

# **Strategies for the deployment of renewables and market liberalization**

## **- The German experience**

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**IET – International Energy Transition**

**MÉXICO – ALEMANIA:  
DIÁLOGOS POR UN FUTURO SUSTENTABLE  
ENERGÍAS RENOVABLES/LIMPIAS  
Ciudad de México, 4 de diciembre de 2014**

# The German Energy Transition (Energiewende) – Targets and objectives

# The Energy transition is not a shock reaction to the nuclear accident in Fukushima!



A long history ...

- The concept “Energiewende” was first coined in 1980 (Öko-Institut)
- Government decisions in 2000-2002: nuclear phase-out extending into the 2020s and introduction of the Renewable Energy Sources Act (EEG)
- New energy concept under the current government in September 2010: extension of nuclear operating times combined with ambitious goals for emission reduction, share of renewables and energy efficiency
- Immediate shutdown of the oldest nuclear power plants and appointment of an Ethics Commission for a safe energy supply after the Fukushima shock in March 2011
- Final report of the Ethics Commission in May 2011, government decision on “The Energiewende” in June 2011: nuclear exit by 2022

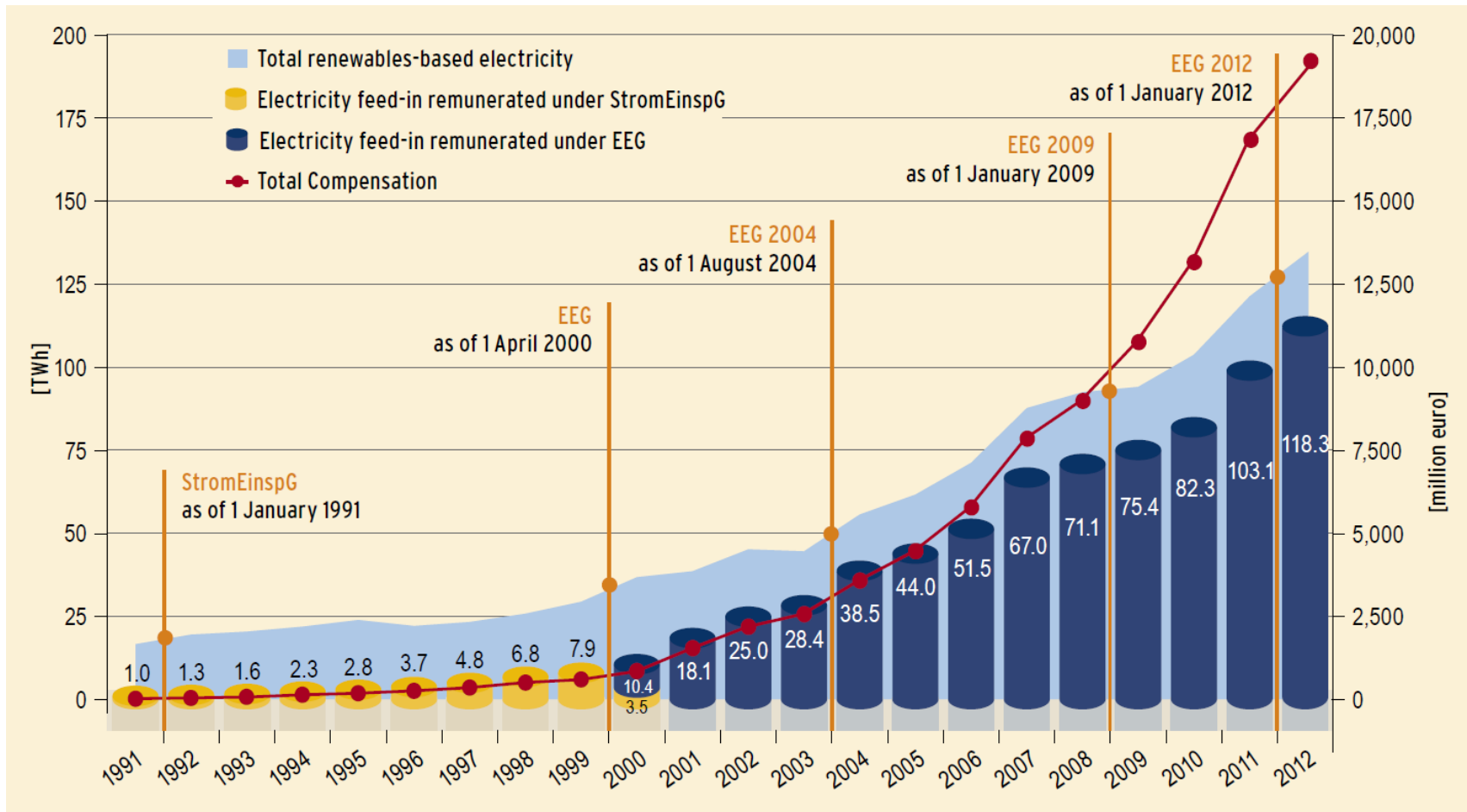
## Long-term targets of the Energiewende

The Energiewende is more than just a nuclear exit: a complete transformation of the energy system of a highly industrialized country

	Climate	Renewable energies		Efficiency				
	GHGs (versus 1990)	share power	share total	primary energy	power	transport	energy productivity	building upgrade
2020	- 40%	35%	18%	- 20%	- 10%	- 10 %	increase by 2.1%/y	double the rate 1% <- 2%
2030	- 55%	50%	30%	⋮	⋮	⋮		
2040	- 70%	65%	45%	▼	▼	▼		
2050	- 80-95%	80%	60%	- 50%	25 %	- 40 %		

Source: BMUB 2011

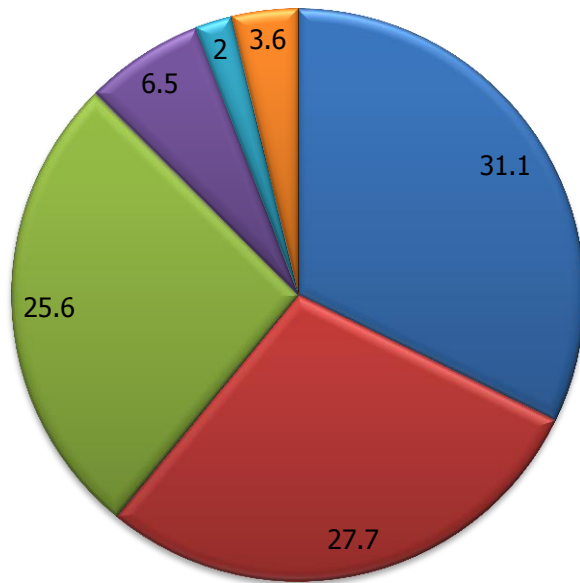
# Renewable energy growth in the electricity sector



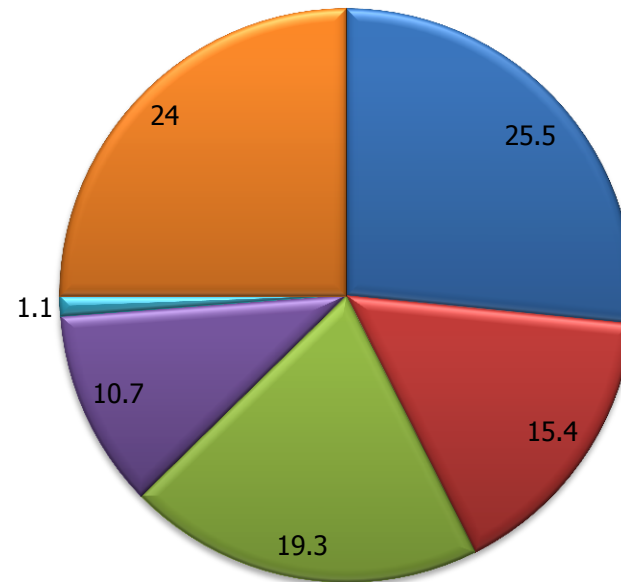
Source: BMUB 2013

# The electricity mix: 1990 and 2013

## 1990



## 2013

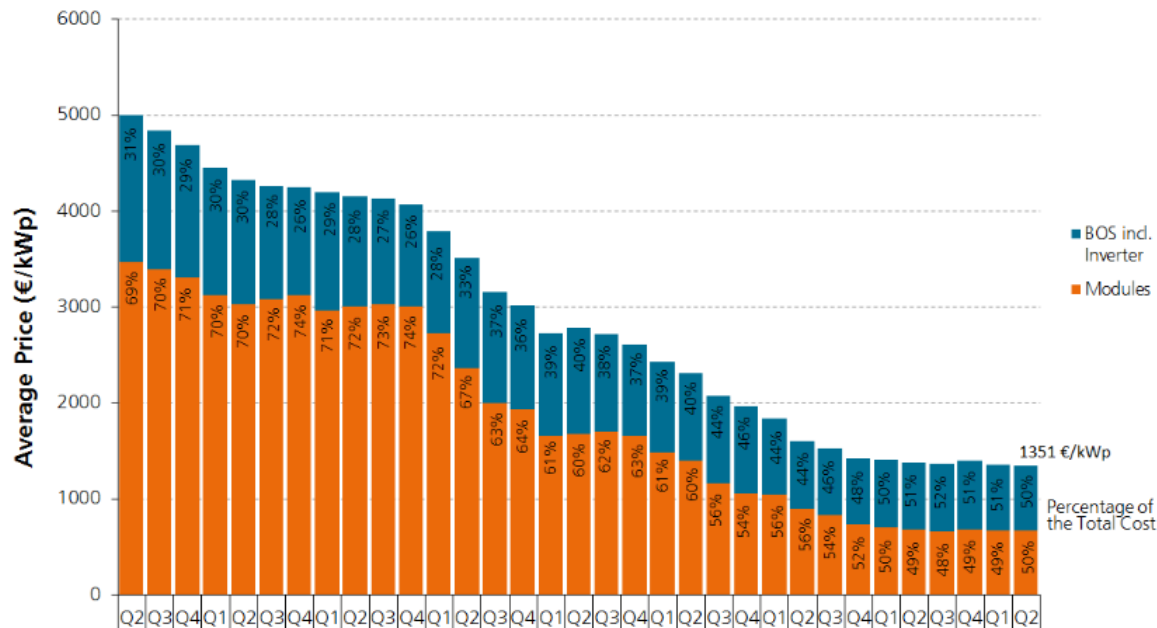


- Lignite
- Nuclear
- Coal
- Gas
- Oil
- Renewables

# Historic costs versus technology learning

- Costs of German energy transition are largely “historic costs”
- Technology costs have decreased dramatically over the past years
- New legislation (EEG 2014) focuses on “winning technologies”

## Average Price for PV Rooftop Systems in Germany (10kWp - 100kWp)



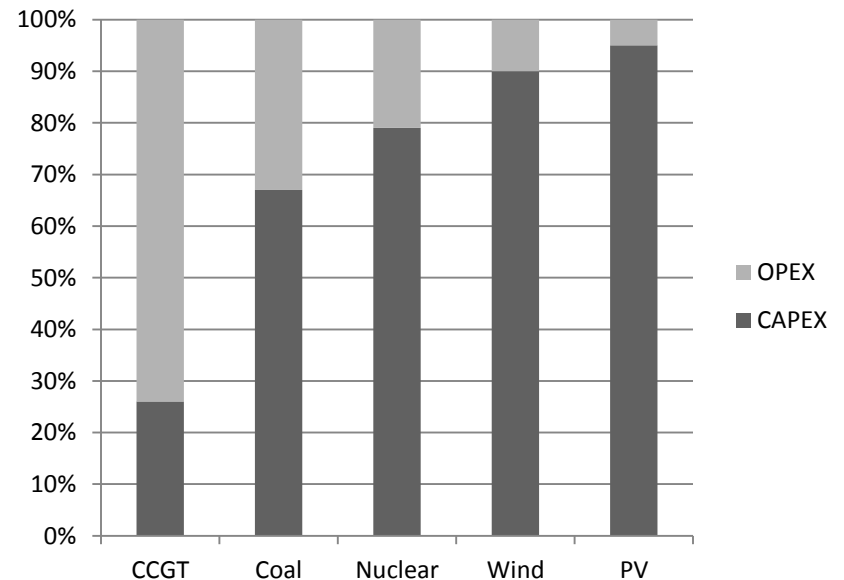
Source: Fraunhofer ISE

# The German electricity system design – Alongside the features of wind and solar PV

# Important features of wind and solar

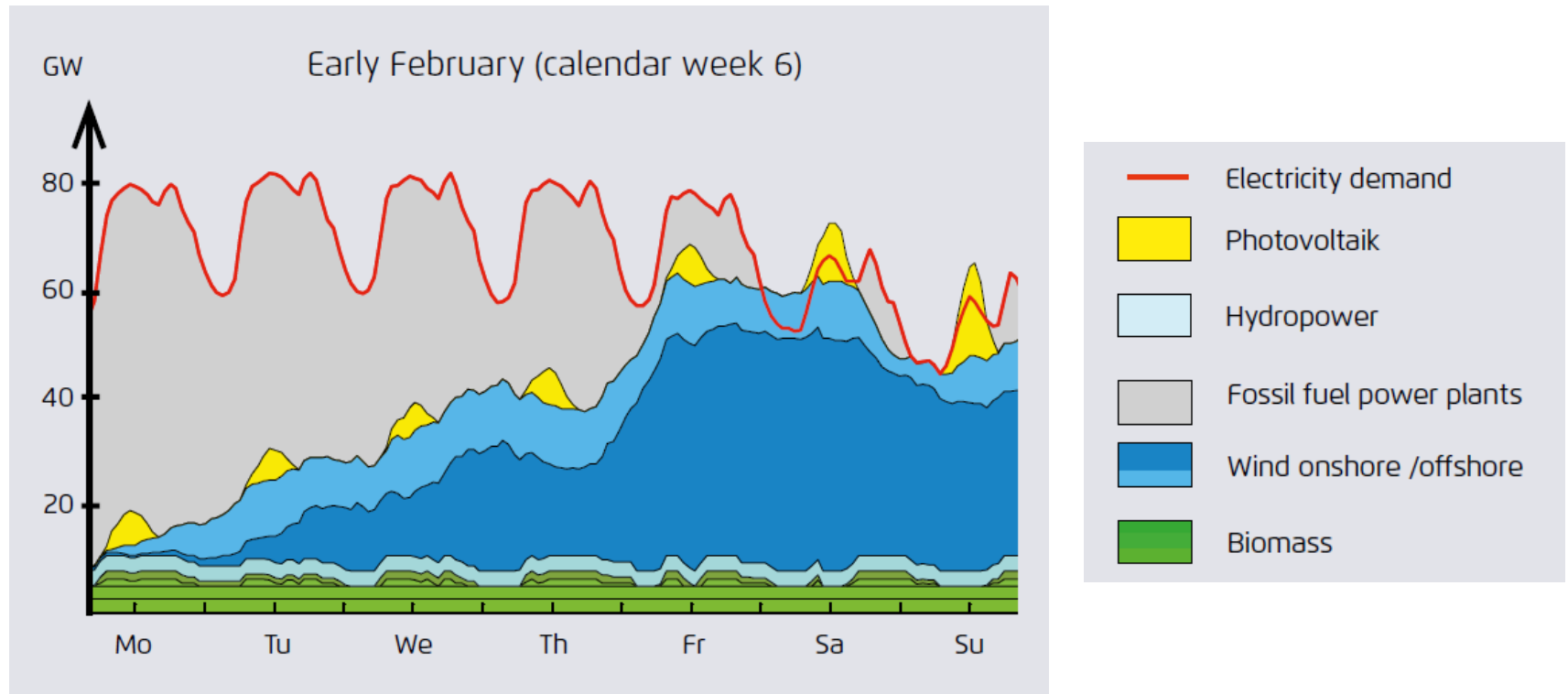
- High upfront investment (capital costs) – **INVESTMENT SECURITY** is crucial!
- Almost zero marginal costs – they come **FIRST** in the **MERIT ORDER!**
- Fluctuating supply (depending on the weather) – backup needs to be provided by other flexibility options

## Share of fixed versus variable costs of selected power generation technologies



# The electricity market is determined by wind and solar PV

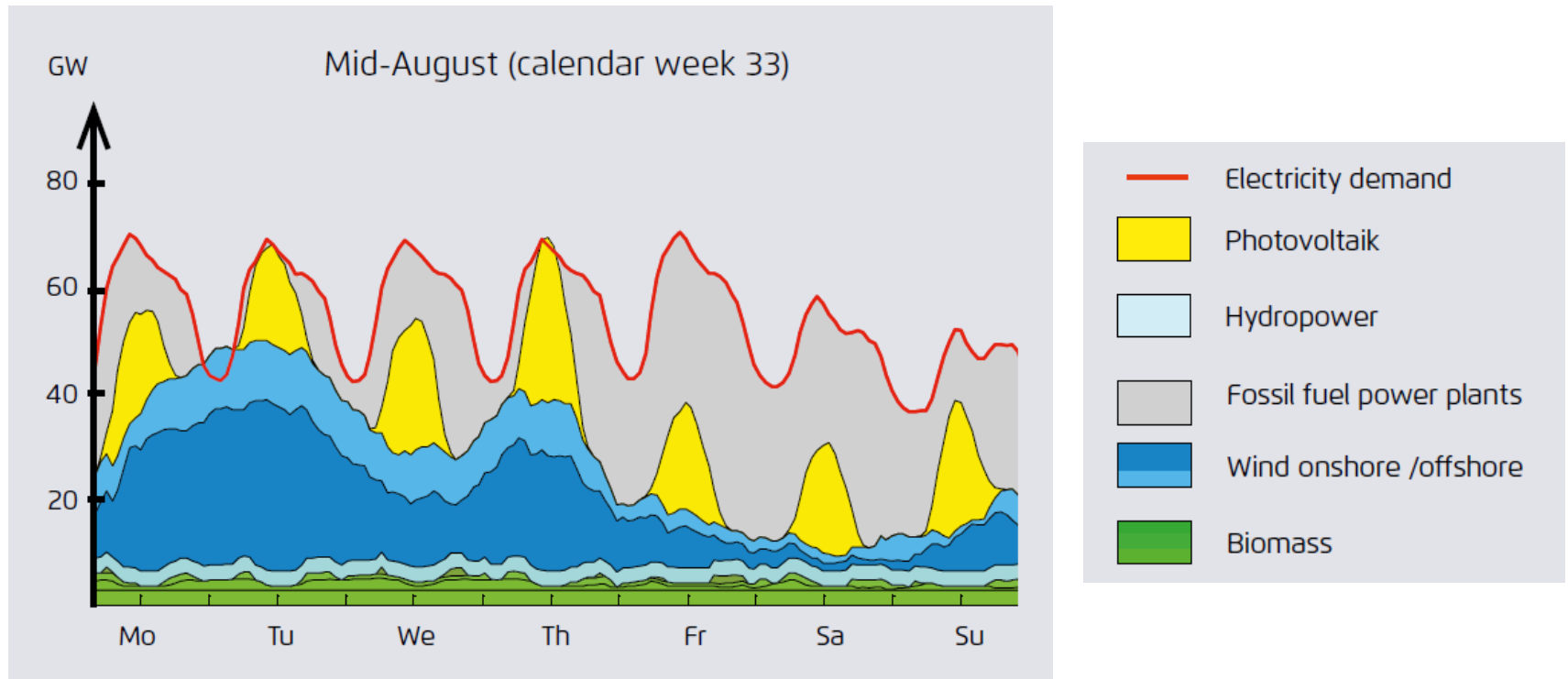
Electricity demand and renewable power generation in 2022



Source: Agora Energiewende 2012

# The electricity market is determined by wind and solar PV

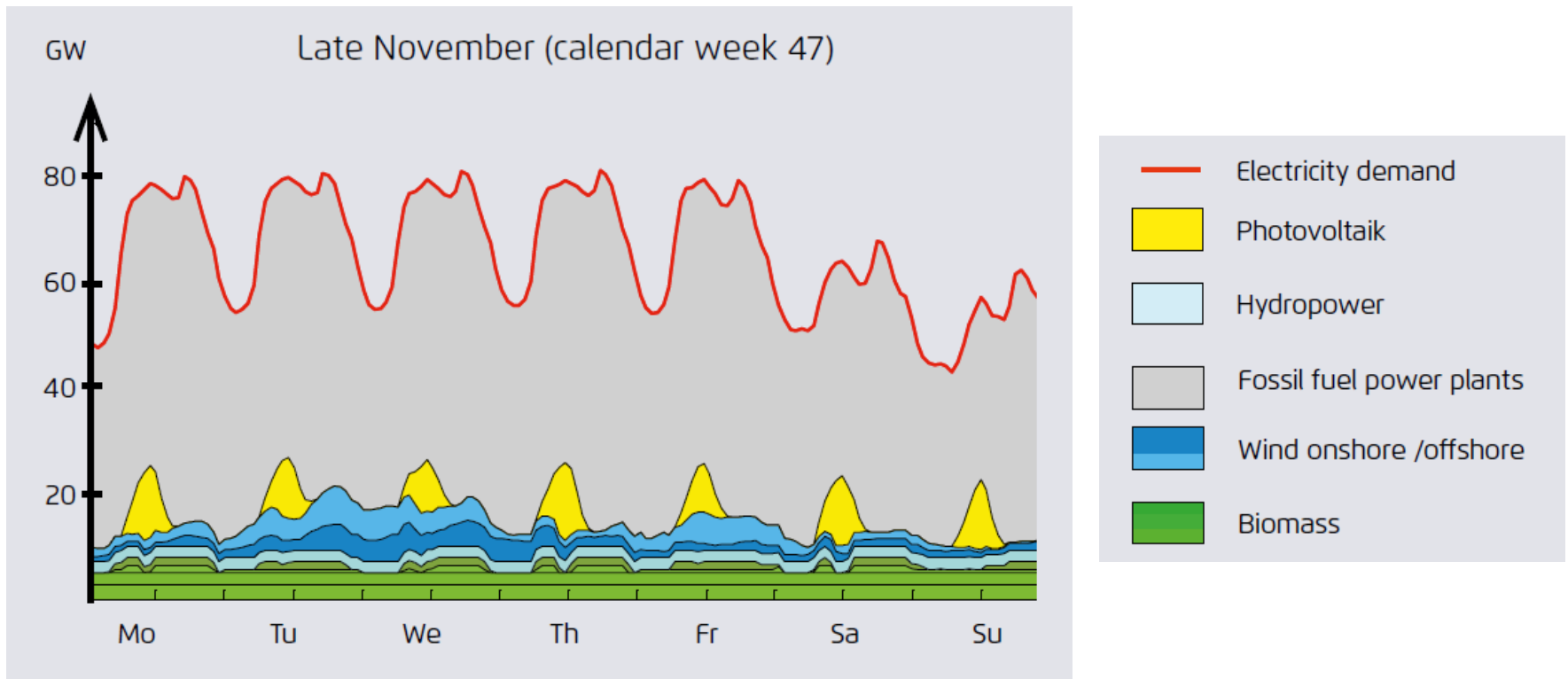
Electricity demand and renewable power generation in 2022



Source: Agora Energiewende 2012

# The electricity market is determined by wind and solar PV

## Electricity demand and renewable power generation in 2022



Source: Agora Energiewende 2012

# The German Energy Transition (Energiewende) – Grid expansion and European integration

## Grid extension plans in Germany

- Transport renewable electricity from the North (onshore and offshore wind) to the load centers in the South
- Avoid grid congestions and loop flows
- NIMBY and public consultation
- Distribution grid upgrade:
  - Most renewable energy projects in Germany are connected to the distribution grid
  - High shares of renewables (PV) in Bavarian distribution grids
  - Bi-directional transformer stations

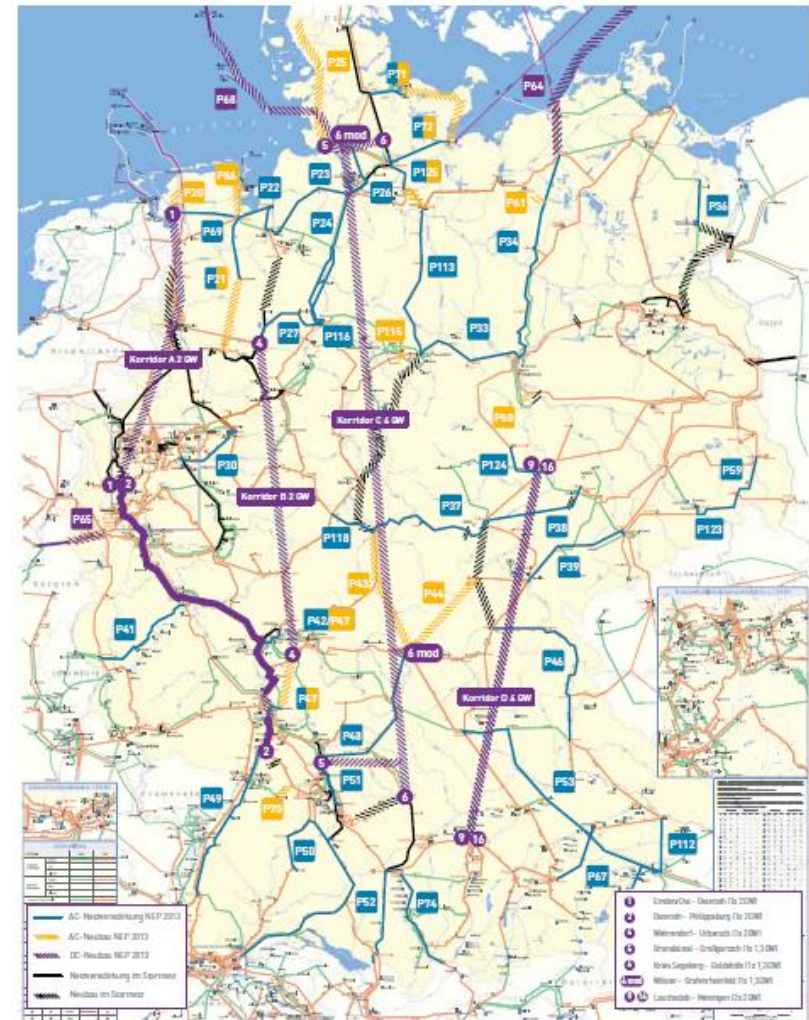
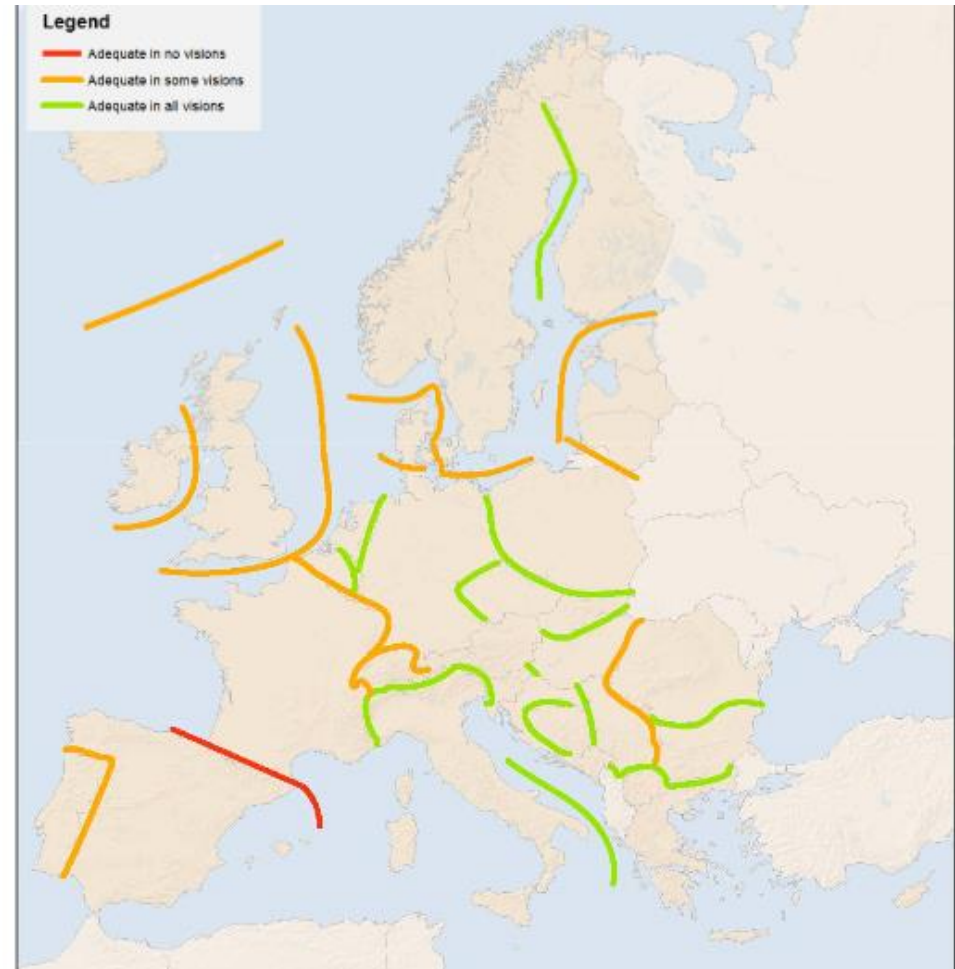


Abb. 7 Szenario B 2023/Quelle: VDE | FNN/Übertragungsnetzbetreiber

# The expansion of the European transmission grid

- 10-year network development plan from ENTSO-e
- The latest report pinpoints about 100 spots on the European grid where bottlenecks exist or may develop in the future
- Transmission adequacy by 2030?
- Full market coupling with European neighbours (e.g. one merit order for Germany and Austria).

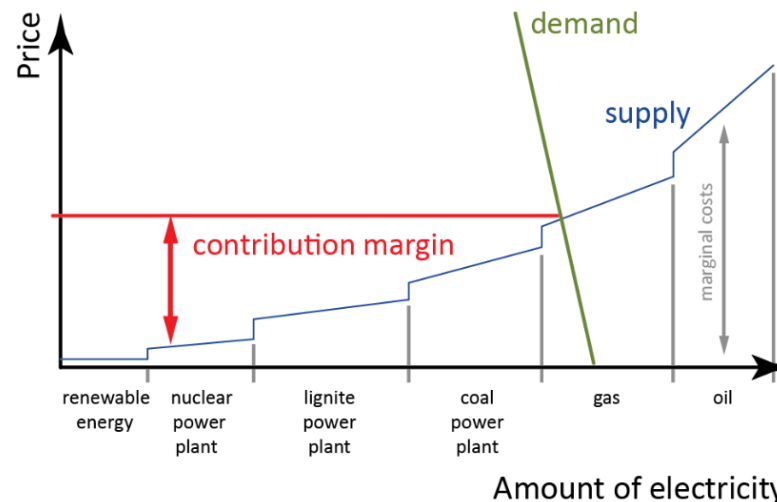


Source: ENTSO-e 2014

# The German Energy Transition (Energiewende) – Dispatch of conventional (and renewable) power plants

# Economic dispatch in liberalized electricity markets

- Typical German Merit Order
- Power plants are dispatched according to their short-term marginal costs (fuel costs and CO<sub>2</sub> costs)
- Wind and solar are only dispatched at times of negative prices on the spot market



## Conventional power plants need to become more flexible

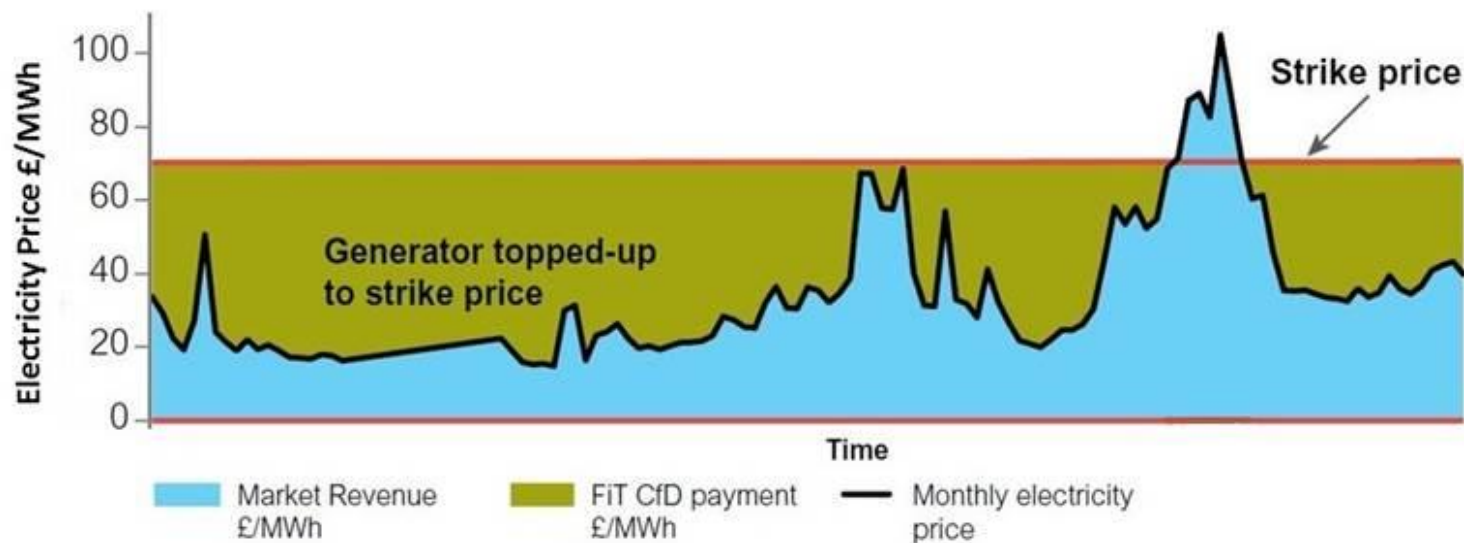
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- Reduce must-run requirements of conventional power plants
- Reduced full-load hours for coal and gas-fired power plants
  - changing economics and additional revenue requirements via capacity markets?
- Operation of combined heat-and-power and biomass plants according to electricity demand (and not according to heat demand)
- Upgrade existing power plant in order to allow for better ramping capabilities

Creating a flexible power market –  
Dispatchability of volatile renewable  
energy sources (wind and solar)

# Confronting renewable energy producers with price risk: from FIT to premium FIT

- Ex-post defined premium FIT payments
- Benchmark: Average monthly wholesale electricity price for wind and solar
- Top-up to the predefined strike price for each renewable energy technology



(Adapted from *Planning our electric future: a white paper for secure, affordable and low-carbon electricity* (Department of Energy and Climate Change, 2011)).

The German Energy Transition  
(Energiewende) –  
Large requirements for electricity  
storage?

- Common myth: renewable energy sources need storage!
- Reality: Existing electricity systems can offer flexibility via grid expansion (smart grids), the flexibility of power plants and demand response
- Studies show that electricity storage (except for large hydro) is today the most expansive flexibility option
- Storage requirements depends on the acceptance of curtailment of wind and solar PV and reduction of “must run” from conventional power plants

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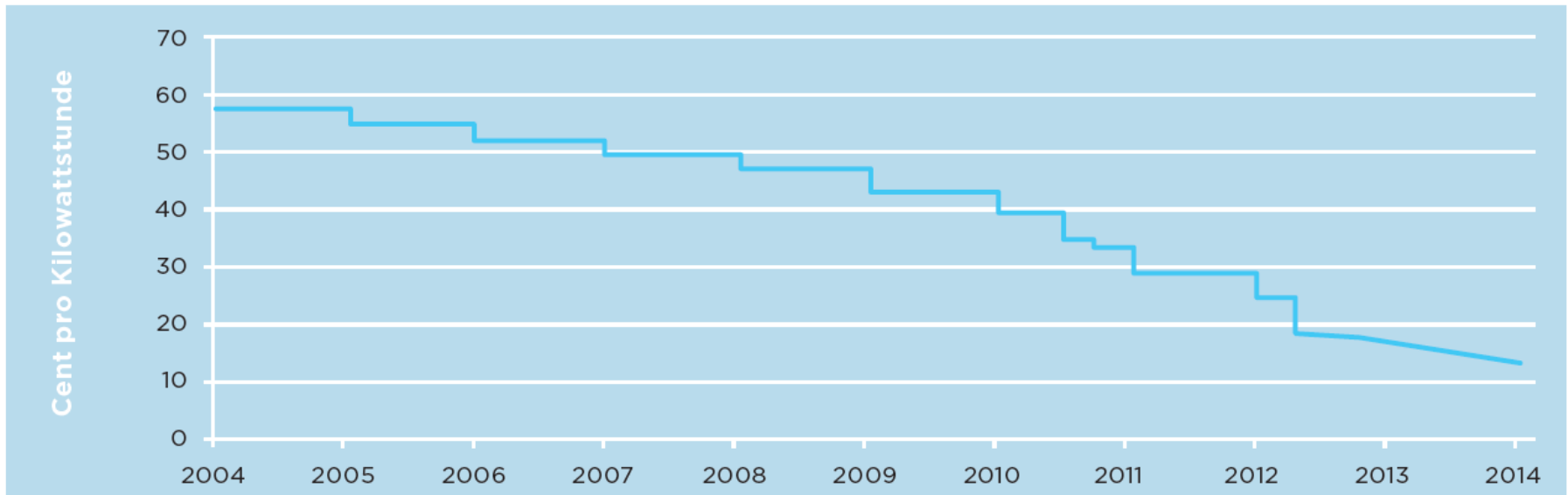
## Major EEG policy changes (focus on solar)

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- Binding direct-to-market sales (500 kW as of 2014, 100 kW as of 2016)
- 400 MW auction for free-standing solar PV (ongoing consultation process; auction will probably take place in 2015).
- Auctions as of 2017 – new price finding mechanism for “sliding market premium”)
- Prosumers: 30% of EEG surcharge on self-produced solar electricity (not applicable for installations smaller 10 kW).
- 0.4 €cent/kWh increase of tariff payment in order to pay aggregator
- Slight increase of tariff level for medium size solar (10-1000 kW – increase of 0.3 €cent/kWh).

## The German PV market

- Total installed capacity of 36 GW
  - about 6% of German electricity supply
  - 40% of peak demand
- Germany managed to reduce PV prices



Quelle: IASS auf Basis von EEG 2004, 2009 und 2012

- In 2004, Bavaria alone accounted for about 50% of the world-wide solar PV market
- Germany absorbed about 50% of world-wide solar PV modules between 2004 and 2009
- In 2013, the German market share was reduced to less than 10%
- For the first time since 2003, Europe has lost its leadership to Asia in terms of newly installed capacity.
- Europe accounted for only 30% of the newly installed capacity in 2013.
- China added 11.8 GW in 2013 (Germany: 3.3 GW; 1 GW in the first half of 2014).