

Present Status of Energy Sector in Germany



Dnipro, April 12th, 2018
Presenter: Carsten Drebenstedt



Outline

- **Energy status in Germany 2017**
- **Conventional energy sources**
- **New energy sources**
- **Conclusion**

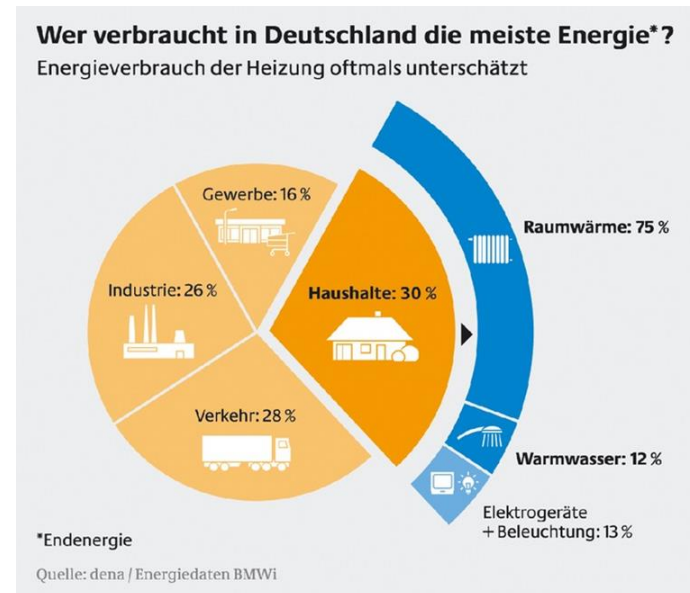
Short Basics of Energy

- Primary energy:

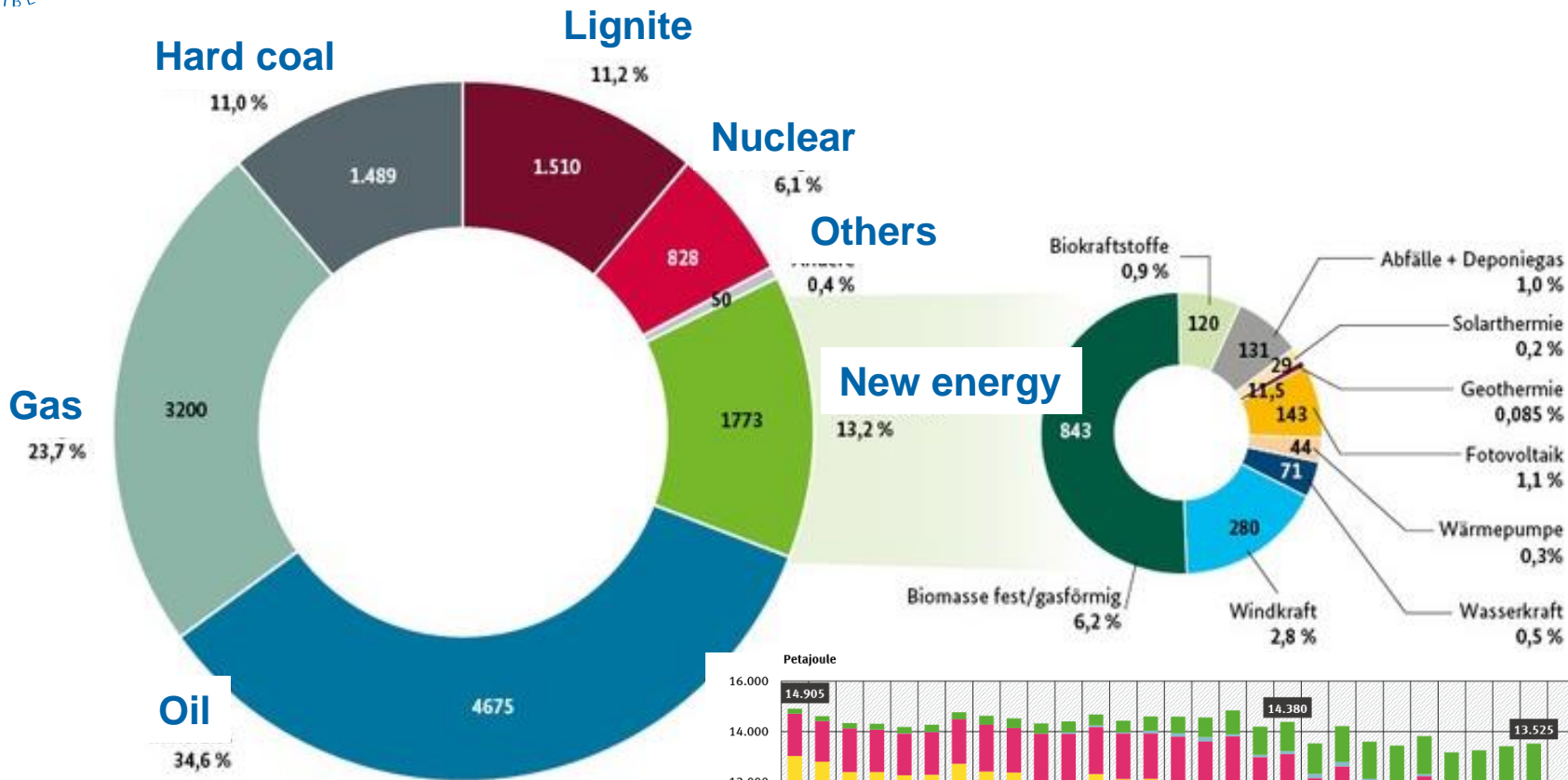
- Heat, 50%
- Mobility, 27%
- Electricity, 23%

- Who consume?

- Households, 30%
- Transport, 28%
- Industry, 26%
- Business, 16%

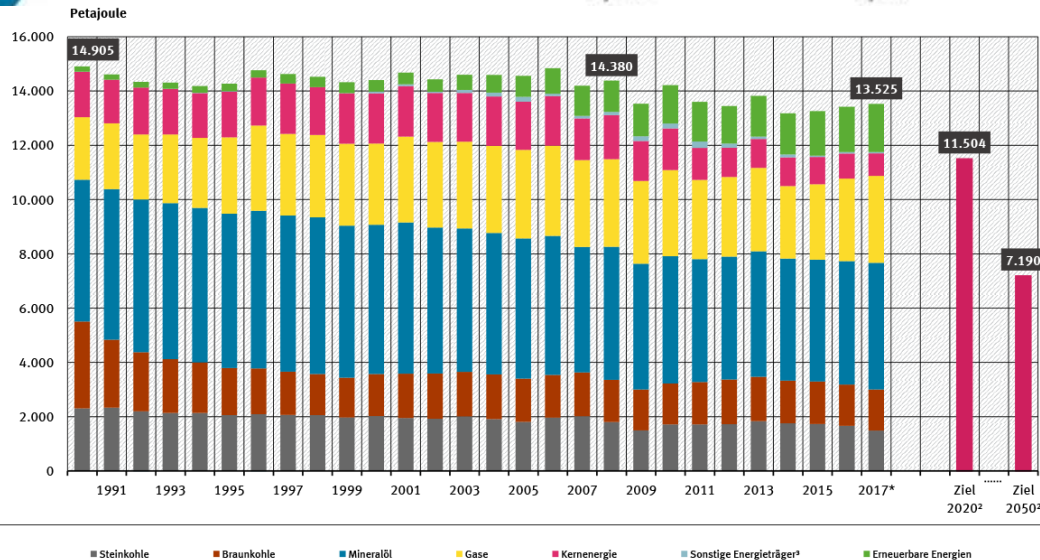


Primary energy consumption in Germany 2017



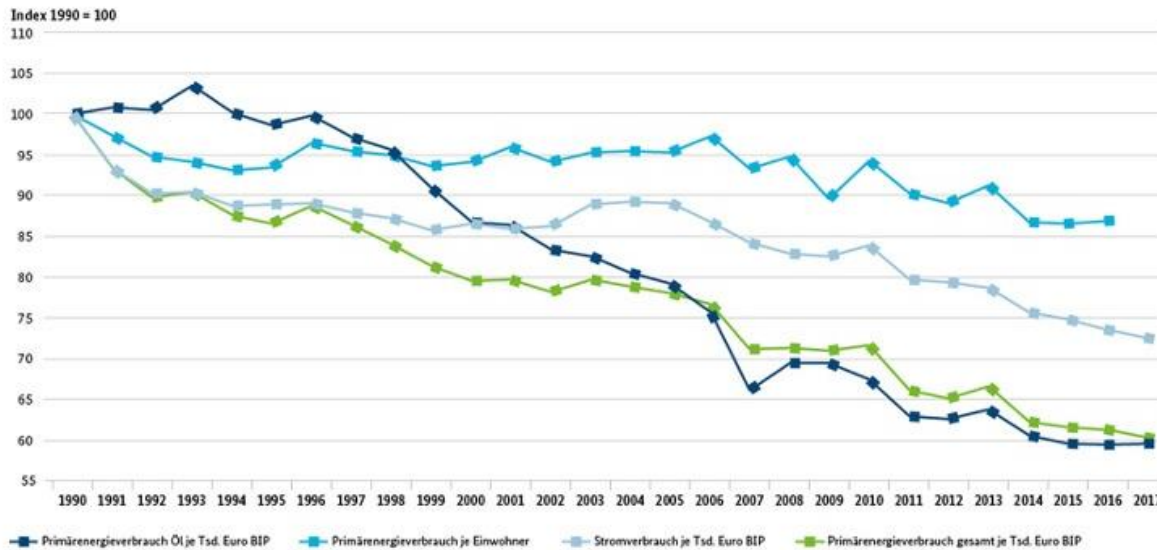
* Vorläufig

Development of primary energy consumption and political targets

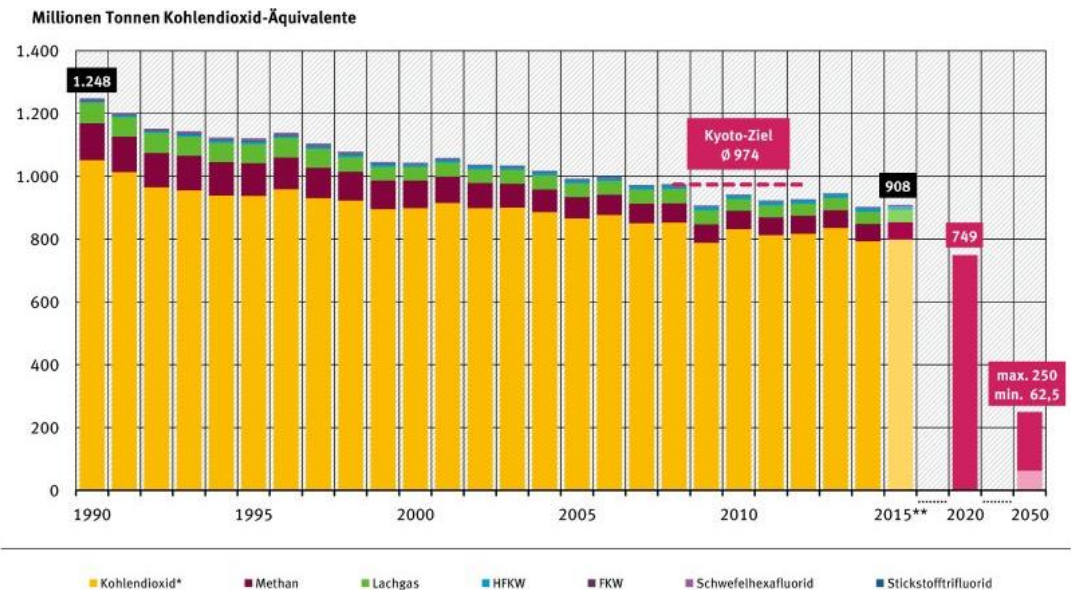


Energy-/ Gas-Emission-Intensity in Germany

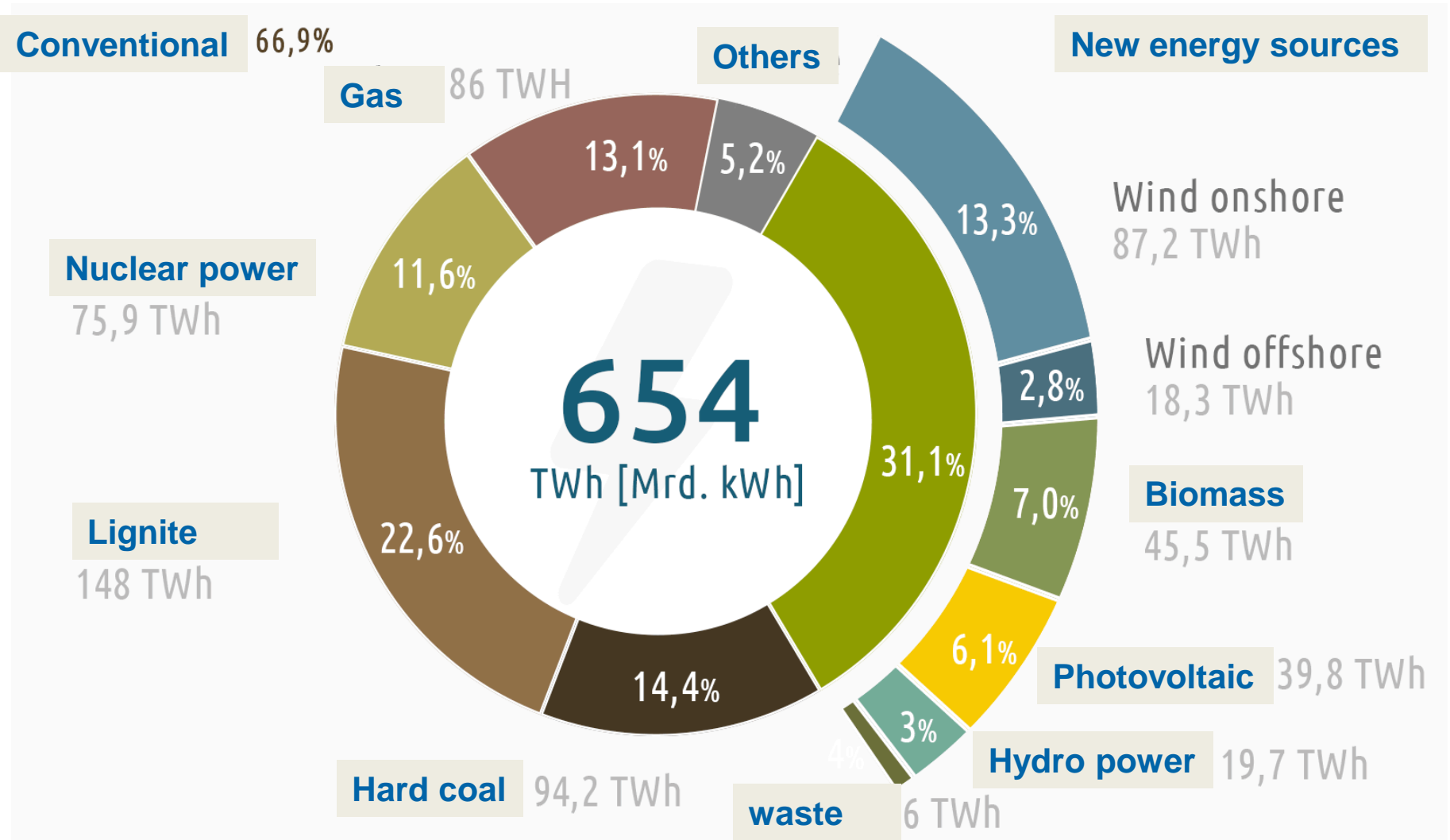
Development of energy-intensity



Development of gas-emission-intensity
Consumption and political targets

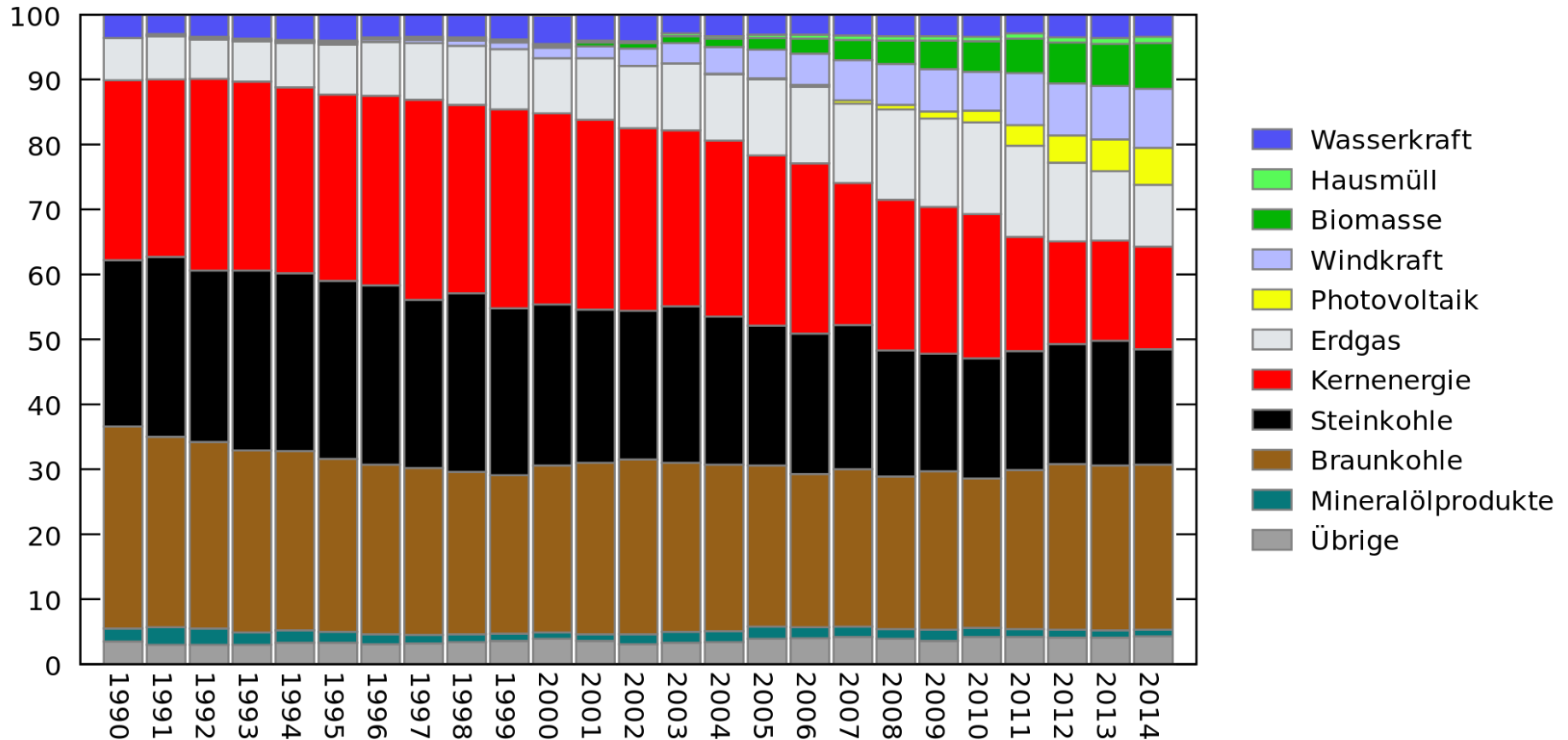


Power Generation in Germany 2017 (Brutto)

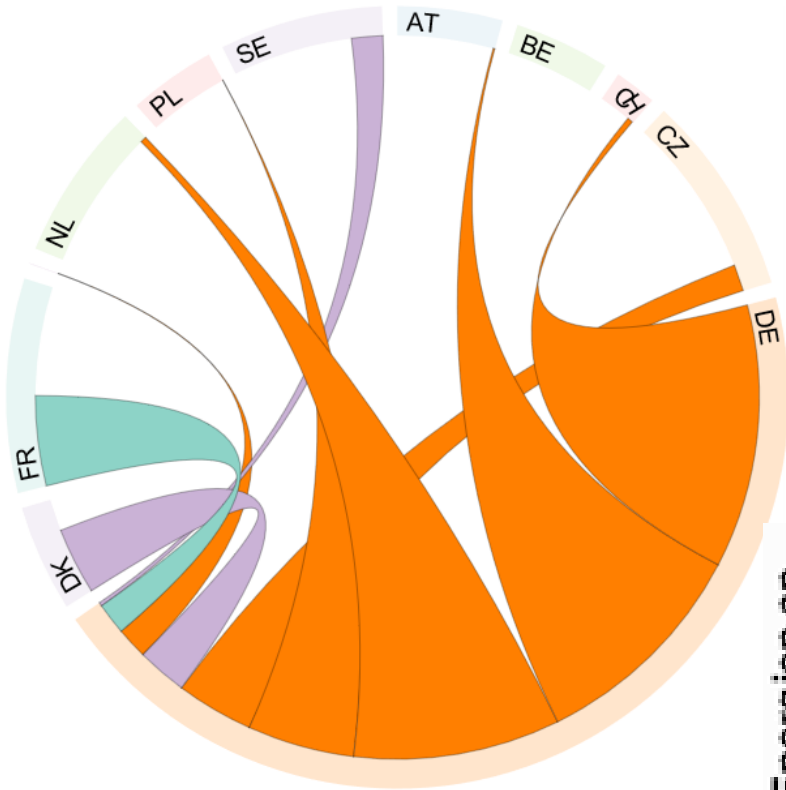


Share of Sources in German Electricity Production

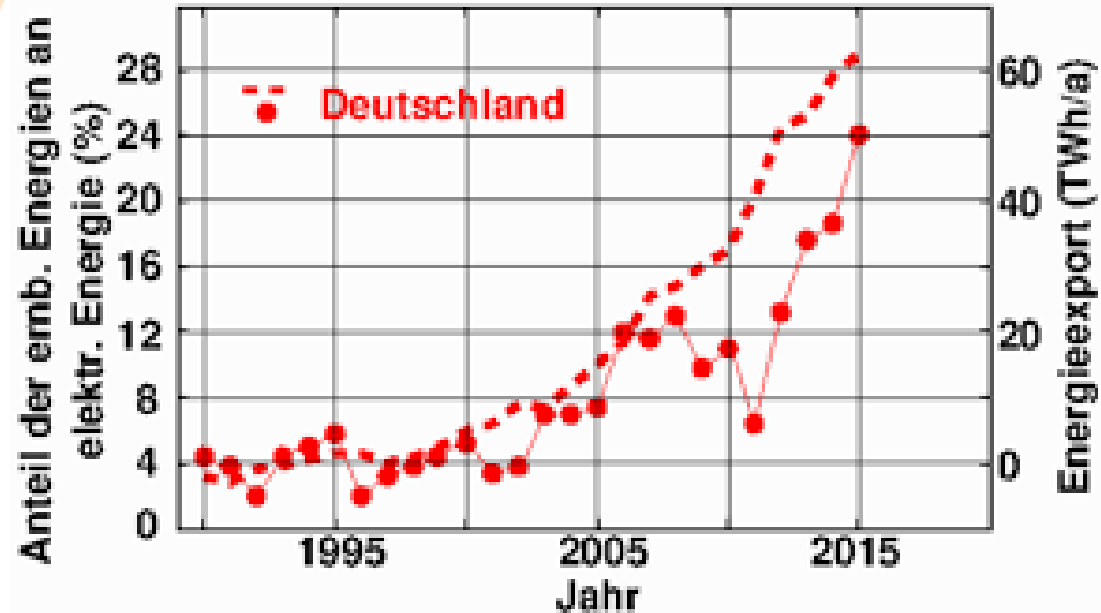
Bruttostromerzeugung in Deutschland nach Energieträgern 1990 - 2014 in Prozent



Electricity Export/ Import Germany 2017



Development of renewables and energy export in Germany





Conventional sources of energy

- Heat:

- **Gas (plus electricity), Oil , Coal**

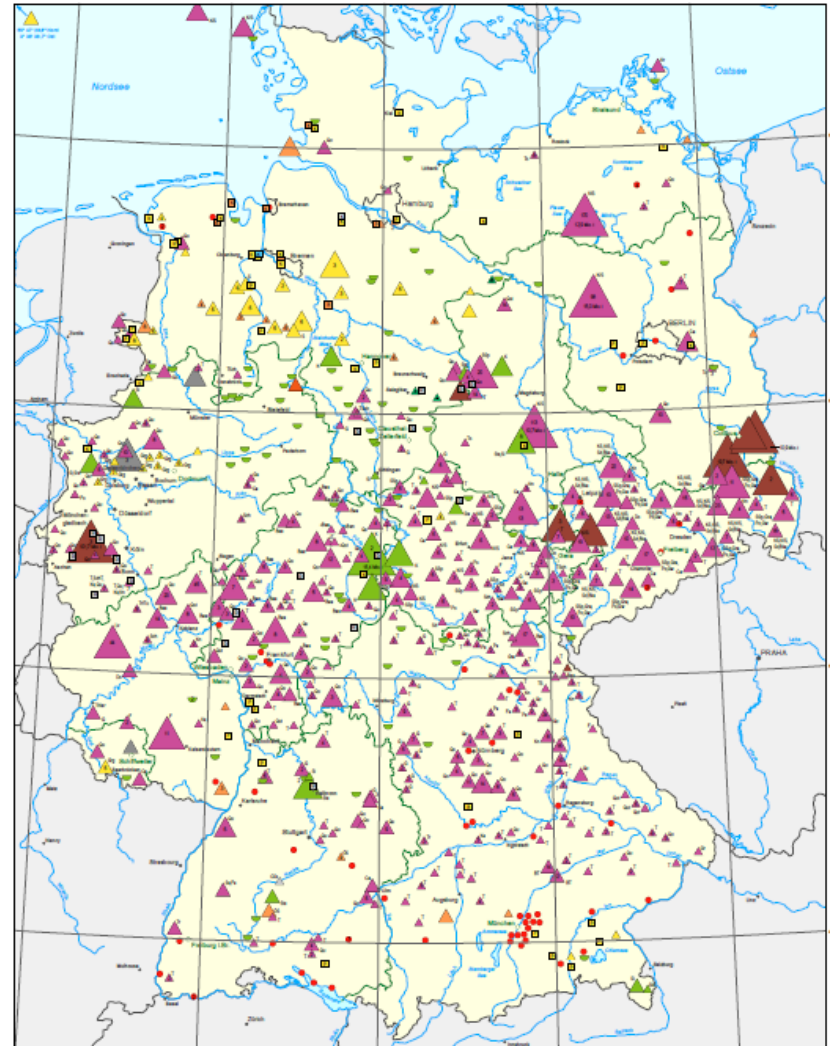
- Mobility:

- **Oil/ Gas**

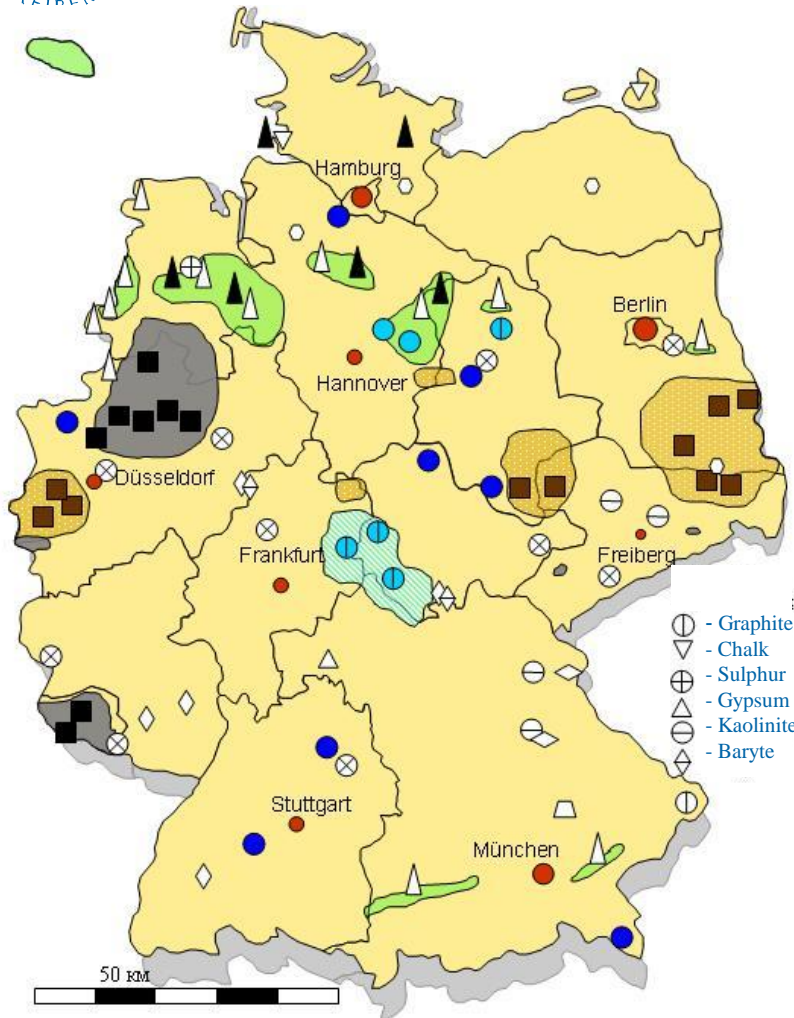
- Electricity:

- **Nuclear (closure of 18 NPP up to 2022)**
- **Coal**
- **Gas**
- **Hydropower**

Geology and Raw Material Production in Germany



Reserves Map and Mining in Germany



- ⊖ - Graphite
- ▽ - Chalk
- ⊕ - Sulphur
- ⊖ - Gypsum
- ⊖ - Kaolinite
- ⊖ - Baryte

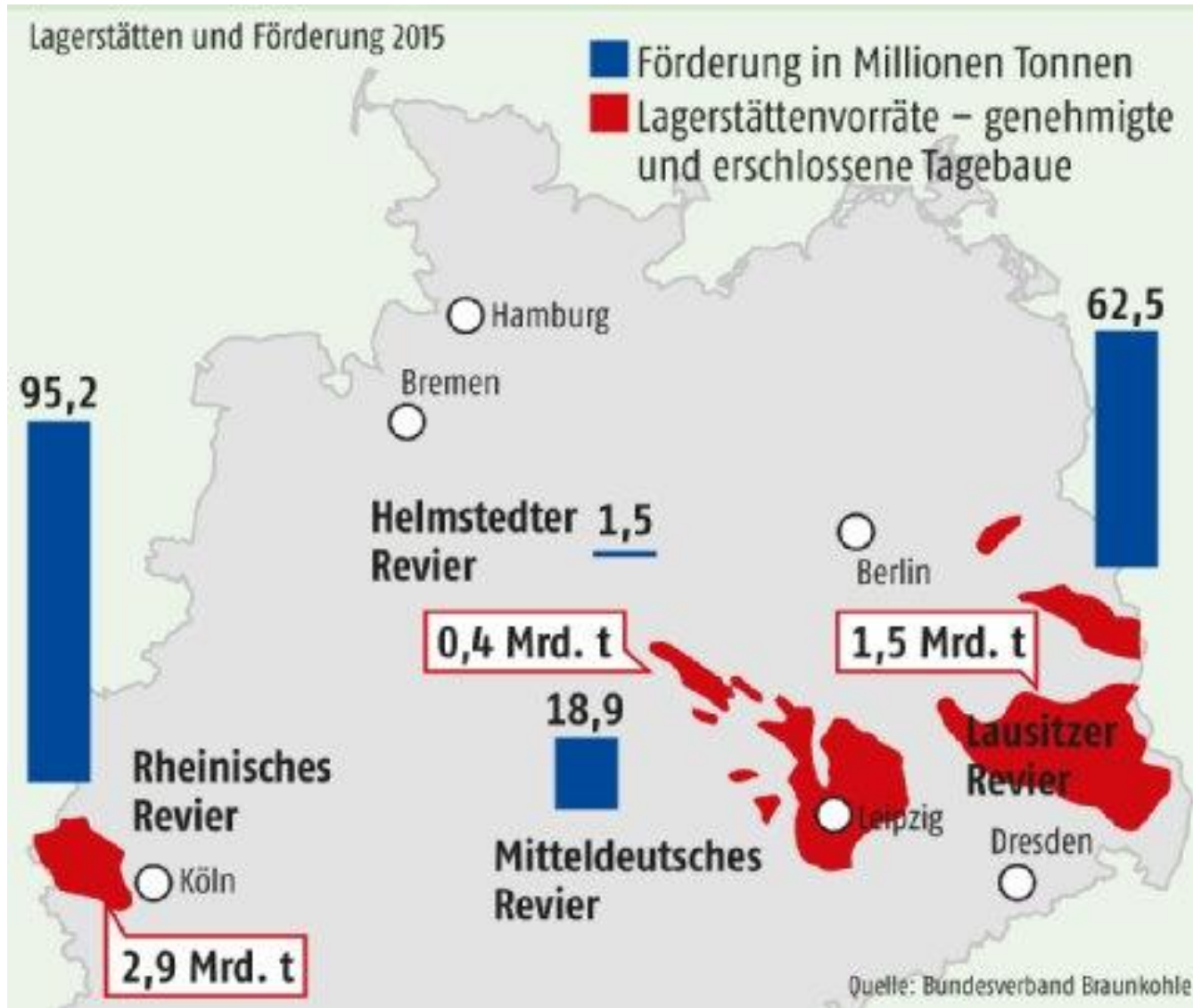
- ▲ - Oil
- ▲ - Natural Gas
- - Lignite
- - Rock Salt
- - Potash
- - Gas Fields
- - Lignite Districts

- - Hard Coal Districts
- - Potash Districts
- - Lime
- - Bentonite
- ◇ - Spar
- ◇ - Fluotite
- ◇ - Peat

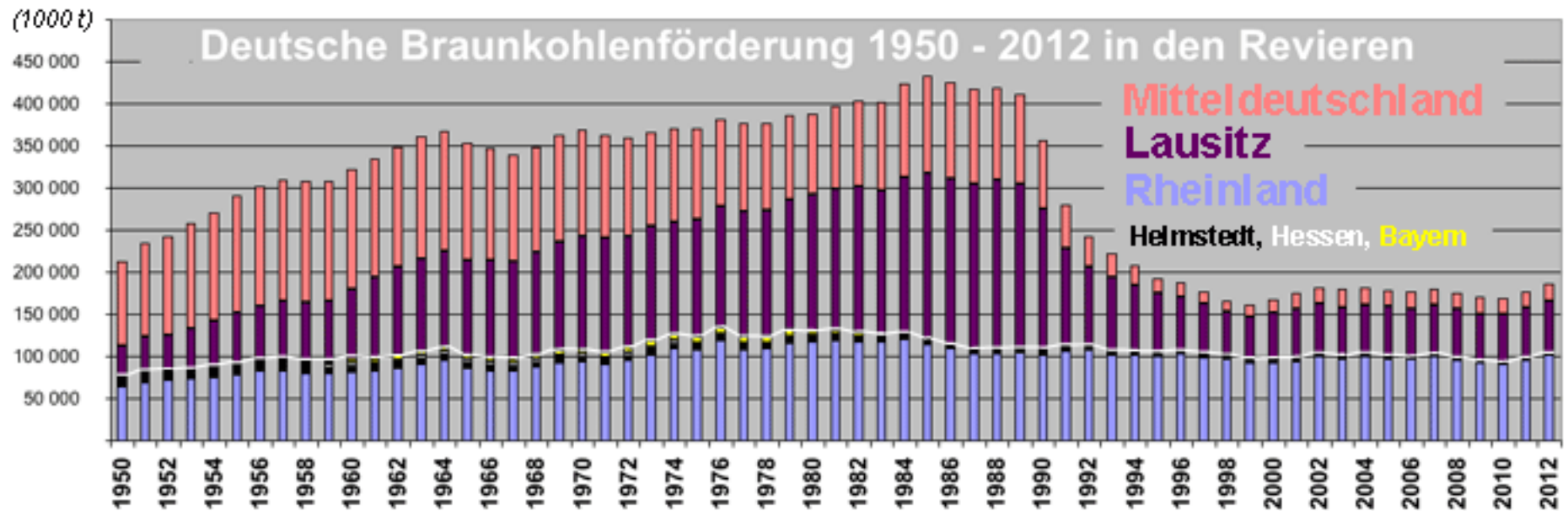
Raw Material	Annual production	Ranking
Lignite	180.0 Mt	1
Hard Coal	6.0 Mt	
Natural Gas	12 Bm ³	
Natural Oil	2.4 Mt	48
Potassium (K ₂ O)	3.6 Mt	3
Hard Salt (NaCl)	15.1 Mt	3
Feldspare	2.2 Mt	3
Gypsum/Ahydrite (natural)	2.6 Mt	9
Kaolinite	3.4 Mt	2
Bentonite	0.5 Mt	6
Sand/Gravel	320.0 Mt	
Hard Rock	140.0 Mt	
Lime	73.0 Mt	
Clays	30.0 Mt	
Special Sands	11.5 Mt	

...

Lignite Reserves and Production in Germany



Lignite production in Germany



Lignite Mining Technology



Lignite Mine Closure in Germany (10 B€/ 25 years+)



Lignite Mining - Protests



(c) 2015 Elmar Aretz



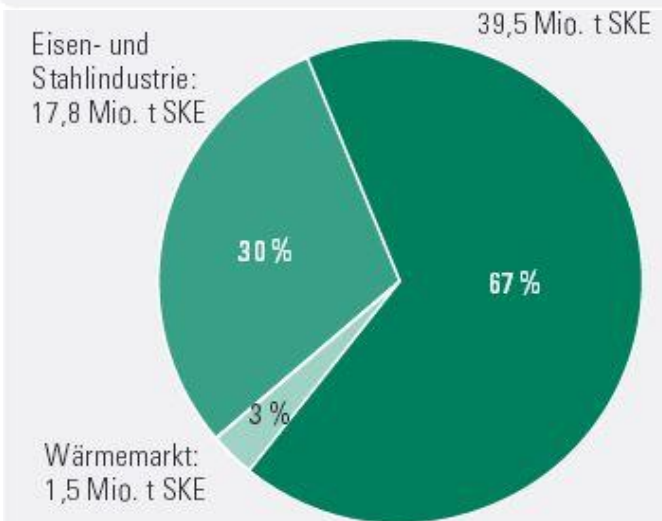
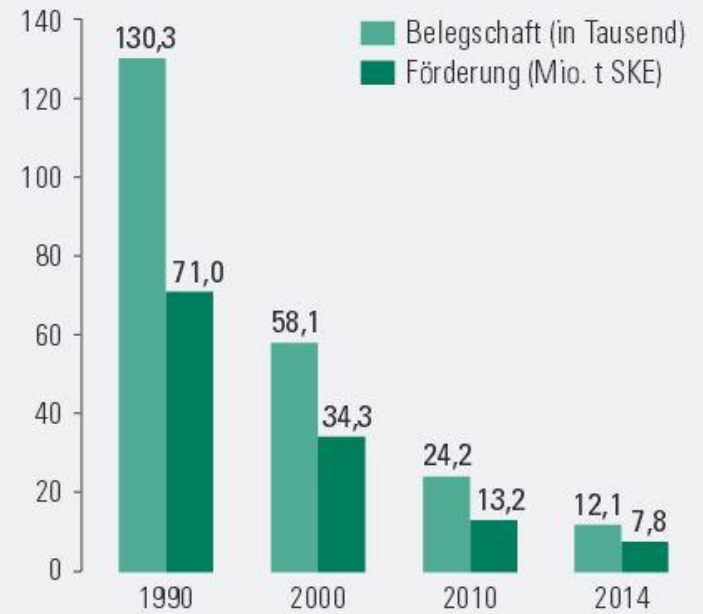
Lignite Mining - Basics

- **Reserves for 100 years**
- **Permissions for 10 mines up to 2040/ 2050 (180 Mt)**
- **High environmental and safety standards**
- **Low emission power plant (Oxyfuel Power Plant 50 MW)**
- **Low cost electricity and heat**
- **High supply security Valuable working places**
- **Acceptance in the Society (CO₂)?**
- **Mine Closure: Mining temporary impact**
- **Perspectives of Coal Benification**
- **High performance mining manufacturers**

Hardcoal Mining - Production



Anpassung im deutschen Steinkohlenbergbau



Hard Coal Production/ Usage – Imports, Perspective

Entwicklung der Marktanteile importierter und heimischer Steinkohle in Deutschland

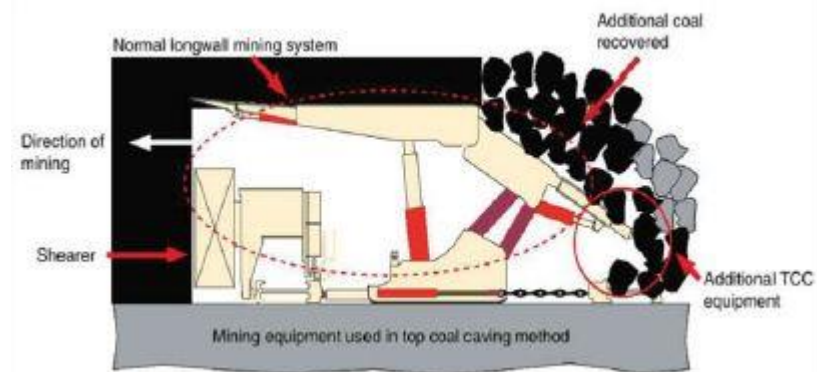
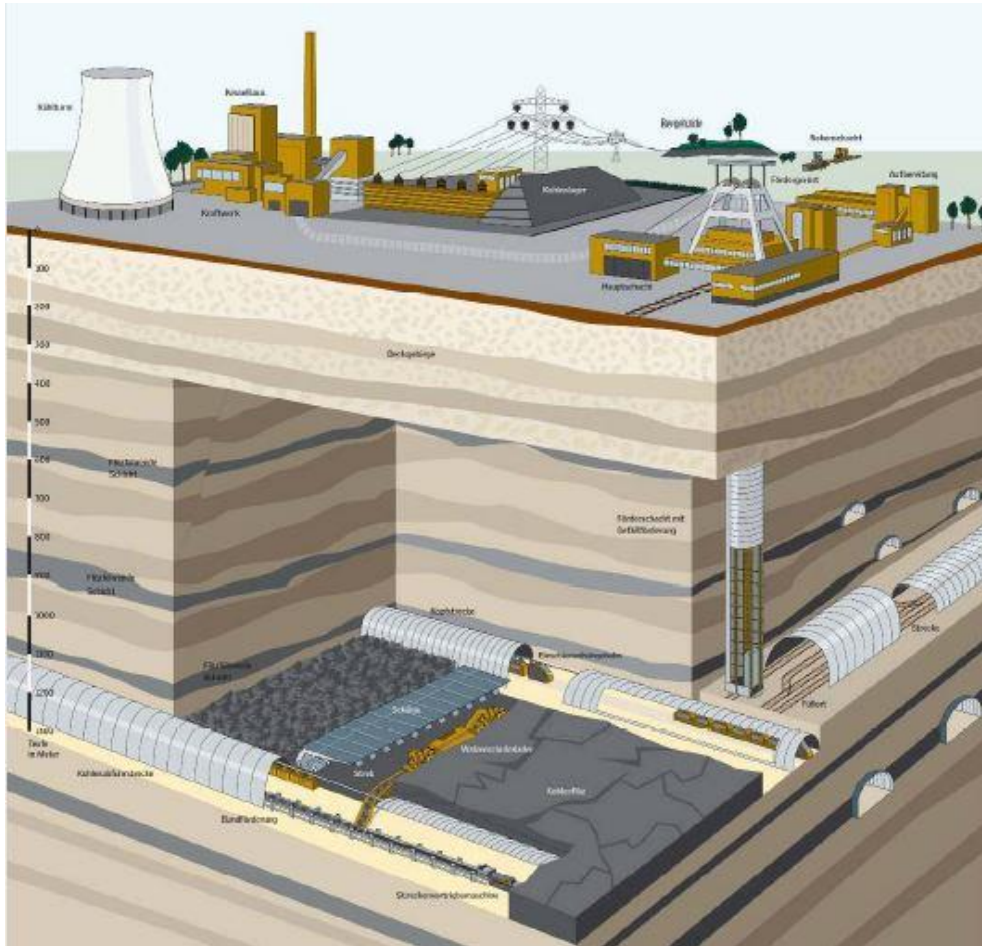


Inländischer Gesamtverbrauch an Steinkohle bis 2050 gemäß Energiereferenzprognose von 2014



Quelle: Energiereferenzprognose EWI/GWS/Prognos 2014, Basisjahr auf 2014 aktualisiert

Hard Coal Mining Technology – Long wall mining



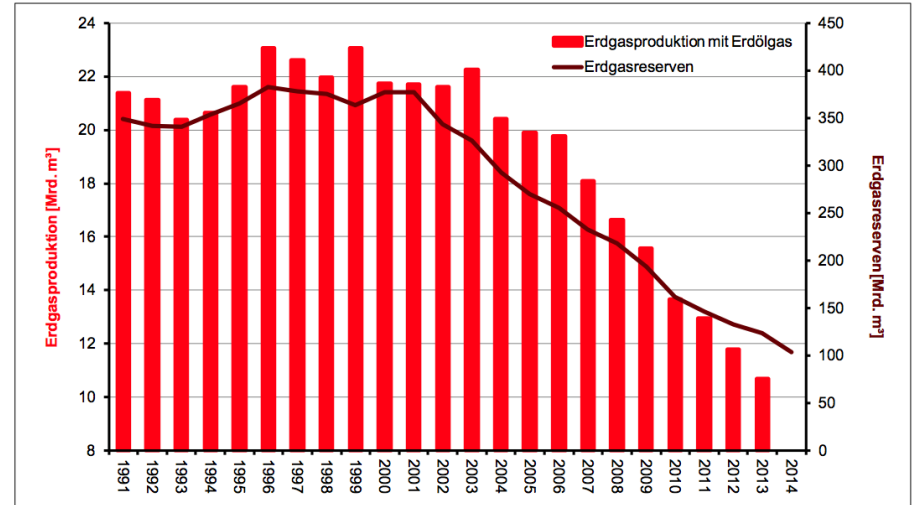


Hard Mining - Basics

- Reserves for >100 years
- High environmental and safety standards
- Supply security high
- Valuable working places
- High costs
- Mine Closure in 2018/ imports
- Steel industry (coking coal)?
- High performance mining manufactures'



Oil and Gas Deposits in Germany



Development of Production and reserves

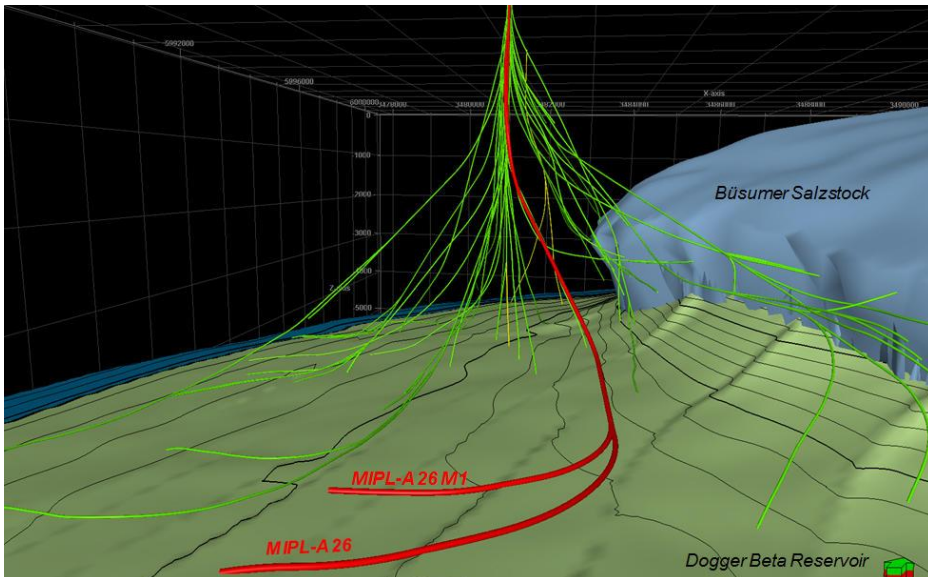
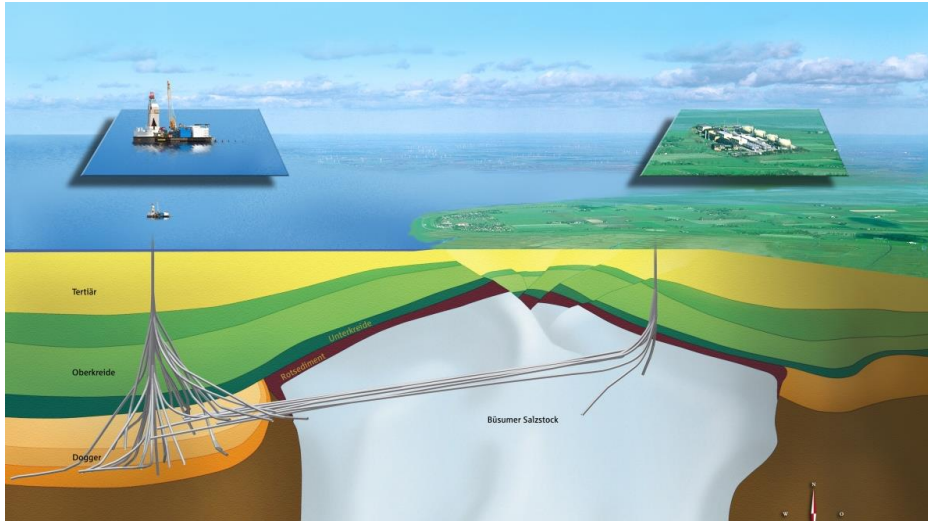
Shares of Natural Gas suppliers



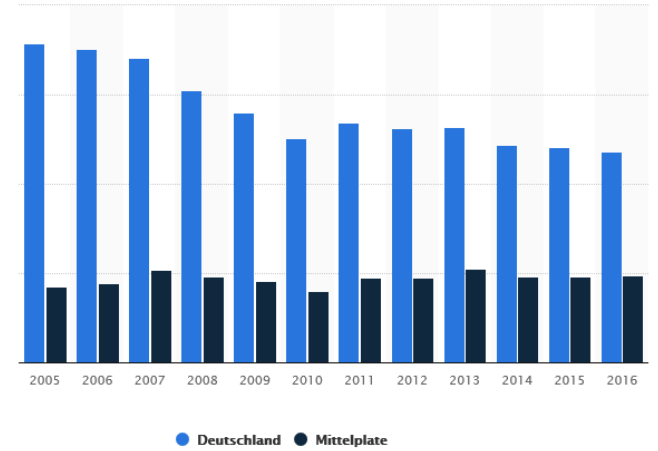
Mrd. m³ *vorläufig, Quelle: Arbeitsgemeinschaft Energiebilanzen

Natural Oil

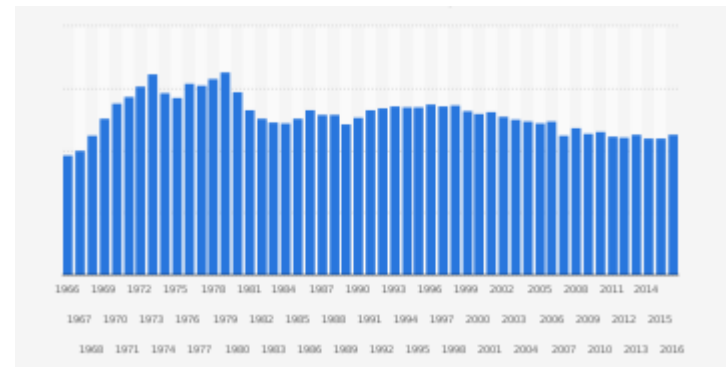
Oil Deposit Mittelplate



Development of Oil Production in Germany



Oil Consumption in Germany



Nuclear Power Energy in Germany



Development of nuclear power plant closure



- Abschaltungen 2011
- Abschaltungen 2015-2022*

Zukünftige Entwicklung der installierten Leistung der Kernenergie in Deutschland (in MW)



* bei Erreichen der in Anlage 3 AtG festgelegten Reststrommengen, spätestens jedoch mit Ablauf des 31.12. des jeweiligen Jahres
 Quelle: Atomgesetz (ATG) §7

Final Storage of nuclear waste?



What energy transition is?

- **Main target:**
 - **Avoid climate change**
 - **Reduction of CO₂ emissions**
- **How to achieve?**
 - **Reduction of use of coal, hydro-carbonates**
 - **Develop of new energy sources (natural limits, priority in net, ...)**
 - **Reduce energy consumption (back calculation)**
 - **Import of energy**
 - **Development energy infrastructure**



What energy transition is?

- **What to do?**
 - **R&D, technology development**
 - **Economic stimulation**
 - (subsidies 2017, 23 bn €/a for 20 year)



New sources of energy

- **Heat (share new sources 2017, 5%):**
 - **Biomass (plus electricity production)**
 - **Heat pump (need electricity)**
 - **Geothermal sources (fracking?)**
 - **Solar**
 - **Hydrogen (need electricity)**
- **Mobility (share new sources, 10%): Biofuel, Electricity**
- **Electricity (share new sources 2017, 31%):**
 - **Wind**
 - **PV**

New sources of energy

- Challenges:

- **Natural limits (biomass, sun, wind)**
- **Availability (sun, wind)**
- **Different regions of sources and demand**
- **Costs of energy**
- ...

- Solutions:

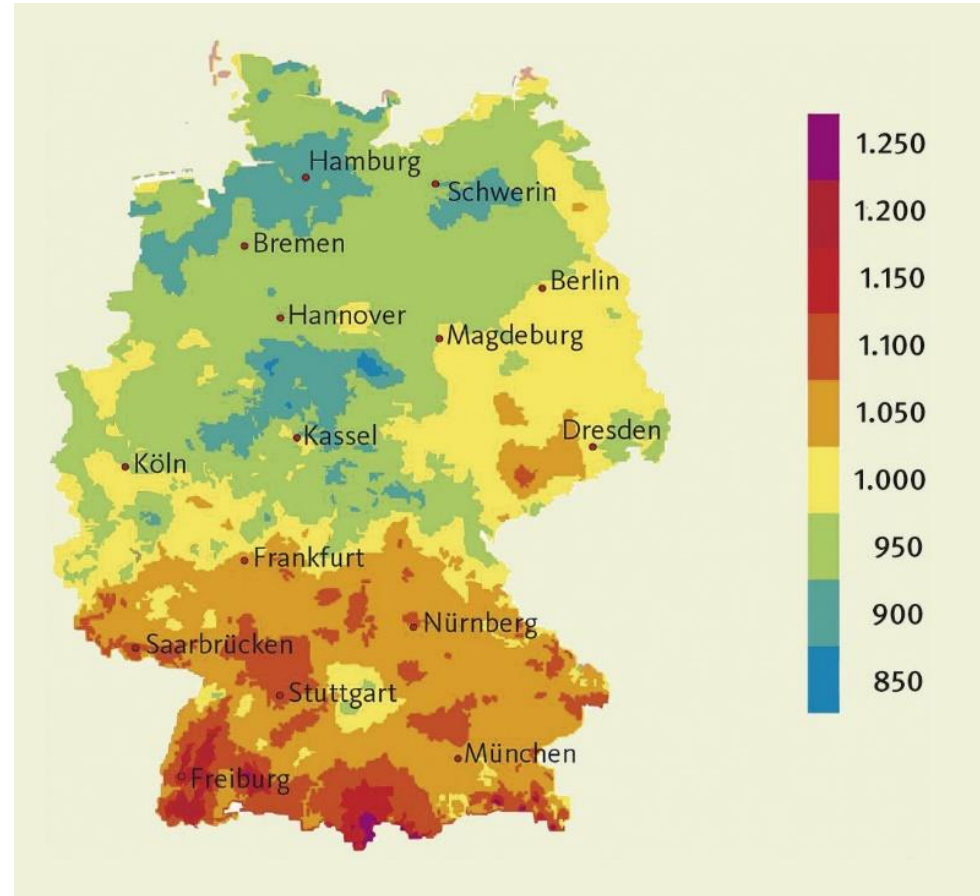
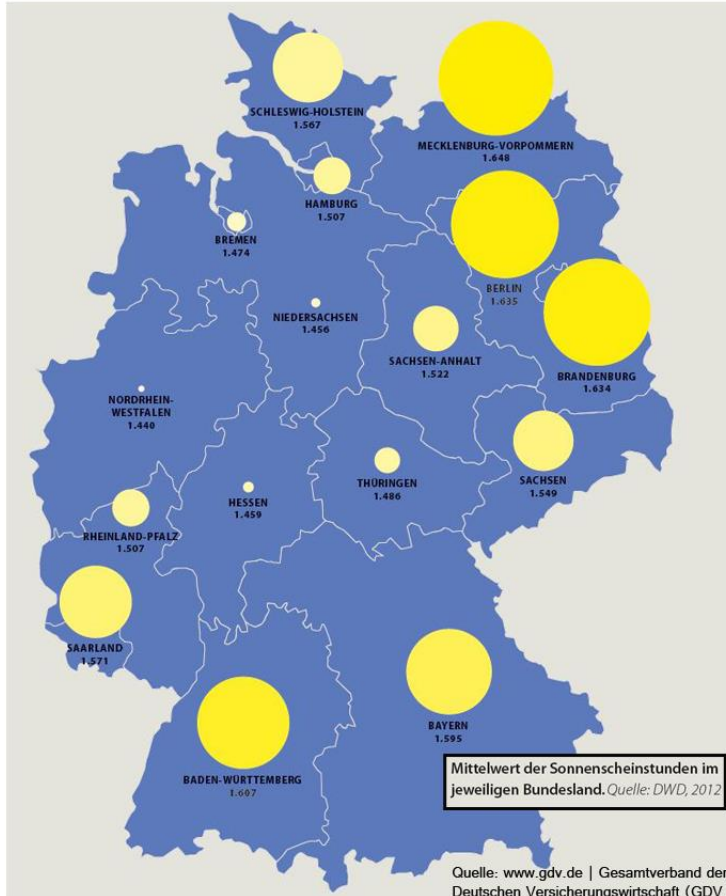
- **Storage facilities (batteries, ...), R&D**
- **Net extension (powerlines,), permission**
- ...

Hours of sunshine in Germany

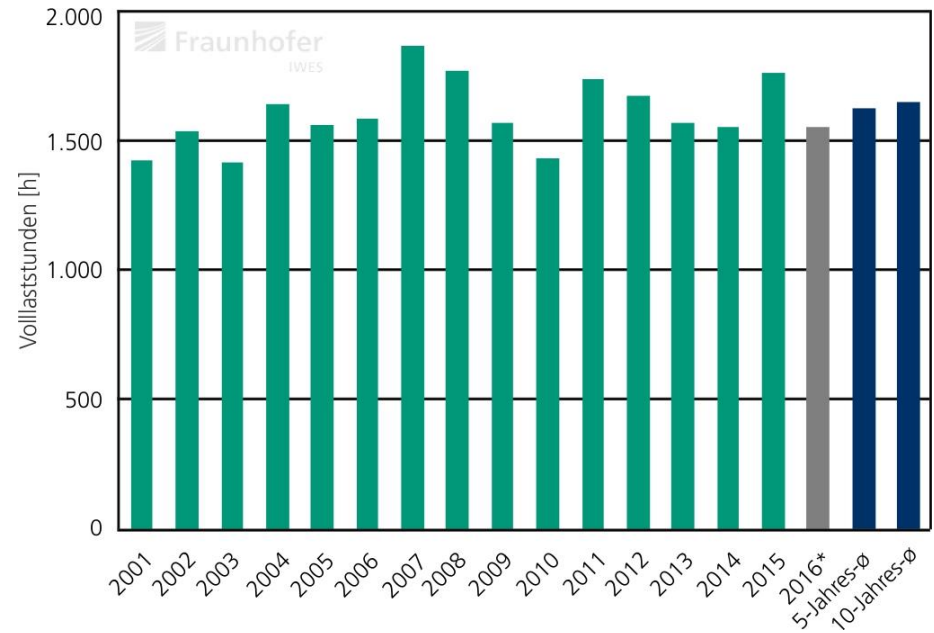
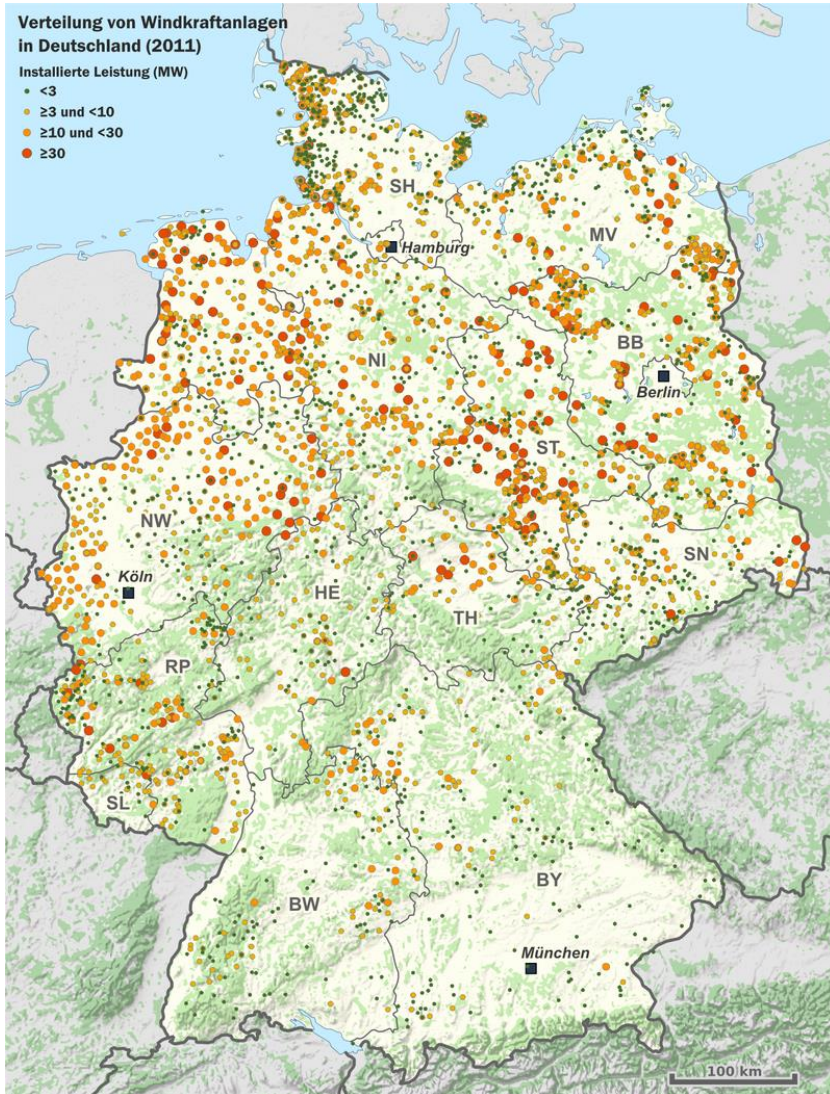


Sonniger Norden

Mecklenburg-Vorpommern mit den meisten Sonnenstunden



Windparks in Germany



Entwicklung der Onshore-Volllaststunden für Gesamtdeutschland

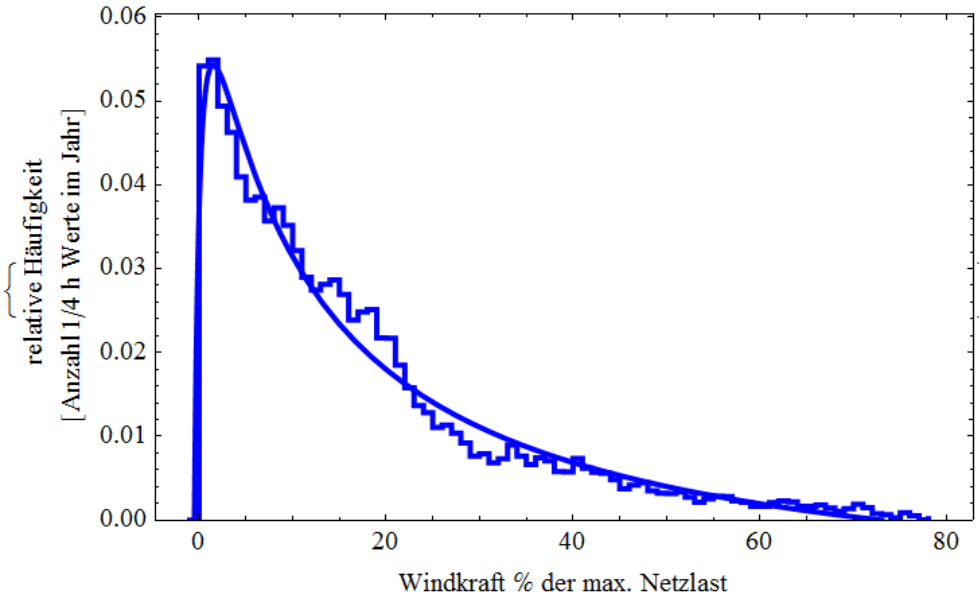
Datenquellen: [\[Keiler and Häuser\]](#), [\[BNetzA\]](#), [\[UeNB\]](#), [\[Hochrechnung TenneT TSO\]](#), [\[Hochrechnung Amprion\]](#), [\[Hochrechnung 50Hz\]](#), [\[Hochrechnung TransnetBW\]](#)

Windparks in Germany



Probability-Density Function

Häufigkeitsdichte Windkraft



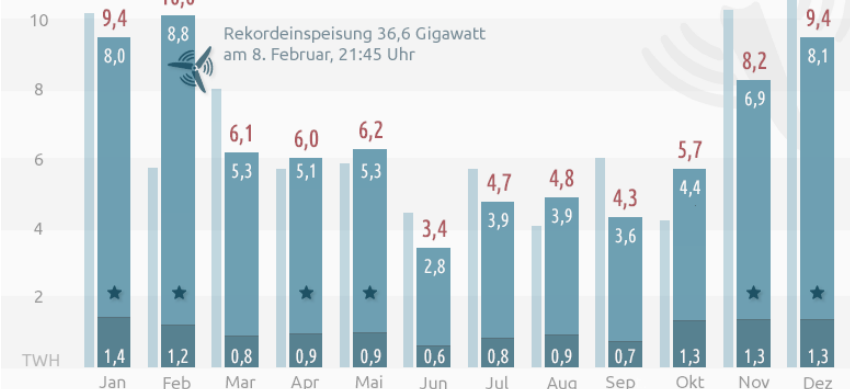
Monthly availability over the year

STROMERZEUGUNG AUS WINDENERGIE 2016

Monatliche Windstromproduktion in Deutschland [On- und Offshore]

⚡ Onshore: 66 TWH [Mrd. kWh] 2016 ⚡ Offshore: 12 TWH 2016 ⚡ 2015

★ Monate mit mehr Windstrom als Atomstrom



Quelle: Fraunhofer ISE, ÜNB, EEX

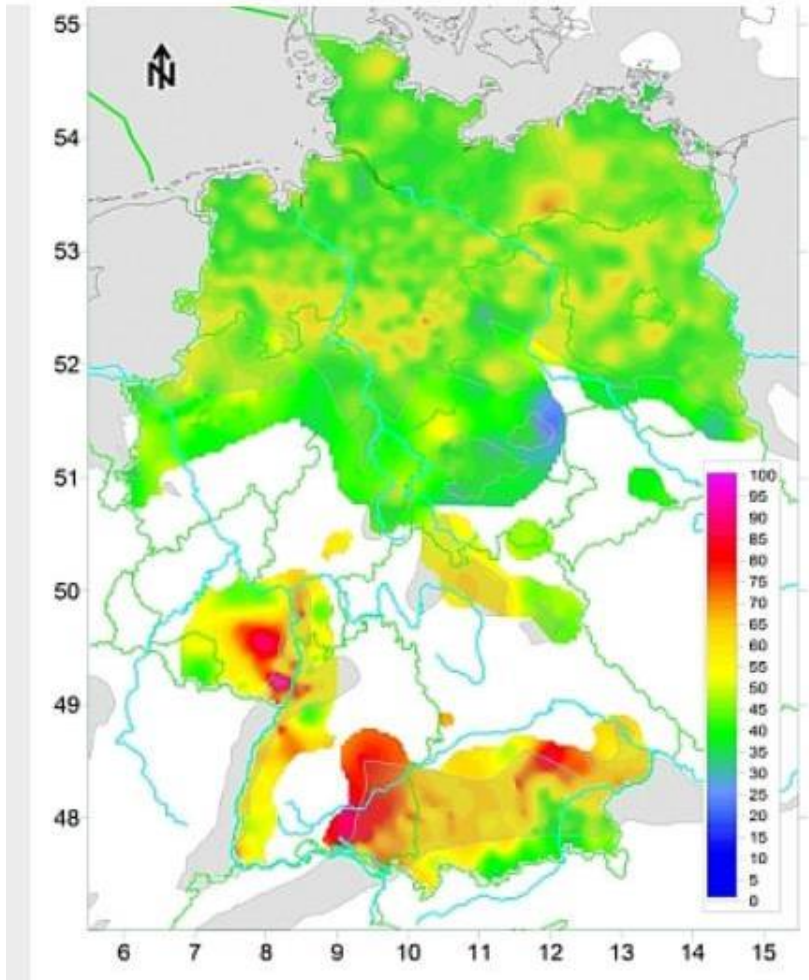
Datum: 13.01.17

STROM-REPORT

Geothermal and shale gas potential in Germany

Geothermal energy areas

Shale gas potential areas

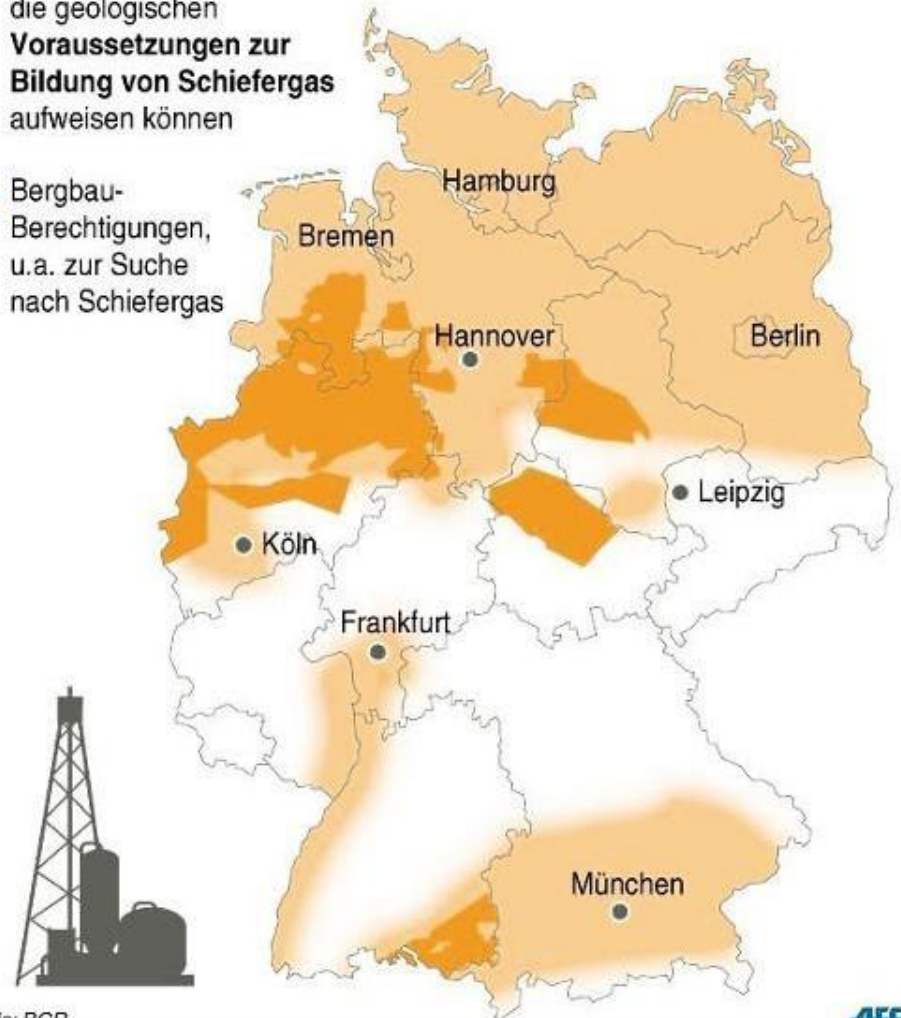


Karte mit der Verbreitung der tiefen Sedimentbecken (grau) in Deutschland und Darstellung der Tiefentemperaturen [°C] in 1000 m Tiefe (blau bis violett)

Quelle: BGR

Regionen, die grundsätzlich die geologischen Voraussetzungen zur Bildung von Schiefergas aufweisen können

Bergbau-Berechtigungen, u.a. zur Suche nach Schiefergas



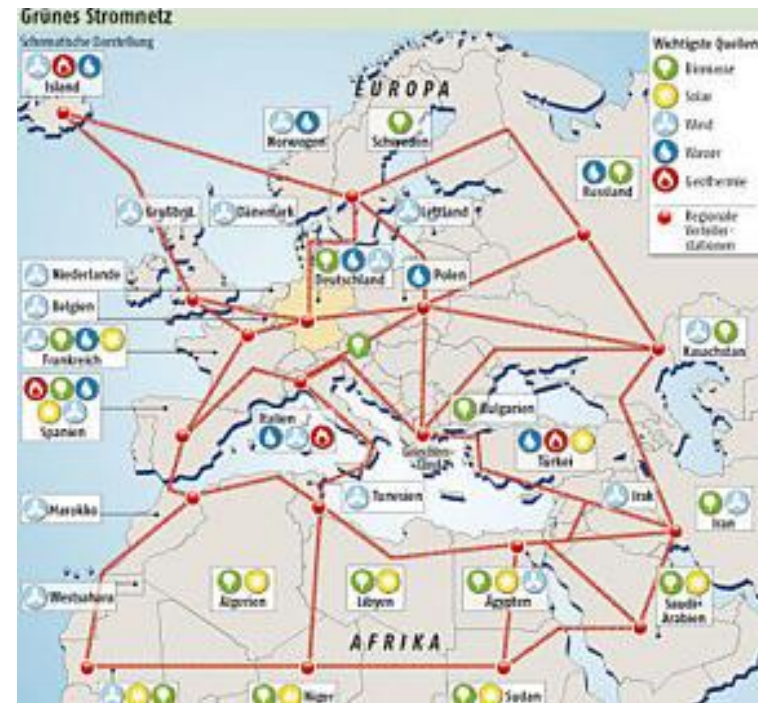
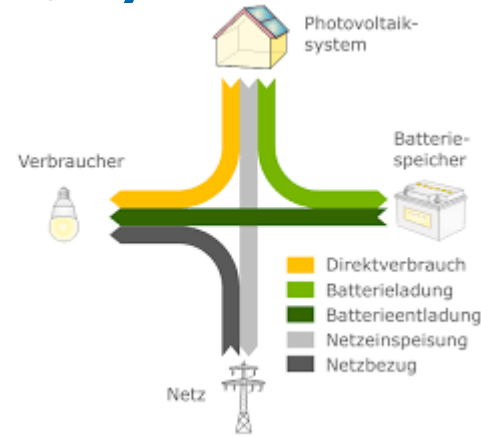
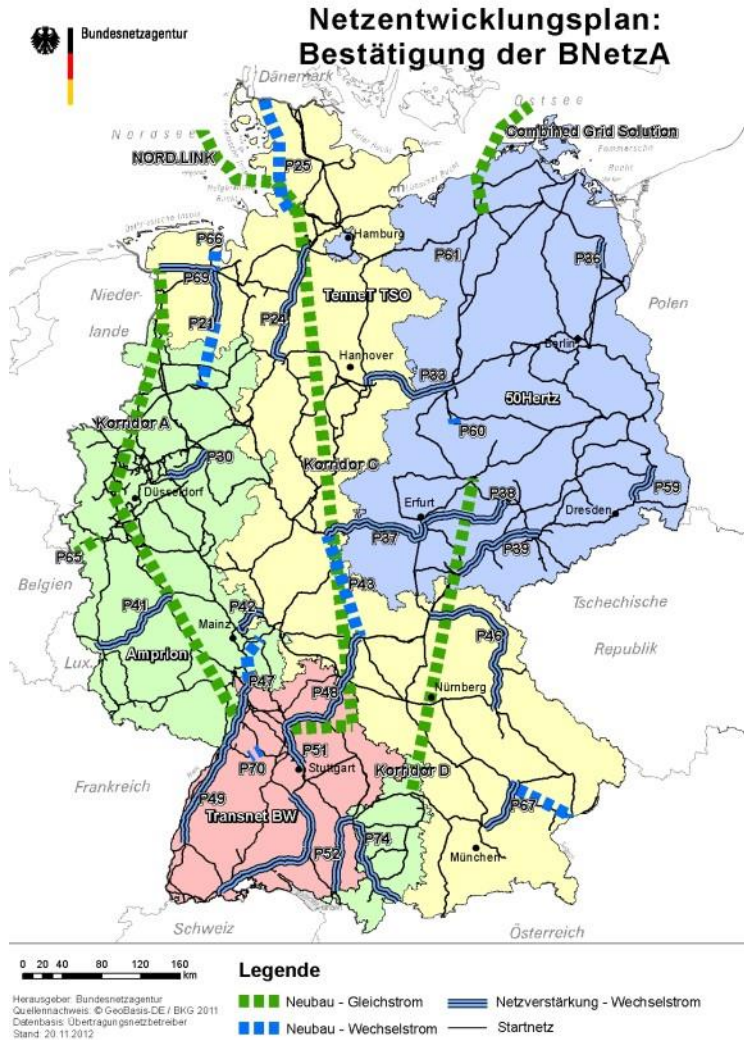
Quelle: BGR



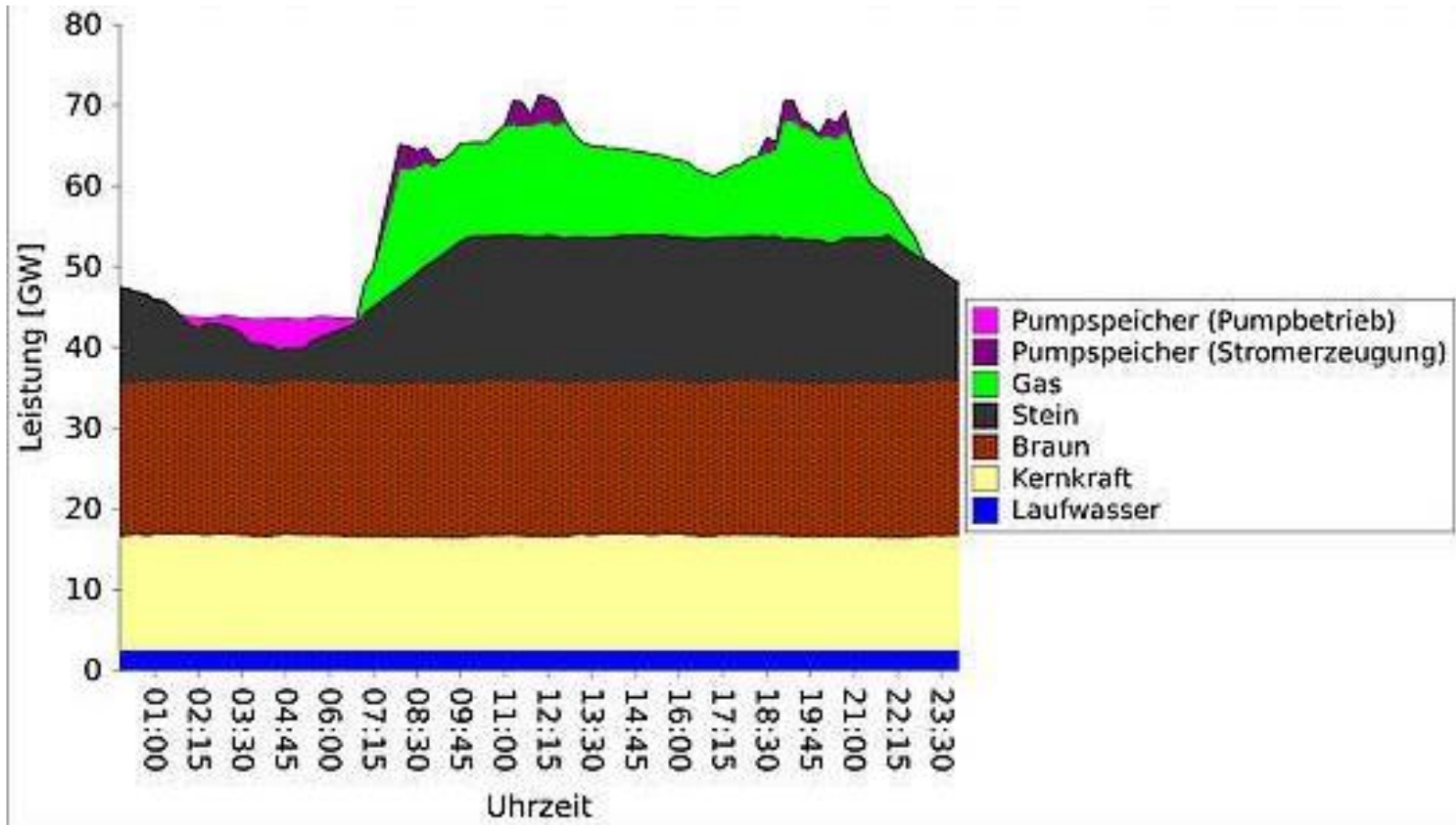
New energy - limits

- **Solar and wind energy volatile (availability natural limited 900h/ 1500h from 8600/ year)**
- **Hydro power/ Biomass natural limited (import?)**
- **Geothermal energy natural limited (problems, fracing)**
- **High costs (financial support for solar, wind, biomass: 22 B€/year for 20 years)**
- **Priority of new energy in the net**
- **Volatility and Overproduction: Net Stability!**
- **Transport of electricity limited (permission)?**
- **Storage of electricity (no solution)?**
- **Not in context with EU-partners**

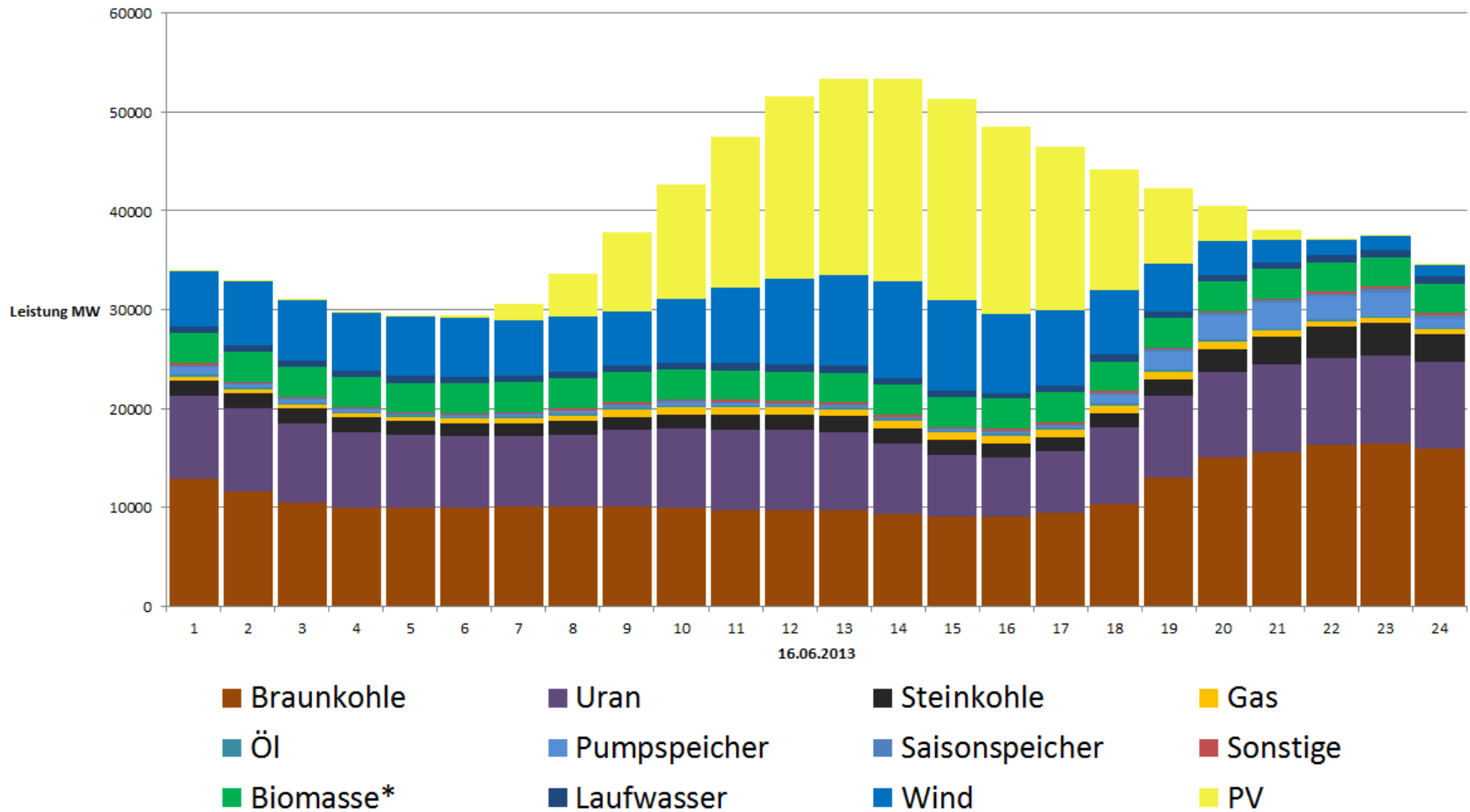
Net development in Germany



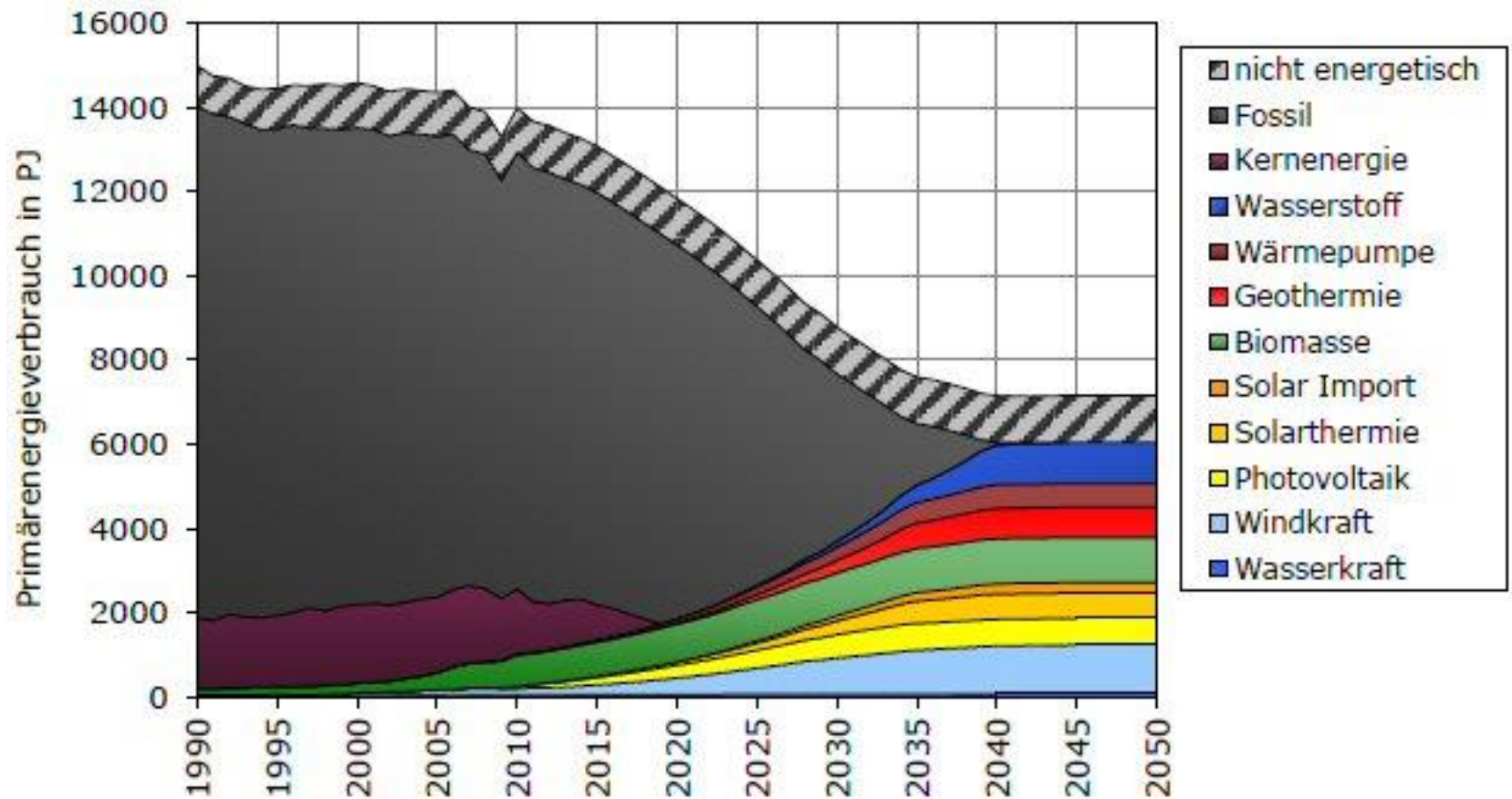
Share of Sources in Daily Electricity Production, no new energy, working day in autumn



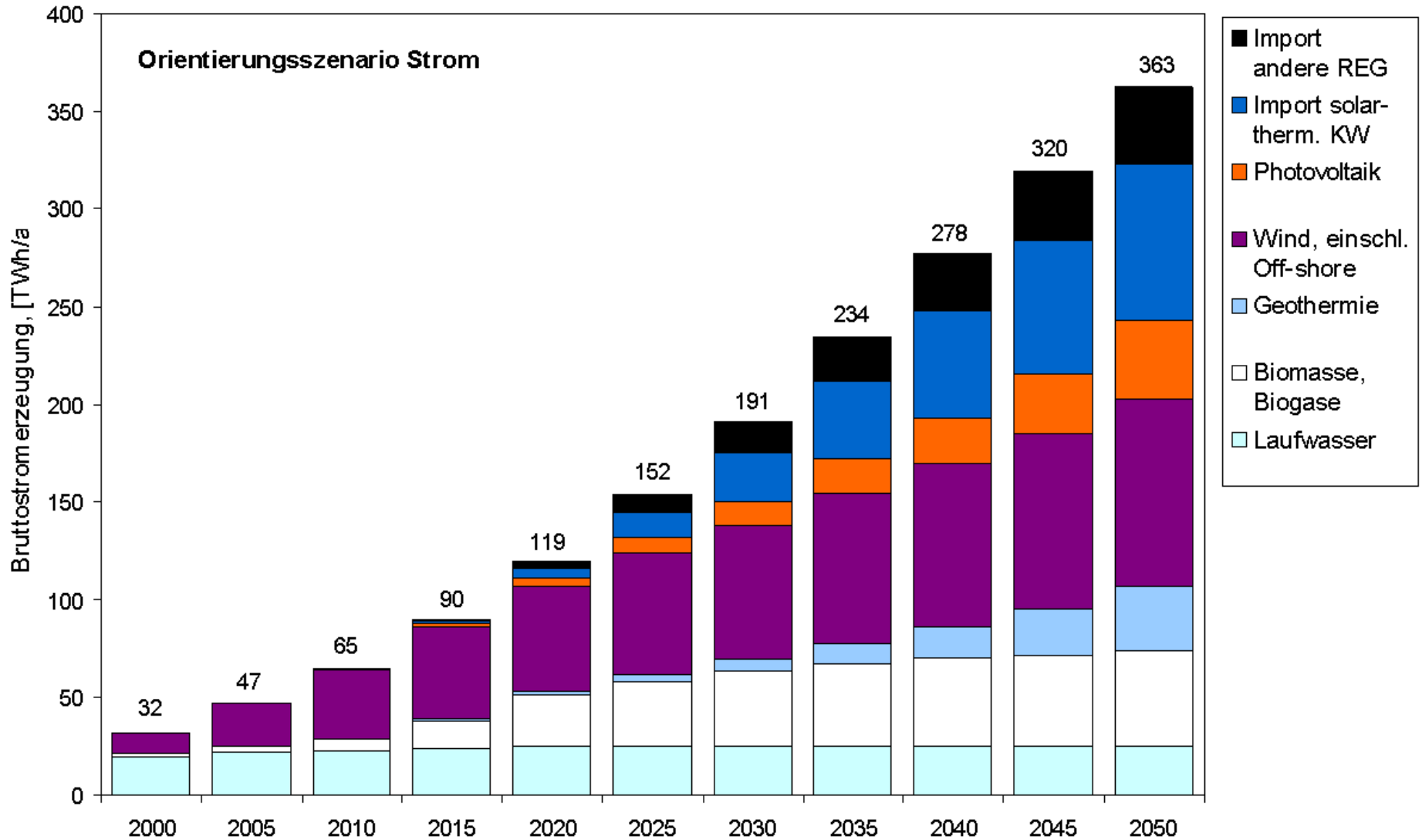
Share of Sources in Daily Electricity Production with NE



German Primary Energy Consumption up to 2050



Scenario of Sources of Electricity from new energy



German Energy Policy - framework

- **Nuclear power ends 2022 (after Fukushima 2011)**
- **Domestic Hard Coal ends 2018 (economic reasons, EU)**
- **Domestic Lignite under pressure (targets strong driven by CO₂ reduction)**
- **CCS R&D stops**
- **Coal Beneficiation Research support limited**
- **Priority for new energy**
- **Net Management/ Storage?**
- **Gas (low use, costs)**





Future of coal industry in Germany

- **Hard coal mining closed 2018/ import (new PP in 2015)**
- **Lignite - important permanent available and cheap source for electricity (partly coupled with heat production); reserves and permission exist up to 2050**
- **New lignite PP after 2010 (high efficiency: 45%); export can bring more benefit than coal closure in Germany**
- **Gap in electricity production, import, net availability and storage facilities after 2022 can be partly compensated by lignite**
- **Lignite – resource for chemical industry**
- **Lignite important for regional development**

German Energy Policy and Sustainable Development Goals 2030



Tagret 13: 22 B€ for Germany

All other targets: 8,5 B€ for the world