# 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

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

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Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

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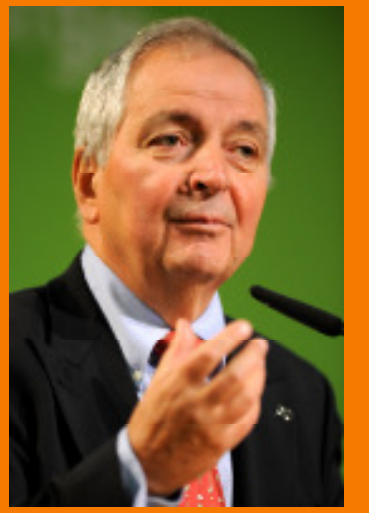
Federal Ministry of Food, Agriculture and Consumer Protection



Patron: Former UNEP executive director, Prof. Dr. Klaus Töpfer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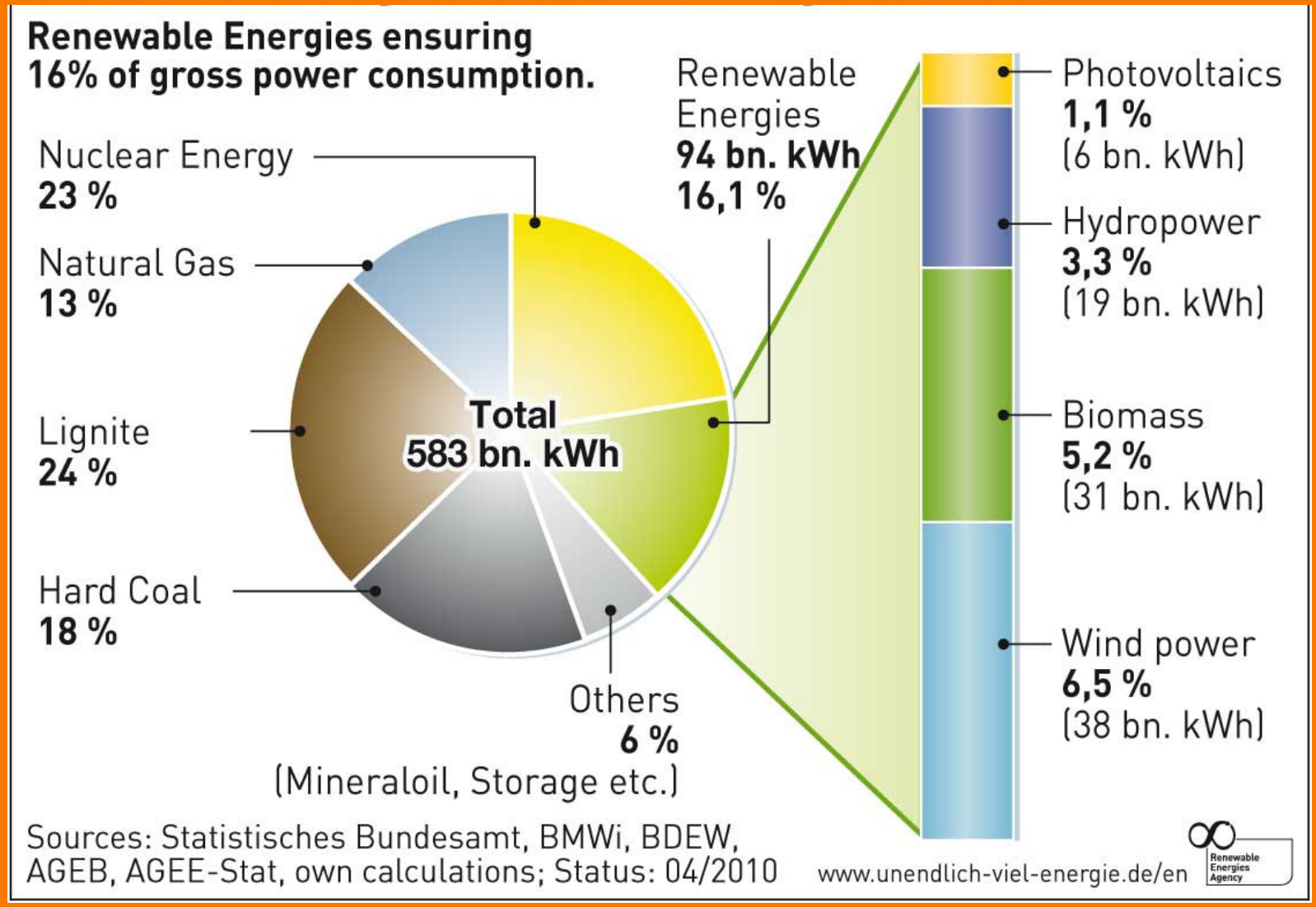
# The German electricity mix 2009: 16.1% renewable energy in the grid

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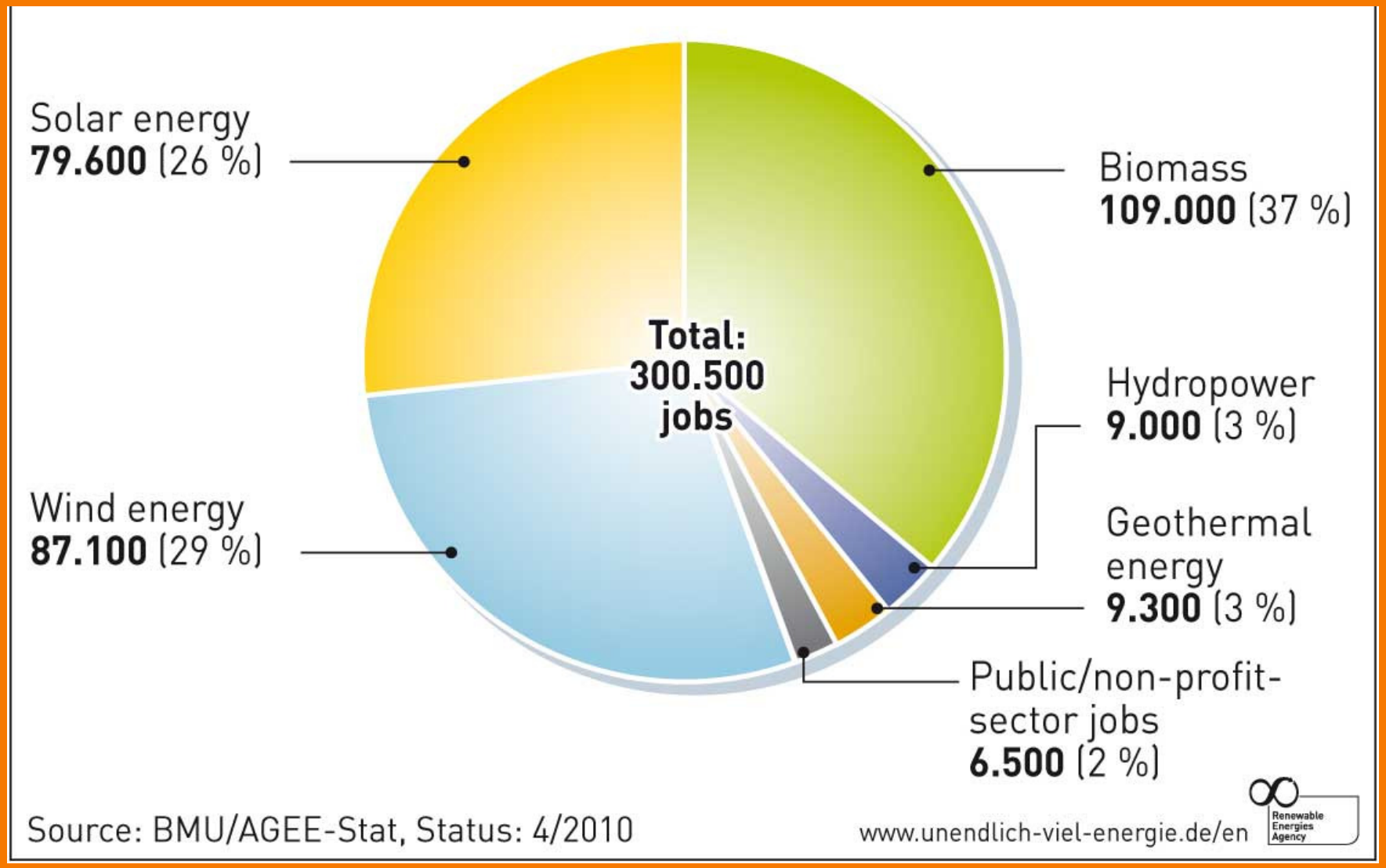
# Result: 300.000 jobs were created, mostly in the wind, solar and bioenergy market

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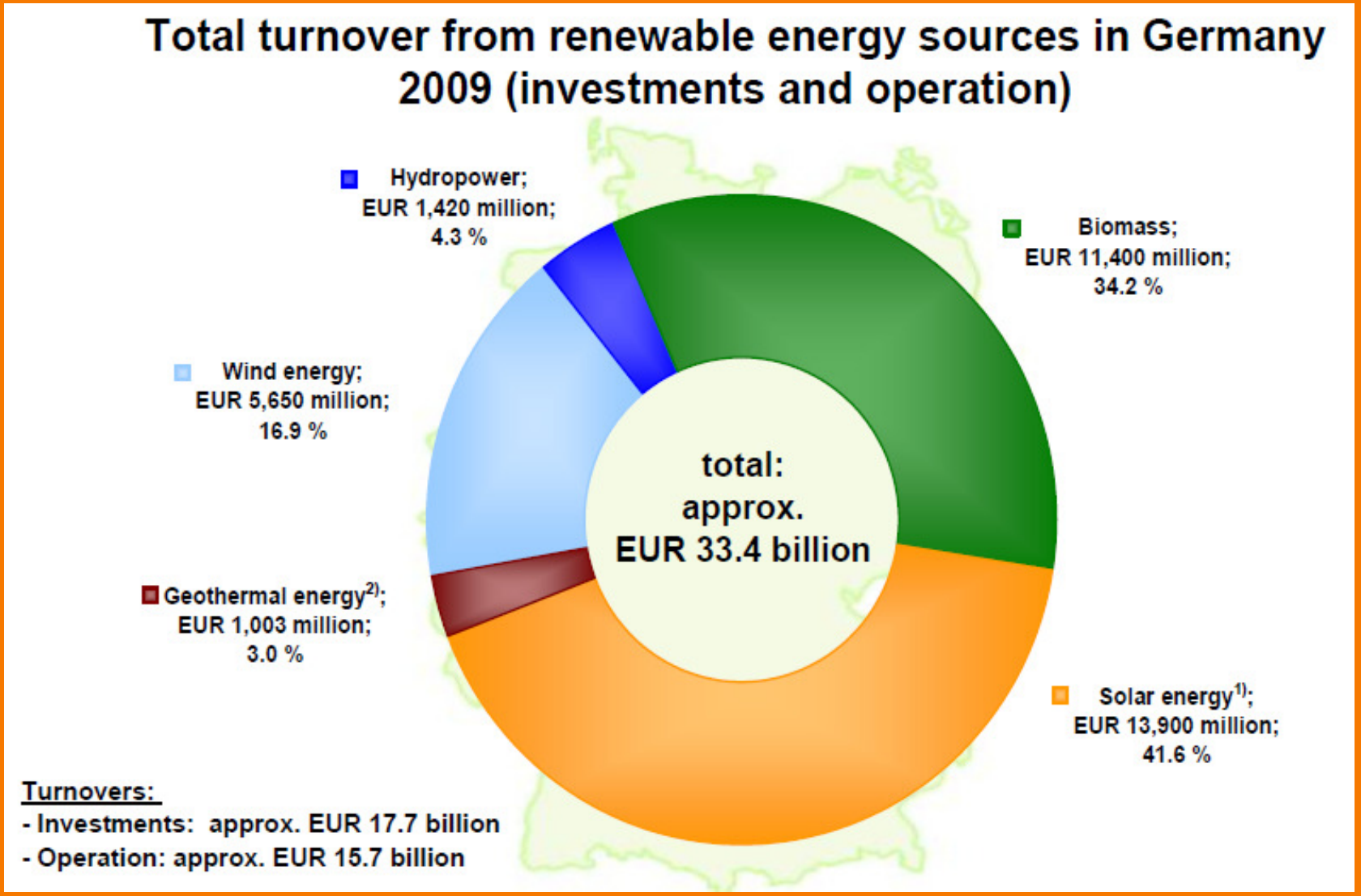
# Result: more than 33 bn. Euros of turnover in 2009

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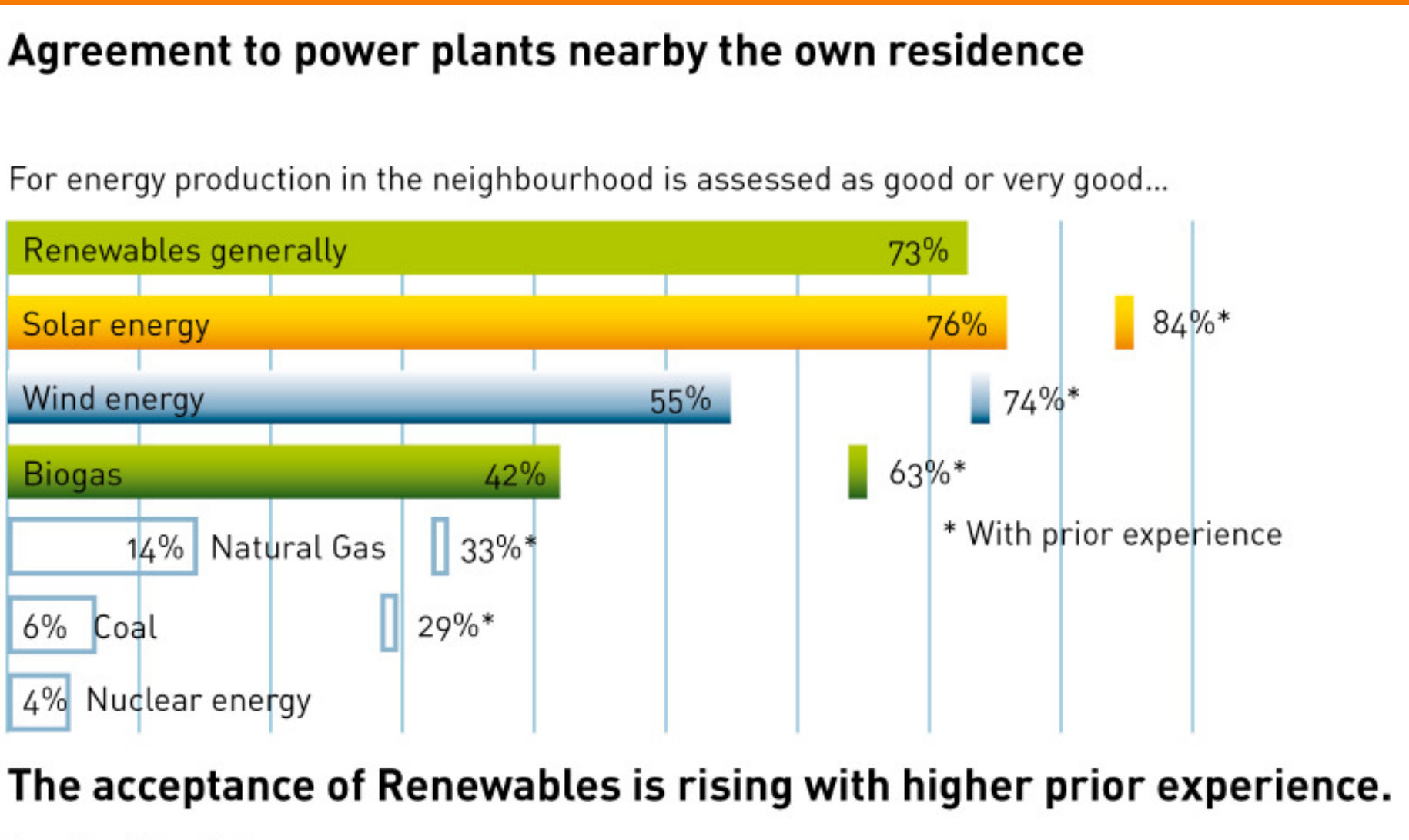
# Statistically speaking, renewable energy „in my backyard“ is not a problem.

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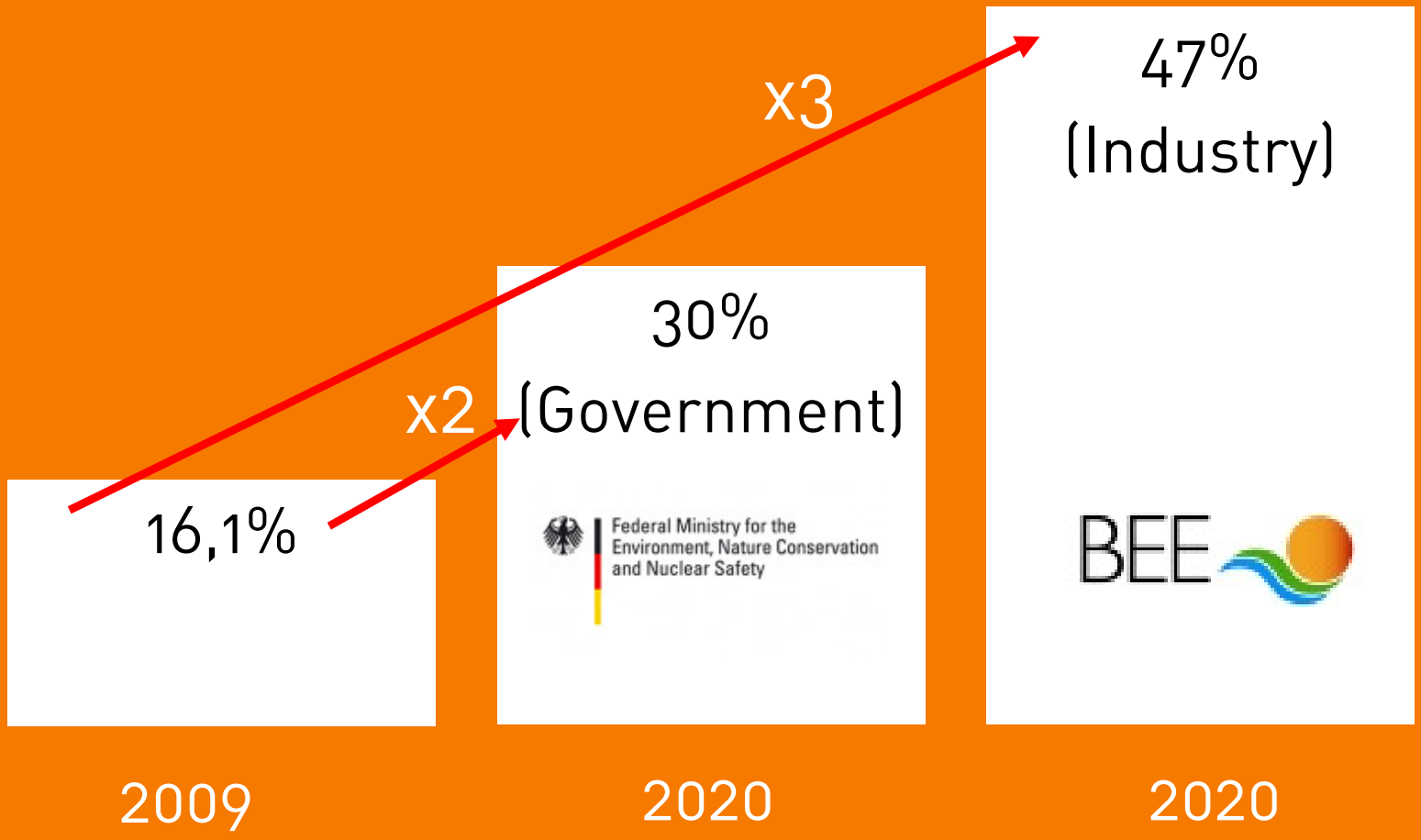
# Challenge 1: Forecasts range between a doubling or triplication of share of electricity

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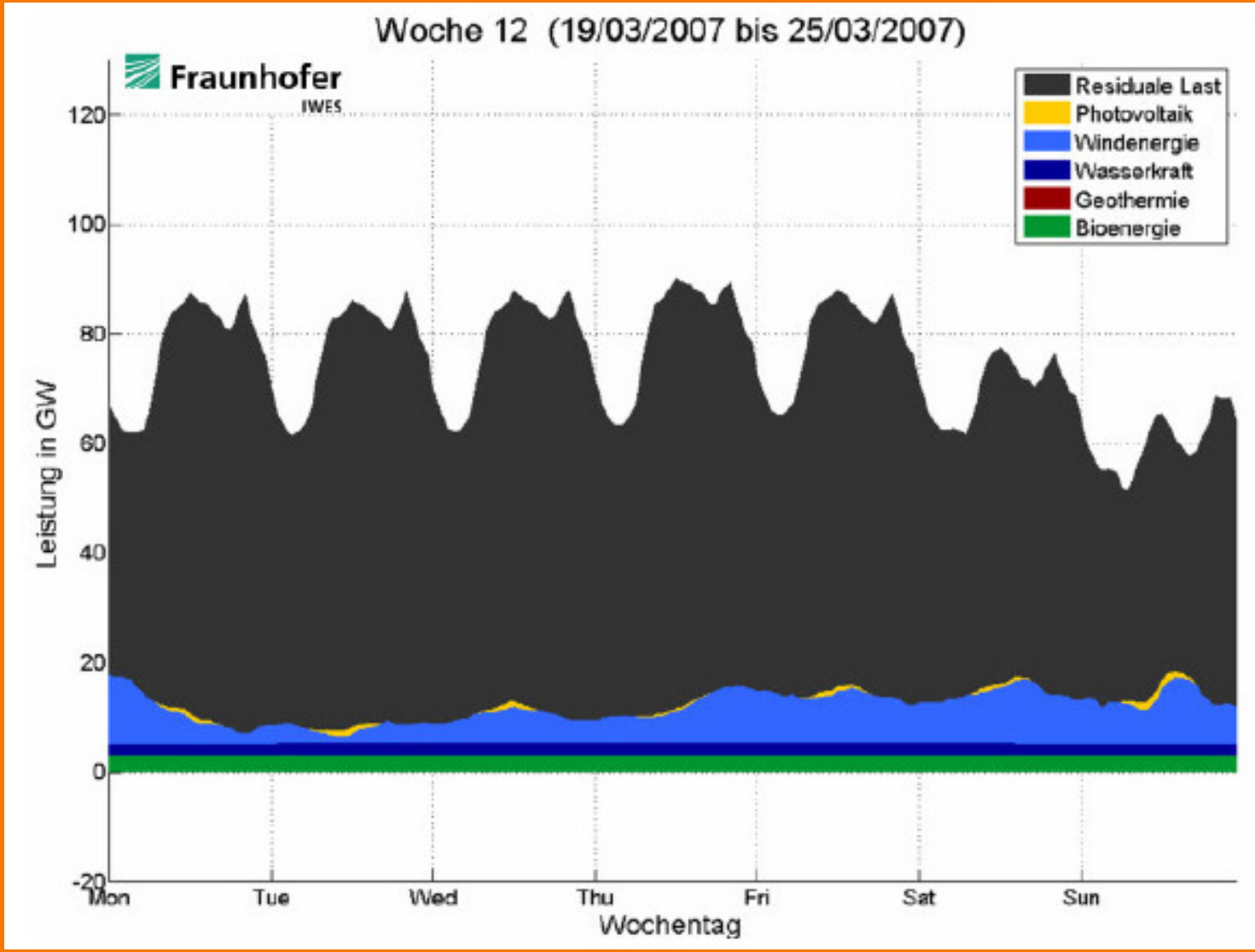
# Challenge 2: the future structure of electricity production won‘t be as constant as today




Study from „Fraunhofer IWES institute, Kassel:

Simulation of electricity structure 2020 by transferring wheather conditions from 2007

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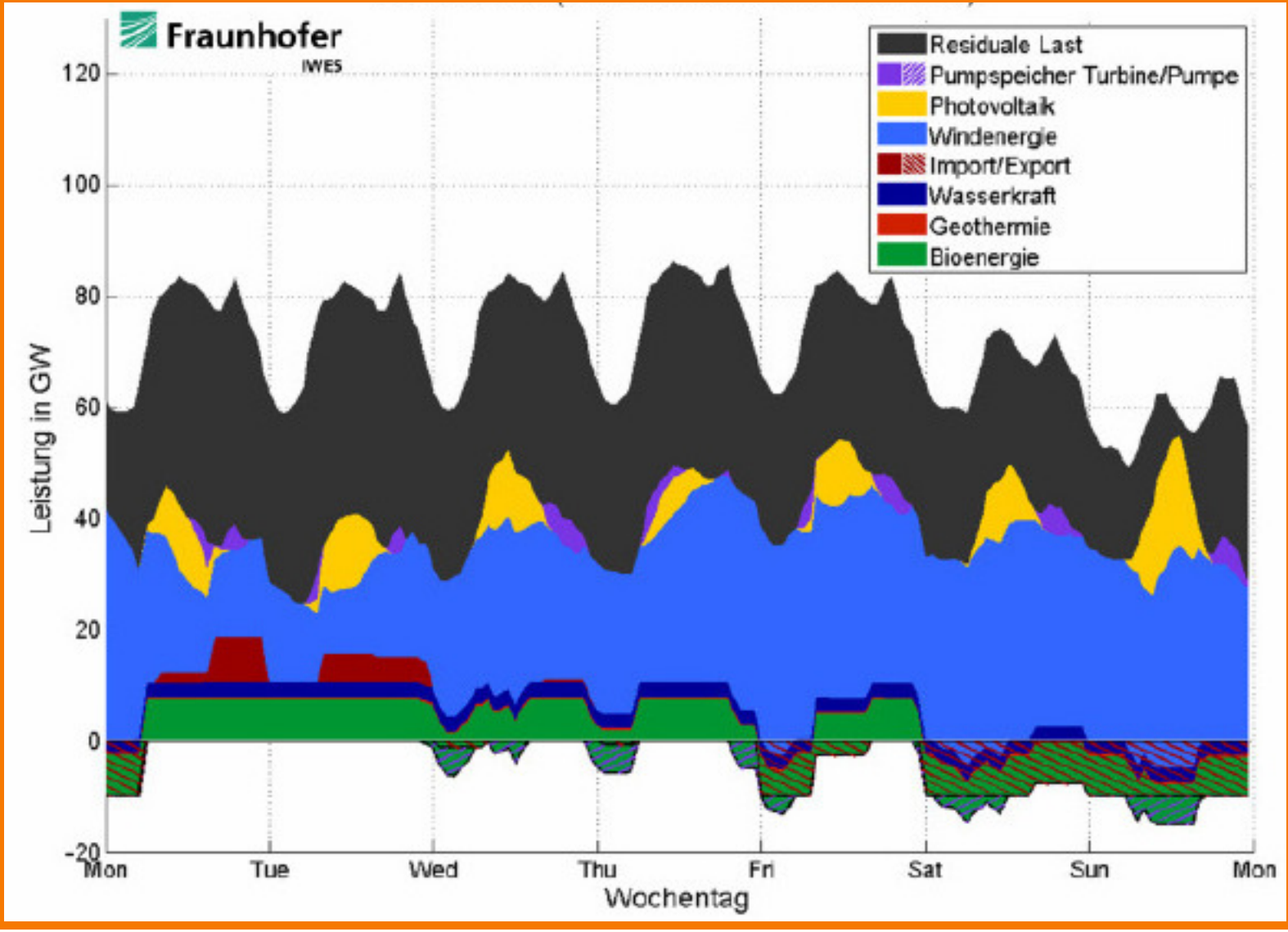
# In 2020 with higher shares of RE, the power input is more dependent on wheather conditions

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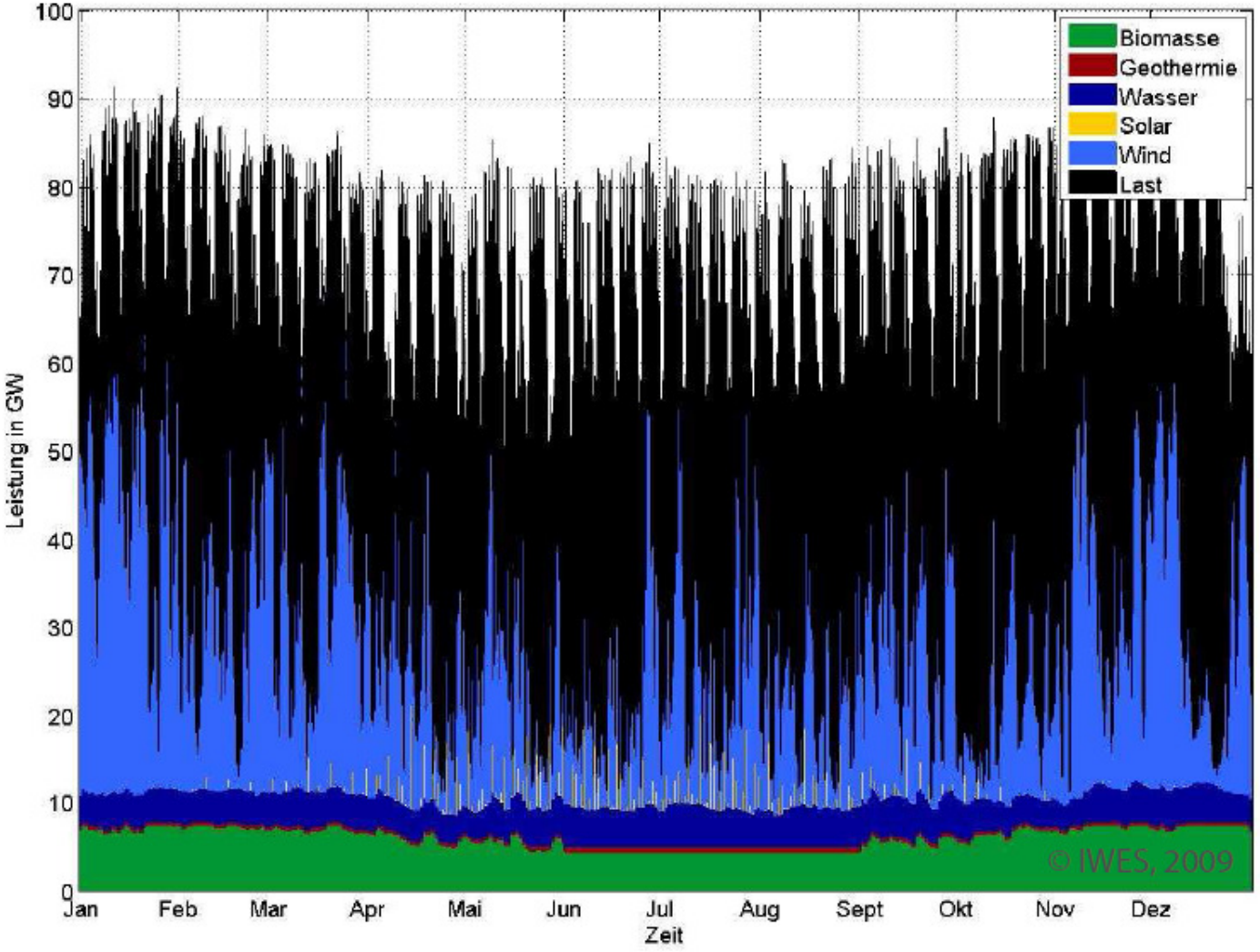
# In an hourly resolution, the up- and downpeaks will be extreme, 100% slots appear frequently




Quelle: Saint-Drenan et al., 2

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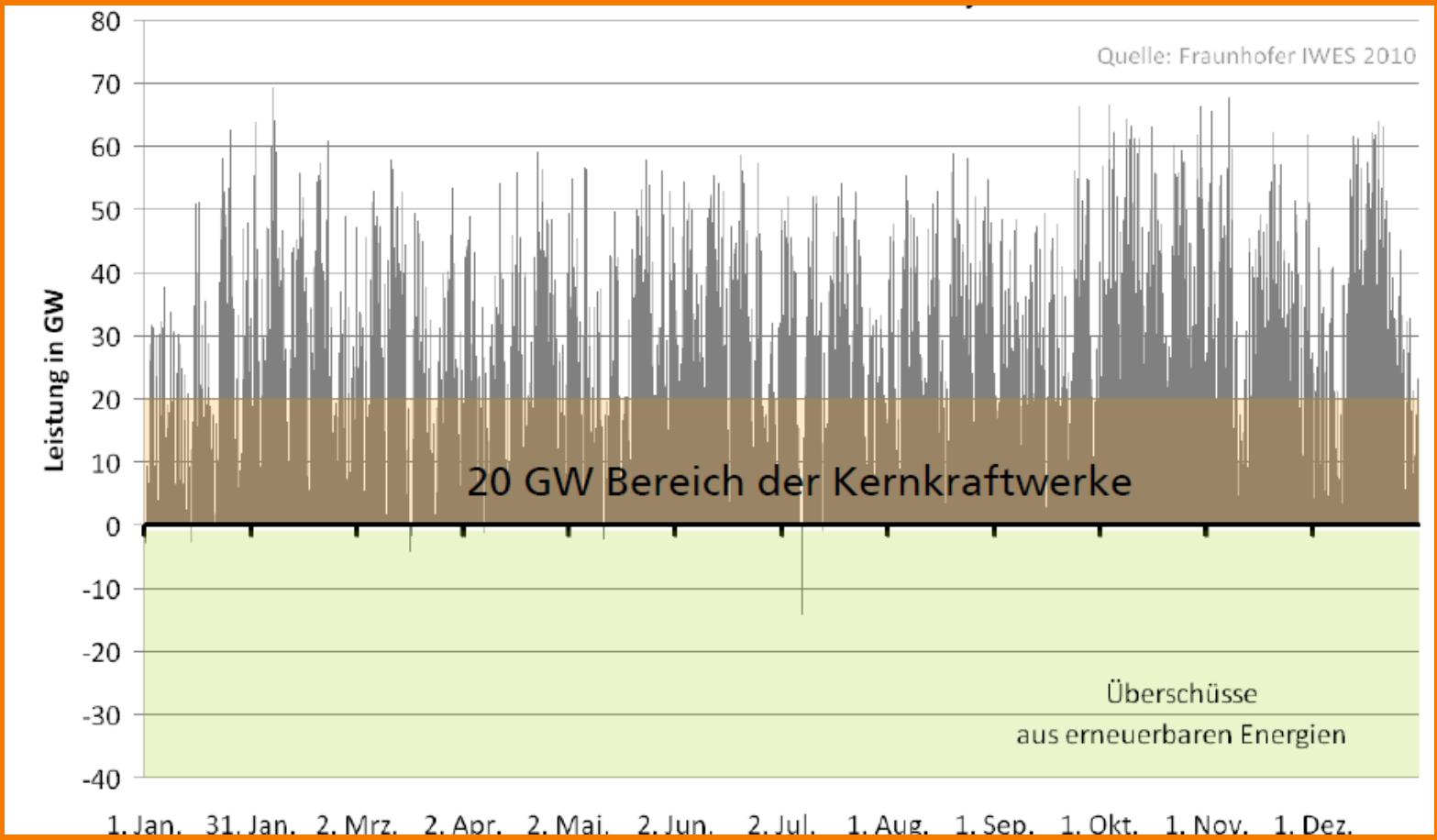
# The residual load doesn‘t leave much space for base load power plants




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

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# 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 condictions
- Covering electricity demand of 12.000 households (Schwäbisch Hall/Stade)
- 1/10.000 of the overall demand


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# 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.

SolarWorld – The Sunpowered Company

ENERCON – Energie für die Welt

Schmack Biogas AG

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?

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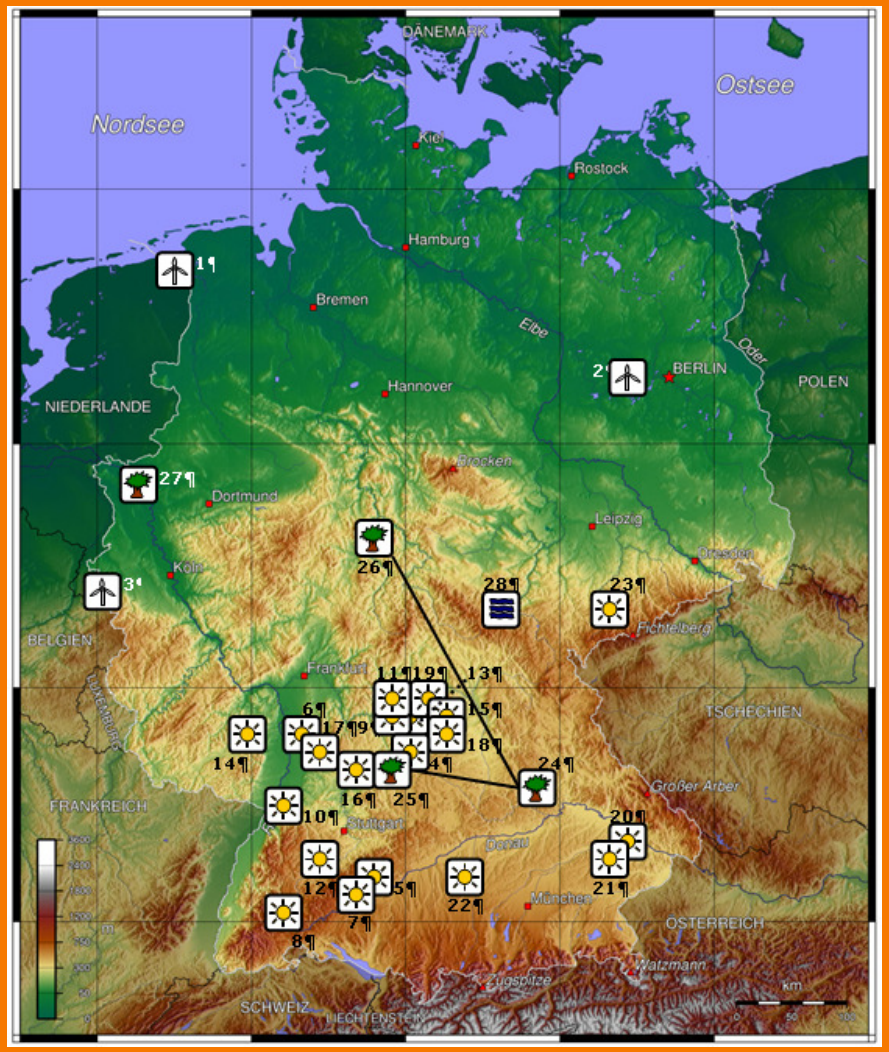
# The structure: Virtual plant, real energy

- 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 |

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# 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 |

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# 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.

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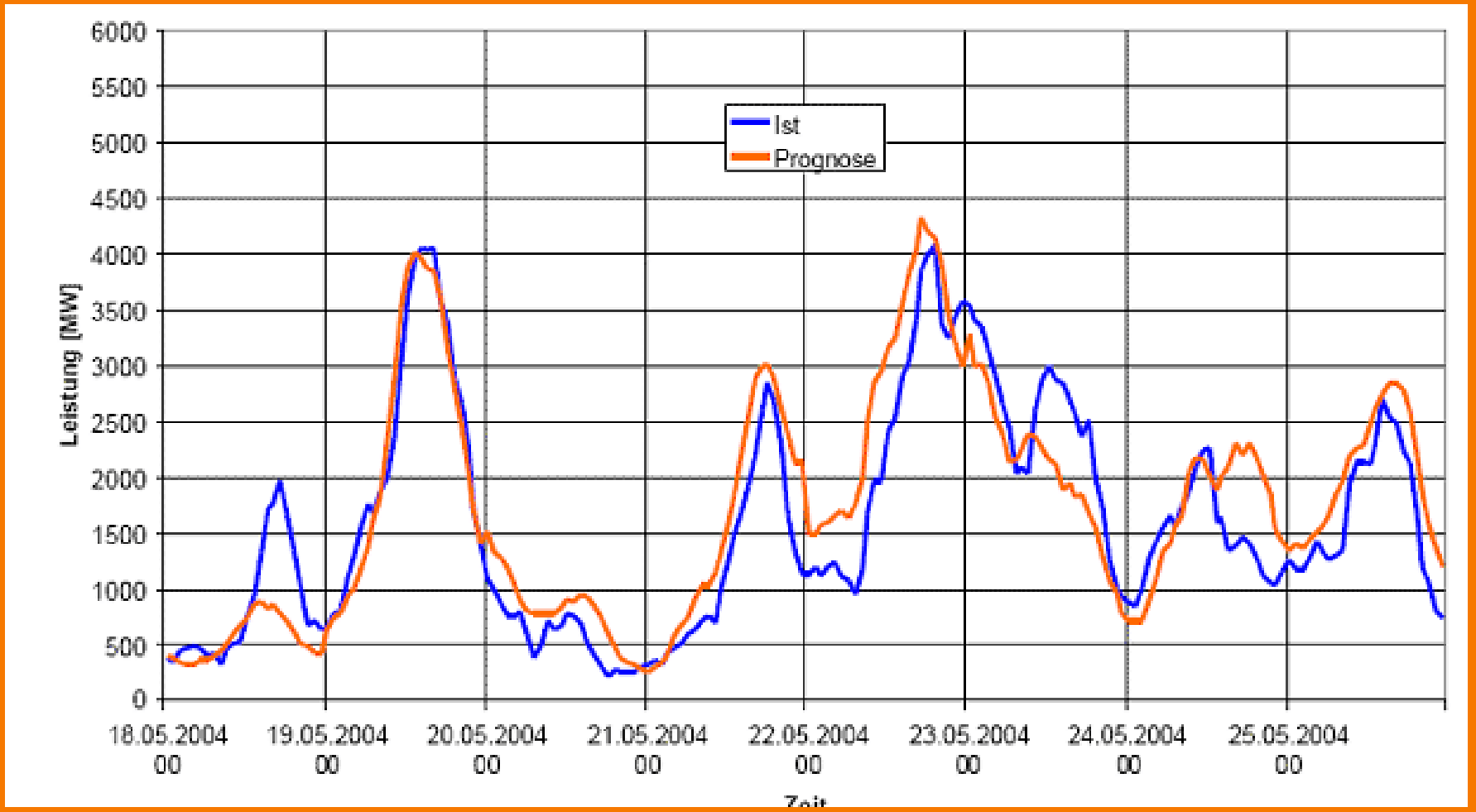
# Reliable weather forecasts are the first key.




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

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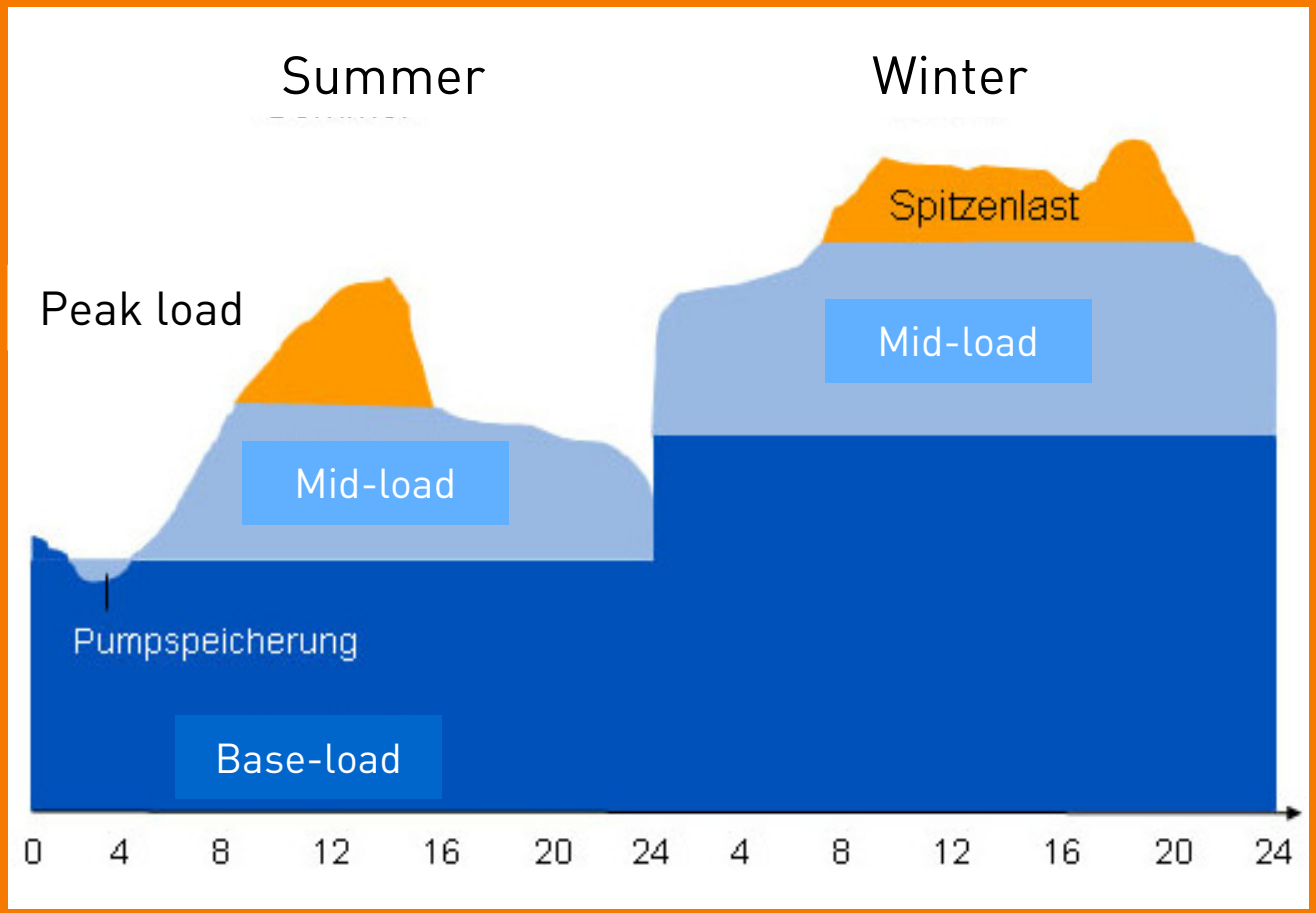
# Demand forecast is the second key to reliable supply.

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

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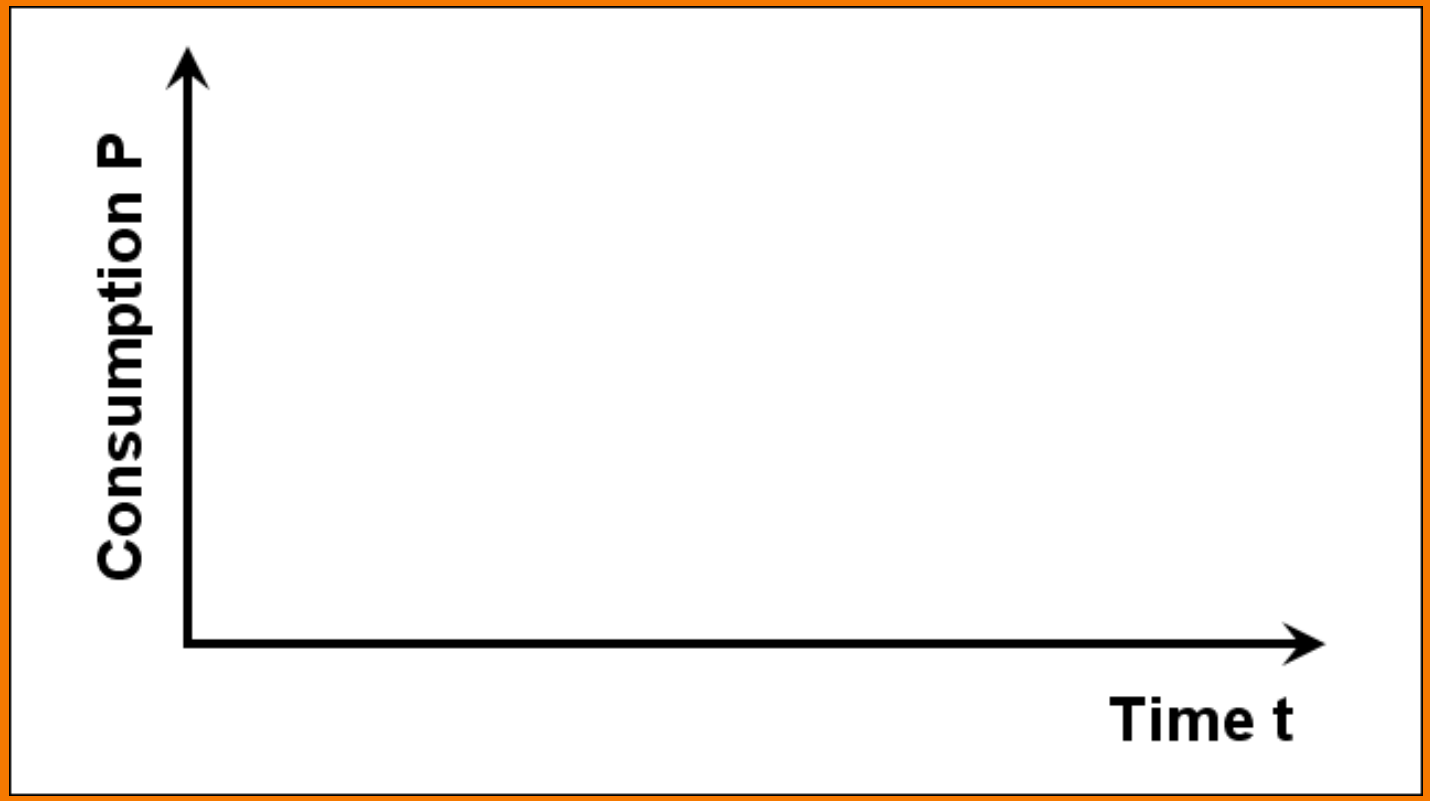
# The virtual power plant – adjusting forecasts and schedules

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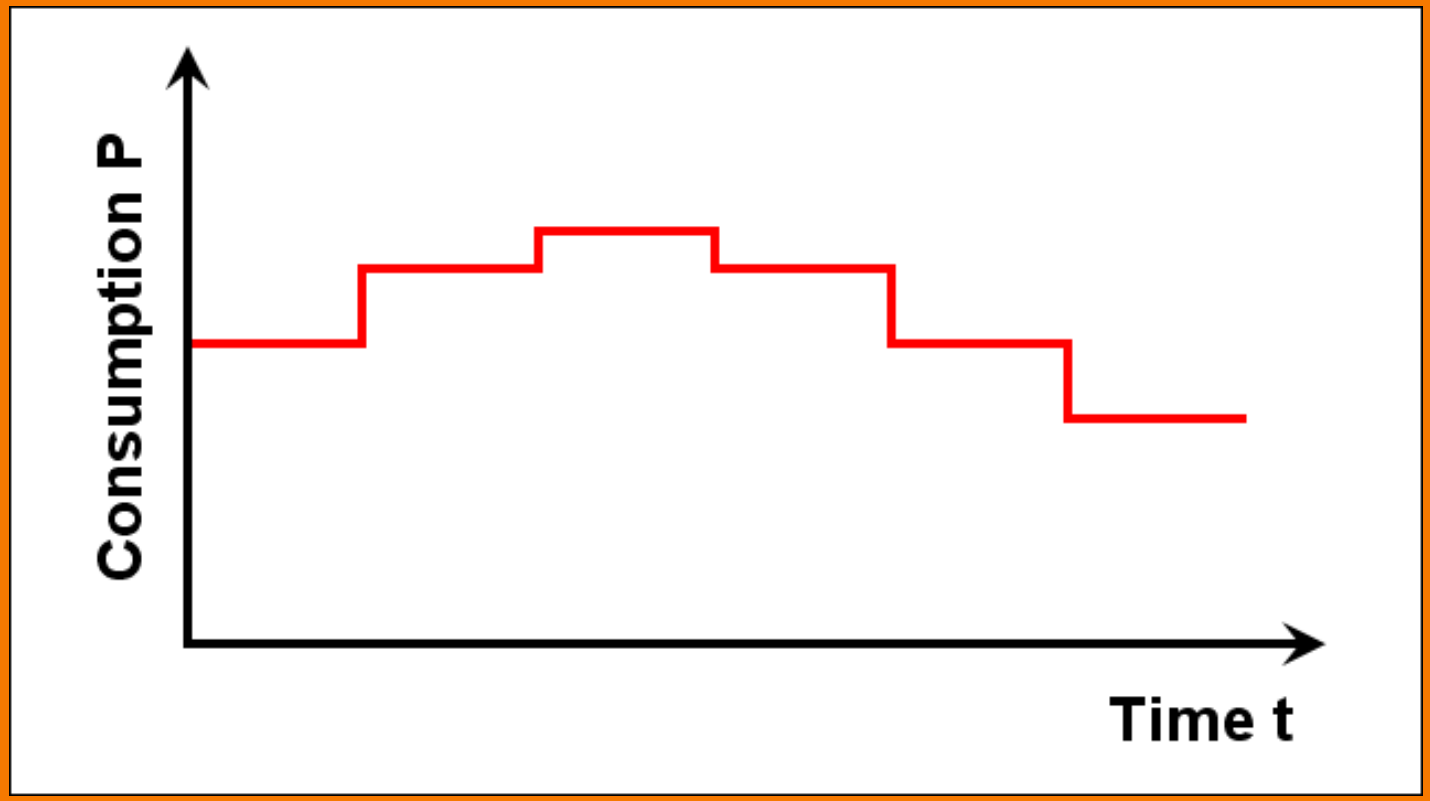
# The virtual power plant – adjusting forecasts and schedules




Calculating the demand

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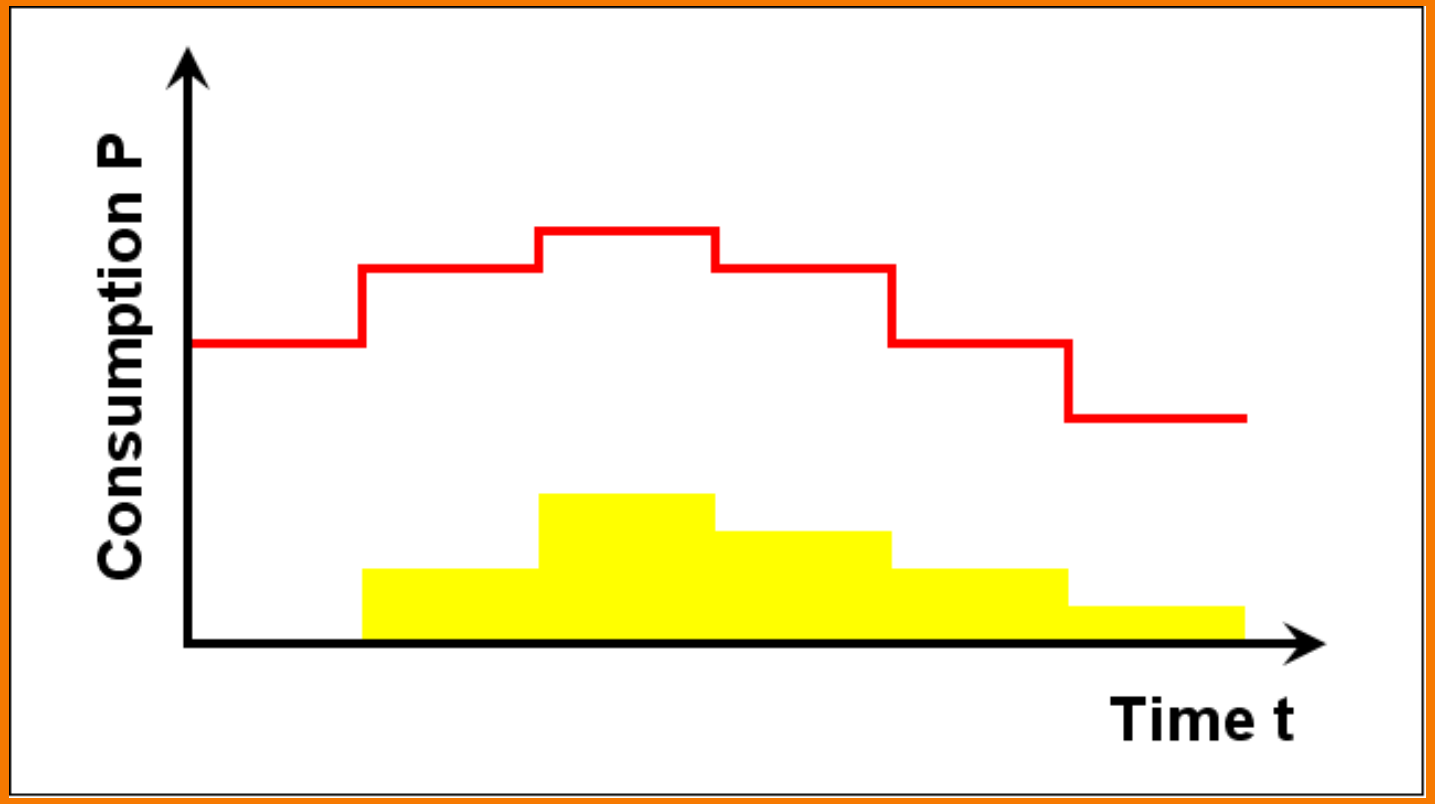
# The virtual power plant – adjusting forecasts and schedules




Forecasting photovoltaics

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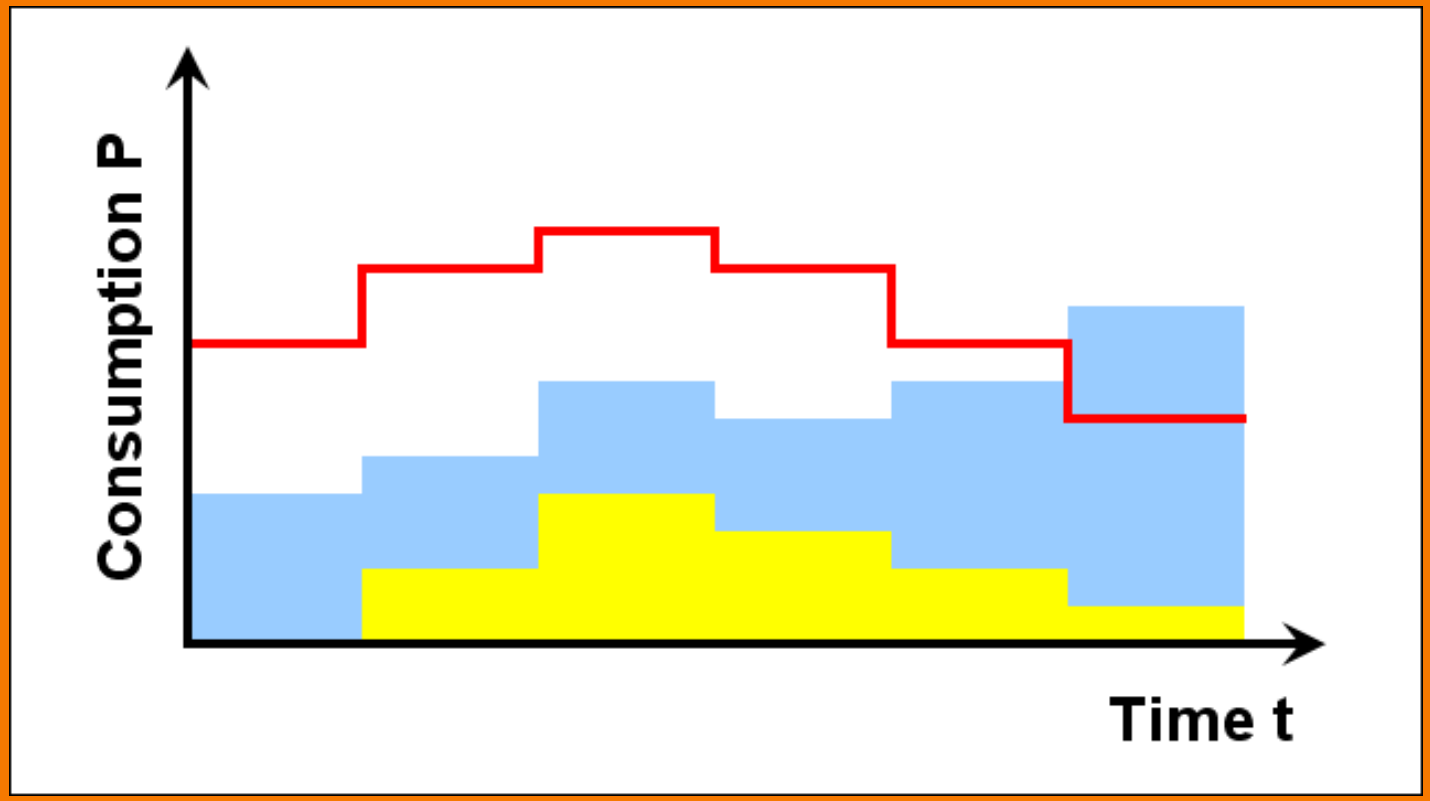
# The virtual power plant – adjusting forecasts and schedules




Forecasting wind

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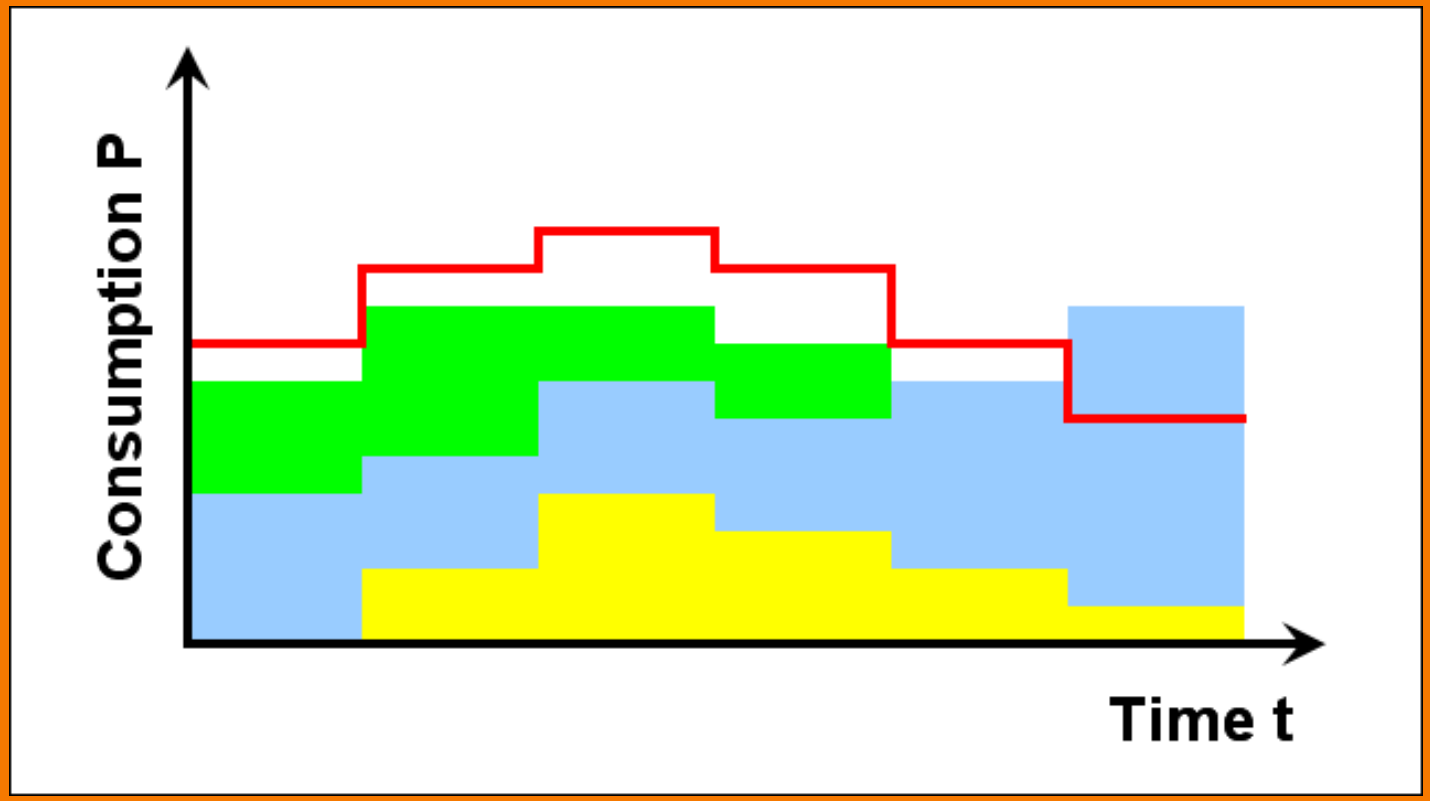
# The virtual power plant – adjusting forecasts and schedules




Creating biogas schedules

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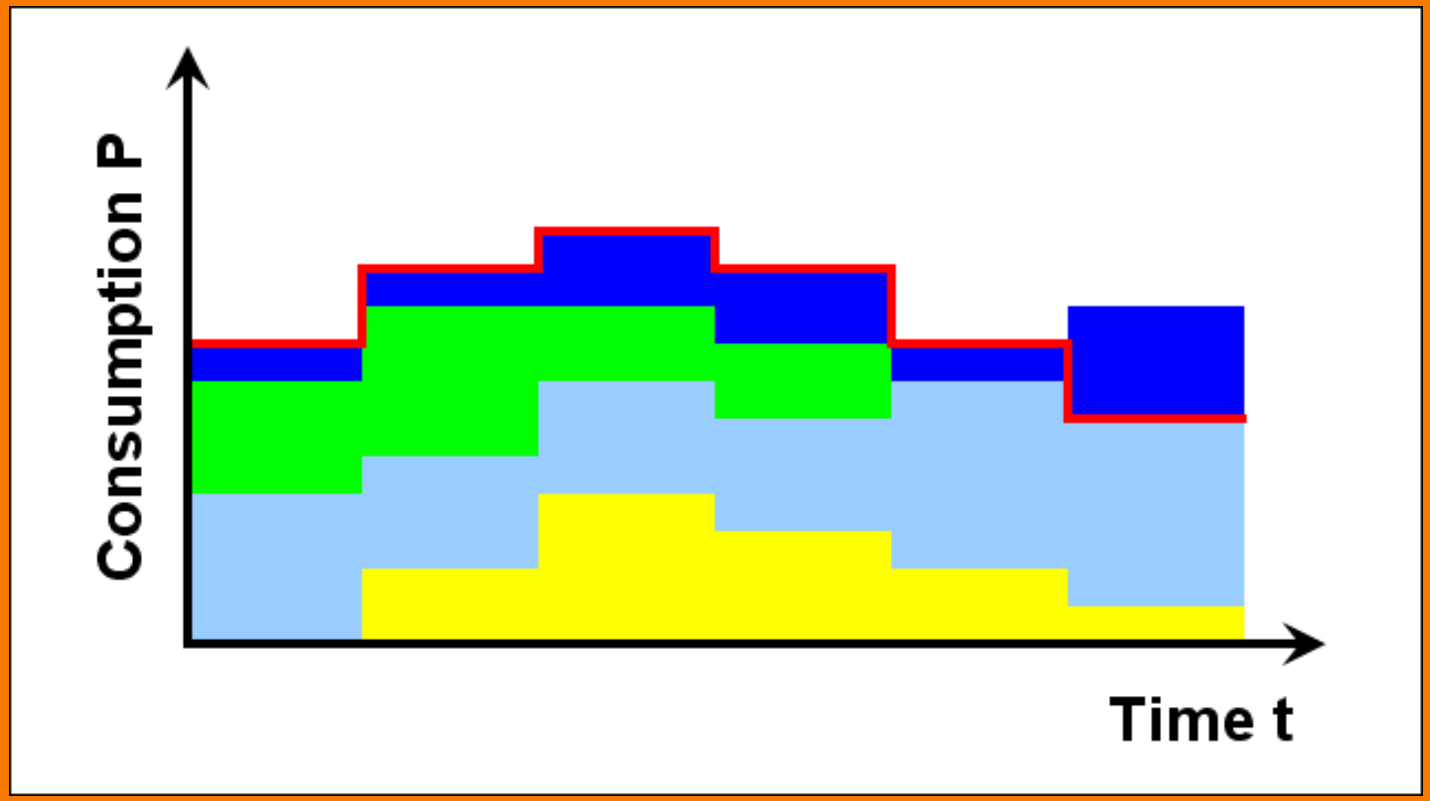
# The virtual power plant – adjusting forecasts and schedules




Creating hydro schedules

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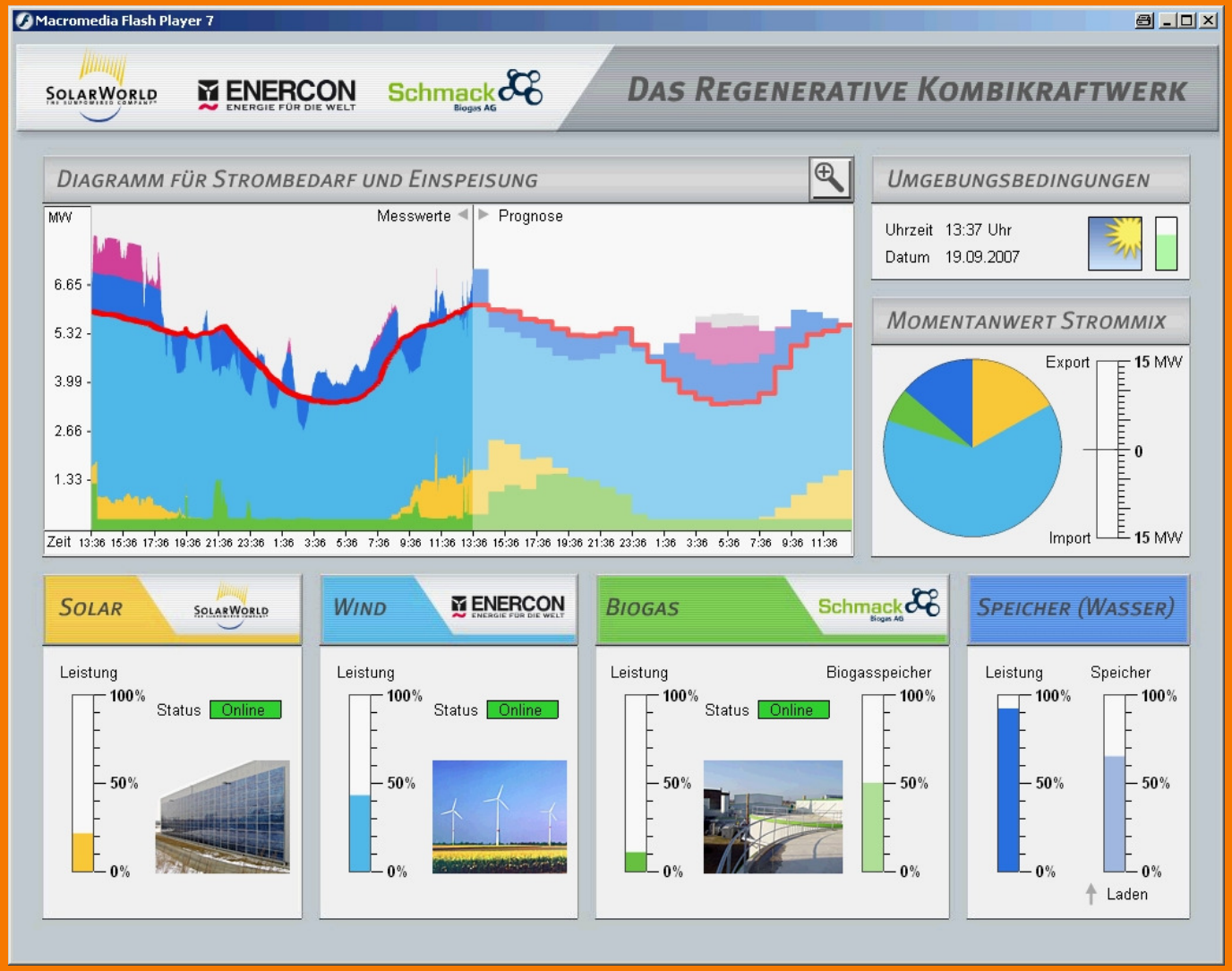
# Schedules and plants are operated via a graphical user interface




See: www.kombikraftwerk.de

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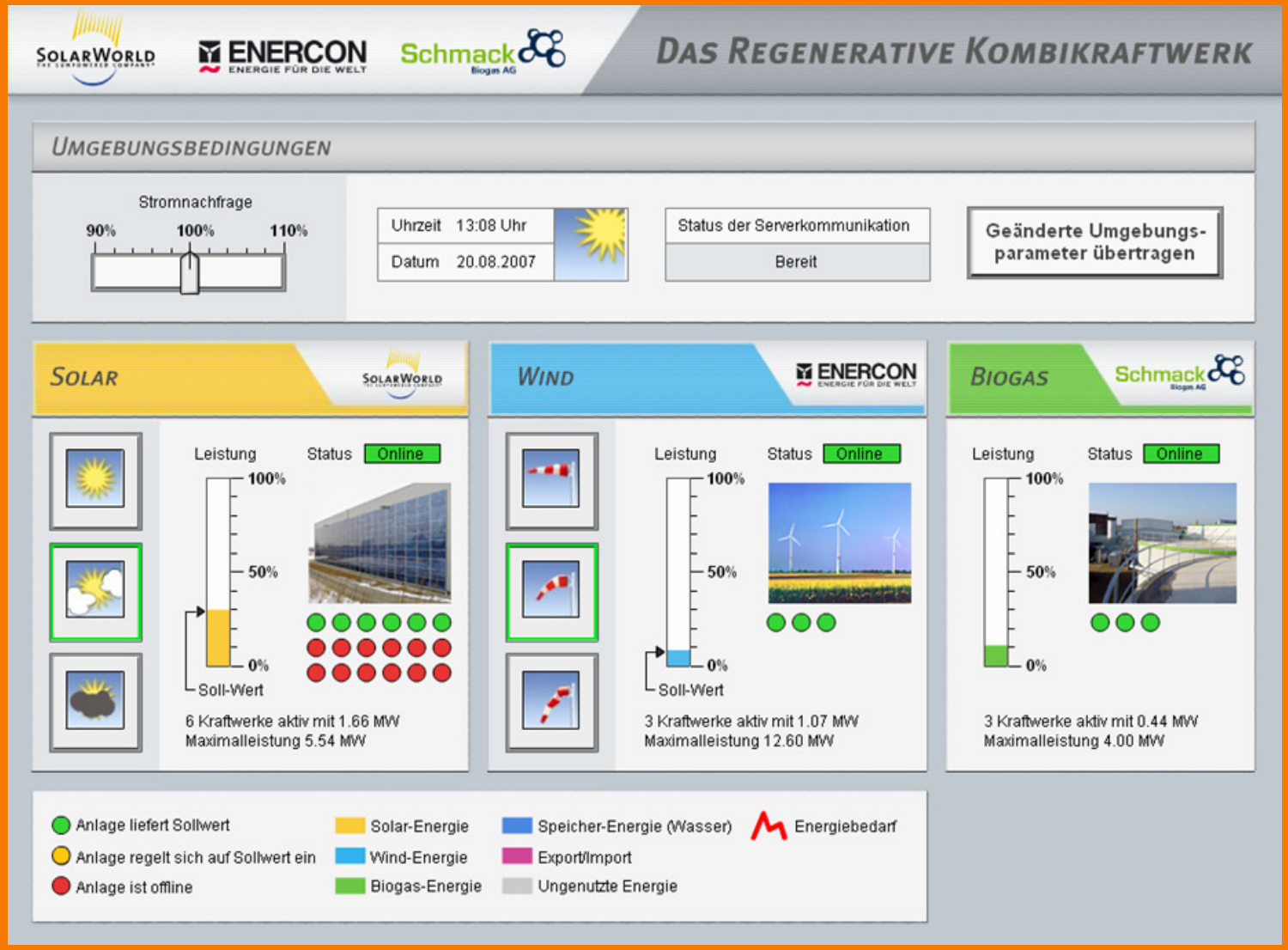
# In the user interface, different scenarios can also be simulated

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# 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.

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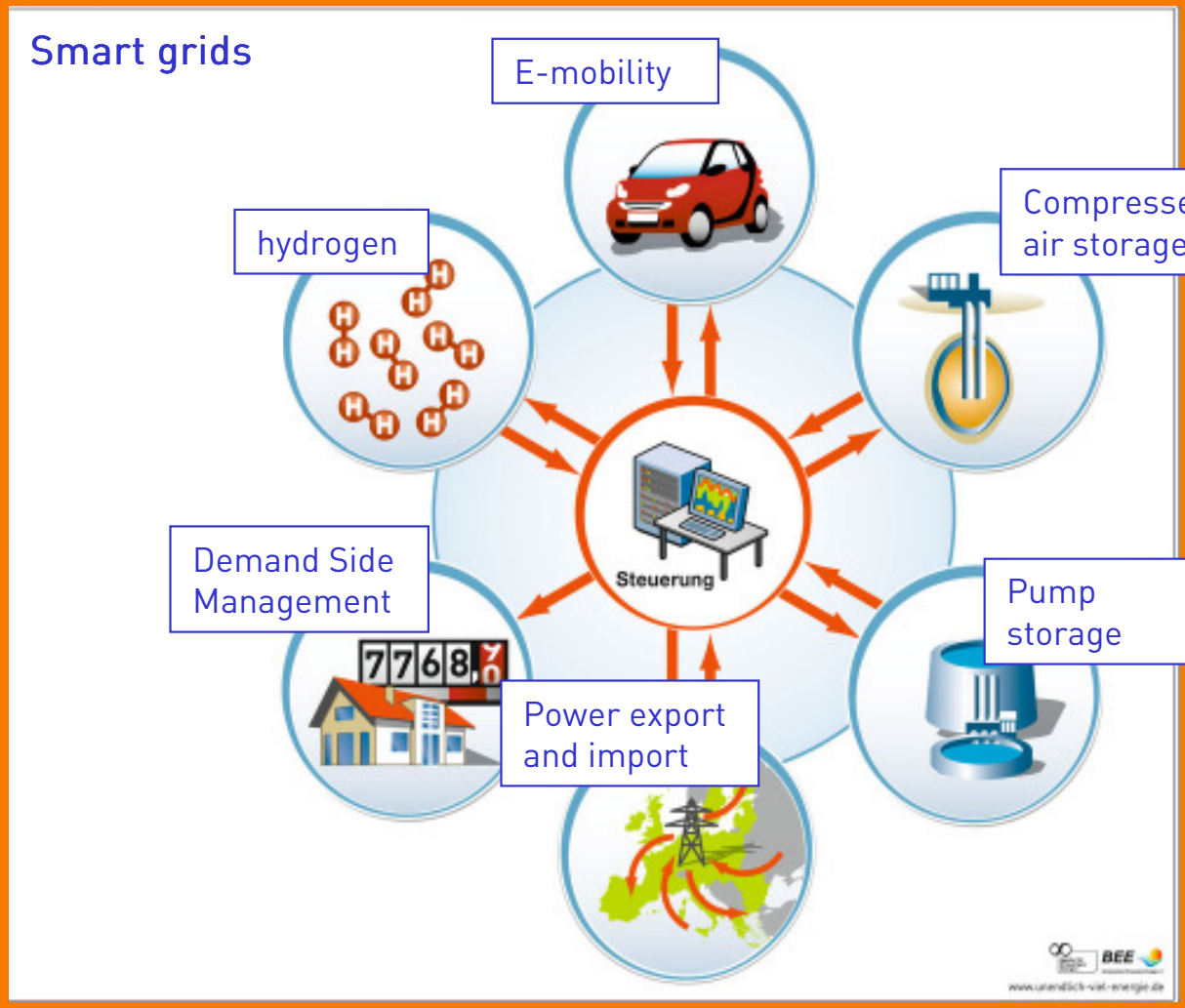
# Remaining issues due to limited potential: Smart grid technology is needed for using every KWh renewable power

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# Thank you for your attention!


www.unendlich-viel-energie.de/english

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