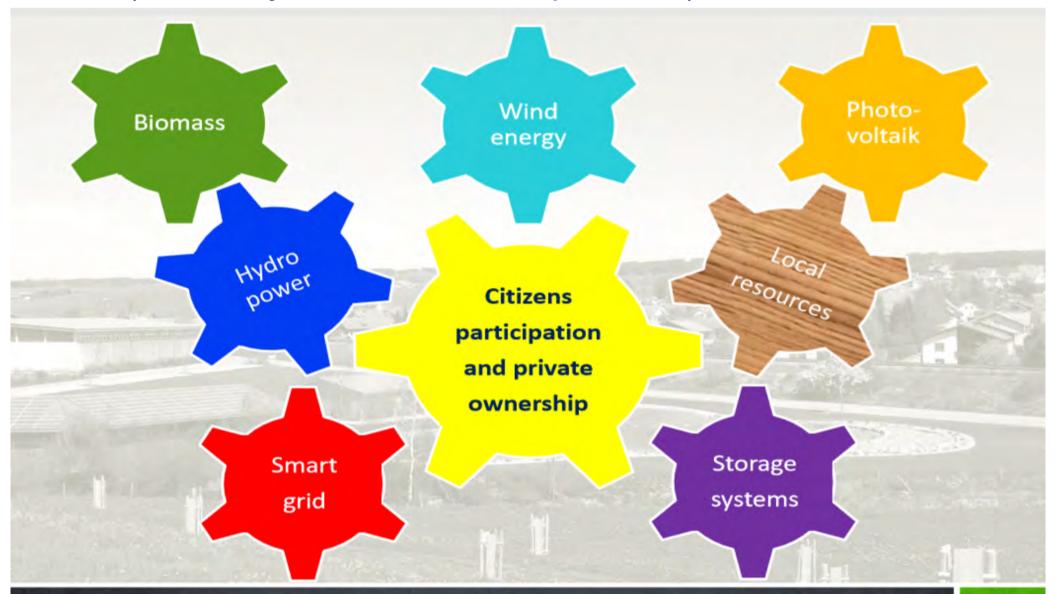


The energy village of Wildpoldsried





Goal: Meet **ALL** Energy needs with renewables (Electricity, Heat, and Transportation)









More than 350 private owners of photovoltaic (5.073 kWp) and 150 thermal solar plants (2.100 m²)



Participation of citizens

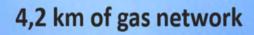




More than 400 private participators in wind turbines, only citizens of Wildpoldsried





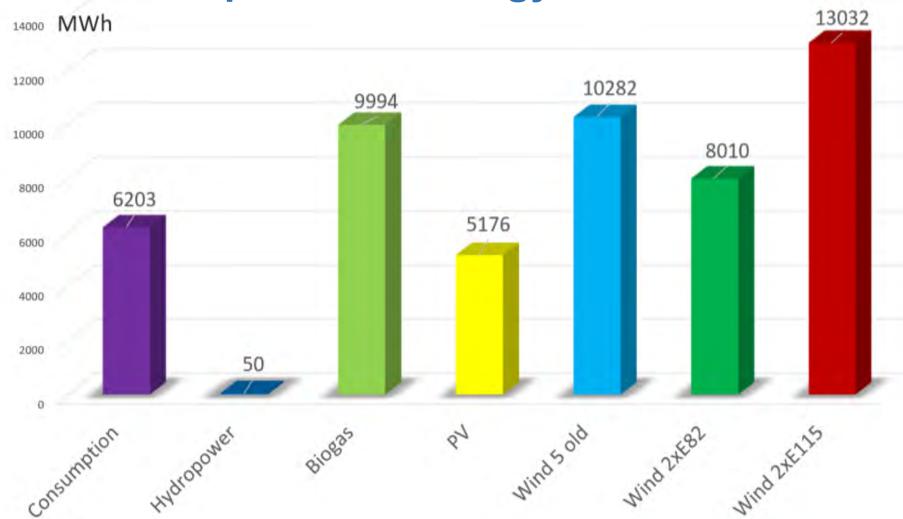


Heat



Heat

Wildpoldsreid Energy Production



together about 46544 MWh = 750%







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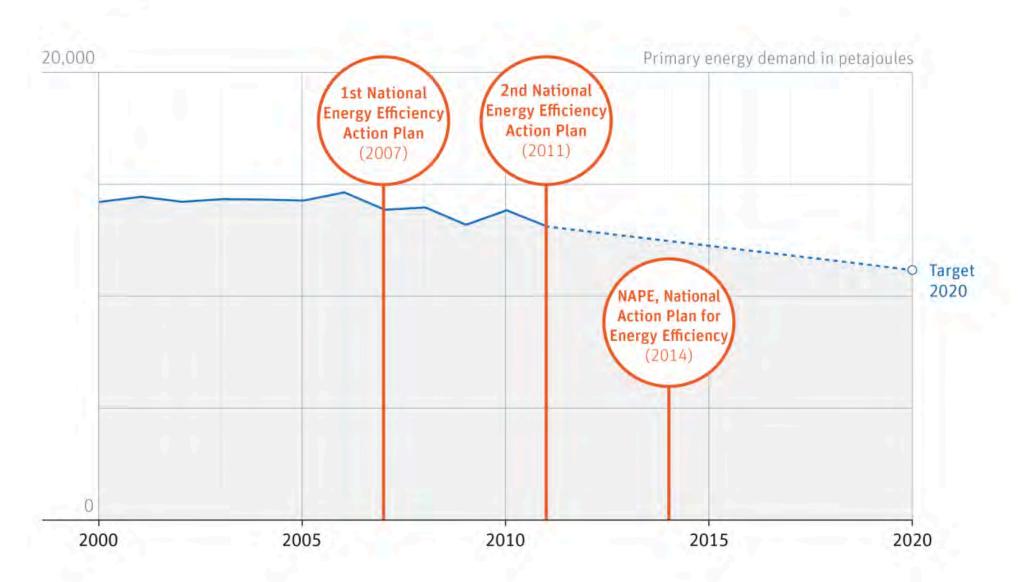


Germany's plan: drive down energy demand



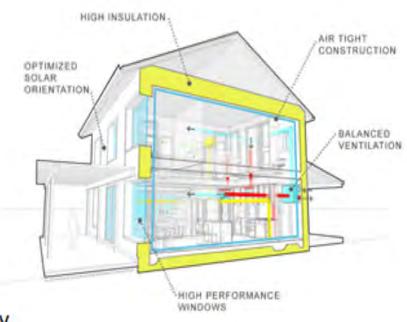
Primary energy demand in Germany, 2000-2020

Source: AGEB, BMWi



Passivhaus, Net Zero, and Plus Energy homes

- Passive House (Passivhaus)
 - Design to use much less energy than a standard home
 - Up to 90% savings!
- Net Zero Energy (NZE)
 - Energy Produced = Energy Consumed
 - One year time period
- Net Positive Energy
 - Energy Produced > Energy Consumed
 - One year time period
 - Offset electric vehicle use, embodied energy of building, etc.



Heliotrope

- Feat of sculptural architecture, built in 1994
- Passive house
- Dual axis solar + rotation
 - 30% more solar production
 - · Goes flat when storm is predicted
- Timber construction
 - <carbon footprint than concrete
- Solar thermal for showers and washing machine
- No external funding, difficult to mortgage
- · 200 m2 (2153 ft2)



https://eluxemagazine.com/homestech/what-thehecks-a-heliotrope-house/

Solar Settlement

- Built in the year 2000
- First neighborhood of plus energy houses
- 50 houses, 52 units (one is a two-family unit)
- Privately financed, investment scheme through a chocolatier turned energy & insulation entrepreneur
- Building costs extra 12% in construction
- 150 m² (1614 ft²) unit costs €890,000
 - · Typically 50% of income
- Had dual monthly meter at first, now realtime monitoring system
- District heating
 - Co-gen with wood chips or gas if needed



https://en.wikipedia.org/wiki/Solar Settle

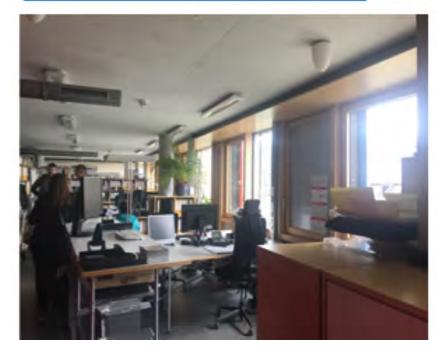


Sunship

- Built in 2006
- Home to Ökoinstitut (EcoInstitute)
 - Also shops, bank, other offices
- Night cooling with ventilation only
 - No mechanical cooling
- Vacuum capsule walls
- Manual ventilation for daytime
- Phase-change, paraffin plaster boards
- External blinds



http://www.rolfdisch.de/en/projects/the-sun-ship/



Bugginger Strasse 50 Bldg - Worlds First Energy Efficient Passiv Haus High Rise



Original 1968 – 21,500 BTU/ sq ft

Renovation 2009 → 4,700 BTU/ sq ft

Freiburg Town Hall – World's First Plus Energy Municipal Building

Opened in 2017



280,000 sq ft bldg.
220 kW of solar PV panels
Geothermal heat pumps for heat/cool
Hybrid solar PV//thermal panels for hot water & improved PV efficiency



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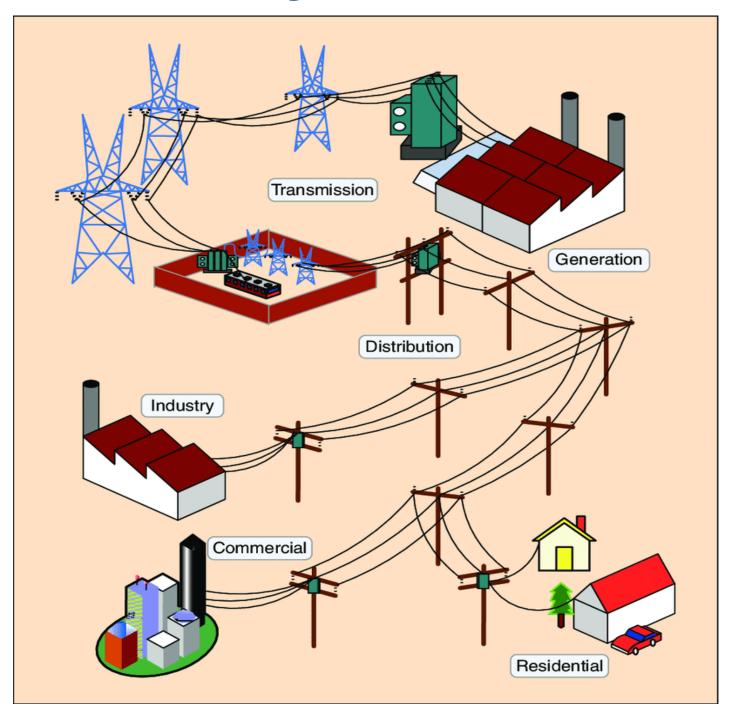


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Last Century's Electric Grid



Smart Grid







Electricity

Mobility

Business

Efficiency

Politics

Inte

24 Apr 2019, 17:27 Julian Wettengel

Renewables hit record 77 percent of German power on Easter Monday

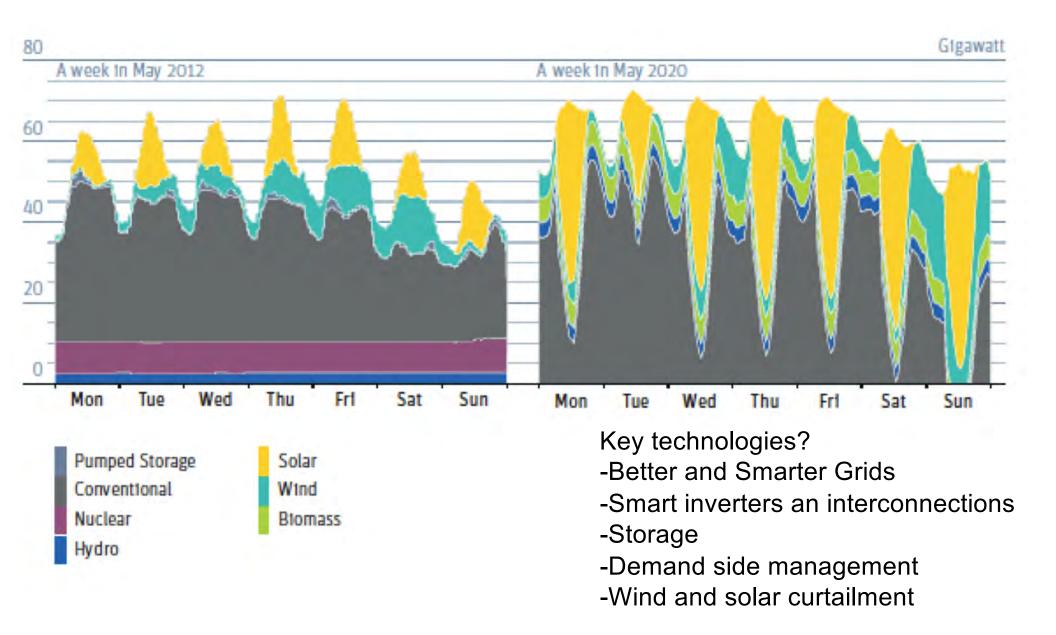
Wind provided 40% of total net power, solar 20%, and biomass 10%



Renewables need flexible backup, not baseload

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

Source: Volker Quaschning, HTW Berlin



2nd Pillar of the Energiewende: Future Grid Network Policies and German Network Development

2013 Network Development Plan led by Federal Network Agency

> Identified need for over 3800 km of new transmission (HVDC)

 Financing mechanisms in development

Grid Expansion Acceleration Act (NABEG)

Additional efforts on energy storage:

- Pumped hydro
- Power to gas
- EU electricity grid interconnection
- Research funding
- Smart Grid and E-Energy pilot communities
- Demand-side management

















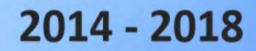
Smart Grid pilot project from 2011 to 2013

IREN2 Goals:

- Microgrid feasibility
- Microgrids as topological power plants
- Integration of operational management and power markets













- Development of a local platform for energy tradings, based on blockchain technology
- Development of business models for the local energy market of the future
- More efficient use of the energy grid through motivation to "grid friendly behaviour" of the participants
- Savings in the energy grid through active identification of prosumer activities...













- Made in "Wildpoldsried"
- lithium ion battery storage system
- fully integrated and smart
- automatically maximises selfconsumption
- from 2 16 kWh
- 10000 charge cycles
- 10 years warranty
- starts at 3500€

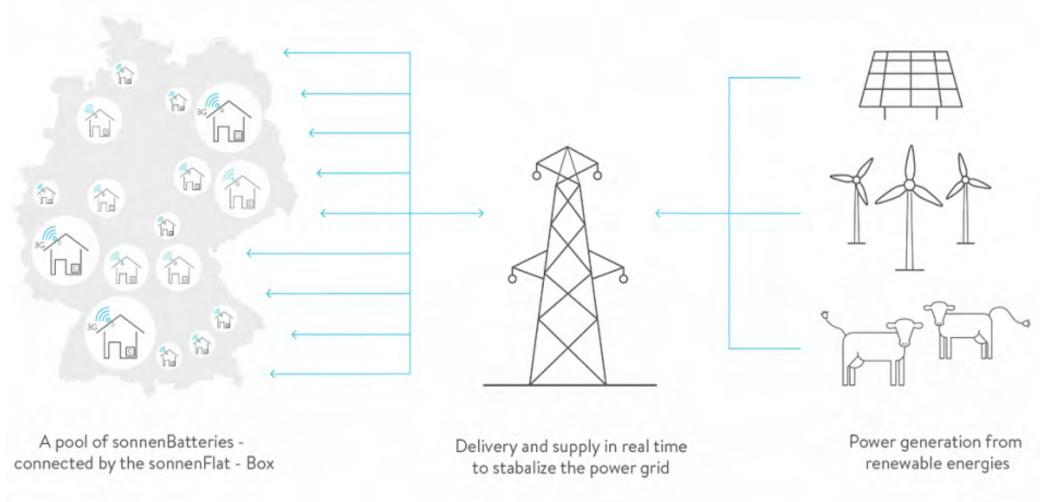








Sonnen Virtual Utility



The Sonnen community connects thousands of SonnenBatterie users and combines many individual home storages into a giant pool of batteries. This "virtual storage" is large enough to buffer vast amounts of energy thereby helping to stabilize the public power grid.

What about in the U.S.?

We are already seeing a similar energy transition starting to take hold in the states.

The U.S. is well positioned to follow Germany's lead.

Can Wildpoldsreid be a model for WI communities?

Lastly - What does this mean for students?

- 1)Energy of the future, will be different from today (fossil fuels → renewables)
- 2) Stay educated to be a smart consumer!
- 3) Energy science will play a larger role in the future for many traditional STEM careers
- 4)Students with interest in this topic should look for opportunities to include renewable energy and energy storage in their academic studies



Questions?

For more info, please see our Germany Study Abroad Blog at:

www.CreateEnergy.org