

WEMAG/Rudolph-Kramer

## **Smart Grids - Business Opportunities in Germany**

Germany Trade & Invest  
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The foreign trade and inward investment promotion agency of the Federal Republic of Germany



**German Parliament**  
Resolutions for Founding/Financing

## Federal Government

Federal Ministry of Economics and Energy - Shareholder



Federal Ministry  
of Economics  
and Energy

Federal Government  
Commissioner for the  
New Federal States



GERMANY  
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## Company Tasks

Investment  
Attraction

Export Promotion

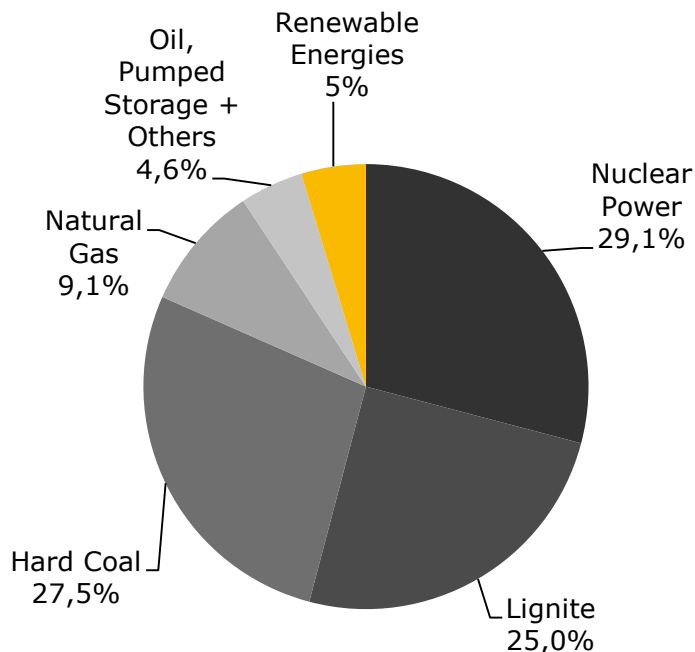
Location Promotion

## Main Objectives

<b>Climate protection measures</b>	<b>2020</b>	<b>2050</b>
GHG cuts vs. 1990	-40%	-80%
<b>Renewable share of...</b>	<b>2020 (2025)</b>	<b>2050</b>
Total energy consumption	18%	60%
Electricity consumption	35% (40-45%)	80%
Heat generation	14%	60%
<b>Energy efficiency measures</b>		
Increase in energy productiveness	2.1% p.a.	
Reduction of energy consumption	-50% (2050 vs. 2008)	
Reduction of electricity consumption	-25% (2050 vs. 2008)	
Renovation rate	2% p.a.	
Reduction of energy consumption for transportation	-10% (2020 vs. 2005) -40% (2050 vs. 2005)	

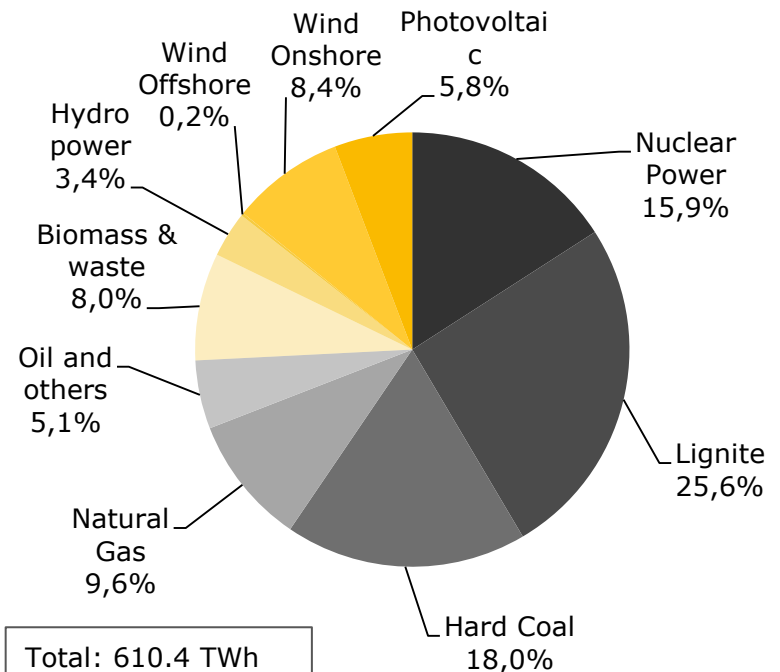
The share of renewable energy in electricity generation has increased from 5% to 27.3% since 1998

## Energy Source Share in Electricity Generation\* (1998)



Total: 557.2 TWh  
Export: 0.6 TWh

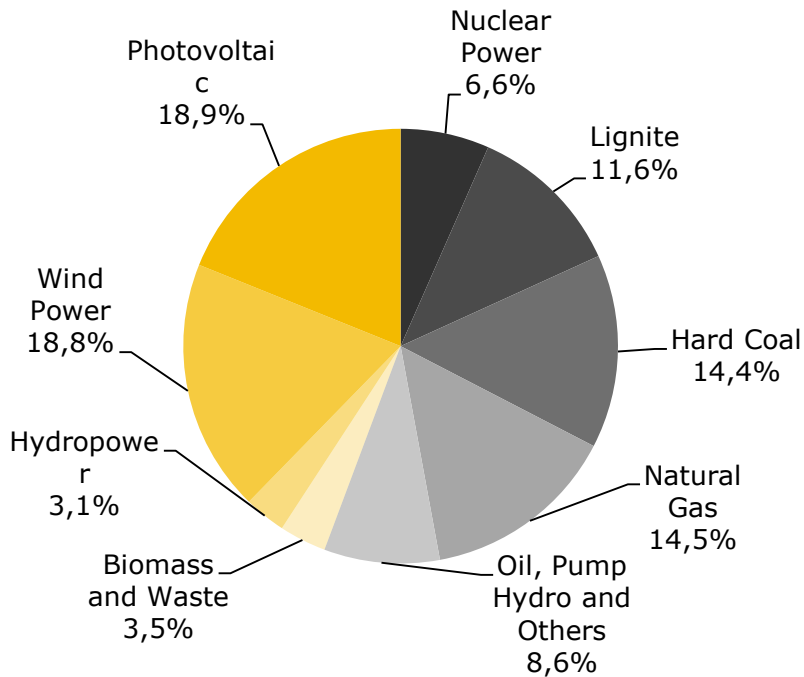
## Energy Source Share in Electricity Generation\* (2014)



Total: 610.4 TWh  
Export: 34.1 TWh

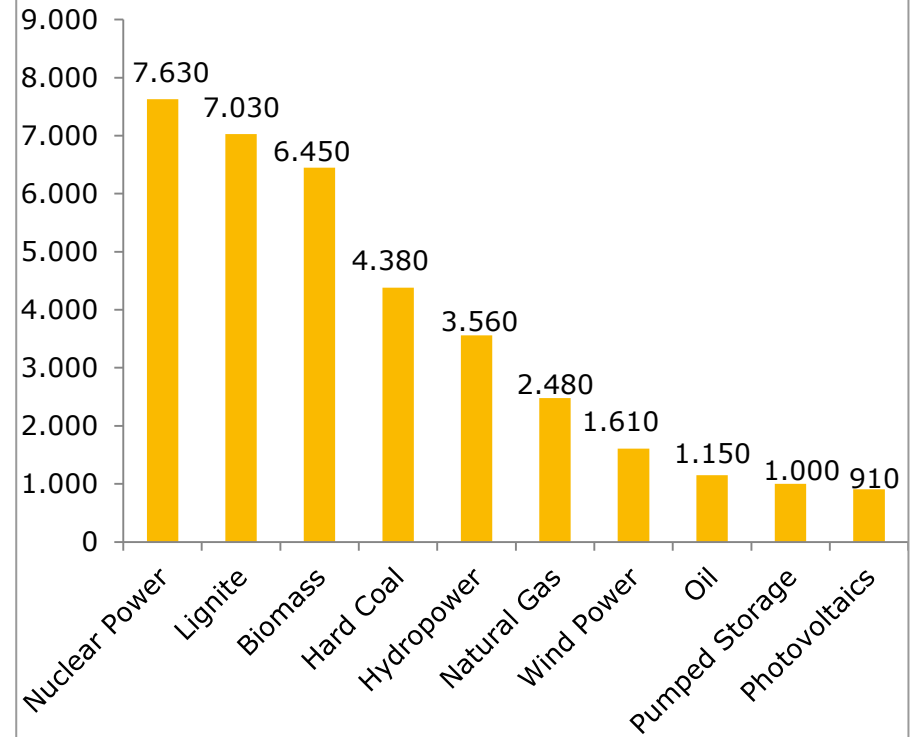
## Plant utilization of conventional power plants remains the highest

### Energy Source Share of Installed Capacity 2013



Total: 183.6 GW    Annual peak load: app. 80 GW  
 wind power: 34.5 GW    PV power: 34.7 GW (1.9 GW\*)

### Average Hours of Yearly Full Load of German Power Plants (2013)



Year: 8,760 h

Source: Bundesnetzagentur 2013, \*BDEW 2014

An enormous expansion of the high voltage grid system is required by 2024.

Grid Expansion	Distance in Km.
DC-New Construction	2,200
AC-New Construction	1,300
DC/AC- Grid Reinforcement	5,200

## Expansion and Reinforcement

### Transmission grid

Grid expansion and Reinforcement of **8,700km** is required by 2024

→Baseline scenario with overhead lines requires:

**22 bn €\***

- Additionally the connection of the offshore-grid is estimated to

**10-12 bn €**



\*Costs estimates per NEP-Draft 2014 49GW/12GW wind onshore/offshore

Approx. 50,000 km of transmission lines needed to mitigate larger, volatile long distance power flows through EU by 2022

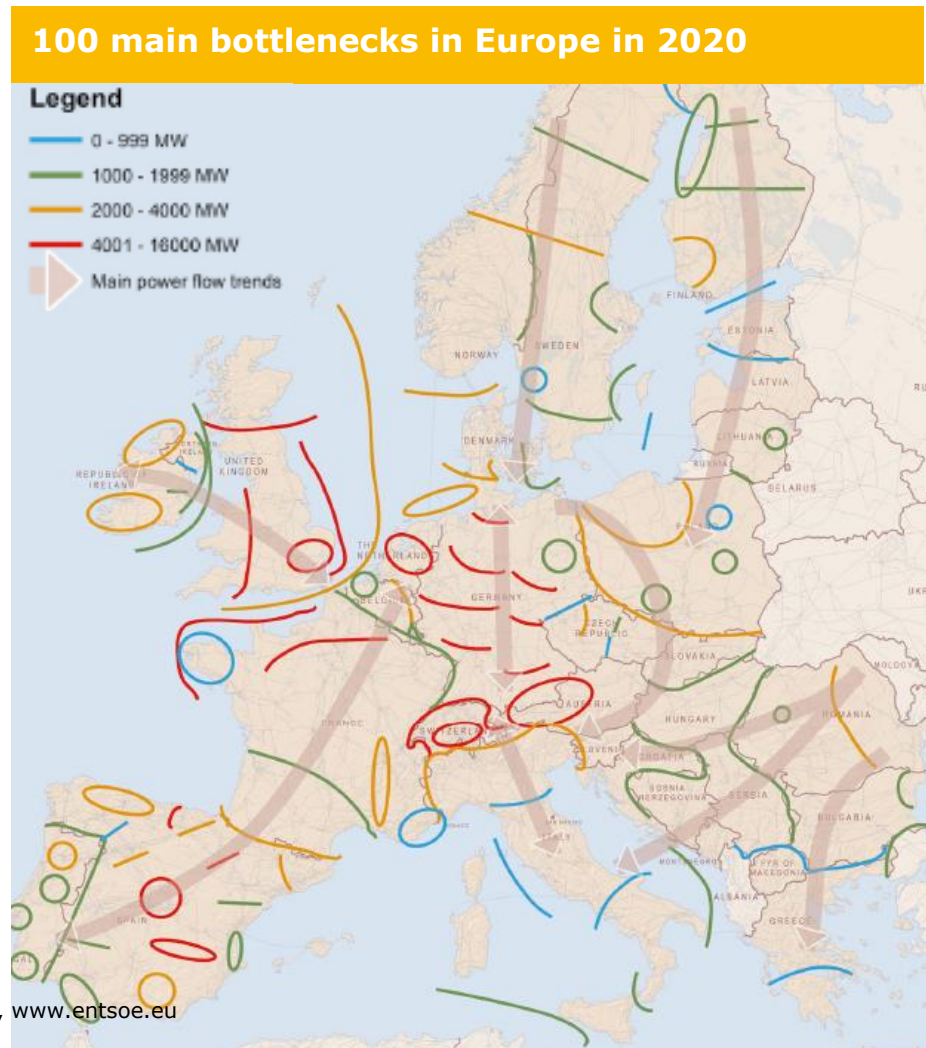
- On the European level, some 100 transmission projects from 100 MW to 4 GW need to address grid bottlenecks until 2022\*\*:

  - 12,590 km HVDC and 37,520 km HVAC
  - **Worth EUR 104bn until 2022 (including EUR 23 bn for subsea cables)**

### Need for new HVDC/HVAC cables until 2022 in km

2012-2014 (km)	HVDC	HVAC >330 kV
Subsea Cables	9,000	400
Underground Cables	1,490	420
New OHL	2,100	28,400
Upgrade OHL	0	8,300
<b>Total</b>	<b>12,500</b>	<b>37,520</b>

Source: TYNDP-2012. Ten-year network development plan ENTSO-E , July 2012, [www.entsoe.eu](http://www.entsoe.eu)



## Massive needs to expand the distribution grid

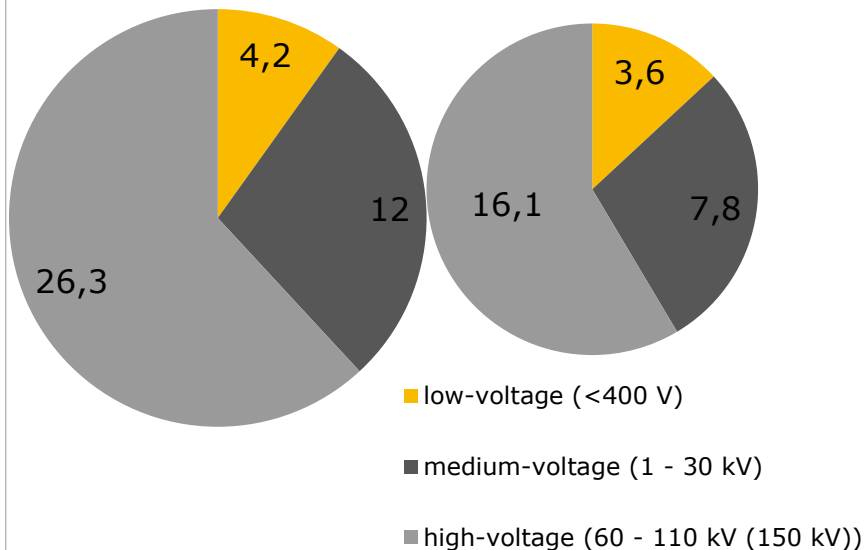
### Investment needs for the distribution grid extension and conversion until 2030

#### Scenario 1

(increased and faster expansion of renewables): **€42.5bn**

#### Scenario 2

(conservative estimation): **€27.5bn**

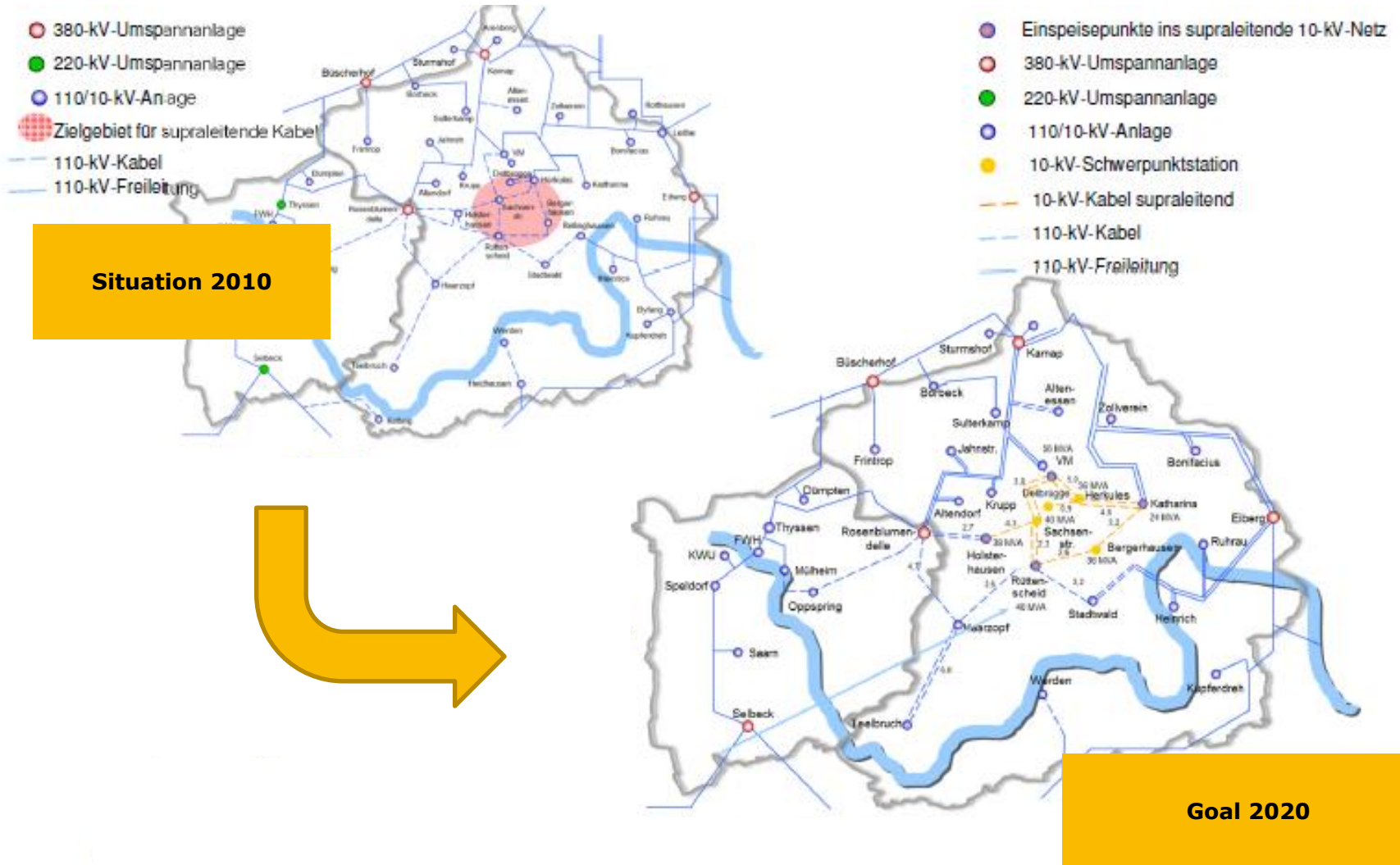


### Results of the Distribution Grid Study(Dena, 2012):

- the German distribution grids require
  - expansions of 135,000 km up to 193,000 km
  - conversions of 21,000 to 25,000 km
- investment needs for the grid extension and conversion:
  - until 2020: €18.4bn – €26.7bn
  - until 2030: €27.5bn – €42.5bn
- investment needs can be reduced by various technical options, e.g. :
  - innovative operational resources,
  - down-regulation of power peaks of renewable generation,
  - storage systems



## High voltage grid in Essen area



## Testing phase 2014 - 2016



## Funding programme "Smart Energy - Digital Agenda for the Energy Transition" (SINTEG)

### The programme supports the establishment of SINTEG pilot regions/showcases:

- To develop and demonstrate large-scale solutions for a reliable and efficient energy supply and smart grids with a high degree of fluctuating energy (temporarily up to 100 % renewable energy).
- To improve the interplay between electricity generation, consumption, storage, and the grid.

**Example:** A pilot region might, for instance, use smart grids to improve demand-side flexibility, and to connect load centres where there is high population and industrial density, with regions in which there are temporary surpluses of renewable energy.

- Eligible are enterprises of the commercial economy, universities and non-university research organizations with registered office and core activities in Germany; supported are collaborative projects (Verbundprojekte)
- Amount of funding: total of up to Euro 80 million in funding for at least two large showcase regions
- Type of support: The support is provided in the form of a non-repayable cash grant. The rate depends on the type of organization.
- Deadline for submission of project draft: 31. Mai 2015. Funding is granted for a project duration of 4 years

Note: SINTEG = Förderprogramm "Schaufenster intelligente Energie - Digitale Agenda für die Energiewende"; Link to announcement (German only): <http://www.bmwi.de/BMWi/Redaktion/PDF/B/bekanntmachung-foederung-schaufenster-intelligente-energie-digitale-agenda-fuer-die-energiewende,property=pdf,bereich=bmwi2012,sprache=de,rwb=true.pdf>; Source: Federal Ministry for Economic Affairs and Energy 2015

The German Energy Economy Law (§21c, §21b, §21d, §21e, §21f, §21i) already has requirements in place for a Smart Meter roll-out

## Smart Meters are already required for:

- Buildings newly connected to the energy supply grid or buildings undergoing large renovations.
- End users whose annual energy use exceeds 6,000 kWh.
- New (from 2011) power generating facilities with a capacity exceeding 7 kW.
- **Under current legislation, 23% of Germany's 50 million meters would be smart by 2022.**



Picture Source: Landis + Gyr

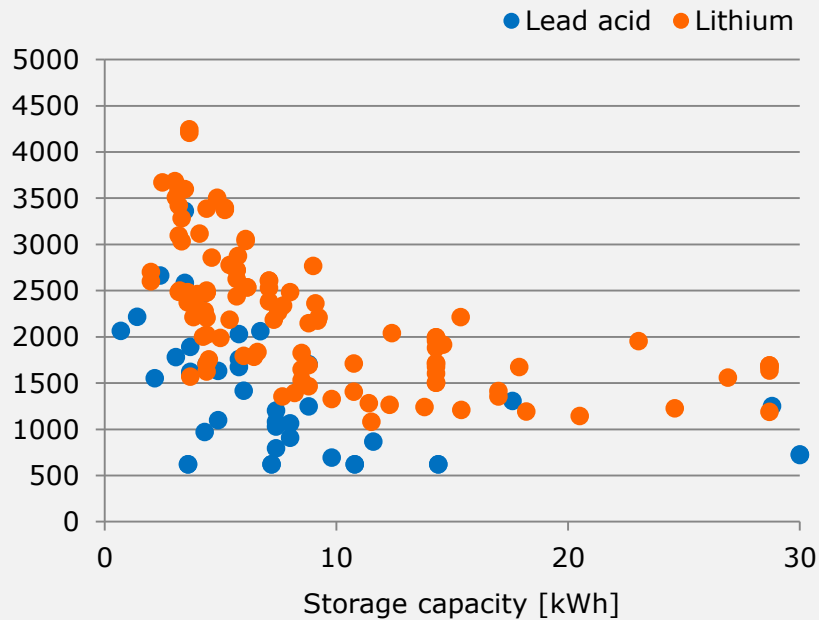
## EU requirement to prepare large roll-out by 2022

Government-commissioned cost-benefit analysis recommends:

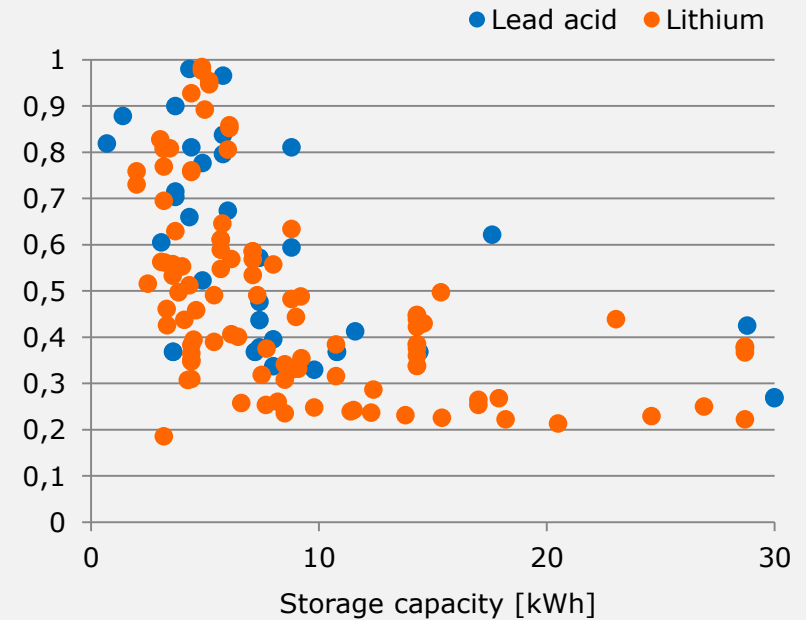
- Extending requirements to existing RE facilities and gradually replacing all meters with intelligent meters that can be upgraded to full Smart Metering Systems (SMS)
  - **50 million intelligent meters and SMS until 2029 for electricity (100%)**
  - **14 million intelligent meters for gas by 2029**

Low-price PV + Battery systems are reaching competitiveness now!

Battery system costs 2014 [EUR/kWh]



LCOS 2014 [EUR/kWh]



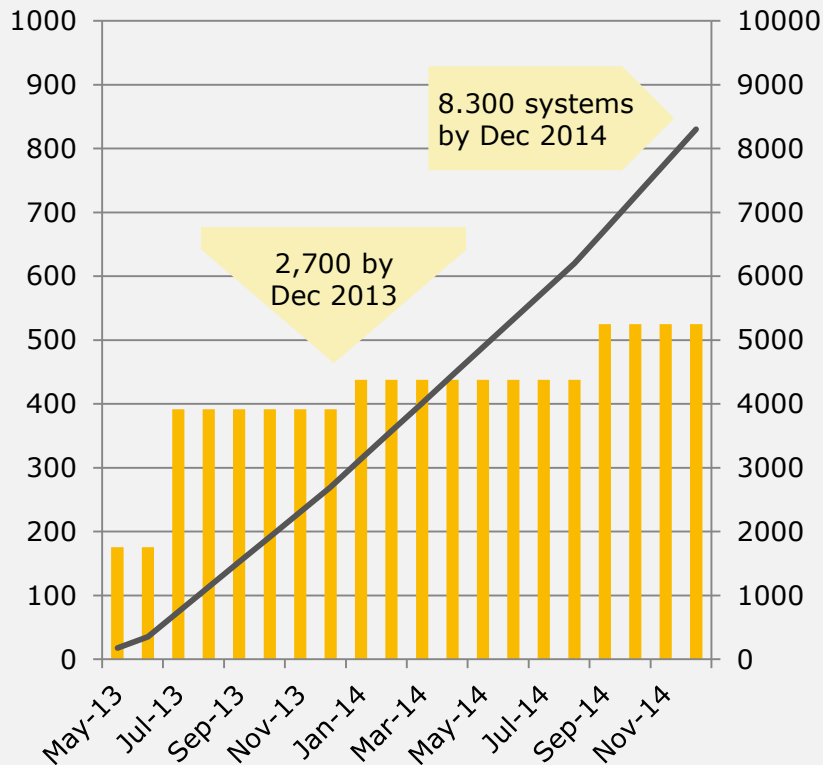
LCOE of low price PV-system in Southern Germany: ~10 €ct./kWh

LCOS of low price PV-Battery system: ~20 €ct./kWh

→ Average household electricity costs: ~30 €ct./kWh

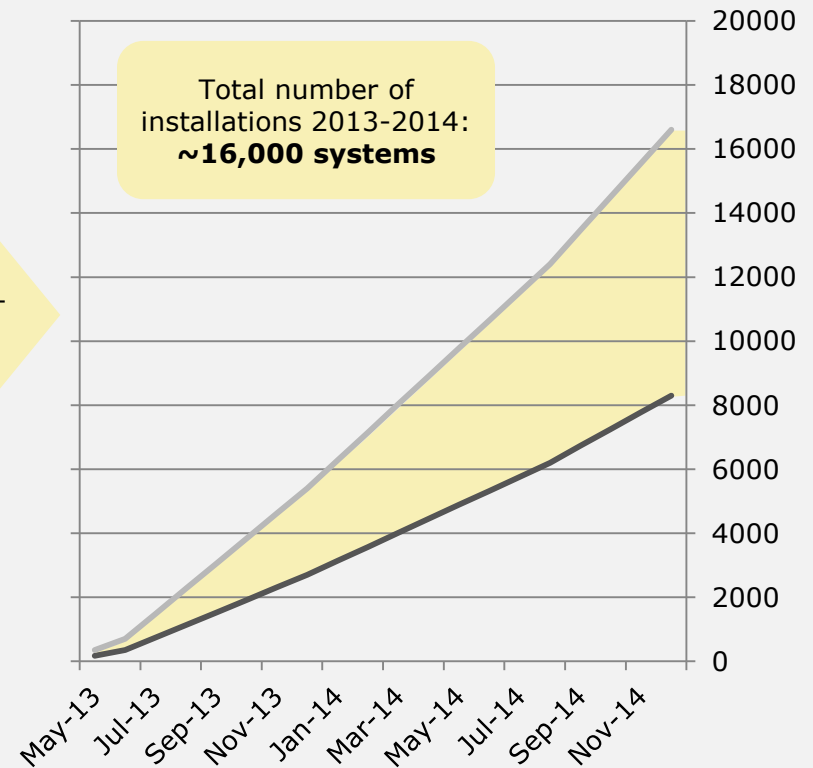
German PV-battery installations increased >50% from 2013 to 2014. Approximately half of the customers use the KfW incentive program.

■ Average number of KfW-supported PV-Batteries per month (left ordinate)  
— Cumulative number of KfW-supported PV-Batteries



— Cumulative number of KfW-supported PV-Batteries  
— Total installations at KfW market-share of 50% (estimated)

KfW market-share: ~50%\*

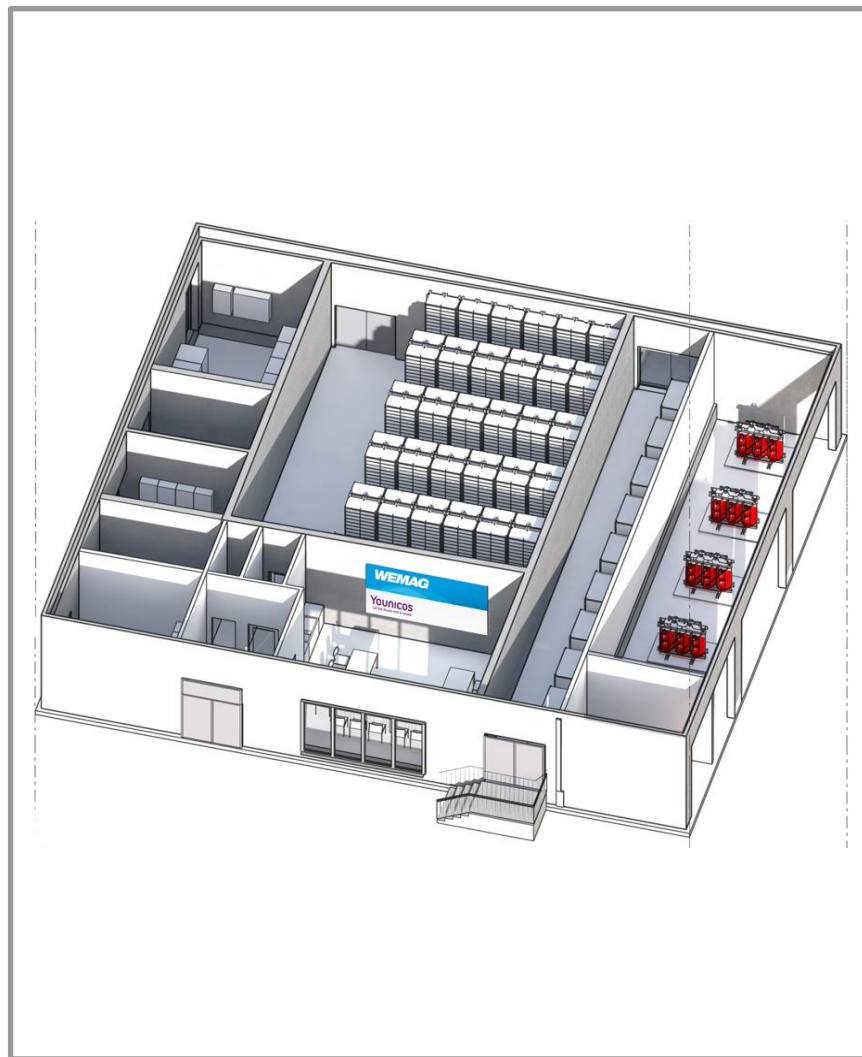


\* Estimation (based on surveys among installers performed by EuPD and BSW). Source: KfW 2015

## Prequalified for the primary control power market (WEMAG/Younicos)

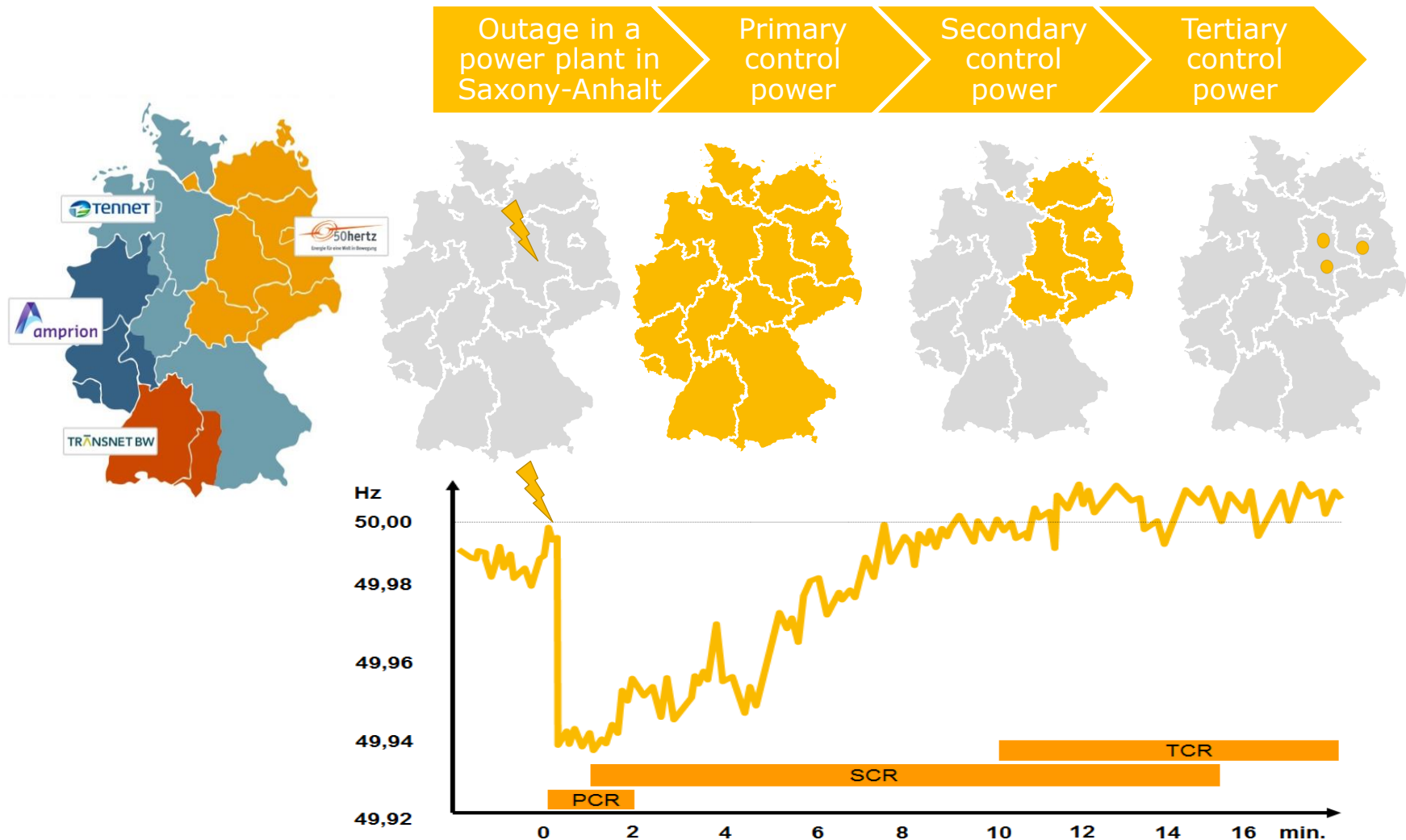
### Key Data

- 5 MW/ 5MWh
- Lithium ion technology
- Bought and operated by medium sized German municipal utility WEMAG
- Fully automated, turnkey battery park
- Battery park will be ready for the primary control power market
- Performance guarantee of 20 years on the battery system



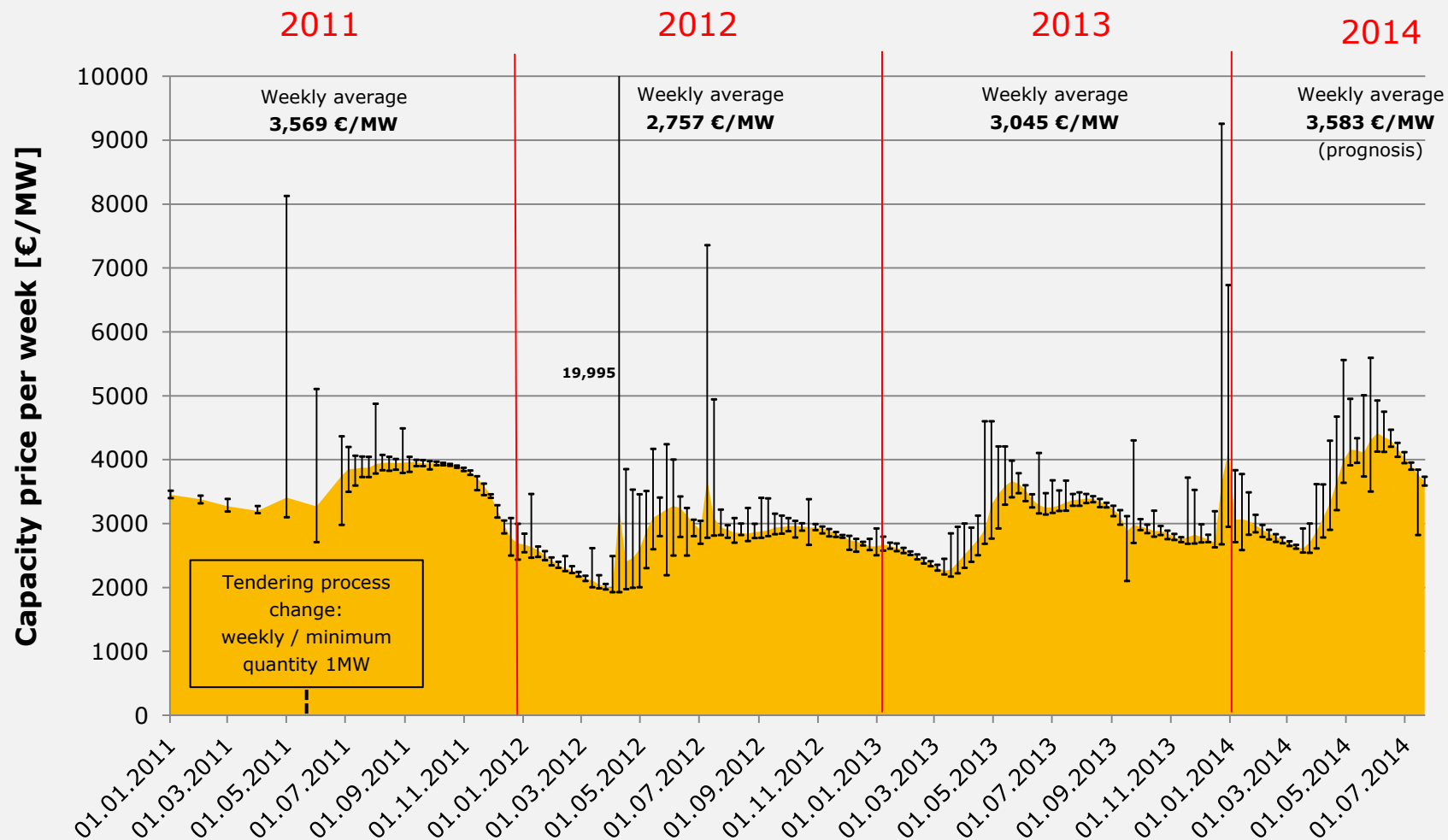
# Control power (Operating reserve)

Interaction between three types of control power in case a generator goes down or there is another disruption to the supply

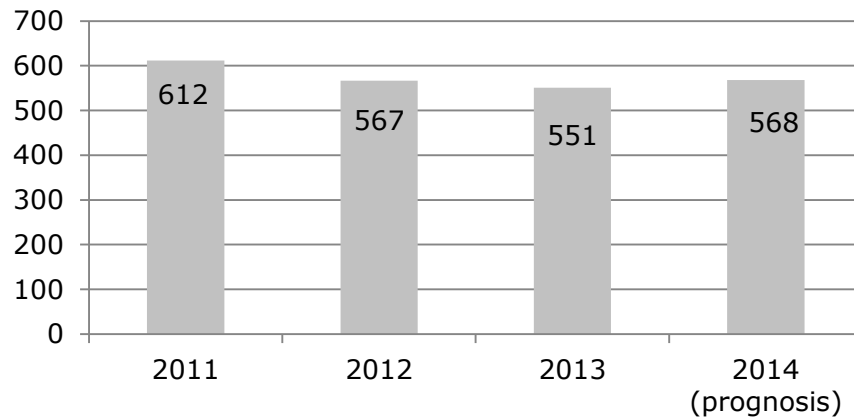




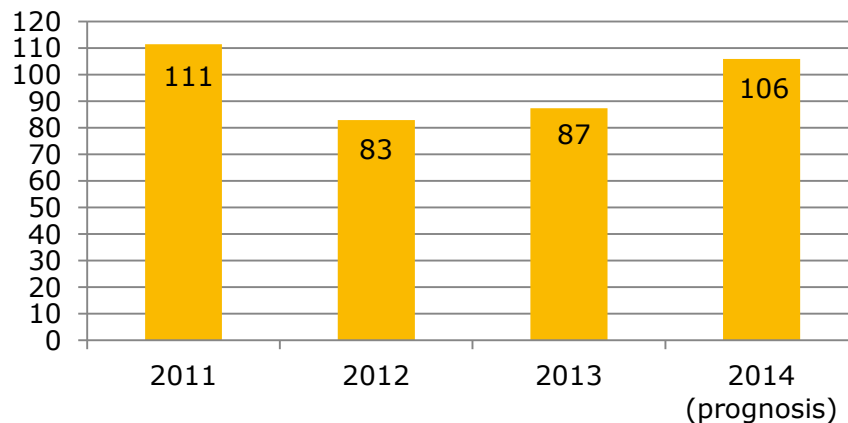
## Primary Control Power Price Development



## Needed power per week [in MW]



## Size of the market [in million €]

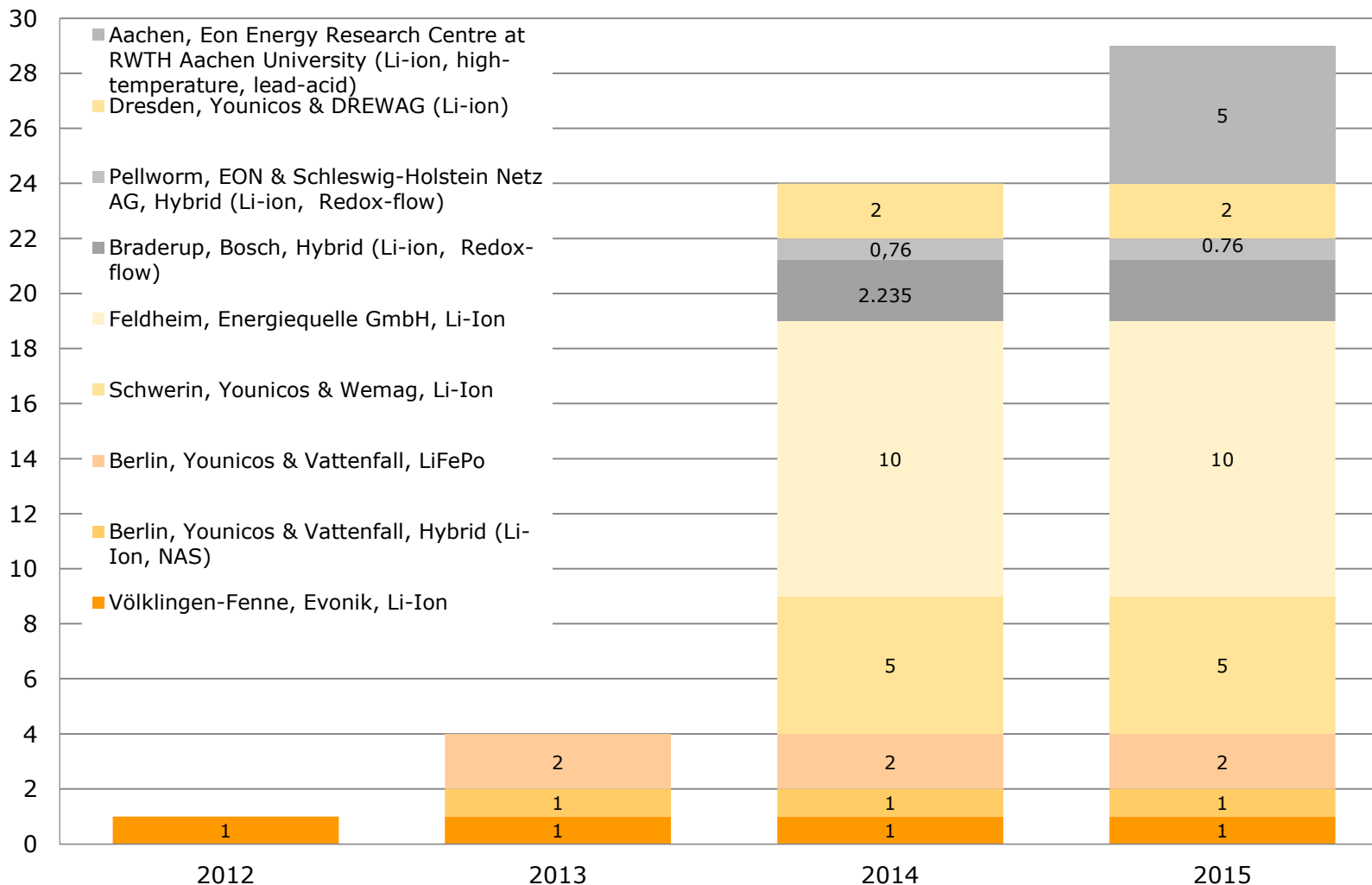


## Calculation of break even CAPEX for new battery systems:

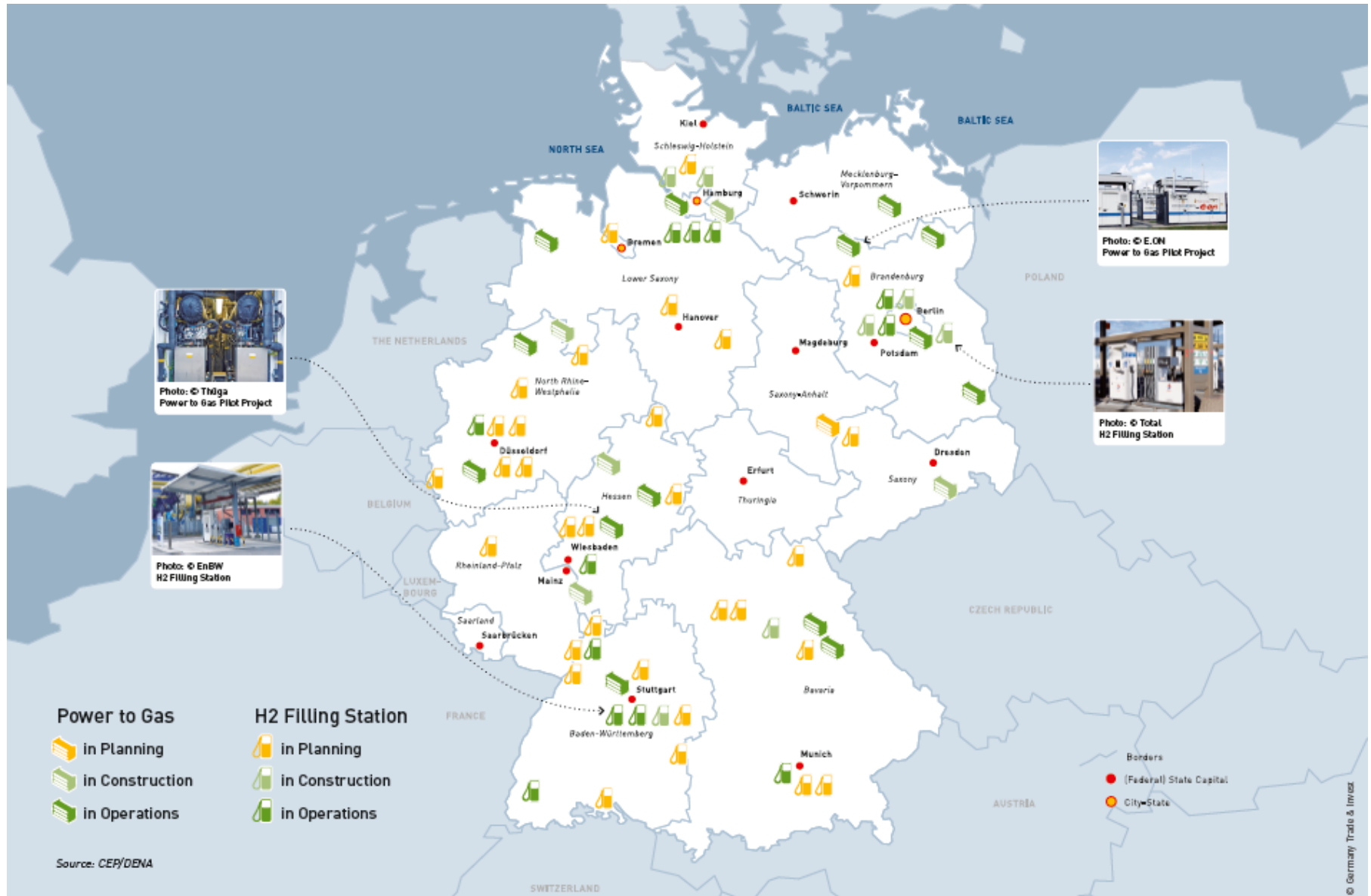
- Mean specific capacity price payment per year:  
 $\approx 165,000 \text{ €/MW}$
- Interest rate: 5 %
- Operation costs: 2 %/a from CAPEX
- Amortization period: 10 a
- Energy/Power ratio: 1:1

**→ max. CAPEX:  
 $\approx 1,100 \text{ €/kWh}$**

## Installed battery capacity in Germany for primary control provision



# Power to Gas pilot plant and H2 Filling Stations



## H2 Mobility action plan until 2023

**Air Liquide, Daimler, Linde, OMV, Shell and Total** agree on an action plan for the Construction of a hydrogen refueling network in Germany.

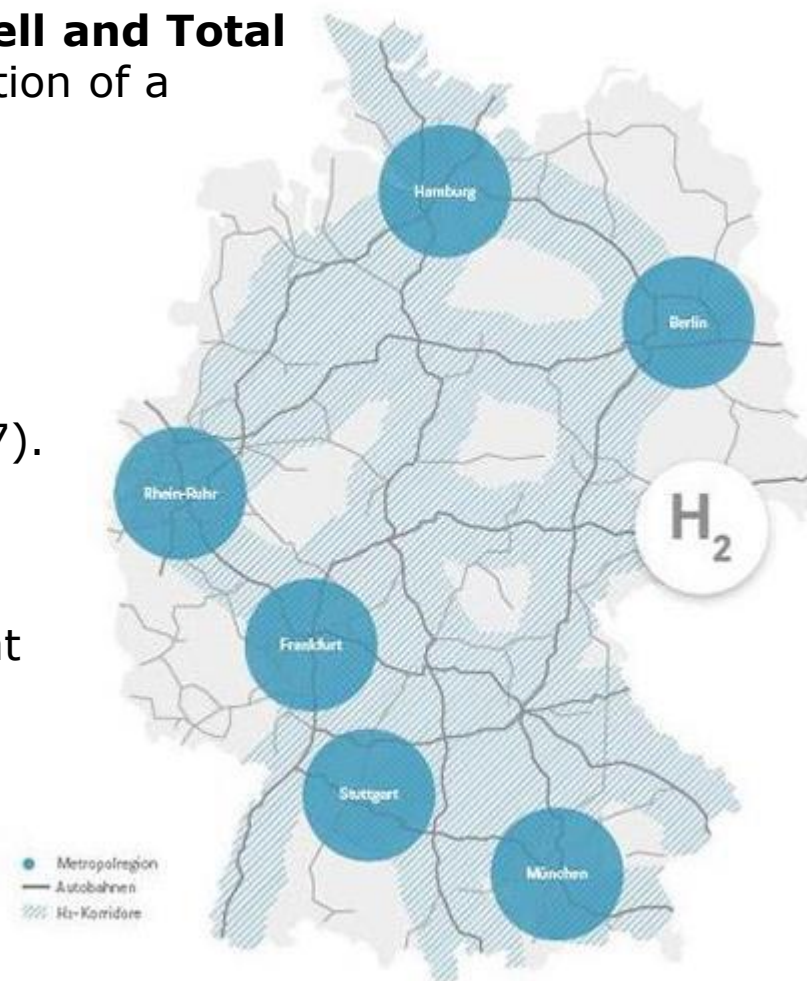
### Targets:

400 HRS until 2023 ( 100 HRS until 2017).

350 mio. € investment.

Max. 90 km distance between two HRS at the motorway.

10 HRS in each metropolitan area.



# Don't hesitate to contact us!

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