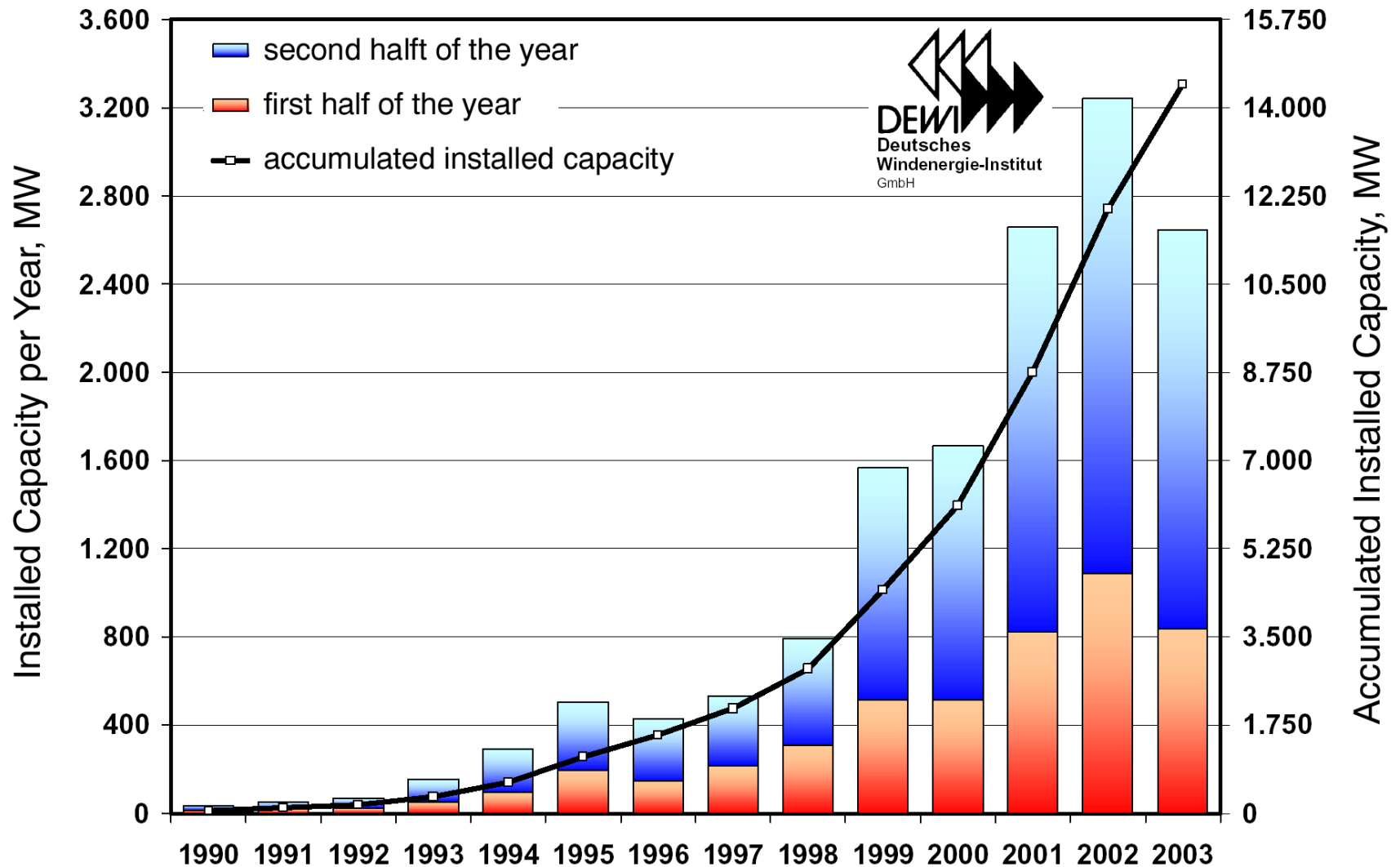


Managing Large Amounts of Wind Generated Power Feed In – Every Day Challenges for a German TSO and Approaches for Improvements

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Some Facts About Wind Power Generation in Germany



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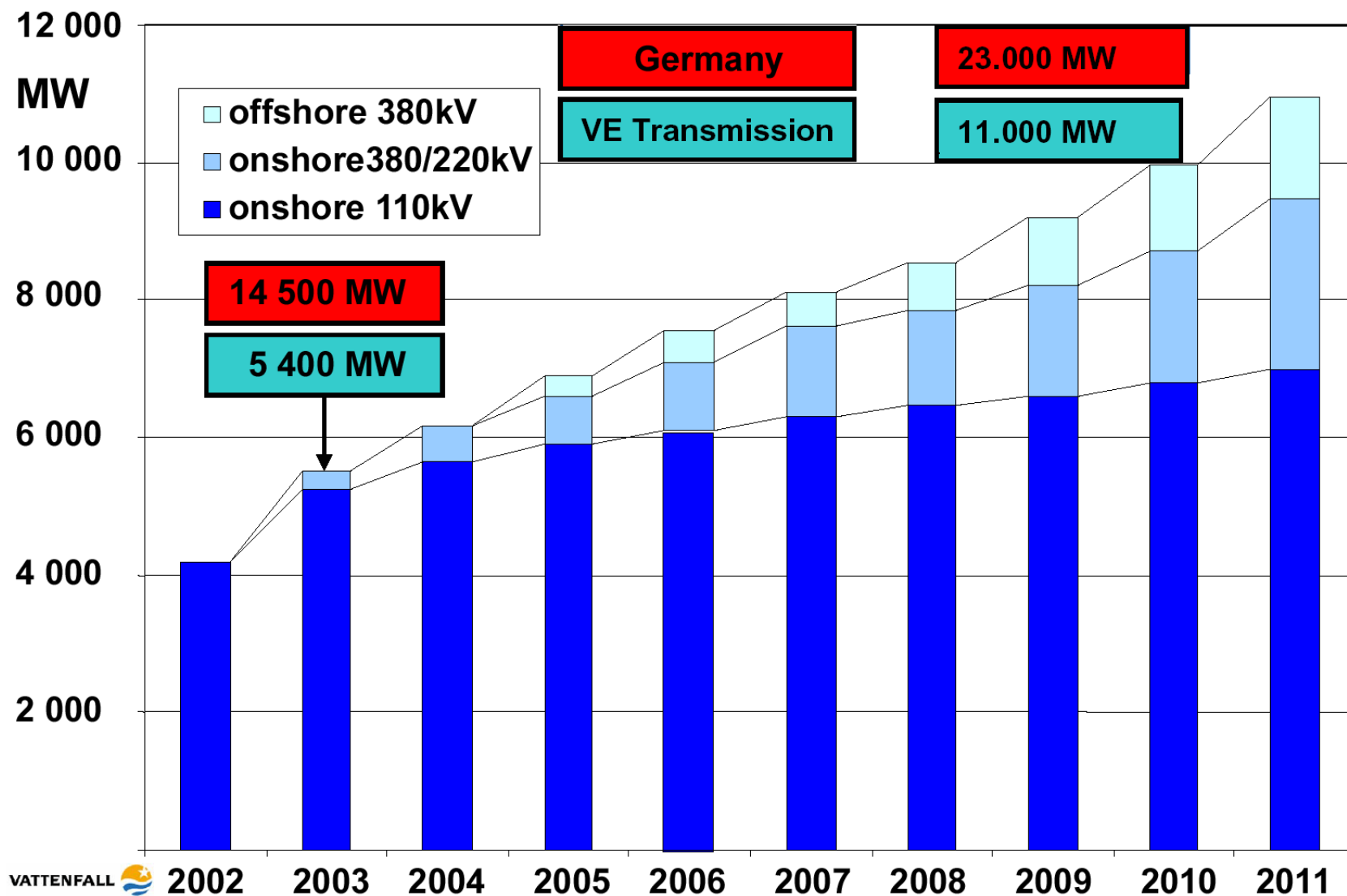
- **conventional power plant capacity in Germany of about 100'000 MW**
- **the 14'500 MW of installed wind power capacity at the end of 2003 could account for close to 6% of the German electricity demand**
- **18.6 TWh wind power feed in in 2003 delivered close to 4% of the electricity demand (bad wind conditions in 2003, conventional backup capacity not taken into account)**
- **according to the German Renewable Energy Act (EEG), grid operators have to accept wind power with priority and pay the producer a fixed price (8.8 Euro ct/kWh for at least 5 years in 2004)**

Outline

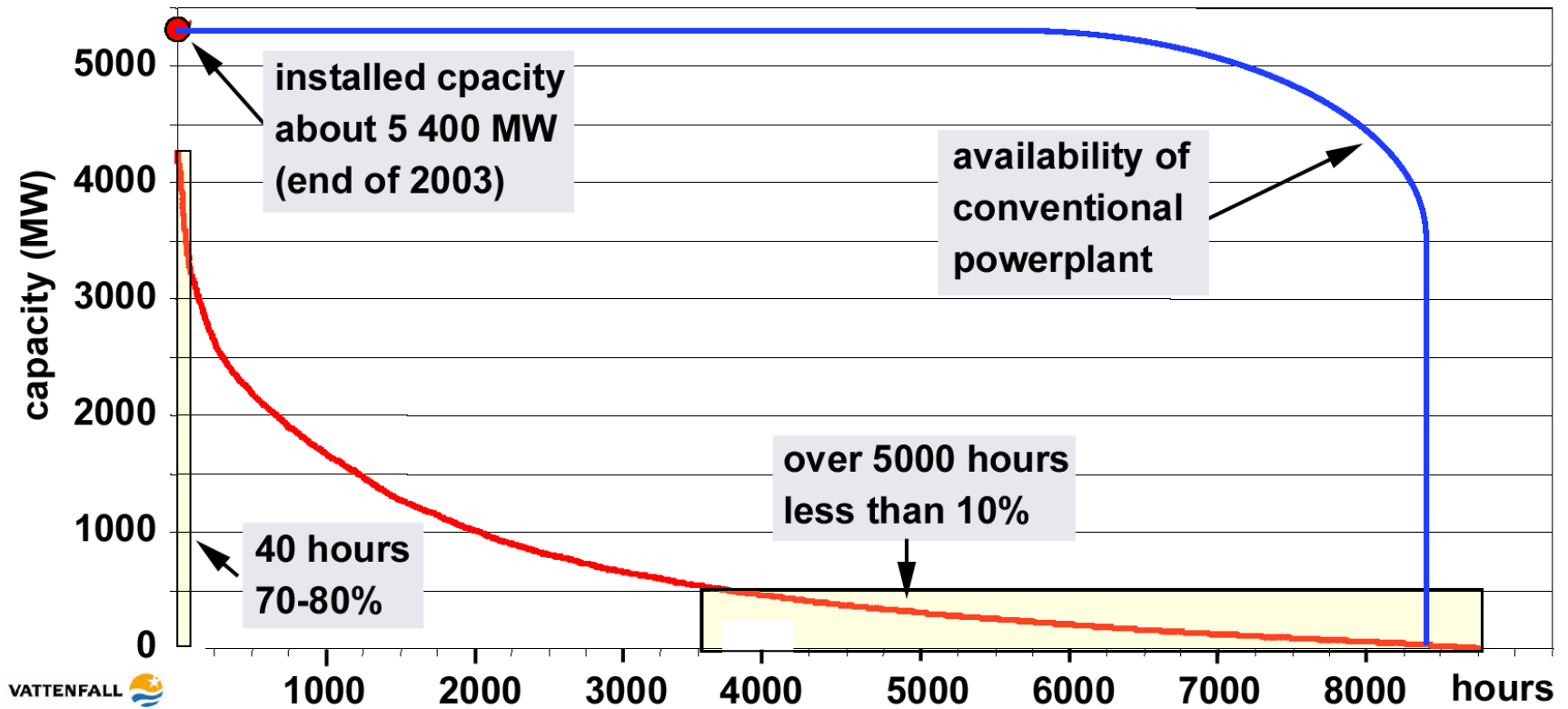
- Wind Power Generation Within the Grid Area of a German Transmission System Operator (TSO) – Vattenfall Europe Transmission GmbH
- Handling the Wind Generated Power Feed In
- Approaches for an in the Long Run Sustainable Development of Wind Generated Power Production
- Conclusions

Installed Wind Power Capacity Vattenfall Grid Area

Wind Power within Vattenfall Grid Area

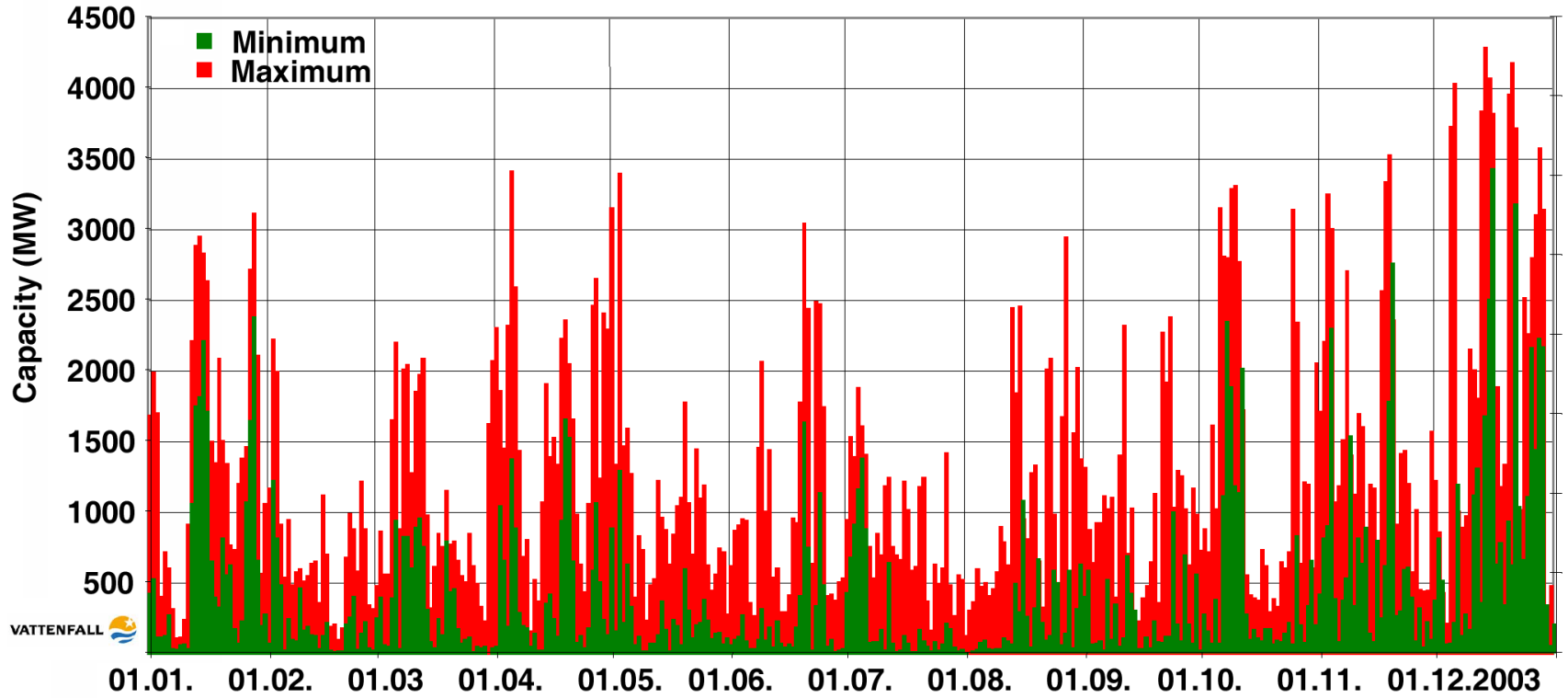


Availability of Wind Power Capacity in 2003

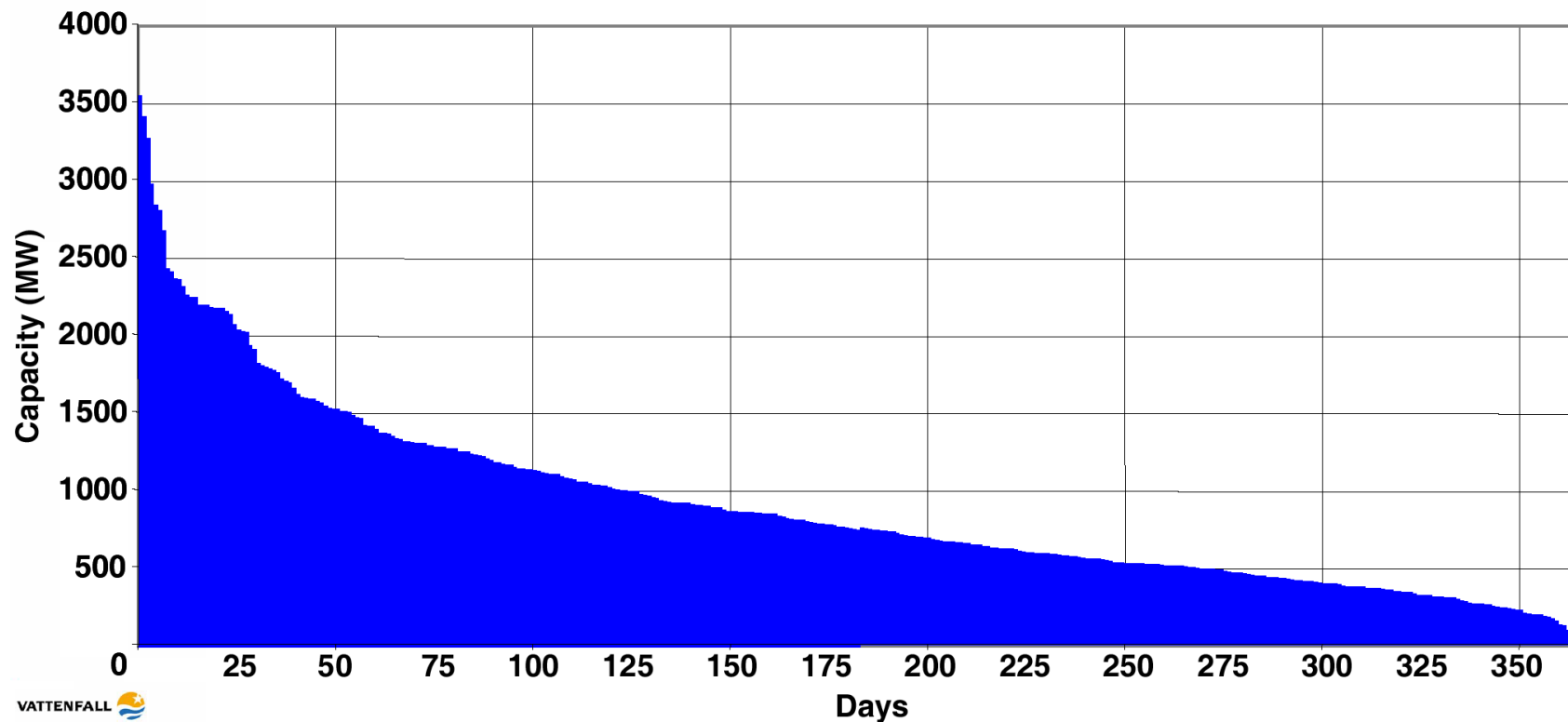


bad wind conditions in 2003

Daily Fluctuation of Available Wind Power Capacity



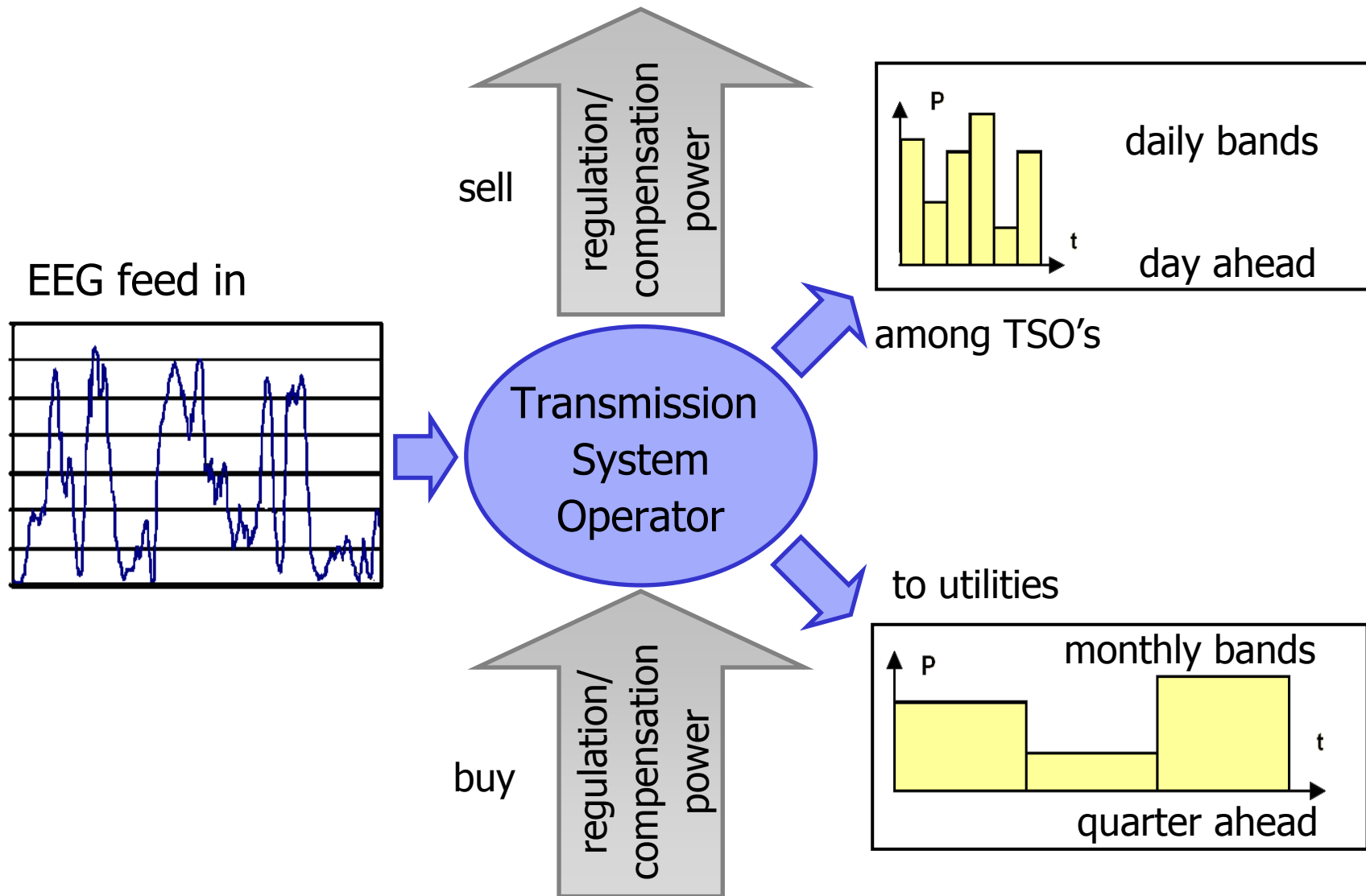
Necessary Compensation Capacity for Wind Power Feed In



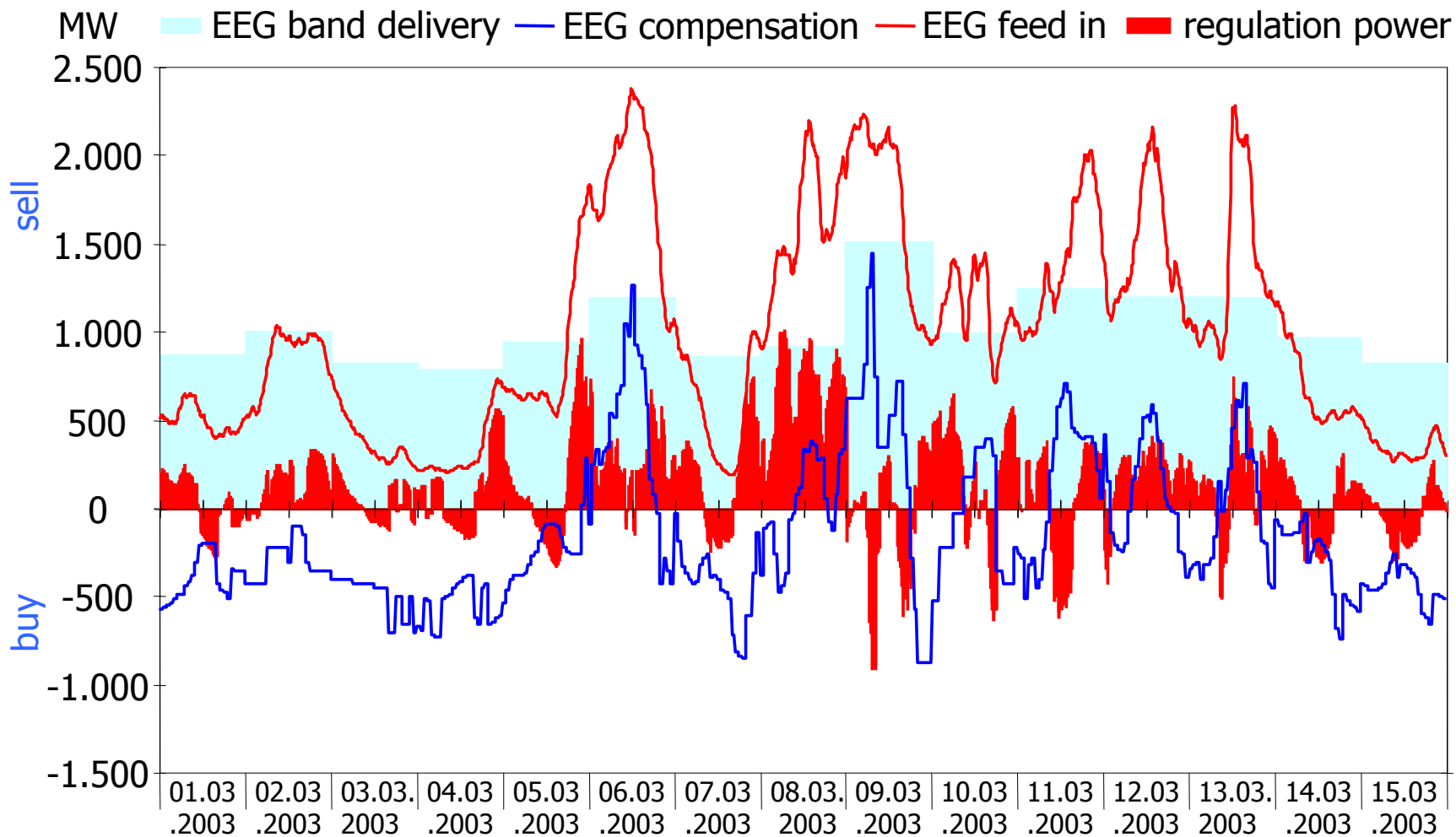
Outline

- Wind Power Generation Within the Grid Area of a German Transmission System Operator (TSO) – Vattenfall Europe Transmission GmbH
- **Handling the Wind Generated Power Feed In**
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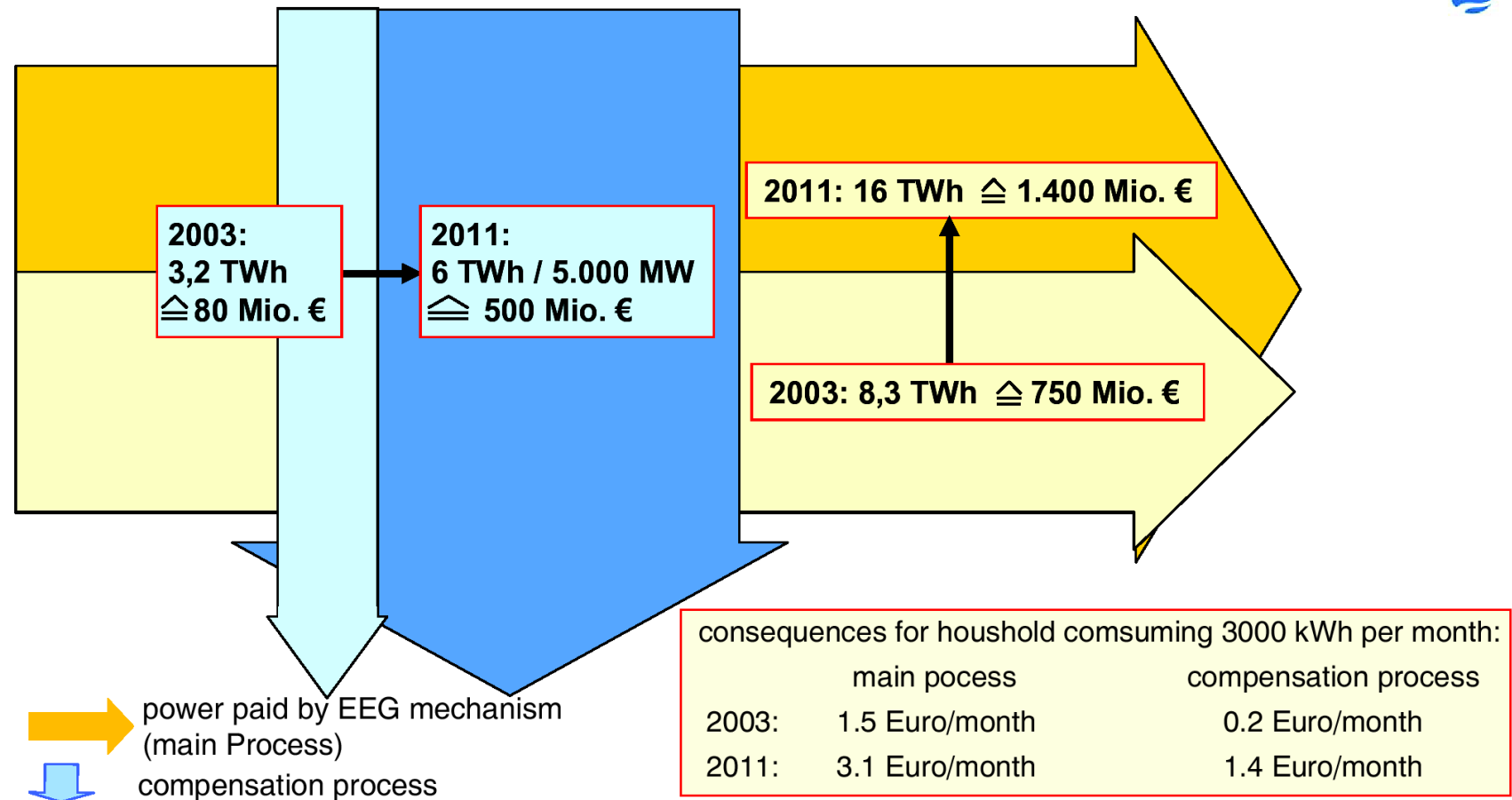
Distribution of EEG Power Feed in According to the EEG



Ensuring a Save Grid Operation



Costs for Additional System Services for EEG Feed In



Outline

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Reducing System Services for Affected TSO's

Approaches within the existing system of EEG power distribution:

- Regulation of fluctuating EEG feed in
- Online forwarding of Wind power feed in to other TSO's
- Forwarding fluctuations to utilities

Issues for a Sustainable Development of Wind Power

- **Development of market skills by wind power producers:**
 - to be able to sell a tradable product at the market
 - to become independent of policy support
- **New ways of compensating fluctuating wind power feed in:**
 - no direct incentives for TSO's to find other means for ensuring a save grid operation apart from providing more regulation power (forwarding of costs to consumers)
 - find players who have incentives for finding new means
- **Investments in new power plants:**
 - environment for long-term investments in new power plants is already rather difficult under the liberized market conditions
 - intermitting wind power feed in poses additional uncertainty for utilization of power plants (wind power has priority)

Introducing An Optional Bonus System

As an alternative to a fixed feed in tariff for wind power generation, a bonus system could be calculated considering the following components:

fixed feed in tariff (for turbines erected in 2011)	8.1 Euro ct/kWh
expected undistributed wholesale price	- 3.5 Euro ct/kWh
costs for integrating wind power into the grid (as claimed by E.ON)	+2.2 Euro ct/kWh
distribution margin	+0.5 Euro ct/kWh
<hr/>	
bonus for wind power feed in	7.3 Euro ct/kWh
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By giving wind power producers the choice of compensation according to this bonus system, they could earn more than receiving the feed in tariff, if they are able to sell their wind power at the market.

Conclusions

- The advance of the wind power generation technology has been successfully supported by the German Renewable Energy Act (EEG) and has led to an energy economically relevant share of wind power generation capacity within the German electricity system
 - Wind generated power fed in according to the EEG mechanism requires already noticeable additional system services by affected transmission system operators, which will increase in the future
 - To enable a in the long run sustainable development for wind power
 - Producers need to become independent from political support and sell their product at the market
 - New solutions need to be found to deal with growing amounts of intermitting wind power feed in
- ⇒ Wind power producers need to be encouraged to deal with the intermitting nature of wind power availability
- ⇒ The introduction of bonus system seems to be a promising approach