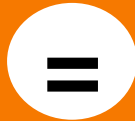
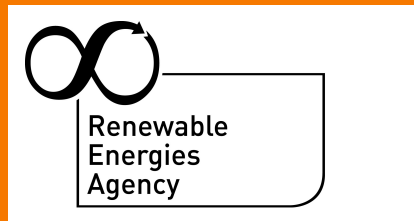


Secure power supply by renewable teamplay: the first German combined power plant



At the International EcoEnergy Clusters Meeting
Gdansk, May 12th, Renewable Energies Agency, Germany

The Renewable Energies Agency: the German information platform, half-government, half industry



Patron: Former UNEP executive director, Prof. Dr. Klaus Töpfer



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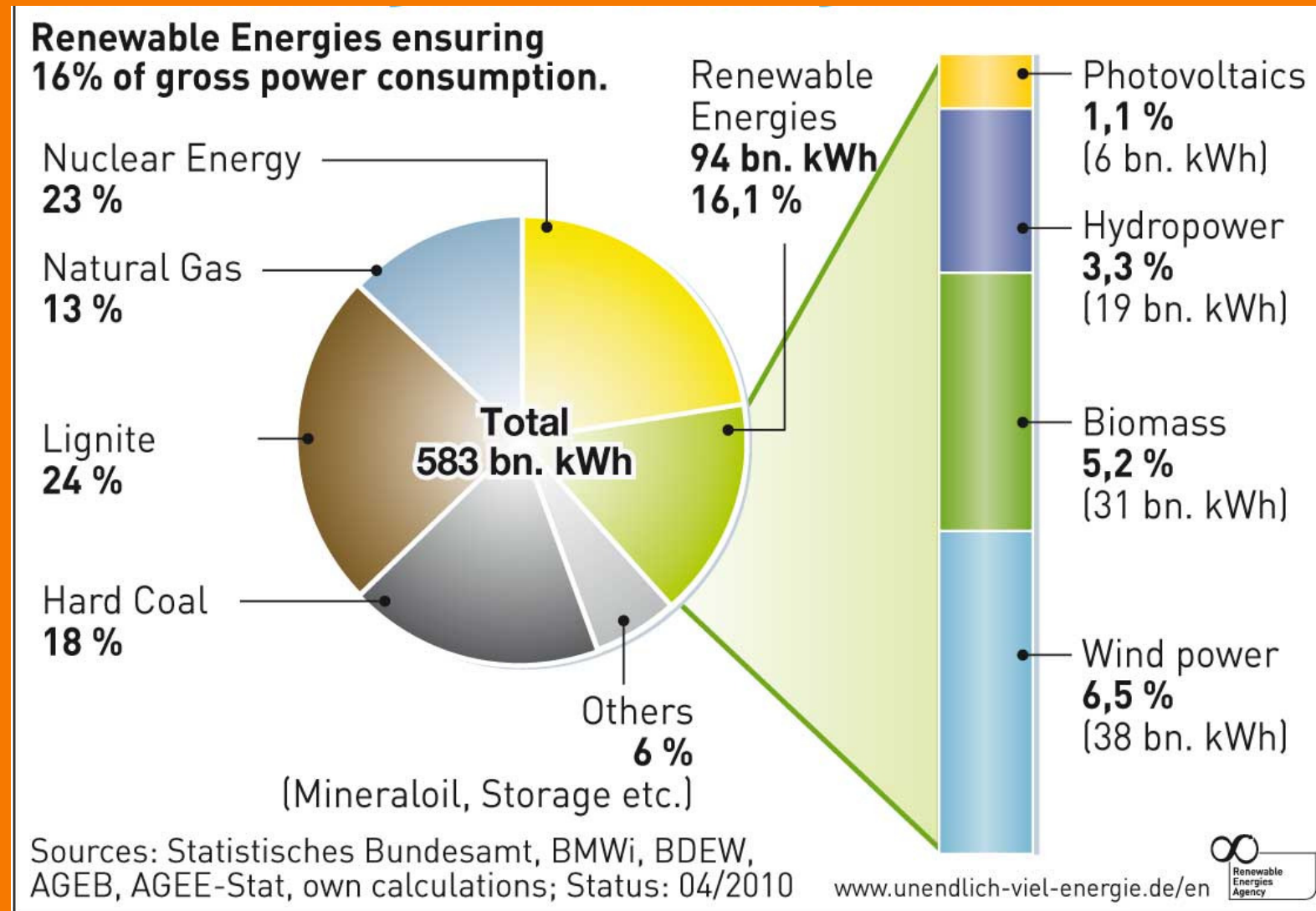
1. German Status of Renewable Energy and Challenges

2. The Project “Combined Power Plant”

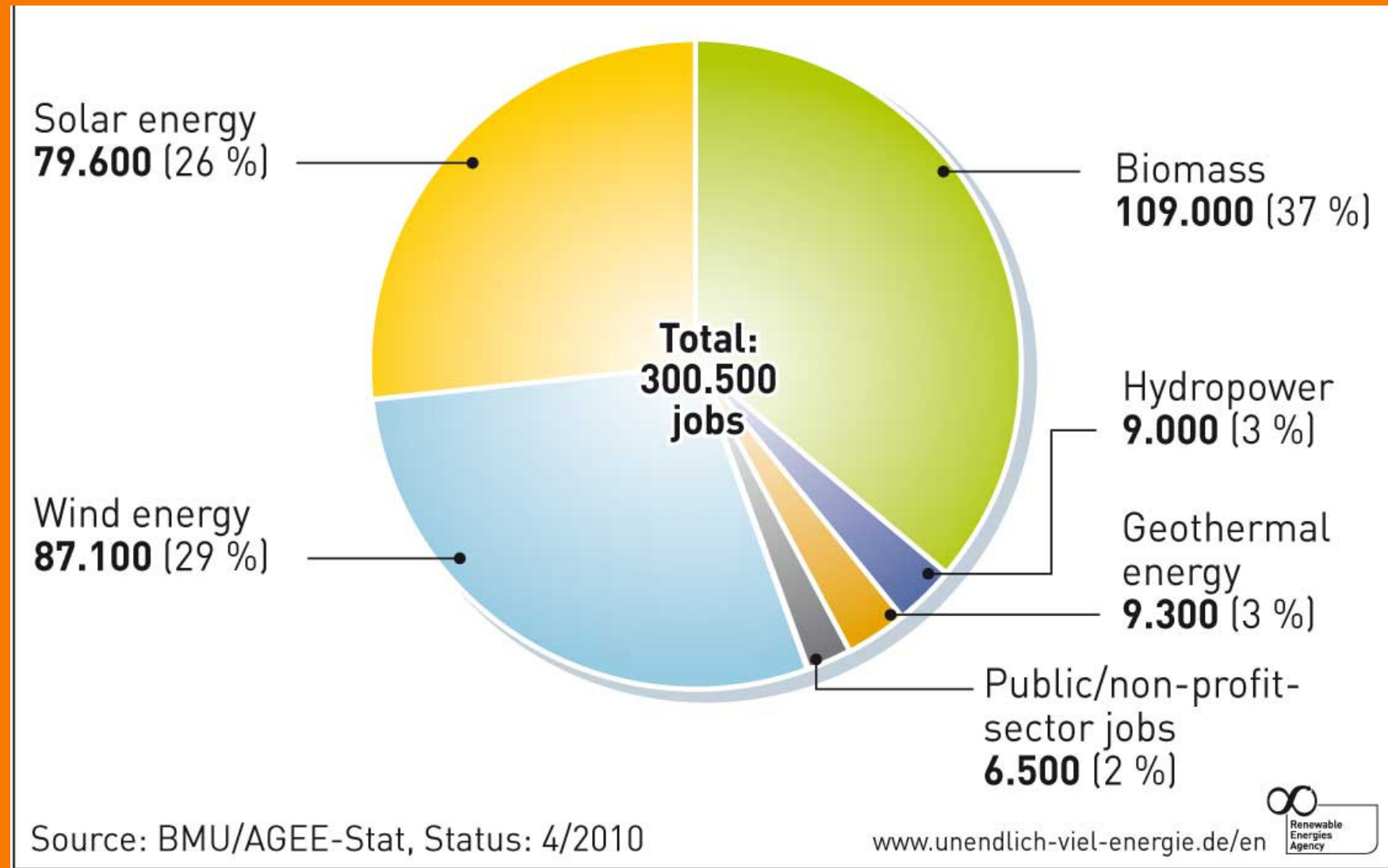
3. Political Implications



The German electricity mix 2009: 16.1% renewable energy in the grid

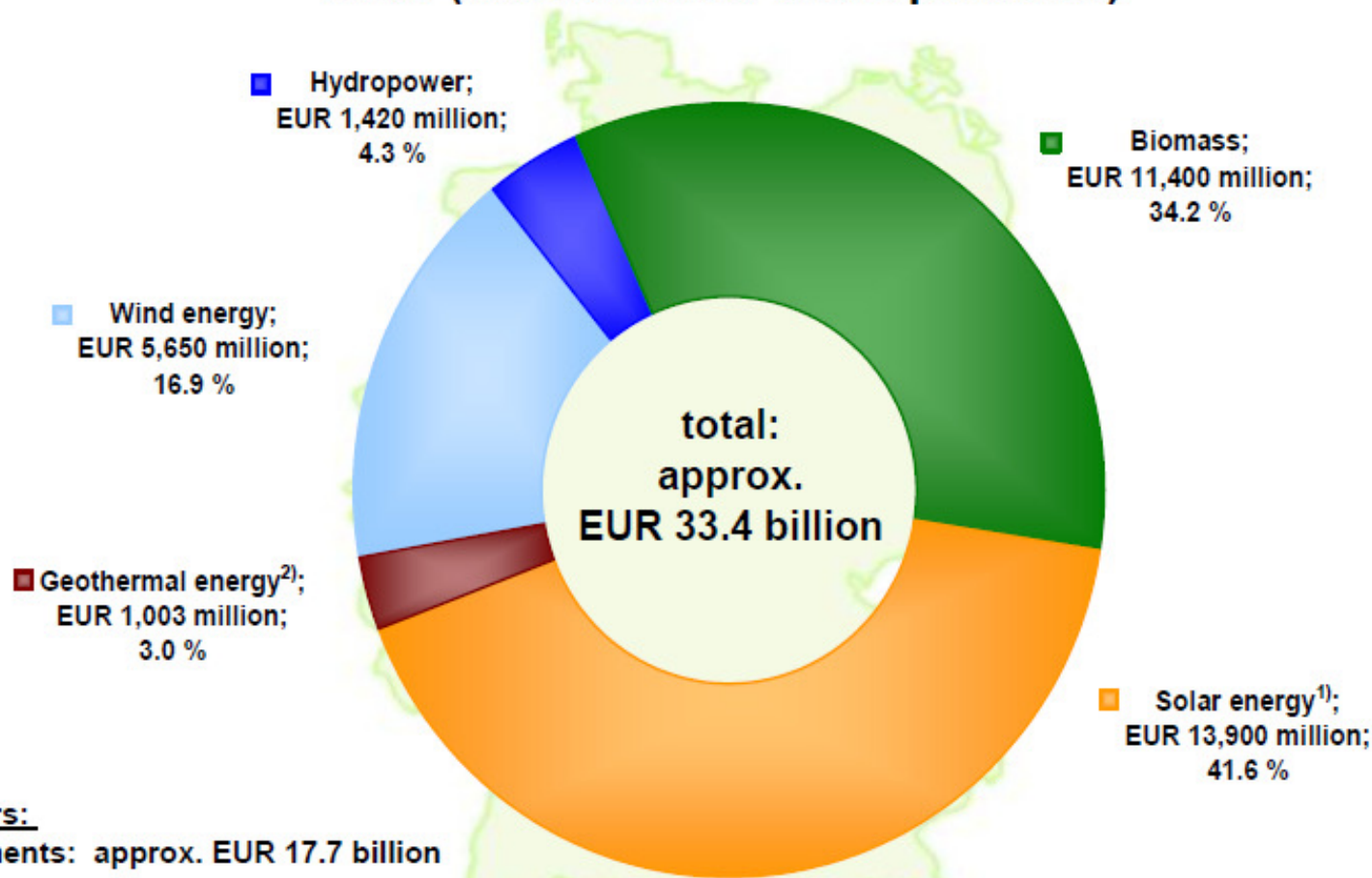


Result: 300.000 jobs were created, mostly in the wind, solar and bioenergy market



Result: more than 33 bn. Euros of turnover in 2009

Total turnover from renewable energy sources in Germany 2009 (investments and operation)



Turnovers:

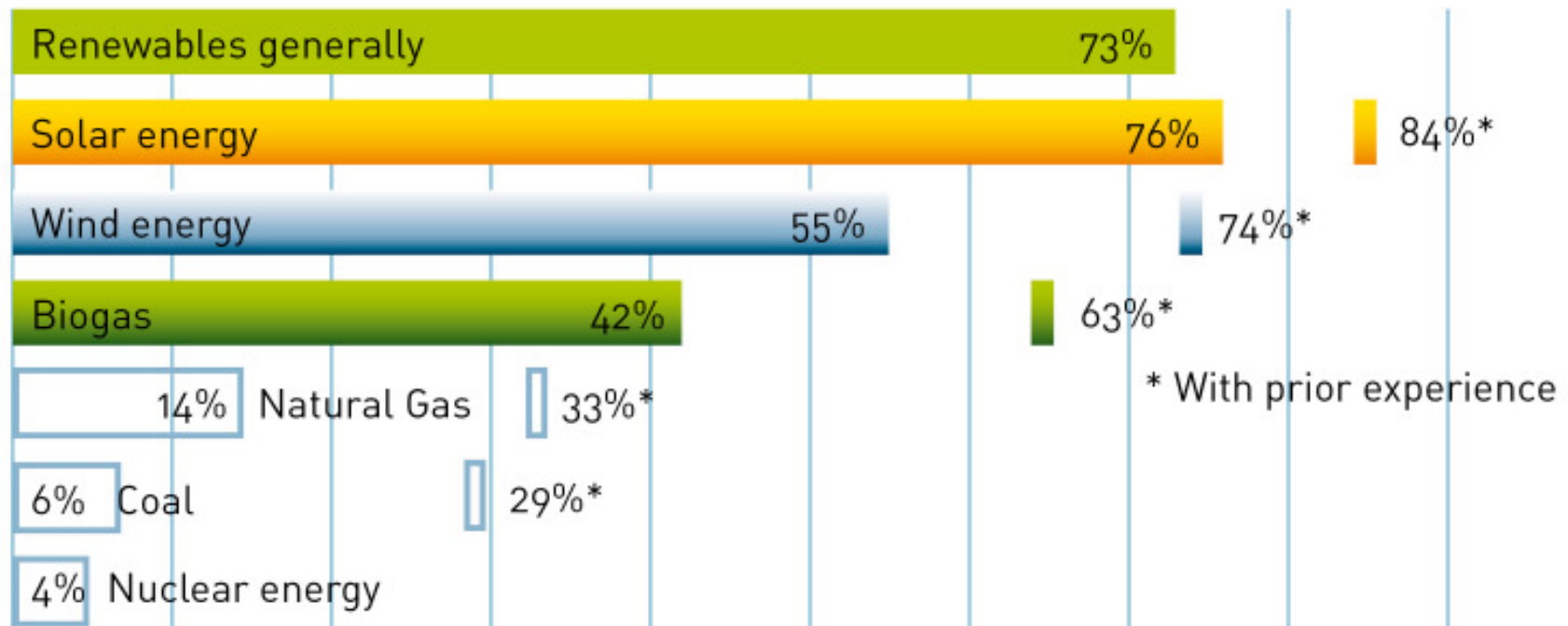
- Investments: approx. EUR 17.7 billion

- Operation: approx. EUR 15.7 billion

Statistically speaking, renewable energy „in my backyard“ is not a problem.

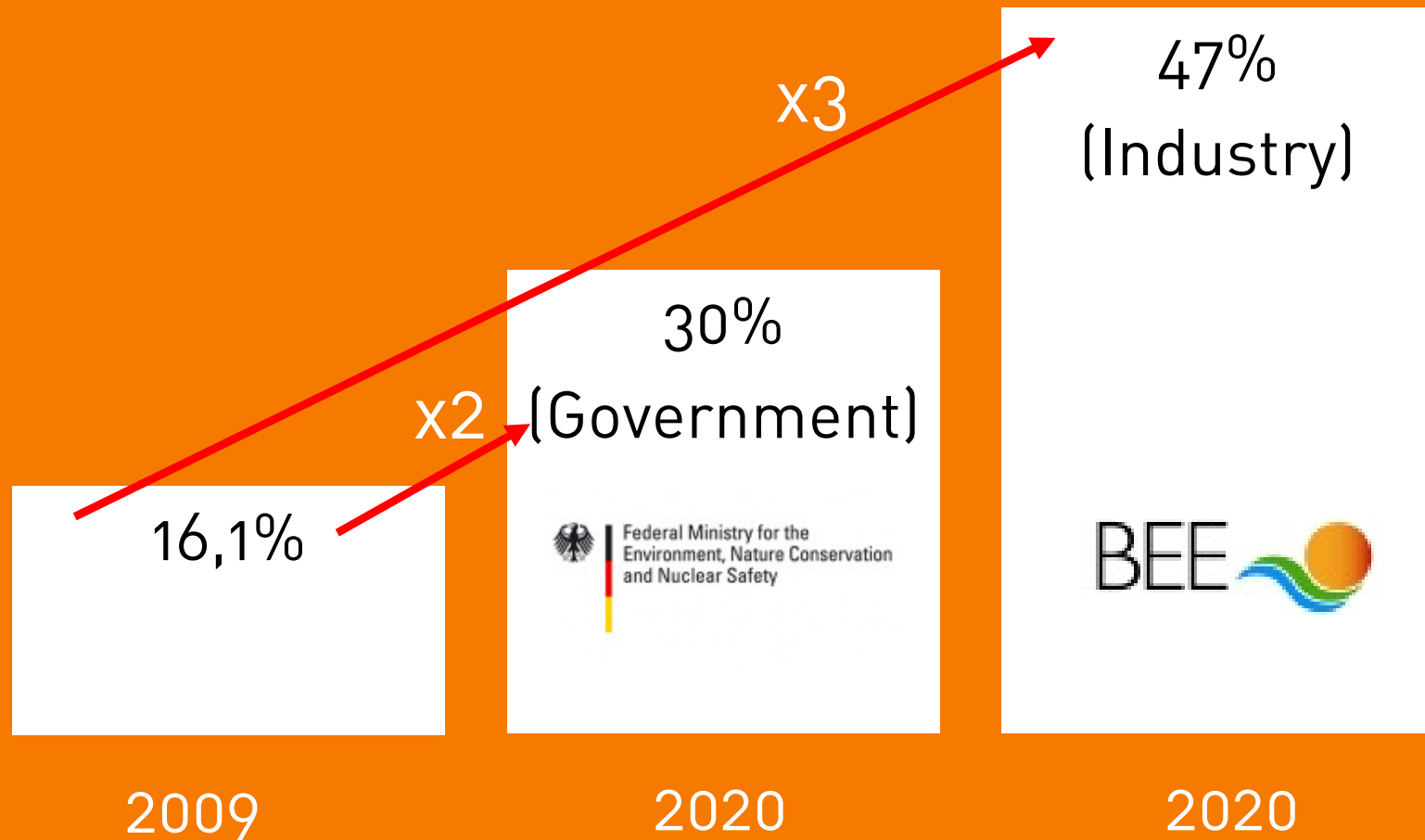
Agreement to power plants nearby the own residence

For energy production in the neighbourhood is assessed as good or very good...

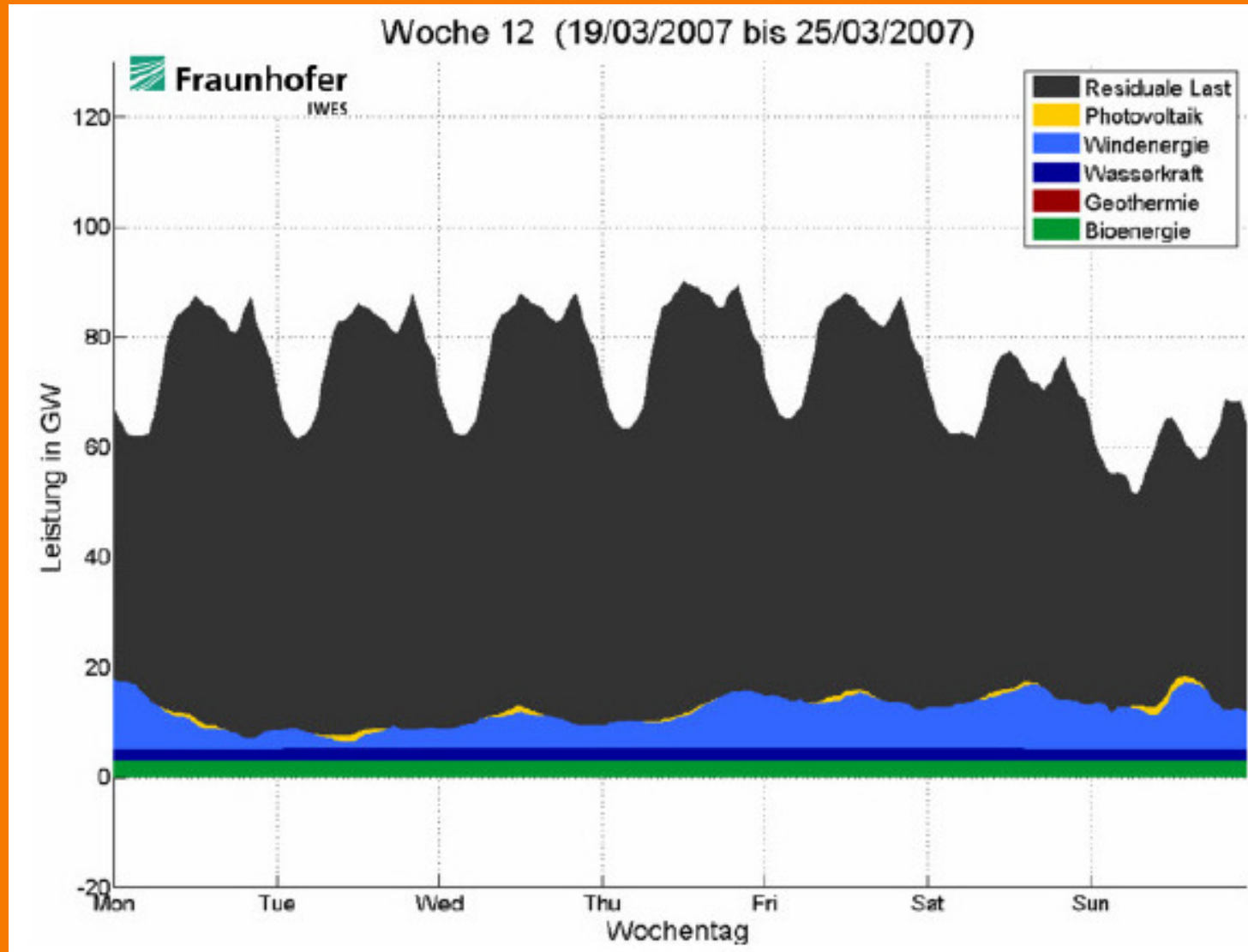


The acceptance of Renewables is rising with higher prior experience.

Challenge 1: Forecasts range between a doubling or tripling of share of electricity



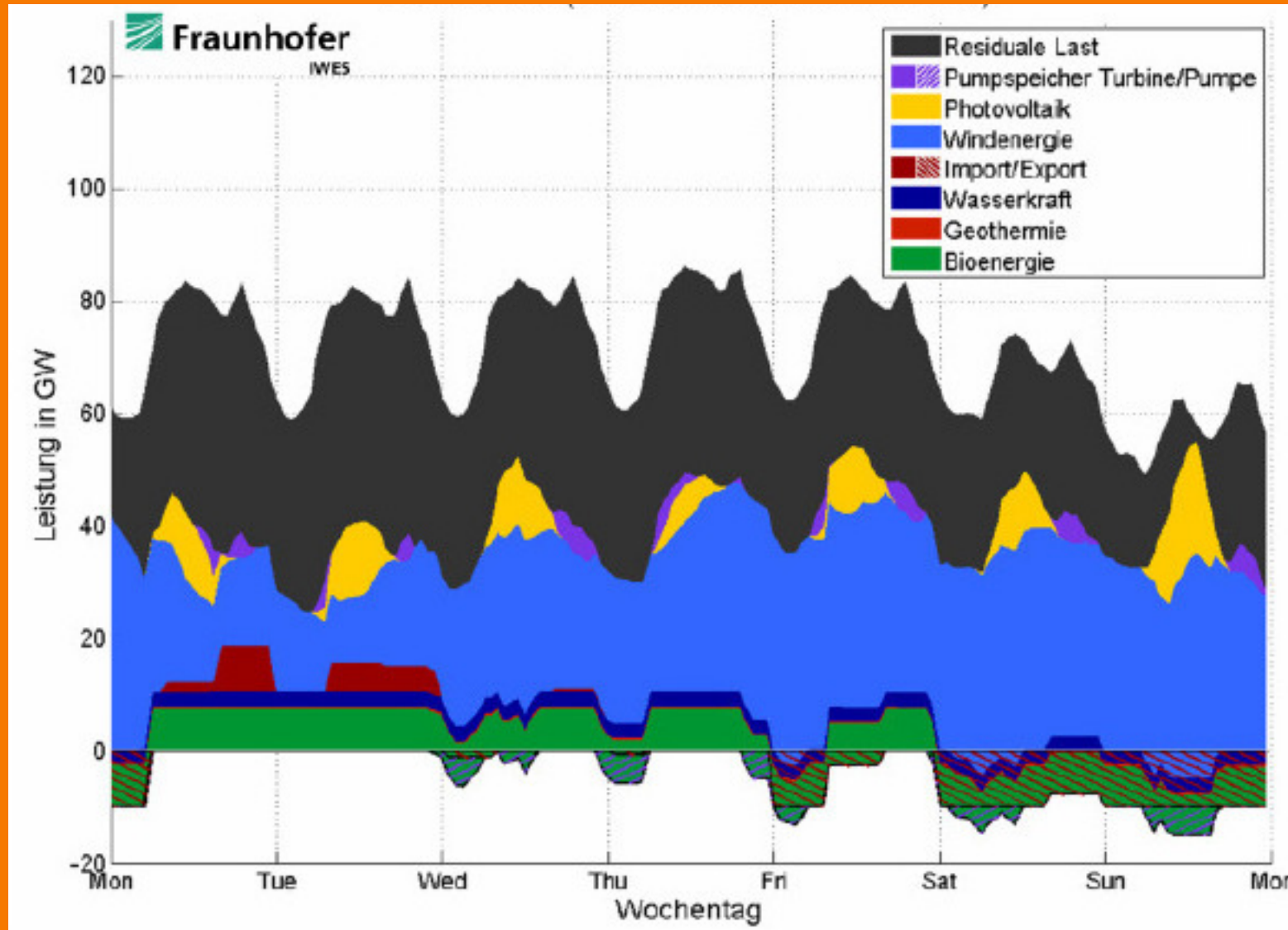
Challenge 2: the future structure of electricity production won't be as constant as today



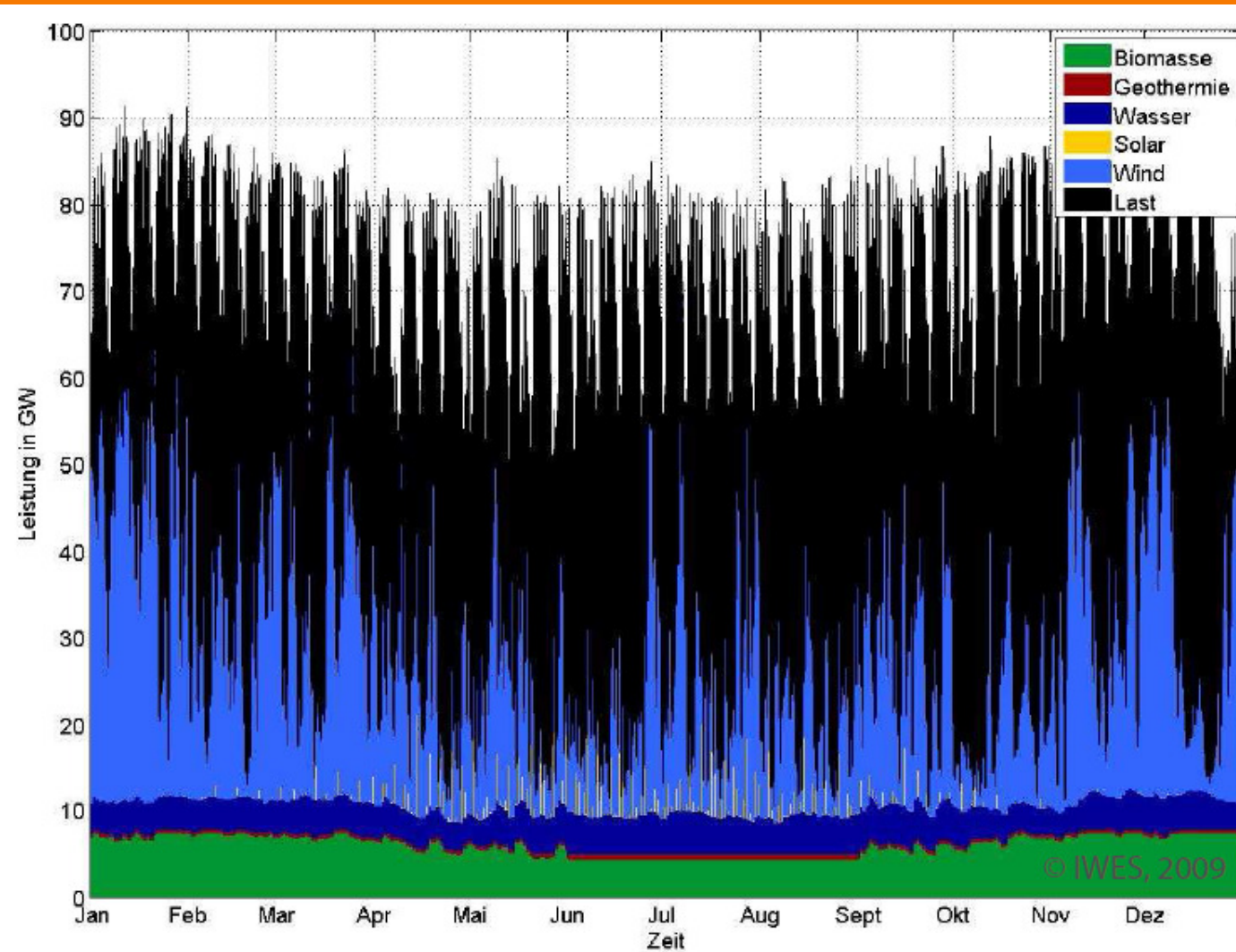
Study from
„Fraunhofer IWES
institute, Kassel:

Simulation of
electricity structure
2020 by transferring
weather
conditions from
2007

In 2020 with higher shares of RE, the power input is more dependent on weather conditions

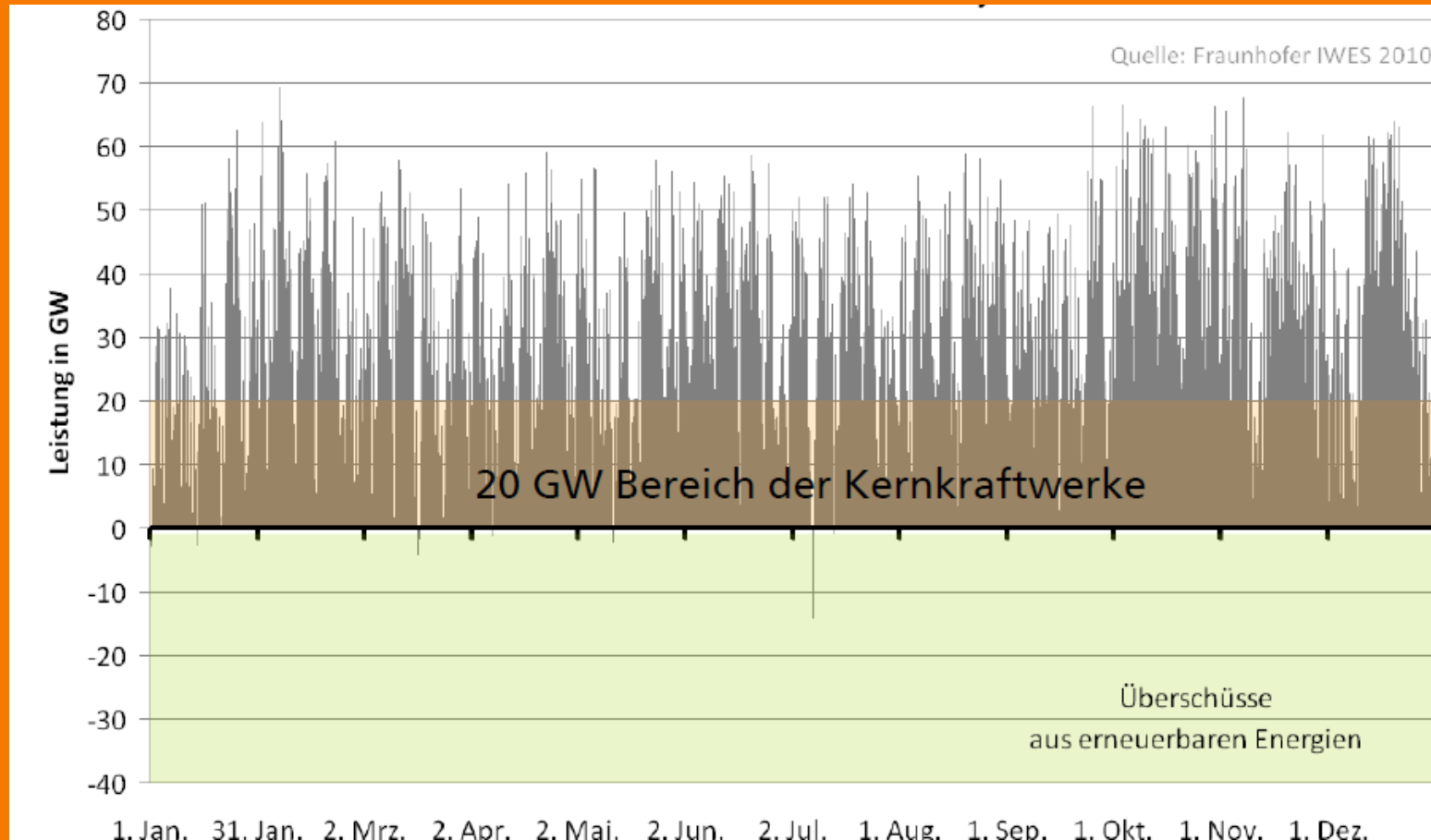


In an hourly resolution, the up- and downpeaks will be extreme, 100% slots appear frequently



Quelle: Saint-Drenan et al., 2

The residual load doesn't leave much space for base load power plants



Band of today's nuclear capacity of 20 GW

Consequences:

1. Full load hours / capacity usage of base load power plant will decrease
2. Renewable Energy must feed in more steadily

Contents

1. German Status of Renewable Energy and Challenges

2. The Project “Combined Power Plant”

3. Political Implications



The Combined Power Plant helps to stabilize the power output by volatile RE sources

- ∞ Real Project in 2007 /2008
- ∞ Functioning in real time
- ∞ Covering demand including fluctuations
- ∞ Independent from weather conditions
- ∞ Covering electricity demand of 12.000 households (Schwäbisch Hall/Stade)
- ∞ 1/10.000 of the overall demand



Motivation – The combined power plant was a promise to the German chancellor Merkel

At the energy summit talks in 2006 three of the leading companies of the renewable industry promised evidence to supply the German electricity system with energy from 100% renewable sources.



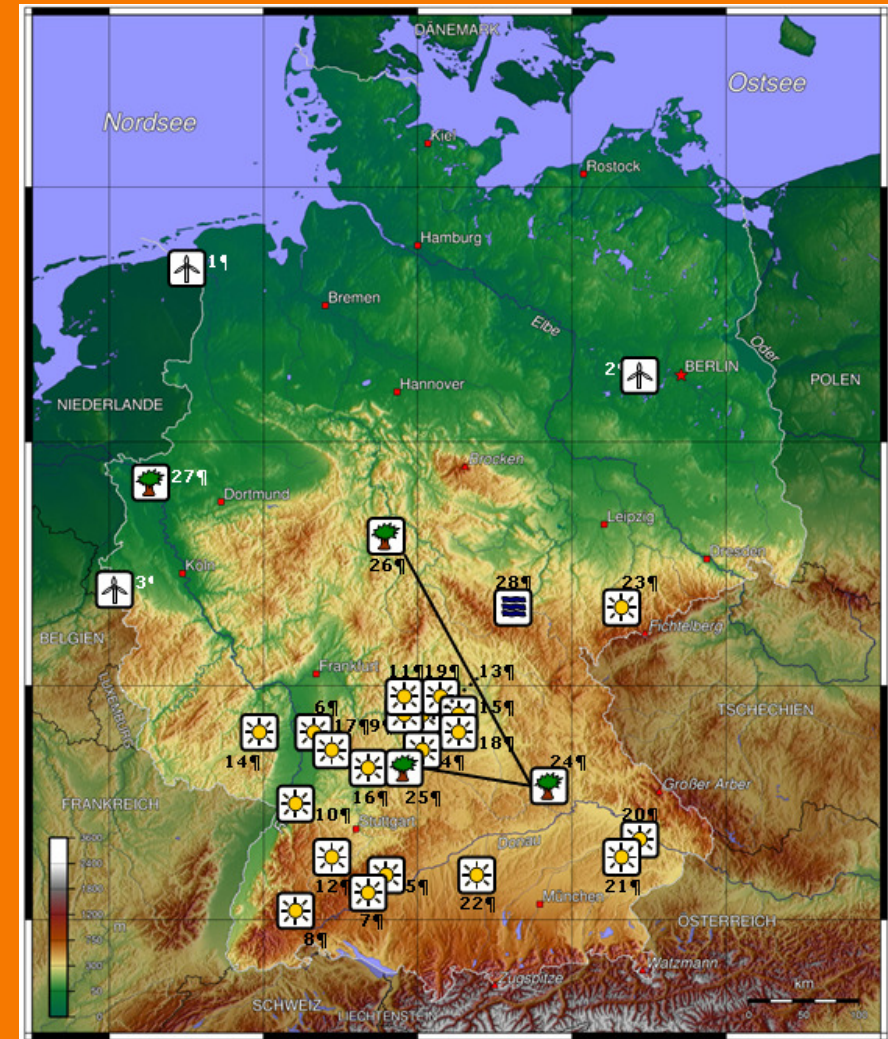
The 2 main questions were:

1. Potential: Is it possible to replace all conventional power generation with renewables?
2. Availability: Have renewables the ability to meet the consumption any time?

The structure: Virtual plant, real energy

- ∞ 36 wind, solar, biomass and hydropower installations spread throughout Germany are linked.
- ∞ The feasibility is shown by downscaling a 100% renewables scenario for 2050
- ∞ Model 1/10000

| | Wind | Solar | Biogas | Hydro |
|-----|------|-------|--------|-------|
| GWh | 16,8 | 6,0 | 10,0 | 8,2 |
| MW | 12,6 | 5,5 | 4,0 | 1,0 |



Efficiency assumptions for the production of renewable electricity

| Biogas | 2006 | Future... |
|--|-------|-----------|
| Tons of Corn/Hektar | 50 | 70 |
| m ³ Gas/Ton of corn | 200 | 200 |
| kWh/m ³ | 5 | 5 |
| kWh _{el} /kWh/m ³ | 2 | 2,5 |
| Agricultural land in Mio. ha | 17 | 17 |
| TWh _{el} | 18.6 | 100 |
| Gas Mio. m ³ | 9.300 | 40.000 |
| Mio. Ton | 46,5 | 200 |
| Mio. Hektar | 0.930 | 2.857 |
| % Agricultural land for el. power generation | 5,47% | 16,81% |

| PV | 2006 | Future... |
|---------------------------------|-------|-----------|
| Full load hours | 950 | 850 |
| W/m ² | 120 | 150 |
| TWh | 2 | 60 |
| Capacity in GW | 2 | 71 |
| Mio. m ² | 21 | 706 |
| Rooftops in Mio. m ² | 3,600 | 3,600 |
| % of Rooftops | 0,58% | 19,61% |
| Wind | | |
| Full Load Hours | 2000 | 2800 |
| Avg. Capacity in KW | 816 | 6.000 |
| TWh | 30.5 | 168 |
| Total Capacity in GW | 20.6 | 60 |

The virtual power plant – Main principle

The calculation of the power mix is done in two ways:

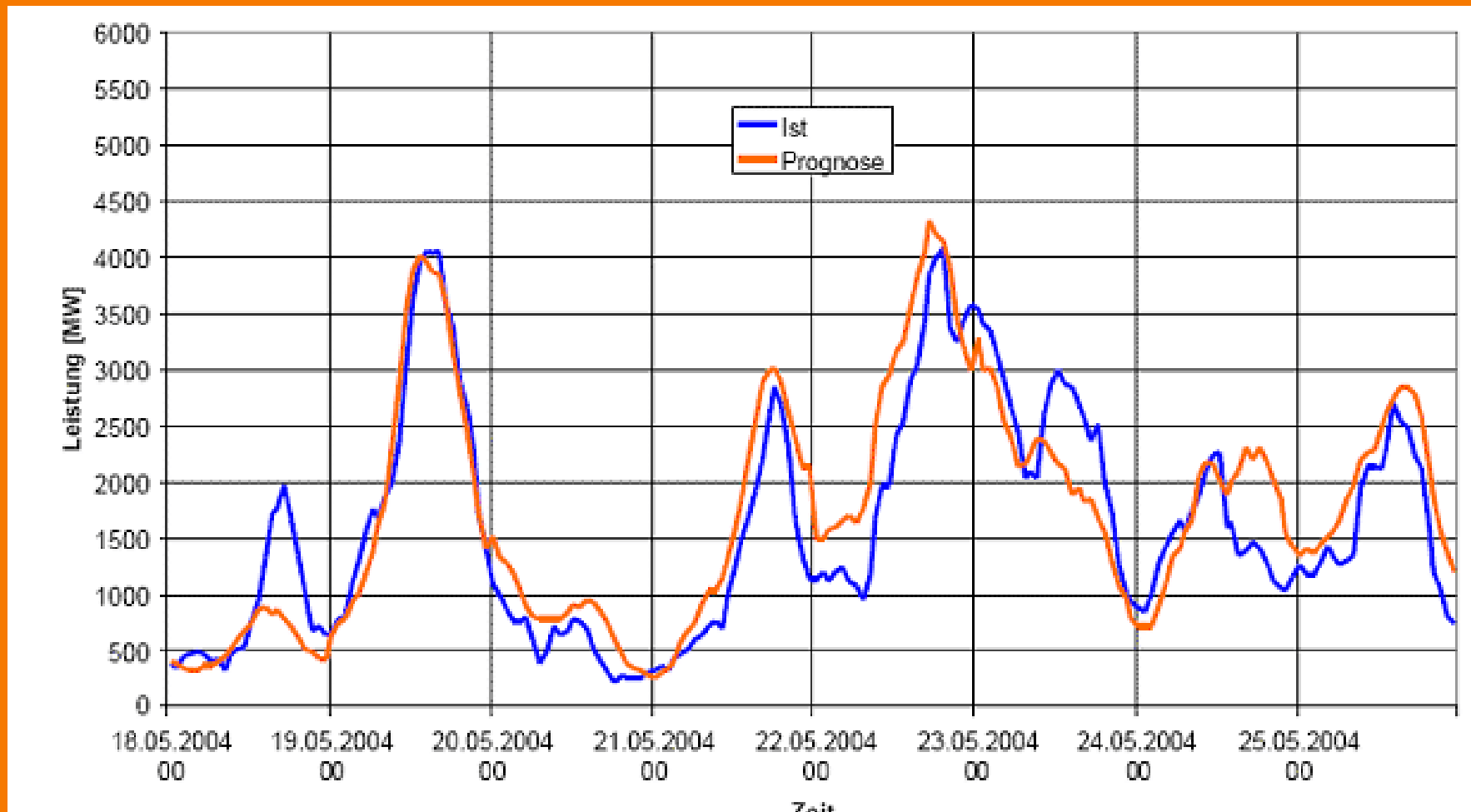
For the future:

- ∞ Weather forecasts lead to power forecasts and schedules.

For the actual timestep:

- ∞ Controlling/Adjusting the schedules.

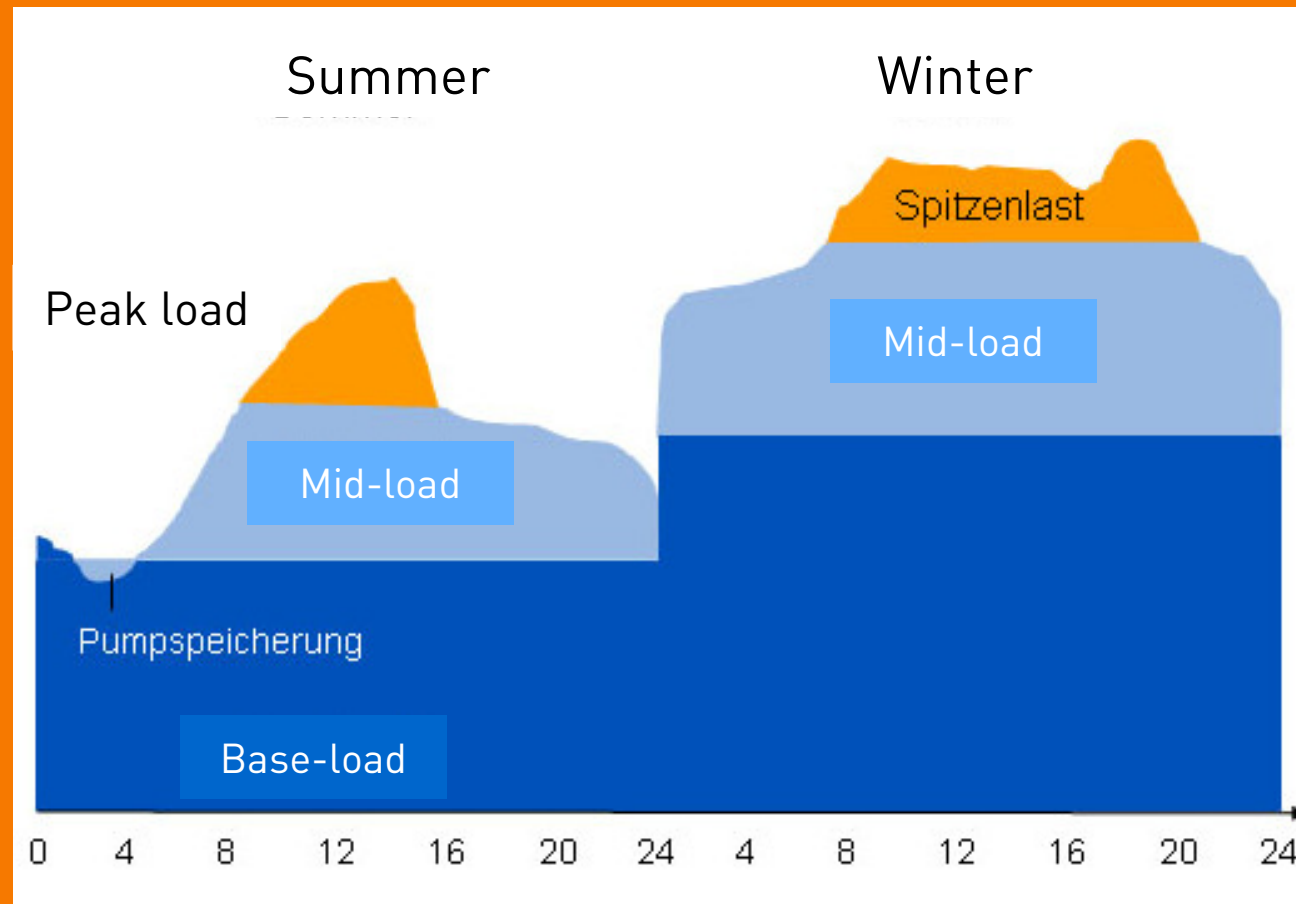
Reliable weather forecasts are the first key.



- ∞ The prediction of weather conditions and wind quantity is nowadays very reliable. Forecasts of wind output for about 48 to 72 hours are subject to a 6 percent error probability.

Demand forecast is the second key to reliable supply.

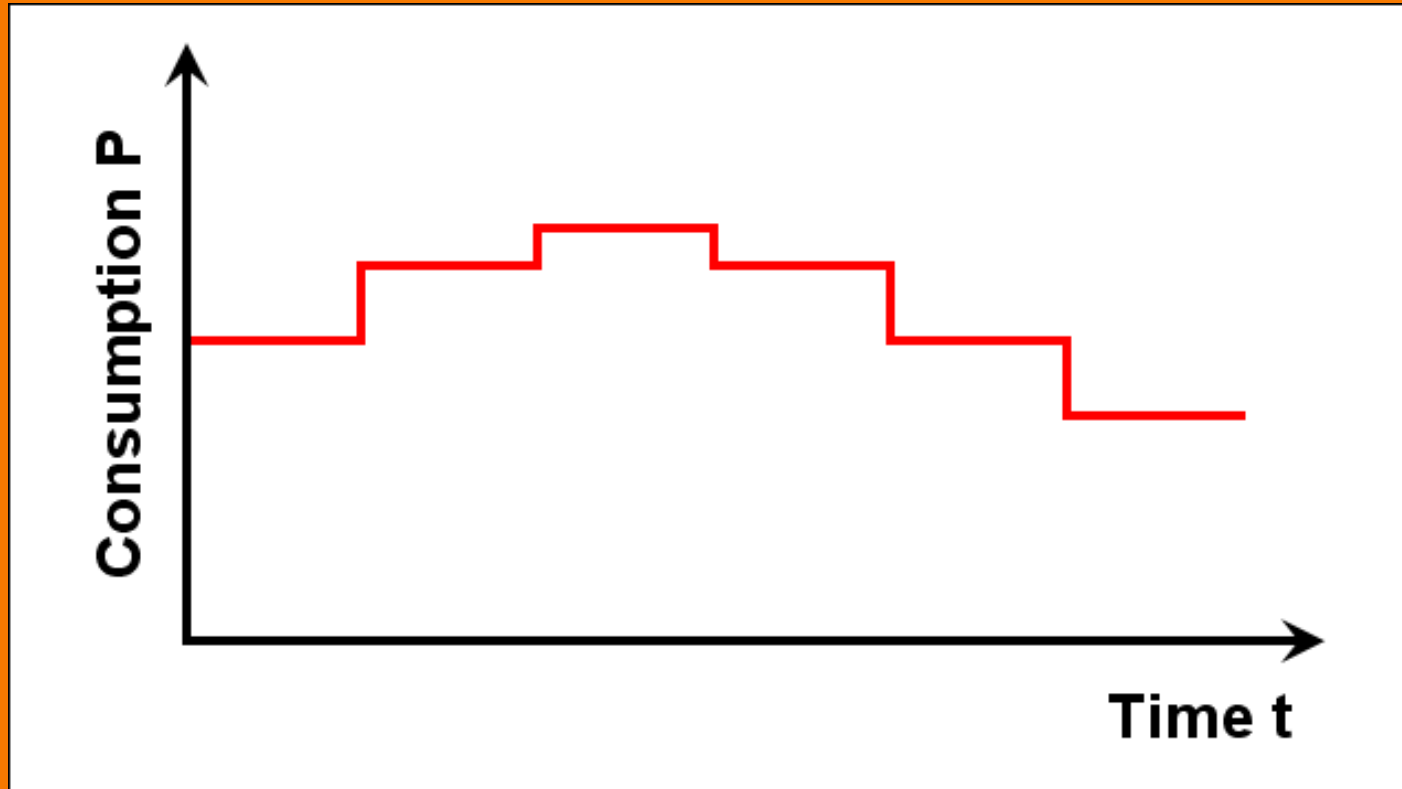
Electricity demand can be accurately predicted. On summer and winter days, demand follows characteristic forecasts.



The virtual power plant – adjusting forecasts and schedules

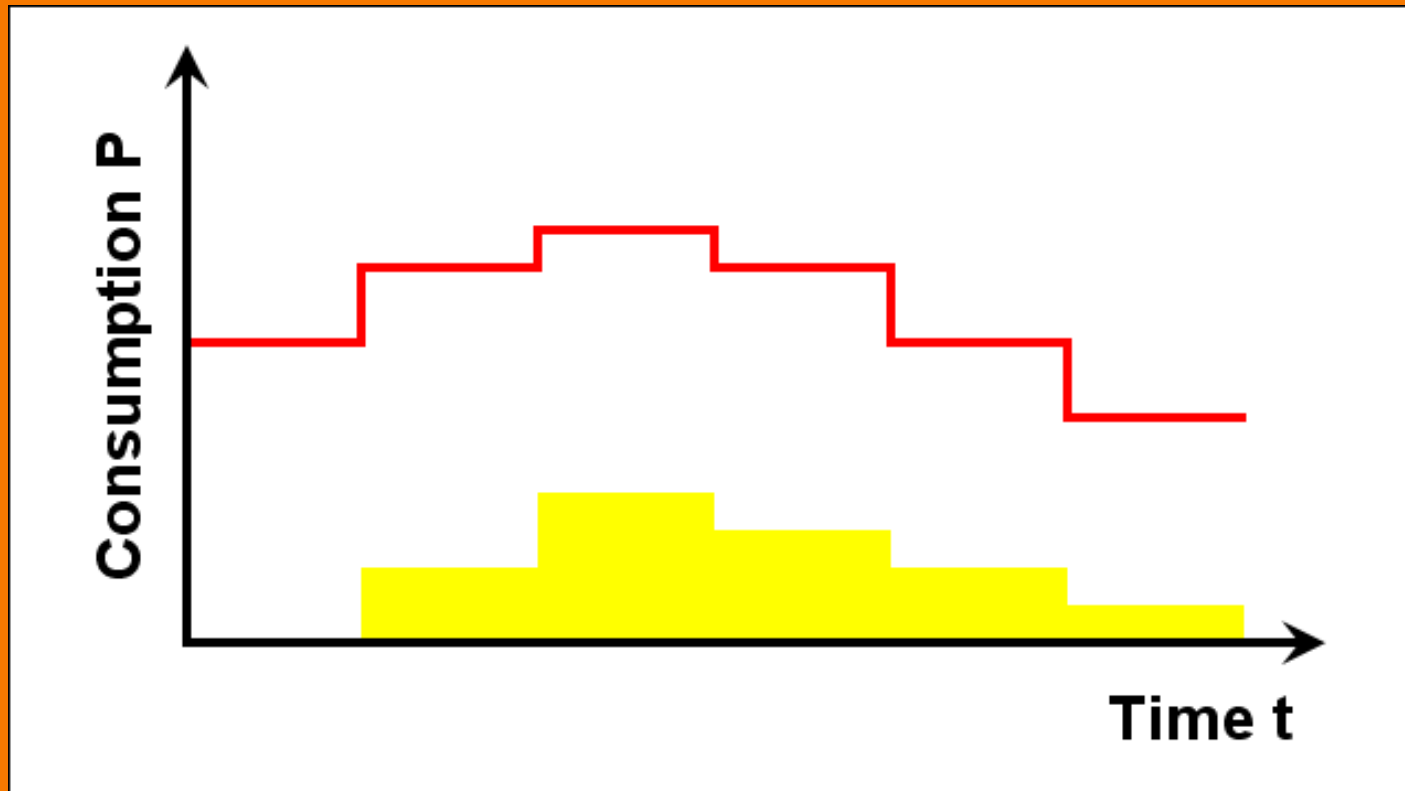


The virtual power plant – adjusting forecasts and schedules



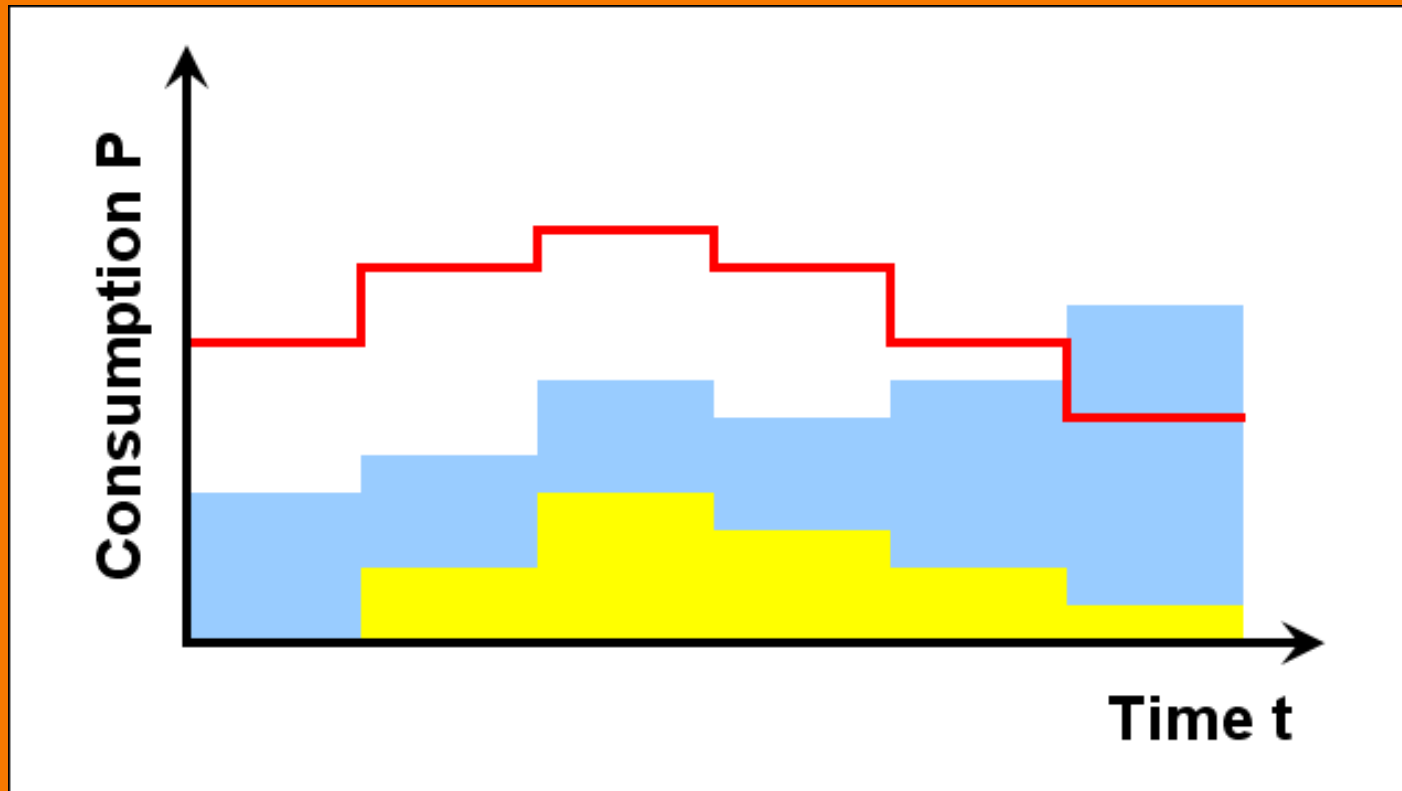
Calculating the demand

The virtual power plant – adjusting forecasts and schedules



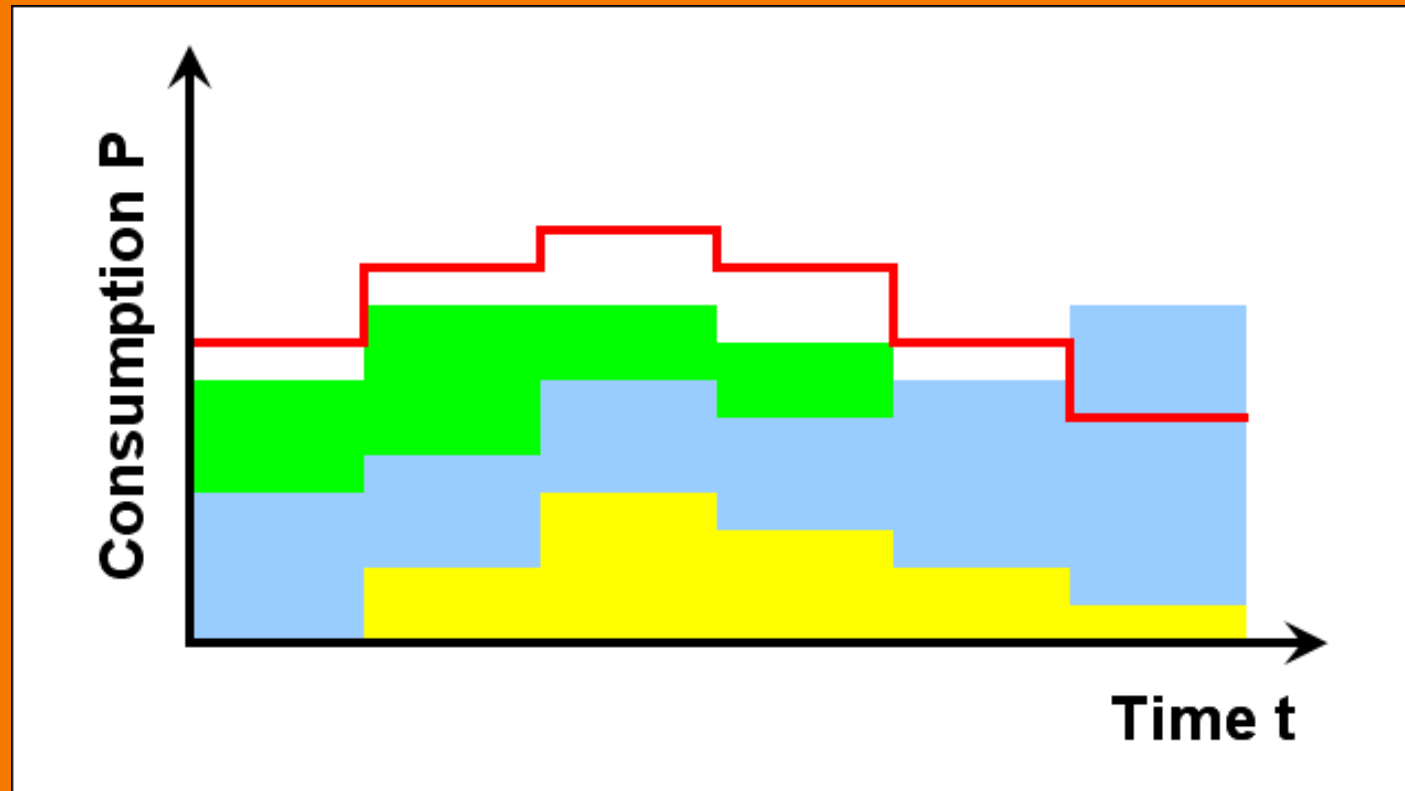
Forecasting photovoltaics

The virtual power plant – adjusting forecasts and schedules



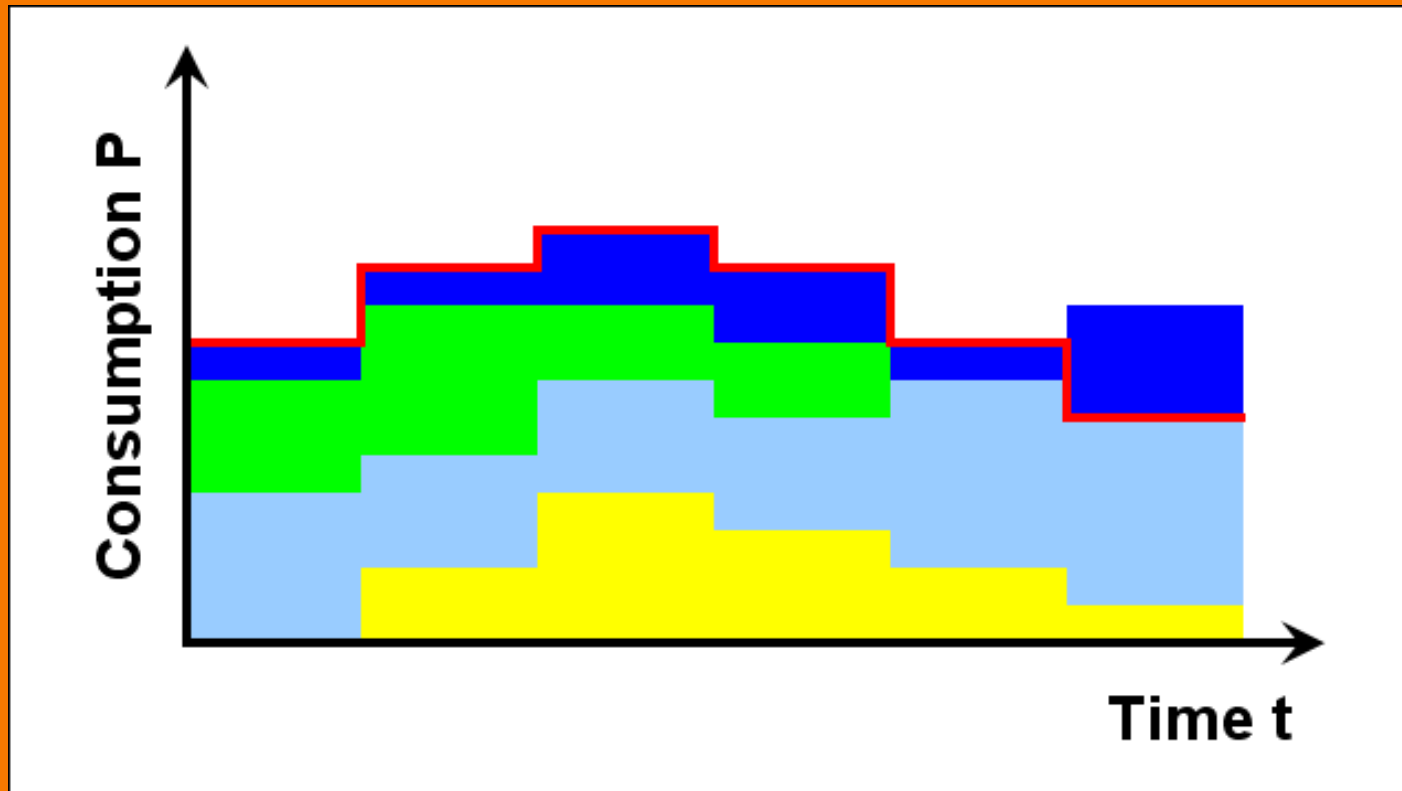
Forecasting wind

The virtual power plant – adjusting forecasts and schedules



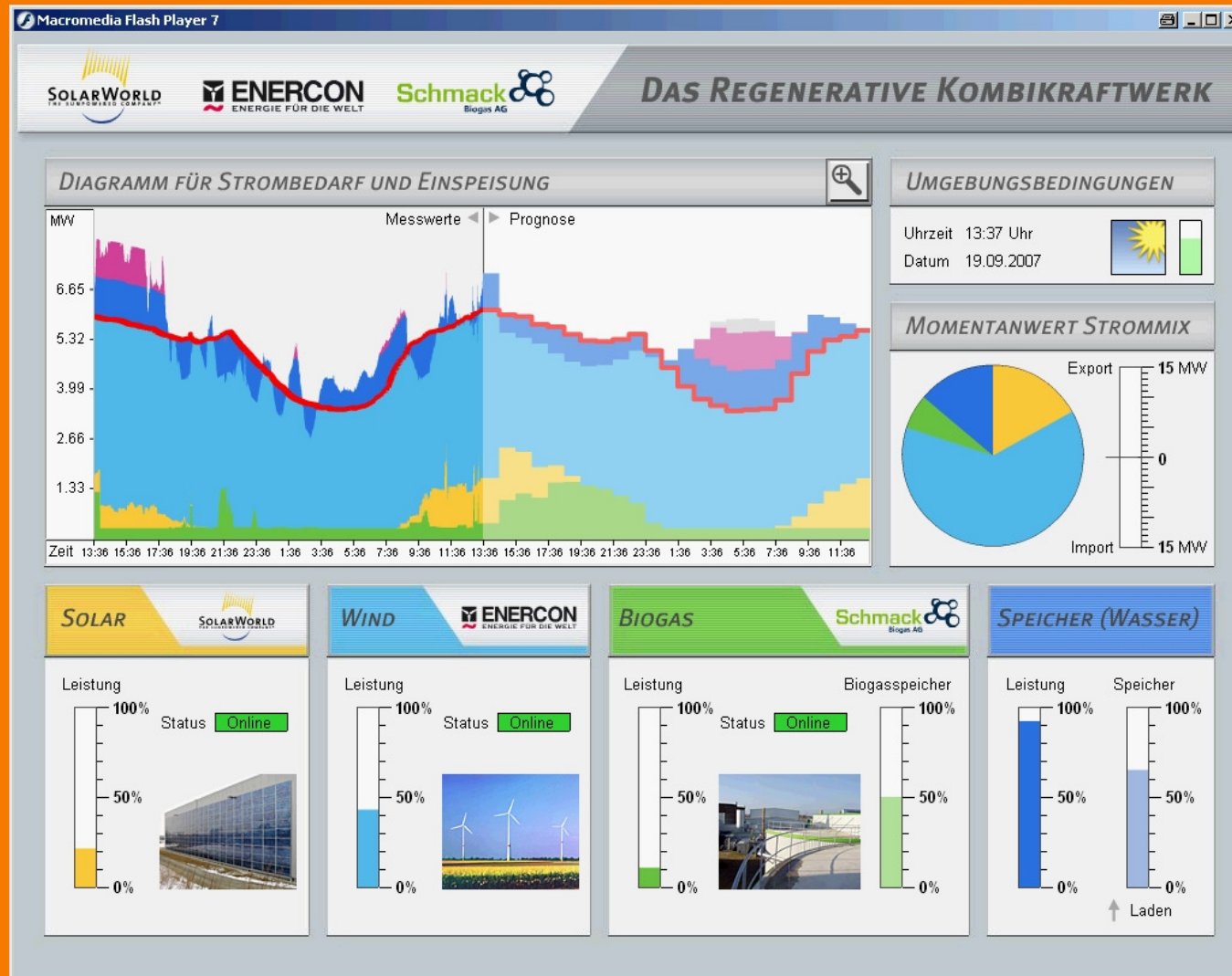
Creating biogas schedules

The virtual power plant – adjusting forecasts and schedules



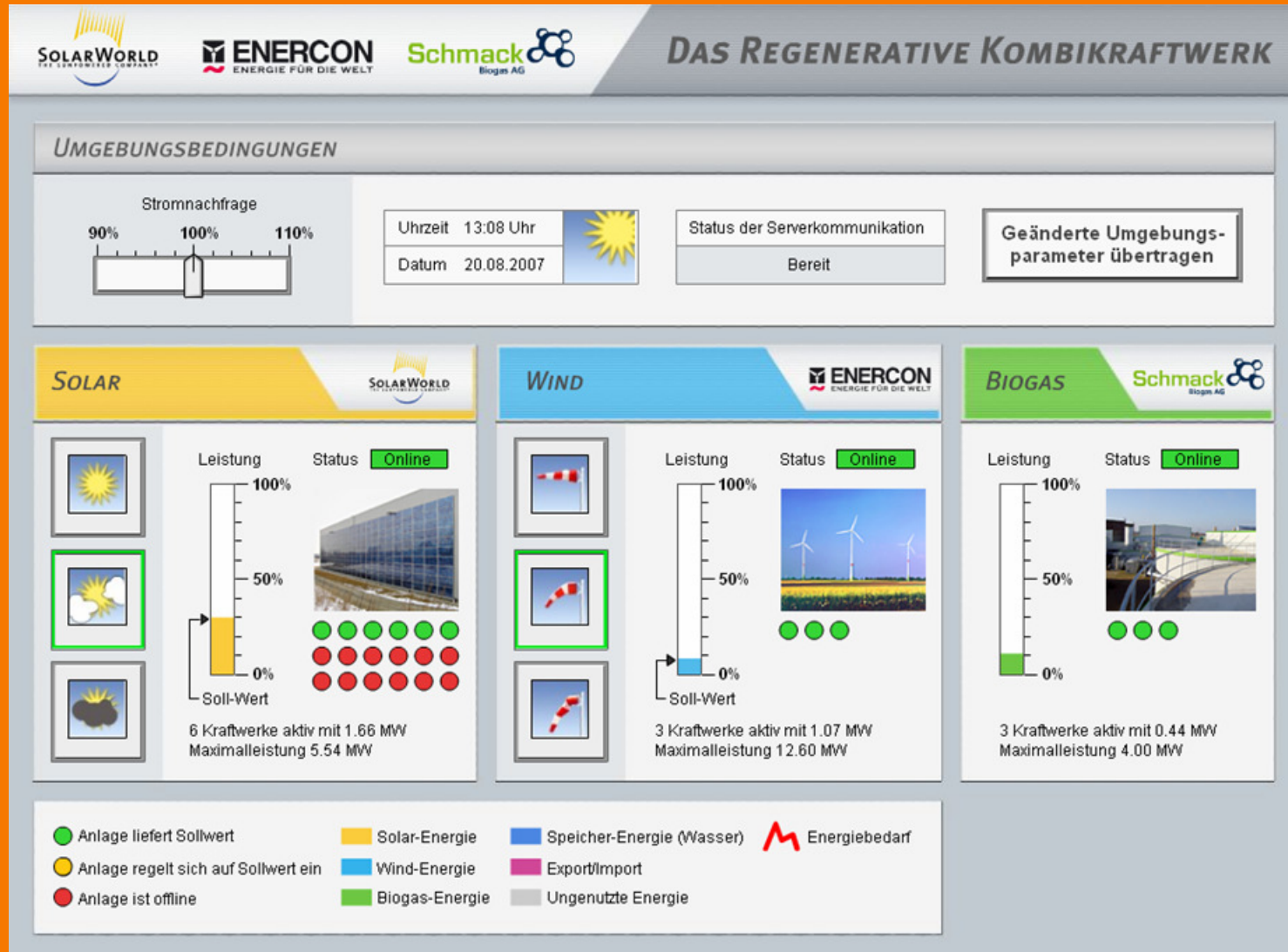
Creating hydro schedules

Schedules and plants are operated via a graphical user interface



See: www.kombikraftwerk.de

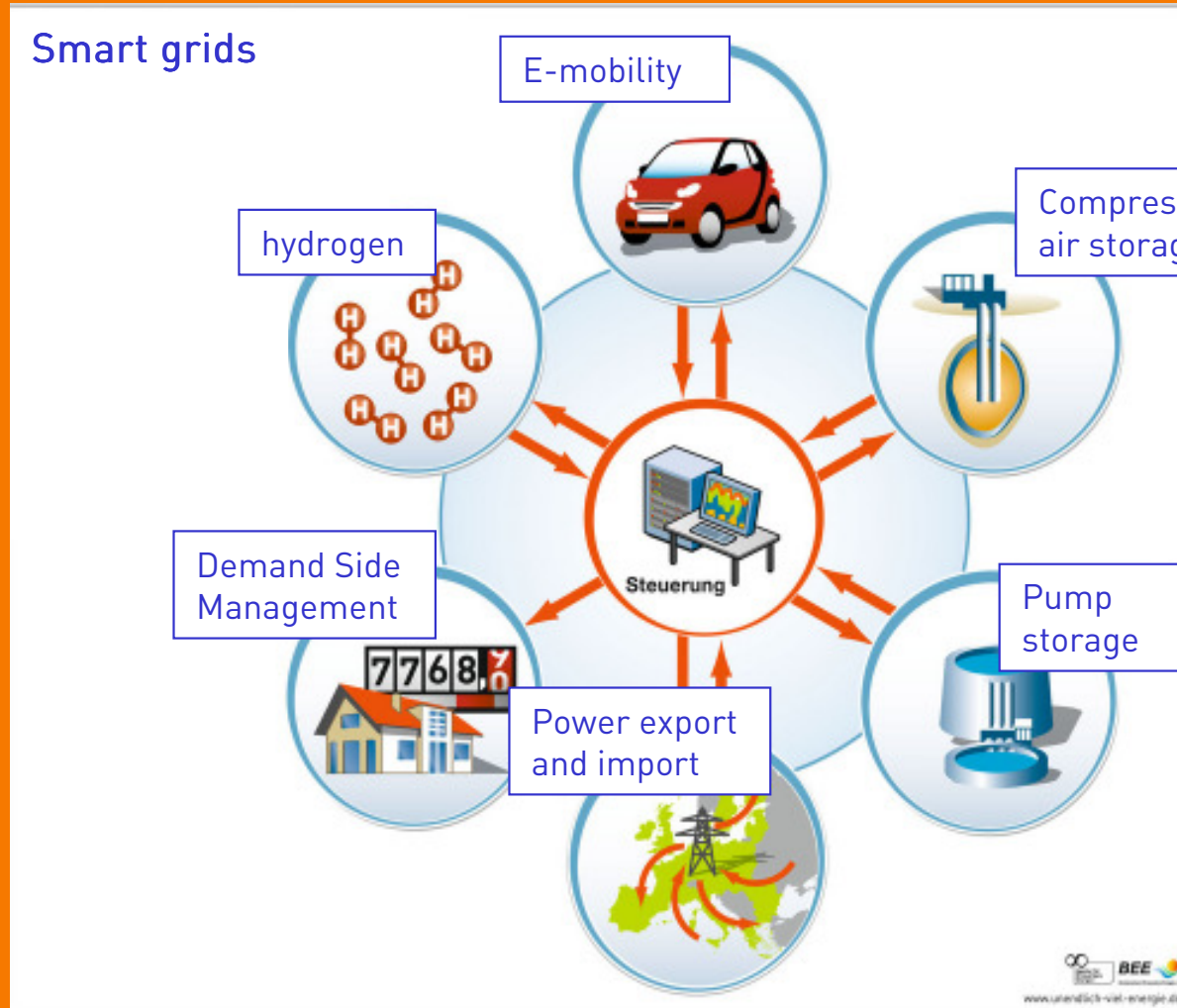
In the user interface, different scenarios can also be simulated



Results: supply and demand matched at every moment under any weather circumstances without „black outs“

- ∞ 100% renewable power without fossil support was proven to be technically feasible.
- ∞ Production characteristics of renewable energy sources met the requirements:
 - wind energy for high demands throughout the day
 - solar energy for noon peaks
 - storage capacity, biogas and hydro during high fluctuations and demand peaks
- ∞ Detailed project results lead to a law initiative for enhancing the German Feed-in-Tariff in 2009:
bonuses for applying combined power plants.

Remaining issues due to limited potential: Smart grid technology is needed for using every KWh renewable power



Thank you for your attention!

The screenshot shows the homepage of the German Renewable Energy Agency Information Platform. The header includes navigation links for 'Homepage', 'Press', 'Downloads', 'About us', 'Calendar', and 'FAQ', along with language options 'deutsch | english'. The main title is 'Germany's Renewable Energy Agency Information Platform'. Below the header is a navigation bar with categories: 'WIND', 'SUN', 'WATER', 'BIOMASS', 'GEOTHERMAL', 'ELECTRICITY', 'HEAT', 'TRANSPORT', 'ECONOMY', and 'POLICY'. A search bar is located on the right side of the navigation bar.

Report:

The graph shows the growth of renewable energy sources in Germany from 2001 to 2009. The y-axis represents energy production in TWh, ranging from 100 to 250. The x-axis represents years from 2001 to 2009. The data points are: 2001: 100; 2002: 120; 2003: 140; 2004: 160; 2005: 180; 2006: 200; 2007: 220; 2008: 238; 2009: 250. The graph is titled 'Renewable energy sources in Germany have significantly surpassed most predictions in the past.'

Short cuts:

- > Report: RES in Germany have surpassed most predictions in the past
- > The combined power plant
- > Industry forecast: Power Supply 2020
- > Feature: Electric mobility
- > The full picture of renewable energy matters
- > Current statistics on renewables
- > Biomass - the all-rounder in energy matters

News

Monday, 09. November 2009
The World Wind Energy Association (WWEA) invites to the "World Summit for..."

Monday, 28. September 2009
2009 Price Report on renewable electricity prices in Europe published

[\[further news\]](#)

Calendar

Tuesday, 26. January 2010
Energy from Biomass and Waste UK

[\[further events\]](#)

Renewable Electric Mobility

The Combined Power Plant

IRENA
INTERNATIONAL RENEWABLE ENERGY AGENCY

www.unendlich-viel-energie.de/english