JÜLICH
FORSCHUNGSZENTRUM

Perspectives for Nuclear Energy in Germany

J.- F. Hake, J. Kupitz,
Institute of Energy and Climate Research
Systems Analysis and Technology Evaluation (IEK-STE)

IAEA/INPRO DIALOGUEFORUM, SEOUL, Rep. of Korea,
27-31 August 2012

List of Contents

1.) Public and Political Environment

Agencies in German Energy Policy 1

Ministry for Economics and Technology

- Implementation of the EnWG, esp. regarding non-discriminating acces to gas and electricity grids.
- Guarantee of security of energy supply in cooperation with the Foreign Ministry.
- Coordinating platform for energy research.

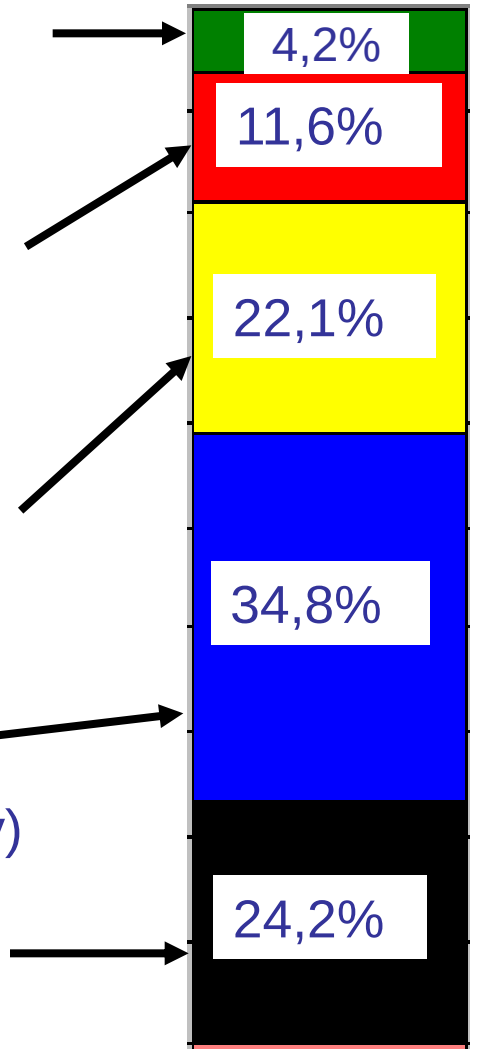
Ministry for the Environment

- Implementation of climate policy, including the administration of German emission trading.
- Subsidization of renewable energy carriers.
- National agency for the maintaining of security in the nuclear power sector.

Further responsible agencies include the Ministries for Finance, for R&D, for Agriculture, for Transport and for Foreign Affairs.

Acceptance as a Problem of Energy Policy

- Support for renewables decreases with growing costs for private households. Local resistance against wind energy leads to legal obstruction of its extension, eg in North Rhine-Westphalia.
- Strong public resistance makes the withdrawal of the nuclear phase-out both politically unlikely and economically unfeasible.
- Growing scepticism against gas deliveries from Russia leads to an increasing politicization of energy imports.
- Social dissatisfaction with rising prices of oil. Search for altern. transport options (e.g. electricity)
- Growing social scepticism against coal obstructs the legal framework for the development and implementation of CCS technology.



Gross Energy Consumption Germany

August 2012

Energy strategies of Parties

Parties reflect public opinion in their energy stategies

100% renewables

B90/Die Grünen

Die LINKE

Both parties accept coal power plants on the regional level.

Fuel mix with coal and nuclear

FDP

CDU/CSU

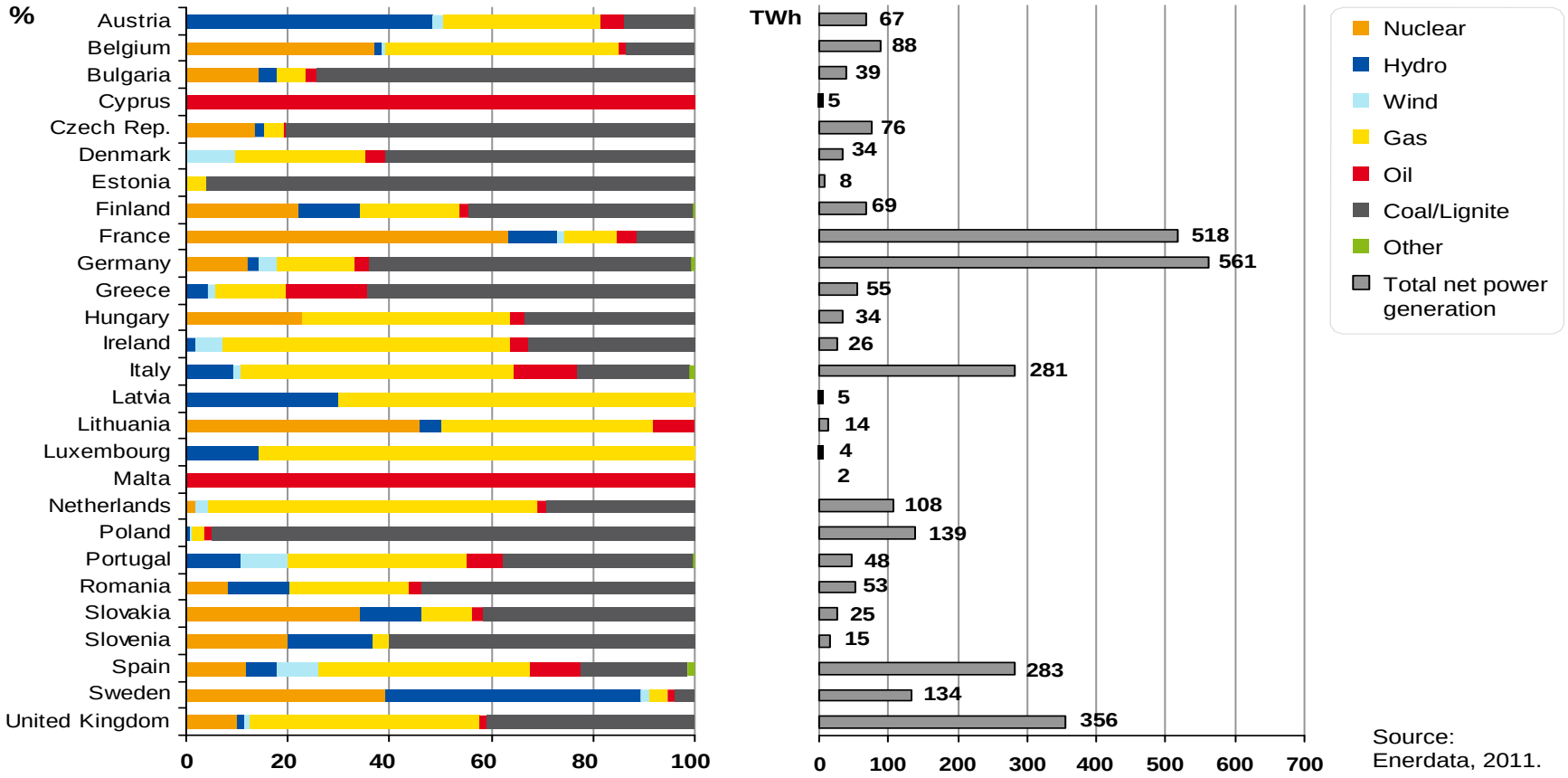
FDP/CDU/CSU Coalition modified and approved nucl. phase-out policy

Fuel mix without nuclear

SPD

2.) German Energy Concept

Shares of Primary Energy Sources in Total Electricity Generation in Europe (2009)



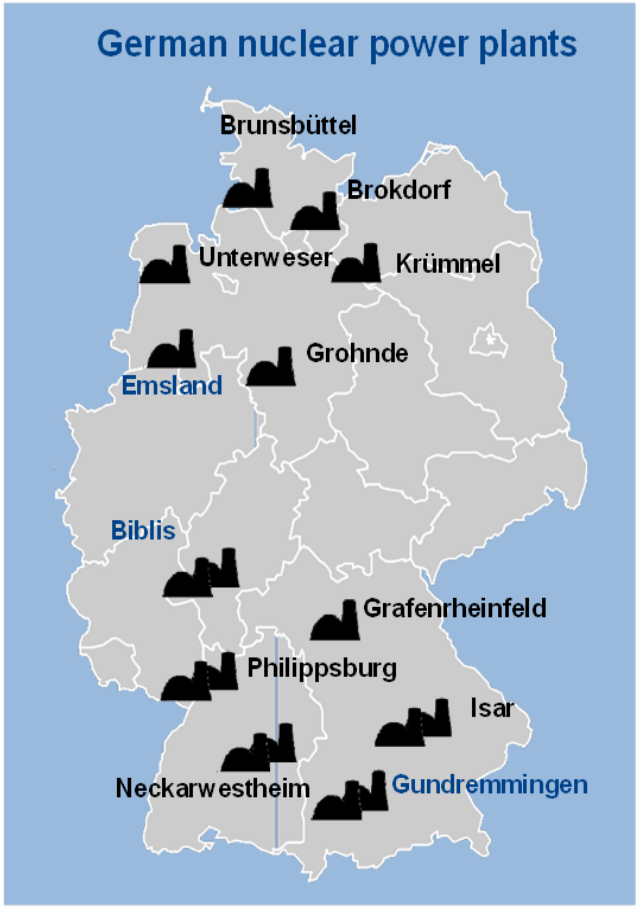
Source: Enerdata, 2011.

Institute of Energy and Climate Research
Systems Analysis and Technology Evaluation
(IEK-STE)

Main Objectives of The German Energy Concept of 2010

- Reduce GHG-emmisions until 2050 by 80% compared to 1990
- Increase share of renewables to 60% of gross final energy consumption in 2050.
- Increase share of renewables to 80% of electricity generation in 2050
- Reduce primary energy consumption until 2050 by 50% compared to 2008.
  - *Reduce power consumption by 25%.*
  - *Increase rate of renovation for energy efficiency in buildings to 2% of all buildings annually.*
  - *Reduce final energy consumption in transportation by 40%.*

Overview of German Nuclear Power Plants



Power plant	Net capacity MW	Commercial commissioning	Closure
Biblis A	1,167	1975	Immediately 8,409 MW
Neckarwestheim I	785	1976	
Biblis B	1,227	1977	
Brunsbüttel	771	1977	
Isar 1	878	1979	
Unterweser	1,345	1979	
Philippsburg 1	890	1980	
Krümmel	1,346	1984	
Grafenrheinfeld	1,275	1982	31 Dec. 2015
Gundremmingen B	1,284	1984	31 Dec. 2017
Philippsburg 2	1,392	1985	31 Dec. 2019
Grohnde	1,360	1985	31 Dec. 2021 4,058 MW
Gundremmingen C	1,288	1985	
Brokdorf	1,410	1986	
Isar 2	1,400	1988	31 Dec. 2022 4,039 MW
Emsland	1,329	1988	
Neckarwestheim II	1,310	1989	

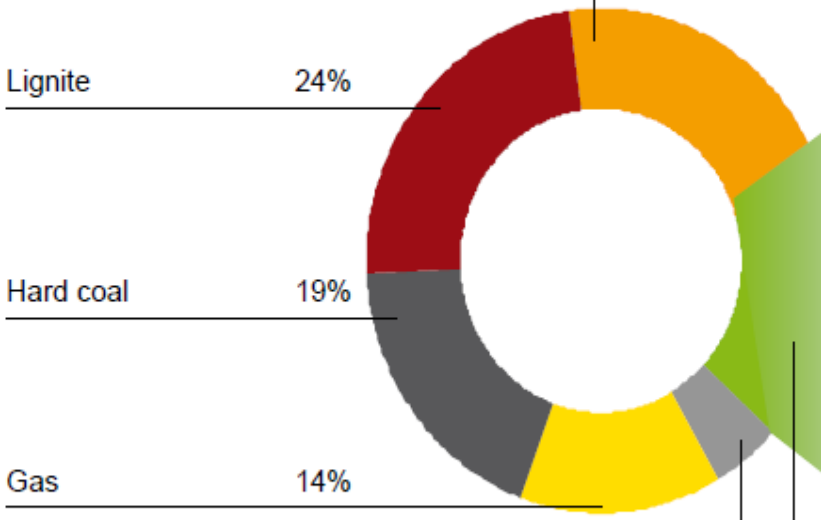
RWE power plants

Contribution of power generated in accordance with the REA

JÜLICH FORSCHUNGSZENTRUM

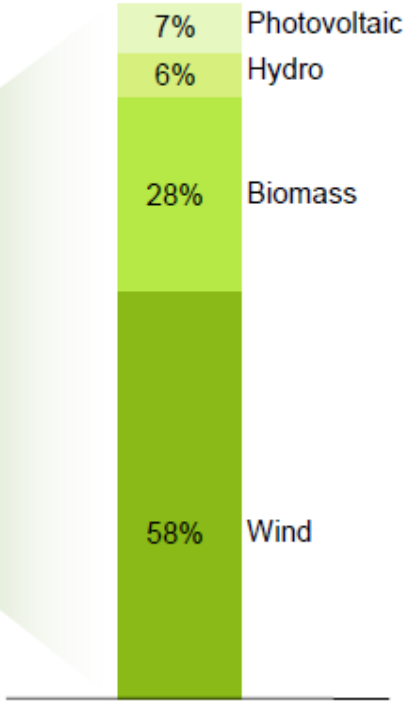
Gross generation in Germany (2010)

620.8 TWh



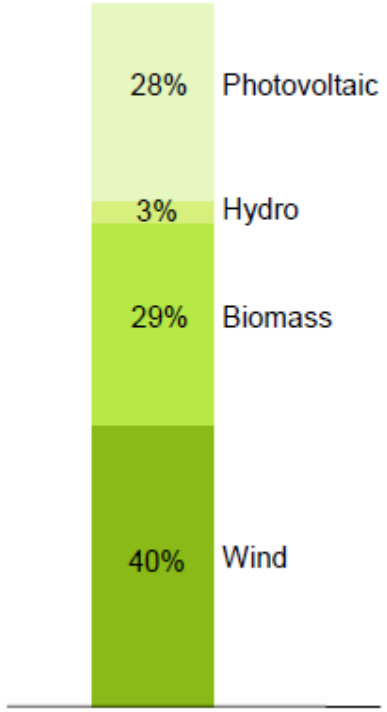
REA[1] generation

92 TWh



REA compensation

€12.3 bn[2]



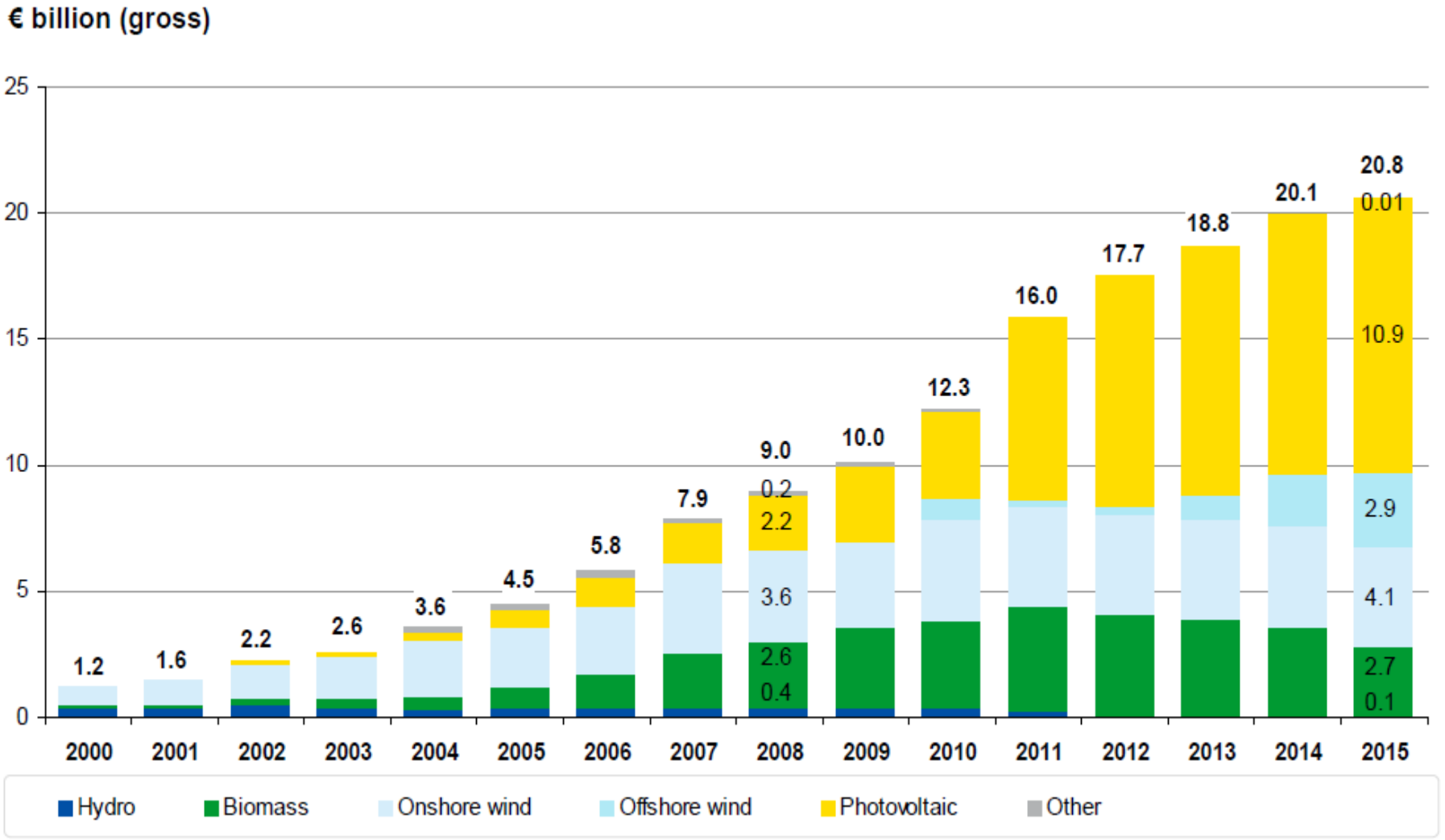
Source: RWE Facts and Figures 2011

3.) Costs and Technical Considerations

Heavy reliance on renewables will require

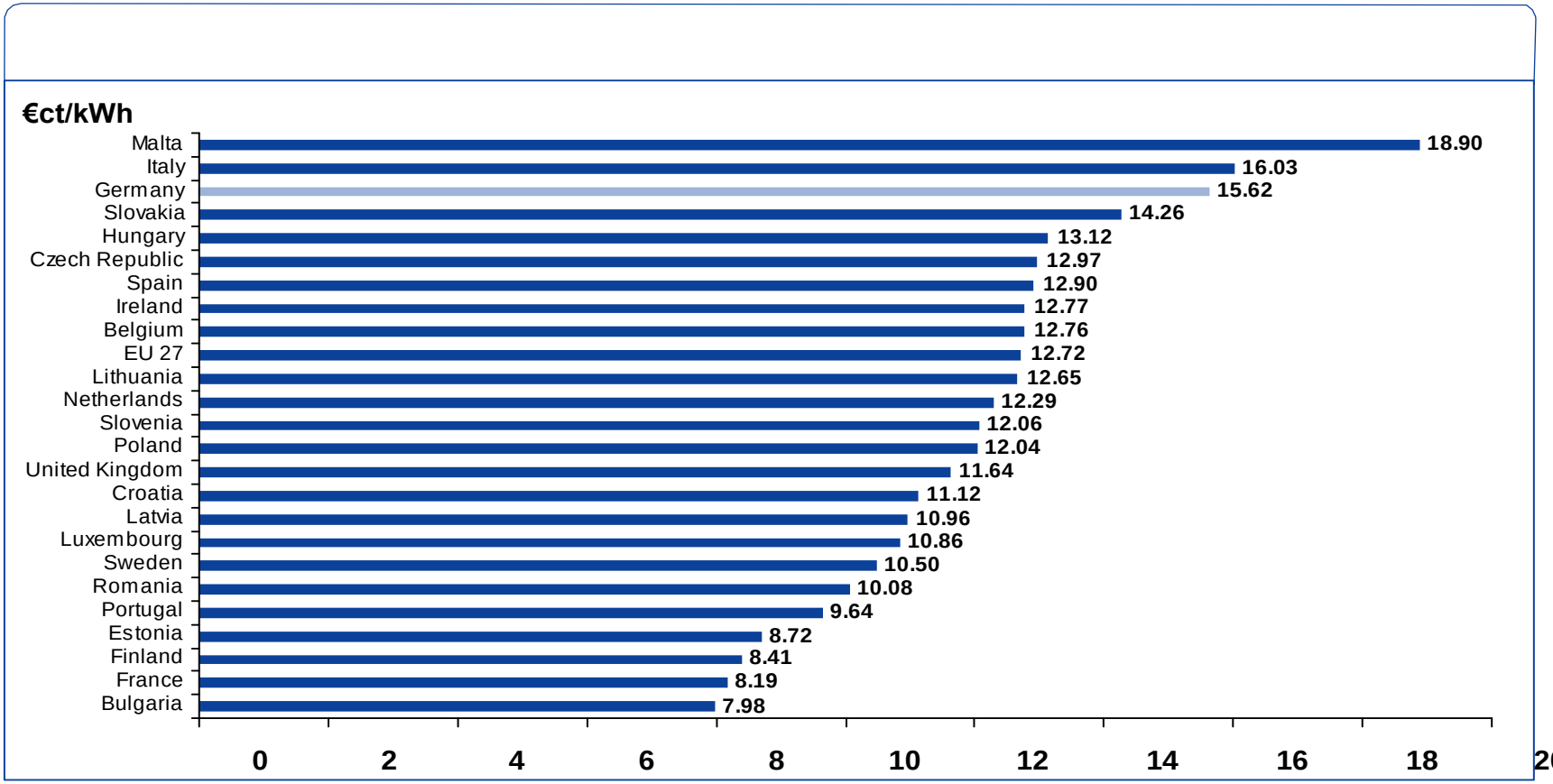
- new high voltage transmission lines to connect electricity generation areas with consumer centers
- new storage facilities to compensate fluctuations

German Renewable Energy Act Compensation and Forecast to 2015



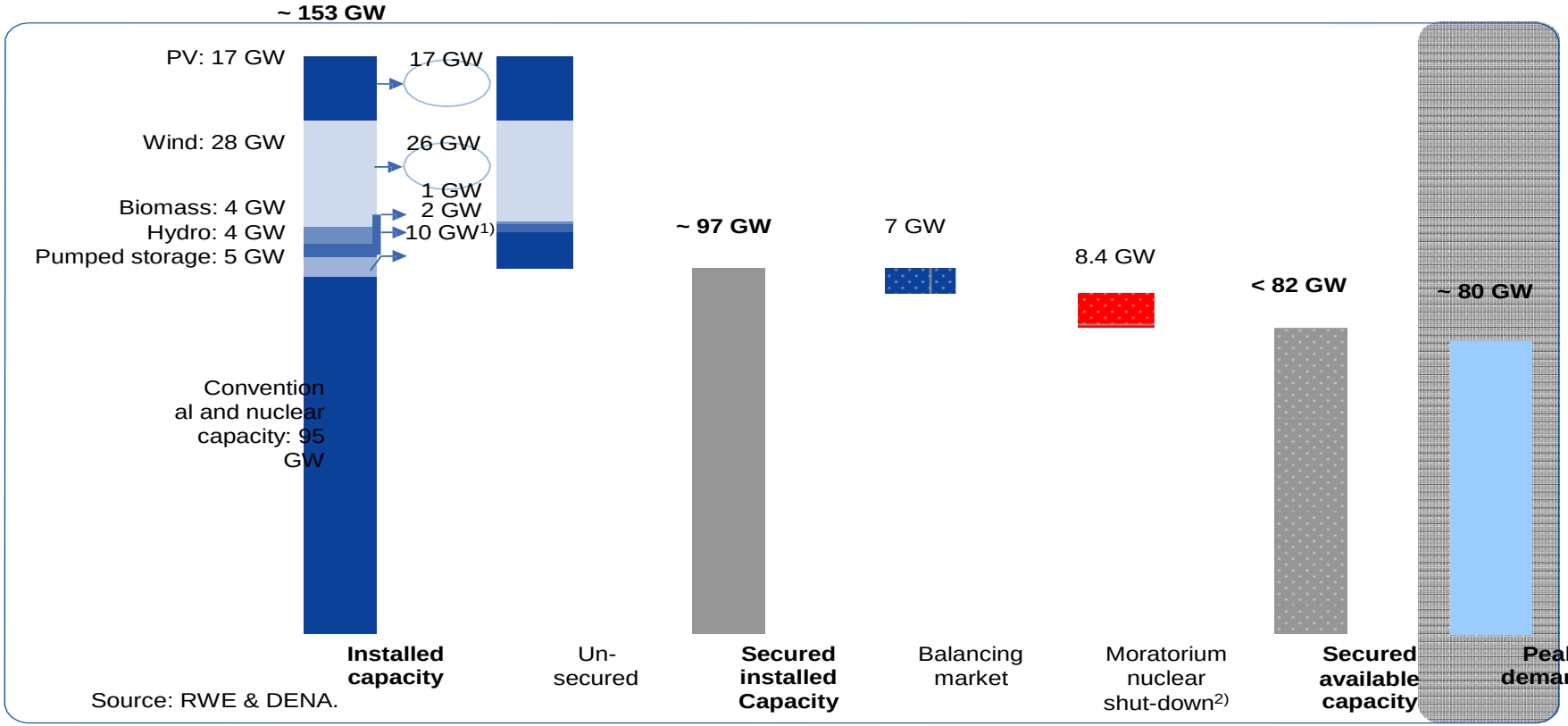
Source: RWE Facts and Figures 2011

Electricity Prices in Europe (for Industrial Customers)



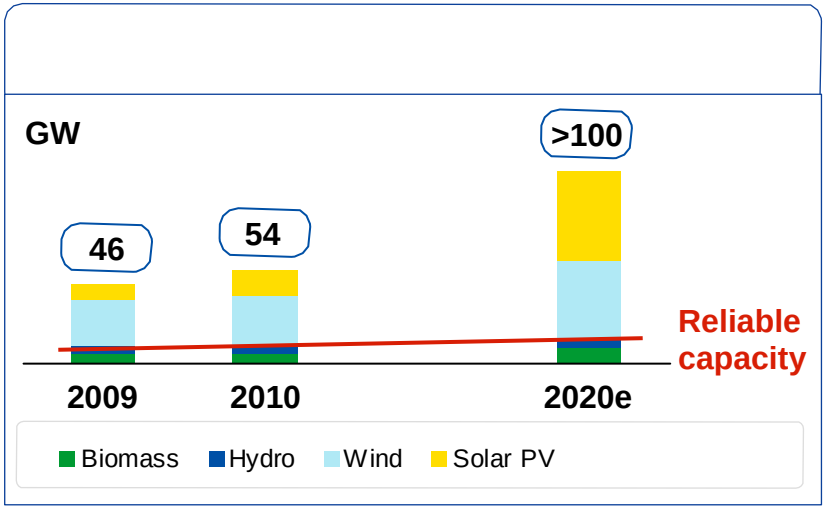
*) Basis: industrial customers with a consumption of 500 – 2,000 MWh; prices excluding value-added tax and all other recoverable taxes and levies. Source: Eurostat, May 2011.

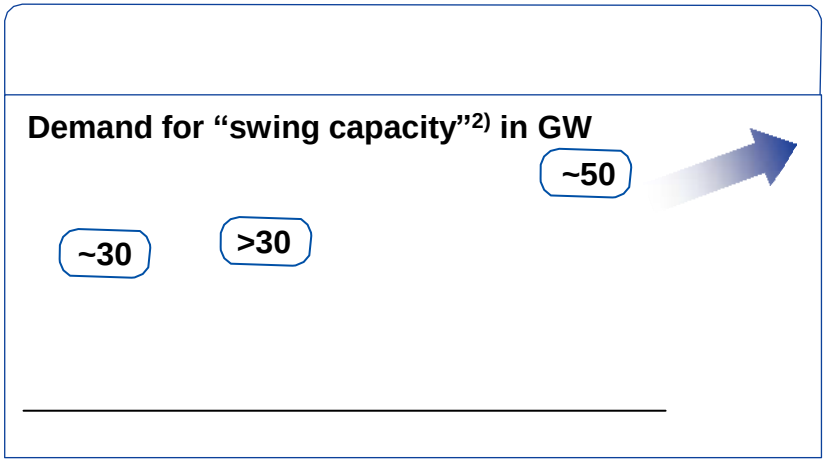
Nuclear Moratorium to Cut Secured Available Capacity down to Peak-demand Level (March 2011)



1) Scheduled or unscheduled outages due to e.g. maintenance or disruption of operation.
2) Reduction in generation capacity of 8.4 GW, assuming that the seven nuclear power plants commissioned before 1980 and the Krümmel power plant stay offline.

The Need for Flexible Power Generation Capacity





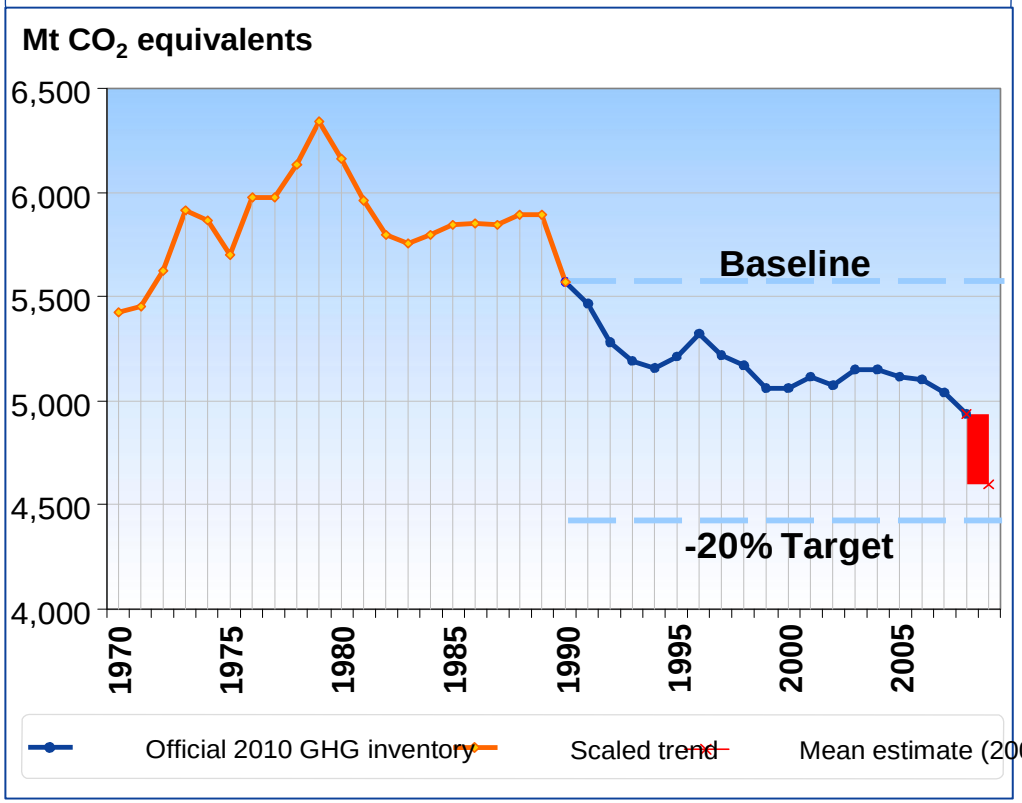
- Strong increase in renewable capacity leads to increased volatility between demand and supply of electricity
- Current swing capacity[2)] is more than 30 GW, which is currently covered
- Demand for swing capacity is expected to grow to up to 50 GW and more which will not be covered by conventional generation capacity
- Tightness of flexible generation capacity can be expected

1) DLR, Fraunhofer, IfnE, Long-term scenario for the development of renewable energies on the basis of the "Leitszenario 2010", June 2010.

2) "Swing capacity" = capacity which needs to be provided by conventional power plants to cover changes in renewable feed-in and/or demand volatility over a period of 12 hours.

2009

Emissions: EU 27 is on Track Towards Achieving its 2020 Reduction Target of 20%



- 2009 emissions stand 17% below the 1990 level and therefore very close to the target of -20% by 2020
- Economic crisis accelerated the decline in EU GHGs emissions
- Return to economic growth may temporarily level off or reverse the decline in emissions
- Impact of German nuclear moratorium is assessed at around 45 mt additional emissions per year
- That‘s 1% of total EU emissions
- CO_2 balances for the EU ETS have turned negative and system is now slightly short

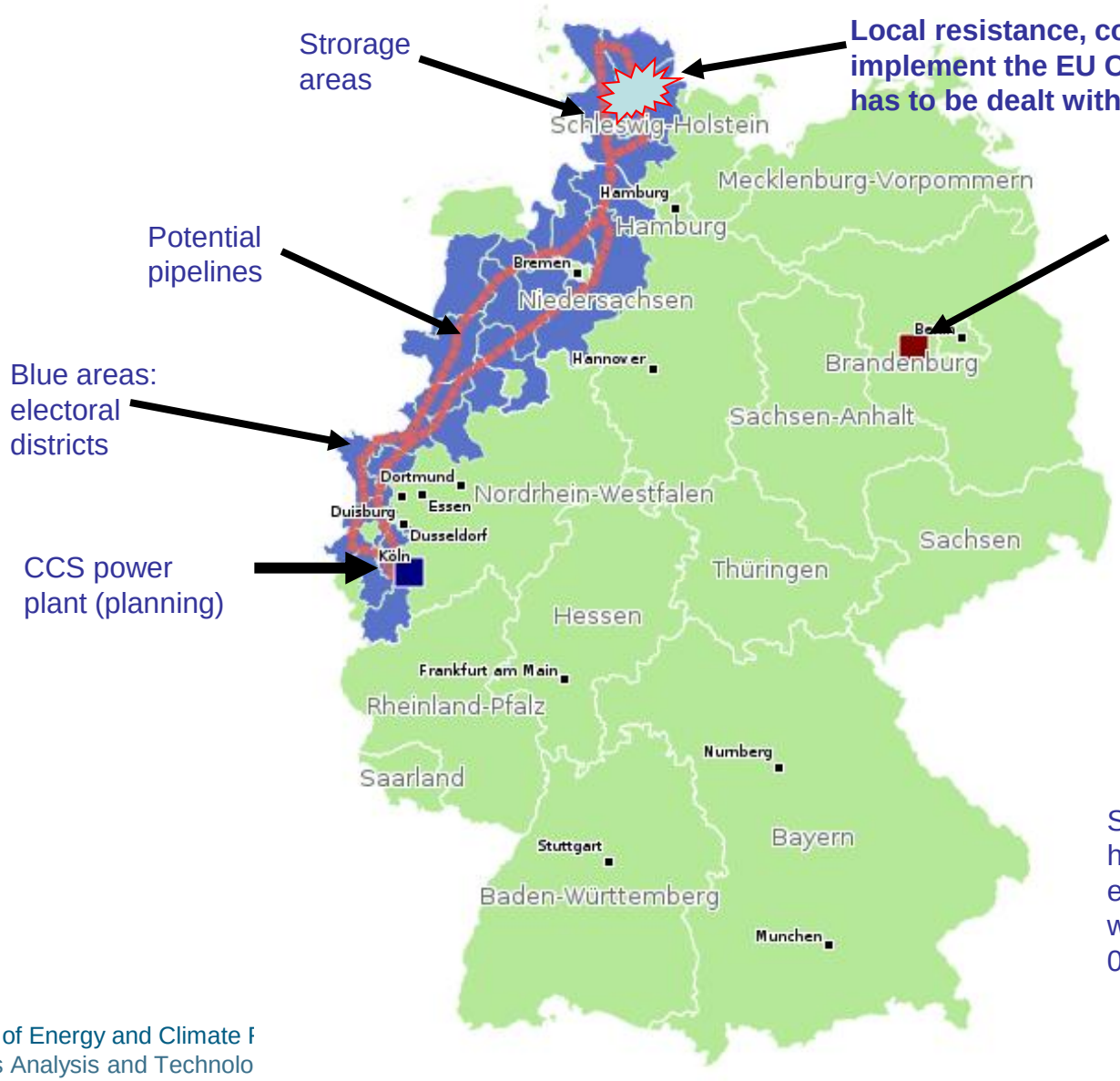
Absolute greenhouse gas emissions in the EU 27, 1970 – 2009, million ton CO_2 equivalents

4.) Carbon Capture and Storage (CCS)

➢ On April 1 2009, the Government concluded a draft for an act on the support of CCS technology. Due to public opposition, the bill was never send to parliament.

➢ On July 14 2010, the Government presented a revised version of the CCS bill, that aimed for the testing and demonstration of storage facilities.

- *Annual storage capacity in Germany may not exceed 8mill. t and each facility may only store 3 mill. t. per year.*
- *Applications for storage facilities need to be presented till end of 2015.*
- *Operating companies need to cover all long-term risks resulting from CCS storage.*
- *Law will be re-evaluated in 2017. Large-scale utilization of CCS only in case of a positive result.*



Source: http://www.eurosolar.de/de/index.php?option=com_wrapper&Itemid=289; [01. 07. 2009]

5.) Conclusions

- To meet the challenges of a future energy system without nuclear power, a diversified portfolio of energy technologies and corresponding R&D is needed.
- While Germany reduced its THG-emissions substantially, it still has the highest emissions in the EU and has to increase its efforts to reach the Kyoto targets.
- Policies to increase the share of renewables in the German energy mix will reduce THG emissions and improve security of supply, but probably also lead to higher feed-in fees.
- Substantial increase of the share of renewables is a challenge for grid stability and competitive electricity costs.
- The phase out of nuclear power and the obstruction of CCS puts increasing pressure on the generation of German base load and make it more difficult to reach the THG-reduction targets.
- Changing the nuclear phase out policy is very unlikely.