

VERBUND Green Power GmbH

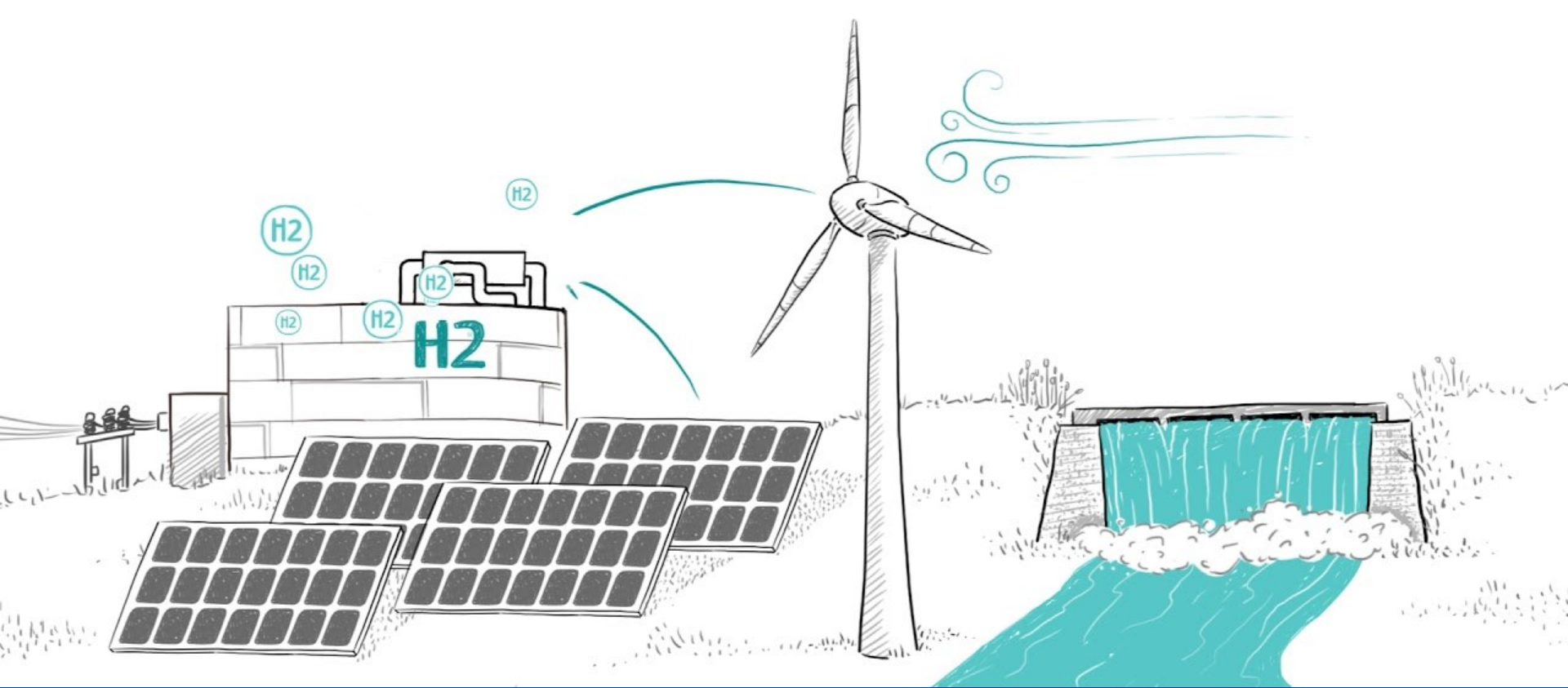
Renewable Assets as an Integrated Part of the Electricity System

Thomas Burchhart

Integrating RES in the Electricity Networks and
Balancing Mechanism in MEDREG and ECRB Regions



15th of April 2021



VERBUND

VERBUND at a Glance

96 % production from renewable sources

approx. 392,000 residential customers –
market leader in the industrial customer segment

approx. 3,000 employees

127 hydro power plants

No. 1 in climate change mitigation
among European power supply companies

Austria's leading electricity company

strategic focus on Austria and Germany

first green bond in German-speaking Europe

largest hydro power producer in Bavaria

51 % owned by the Republic of Austria

more than 2,000 apprentices trained
in the past 60 years

Austria-wide charging infrastructure
for electric vehicles

energy related products and services

social responsibility: € 1.8 million support for
„VERBUND-Stromhilfefonds“ of Caritas
since 2009

market leader in marketing of flexibility and
green electricity in Austria and Germany

environmental measures -
€ 280 millions to be invested until 2025

environmental management – top-10-position of 160
energy companies analysed by oekom research

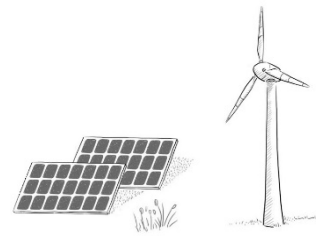


VERBUND - Highlights

- Integrated utility with generation, transmission, trading and sales of electricity
- 127 hydro power plants in Austria and Germany (Bavaria) – approx. 8,2 GW
- 31 TWh total production
- >104 TWh trading volume, active in 10 European countries
- 3,500 km of line length of the Austrian transmission grid



VERBUND 430 MW Wind and PV Assets



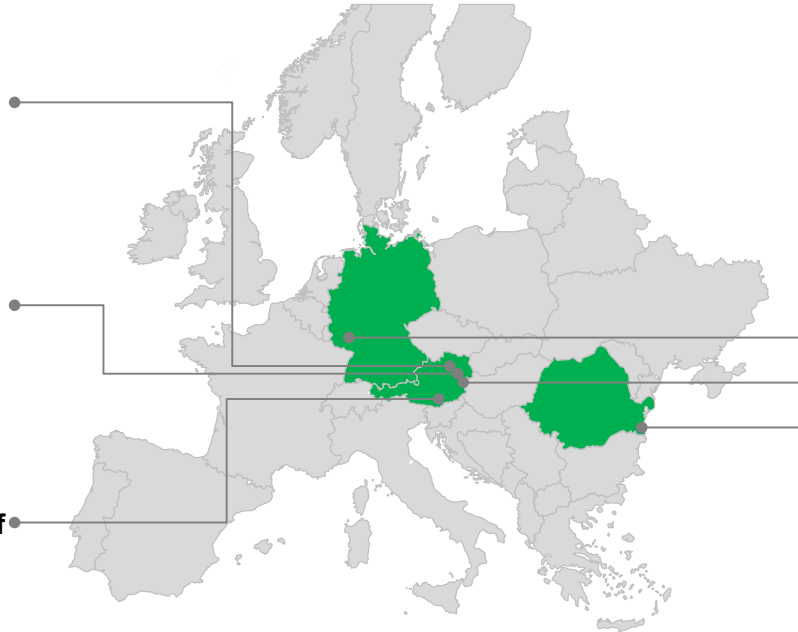
EUD
0,4 MWp



Schönkirchen
11,4 MWp



Ludmannsdorf
1,3 MWp



Ellern, Stetten
86 MW
21 WTG



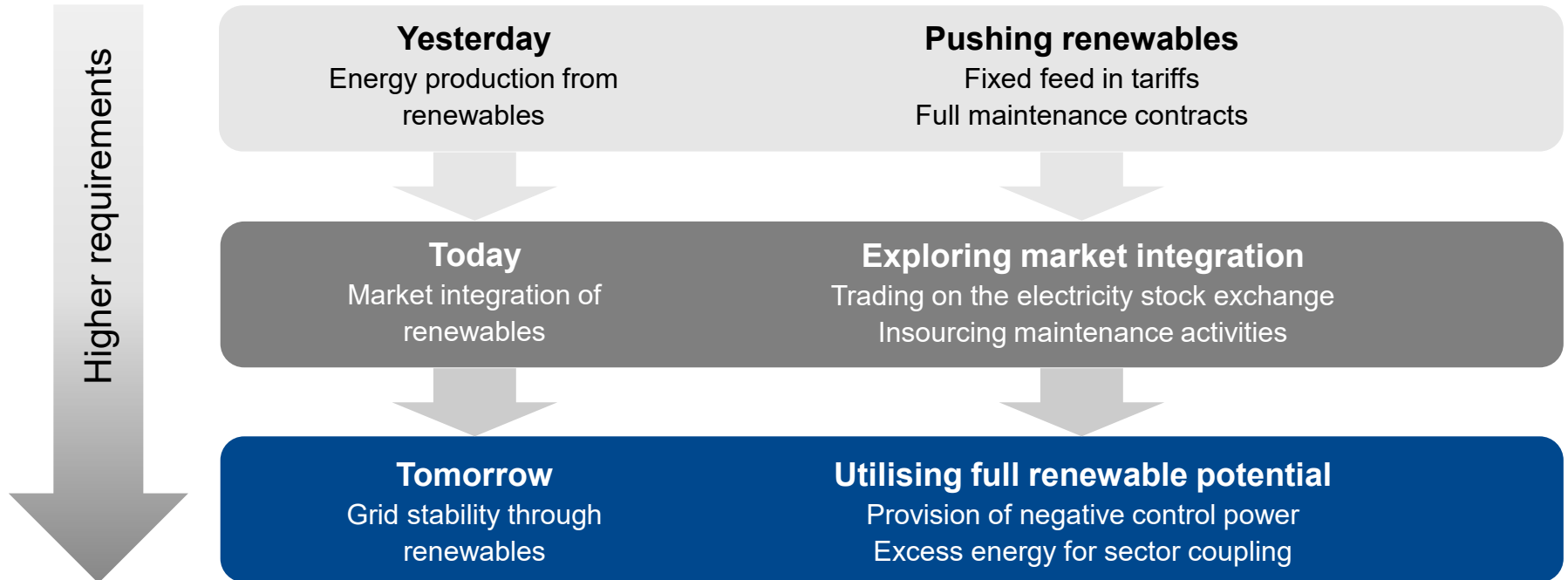
**Bruck, Hollern,
Petronell**
106 MW
44 WTG

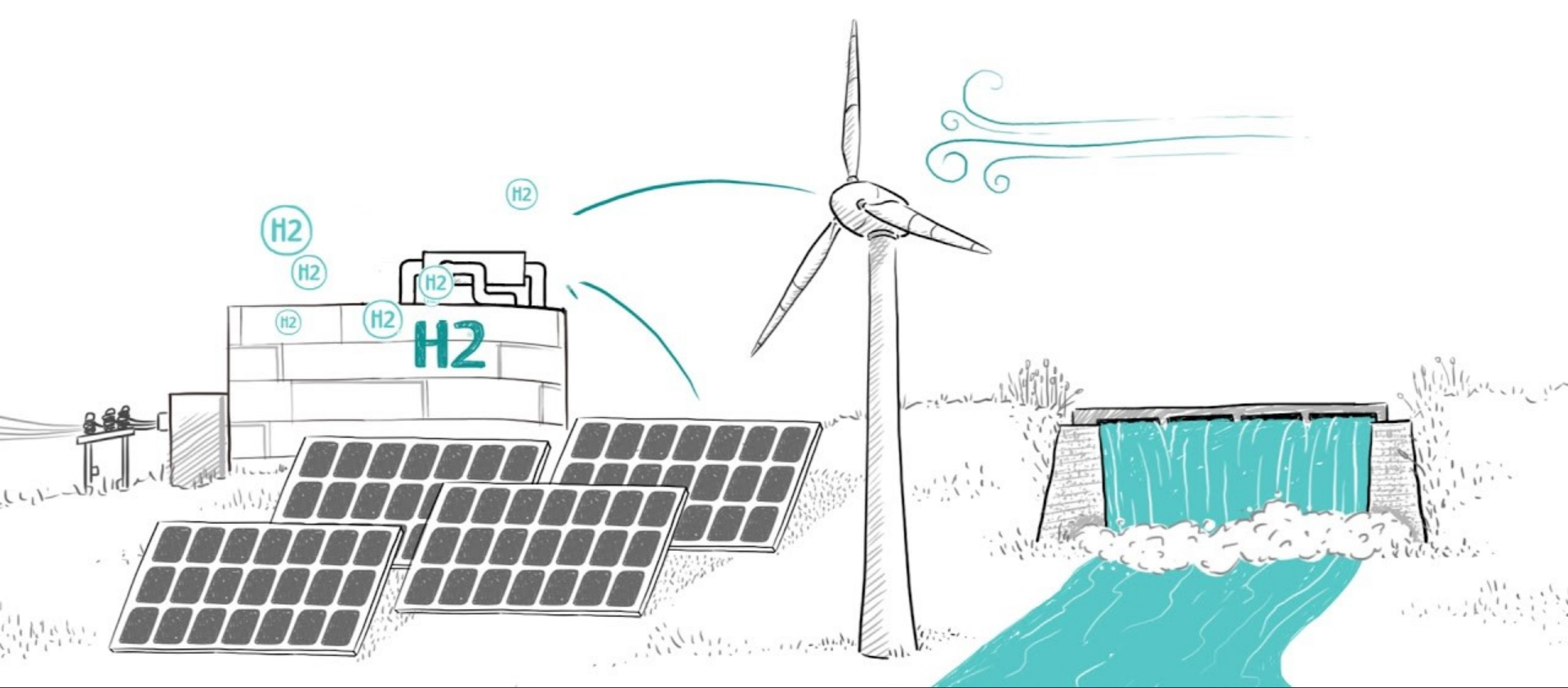


Casimcea
226 MW
88 WTG



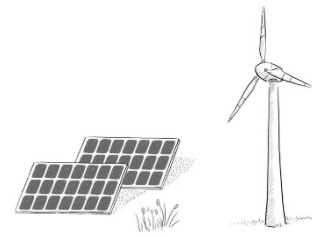
Wind Energy as Integrated Part of the Electricity System





Wind Energy in Romania

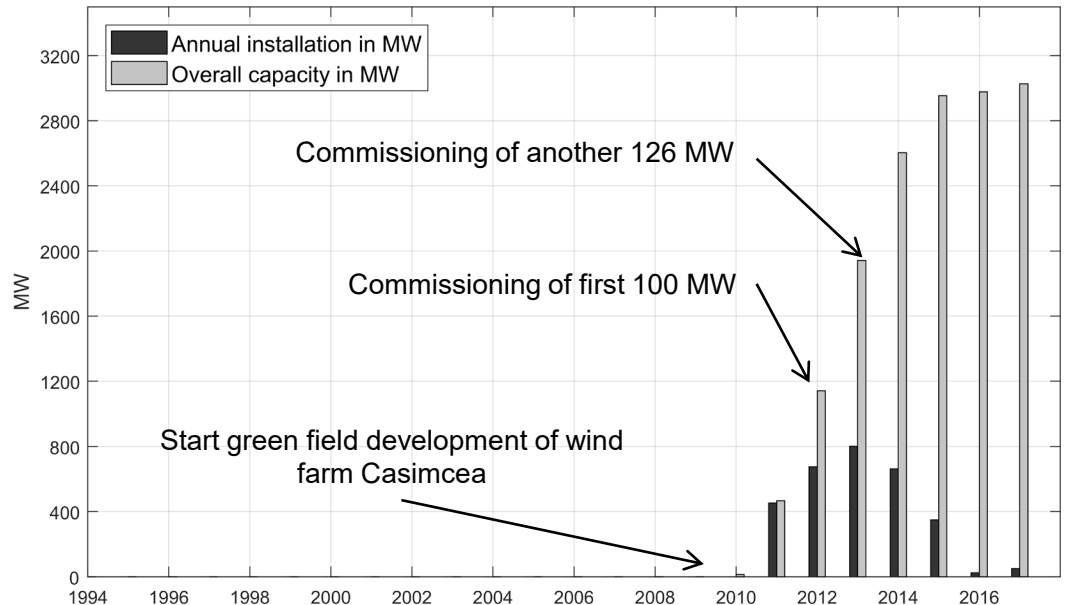
Wind Energy in Romania



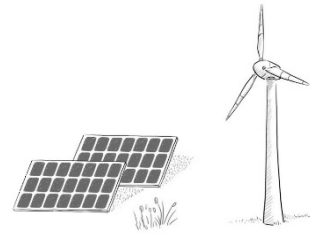
Green electricity law (Legea 220/2008) to promote wind energy was ratified in year 2008

Highlights (end 2016)

- ~1.200 WTGs in operation
- 2.978 MW total installed wind capacity
- 8,8* TWh annual energy production (6,9% of the annual production)
- 5,6 billion Tons CO₂ avoided per year
- ~1.000 employees in wind sector



*...Production from renewables (Wind+Solar)

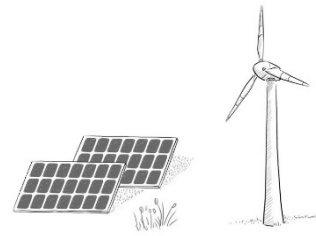


Wind Energy in Romania

Full market integration of wind energy

- Energy is sold on the stock exchange (OPCOM)
 - Provision of day – ahead power performance forecasts and intraday to TSO
 - Power curtailments can be requested by the TSO
 - Intraday market with low liquidity
 - Reduction of balancing costs by short term market
- Reserve of pos. balancing energy of 1%
- **Retrospective changes of the promotion system with massive impact on the revenues**

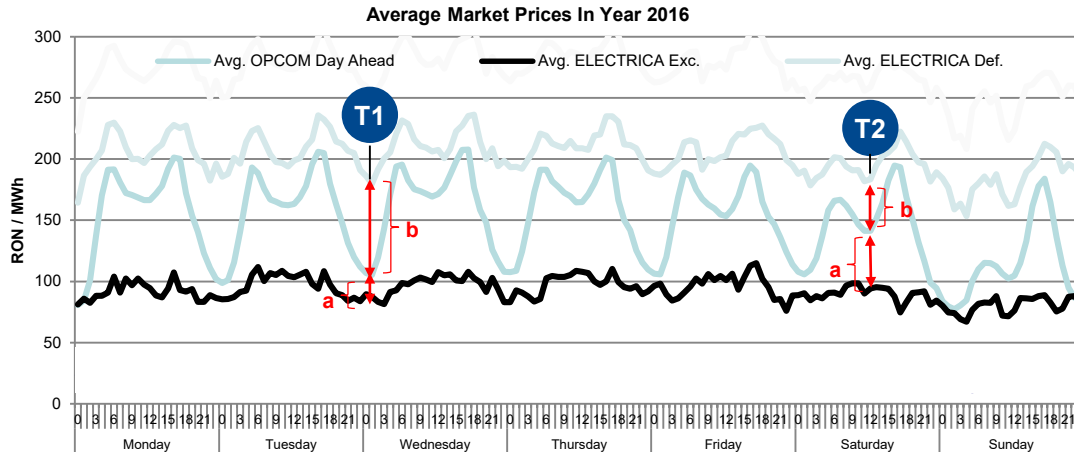
Quota obligation system	=	Energy price/MWh	+	Green certificate(s)
Incentive system for renewables, quota obligation for selling of renewable energy; can be met by purchasing green certificates by the energy seller	=	Selling of the produced energy on the stock market	+	<ul style="list-style-type: none"> ▪ Different number of certificates for different RES technologies ▪ Retrospective changes of the system



Market Situation in Romania

Characteristic Week (2016)

- Balancing energy market not symmetrical
- High costs for deficit energy and low prices for exceeding energy
- No GCs for exceeding energy

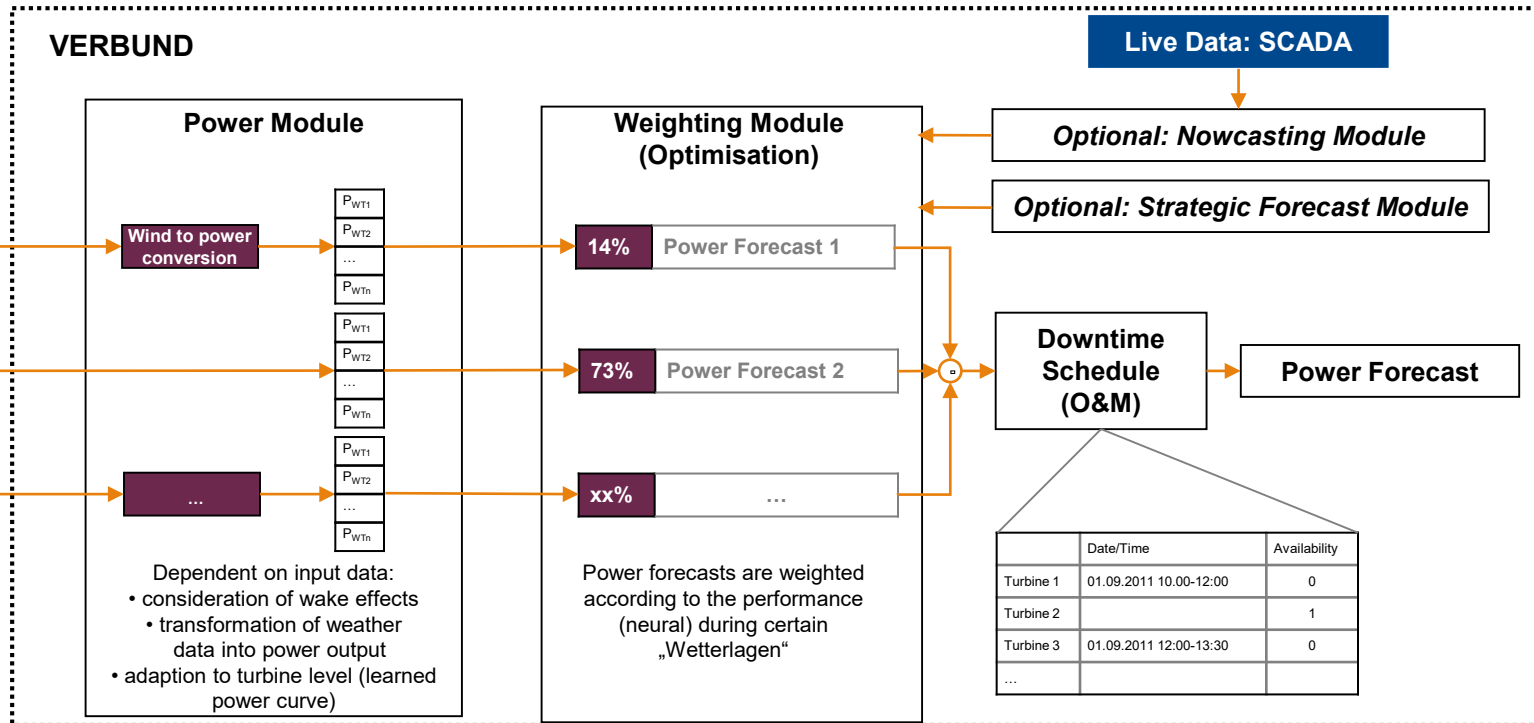


Market Value Wind Energy 2016 (RON/MWh)	Romania
Mean ROPEX/Day-Ahead	149,82
Profile Value Wind 0% Error	133,57 (-11%)
Specific Balancing Energy Costs	23,3

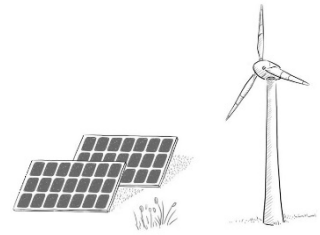
a...cost for excedent energy (lost revenue)
 b...cost for deficit energy

- T1** a<b -> Night
- T2** a>b -> Day

Forecasting and Day-Ahead Scheduling



*) Meteorology and/or power forecast (v, ρ, P, \dots) on turbine level or grid point



How to Increase the Market Value of Wind?

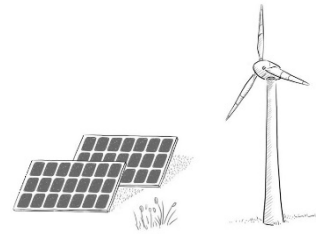
1. Reduction of balancing energy costs

- Continuous improvement of the prediction quality
- **Reduction of systematic** errors and **general optimization** of individual forecasts by consideration of “real” data
- Implement **dynamic weighting** dependent on historic performance of single forecasts during characteristic weather classes (“Wetterlagen”)
- Implement **strategic forecasting** as 2nd optimization step
- Formation of **one balance group** including all Romanian assets (= One Dispatchable Unit, spatial smoothing)
- Improvement the **quality of planned maintenances** (=scheduled downtimes) together with the OEM

2. Increase revenues

- Develop a marketing strategy dependent on local market characteristics to be able to apply potentials and risks in a most effective way (hedging, providing ancillary services, combined offers to end costumers (electricity + GC))

Reduction of OPEX

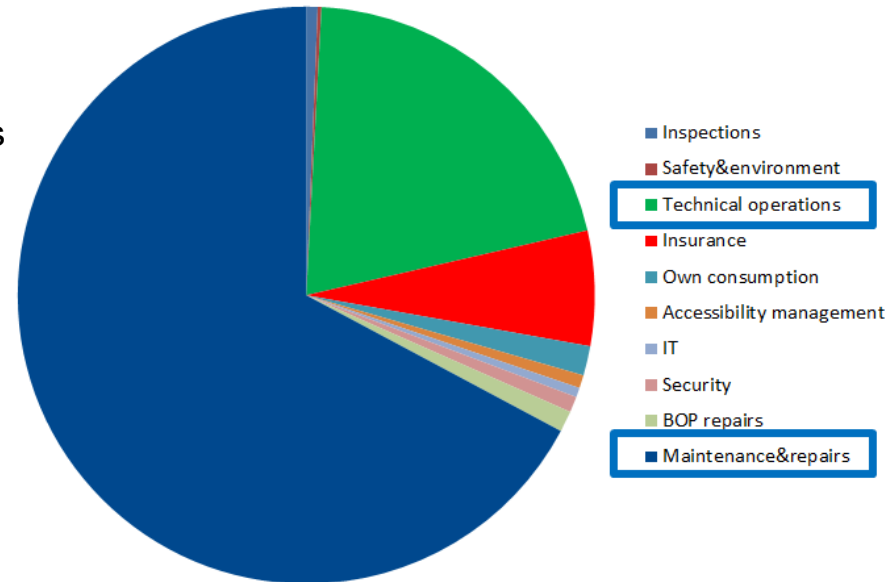


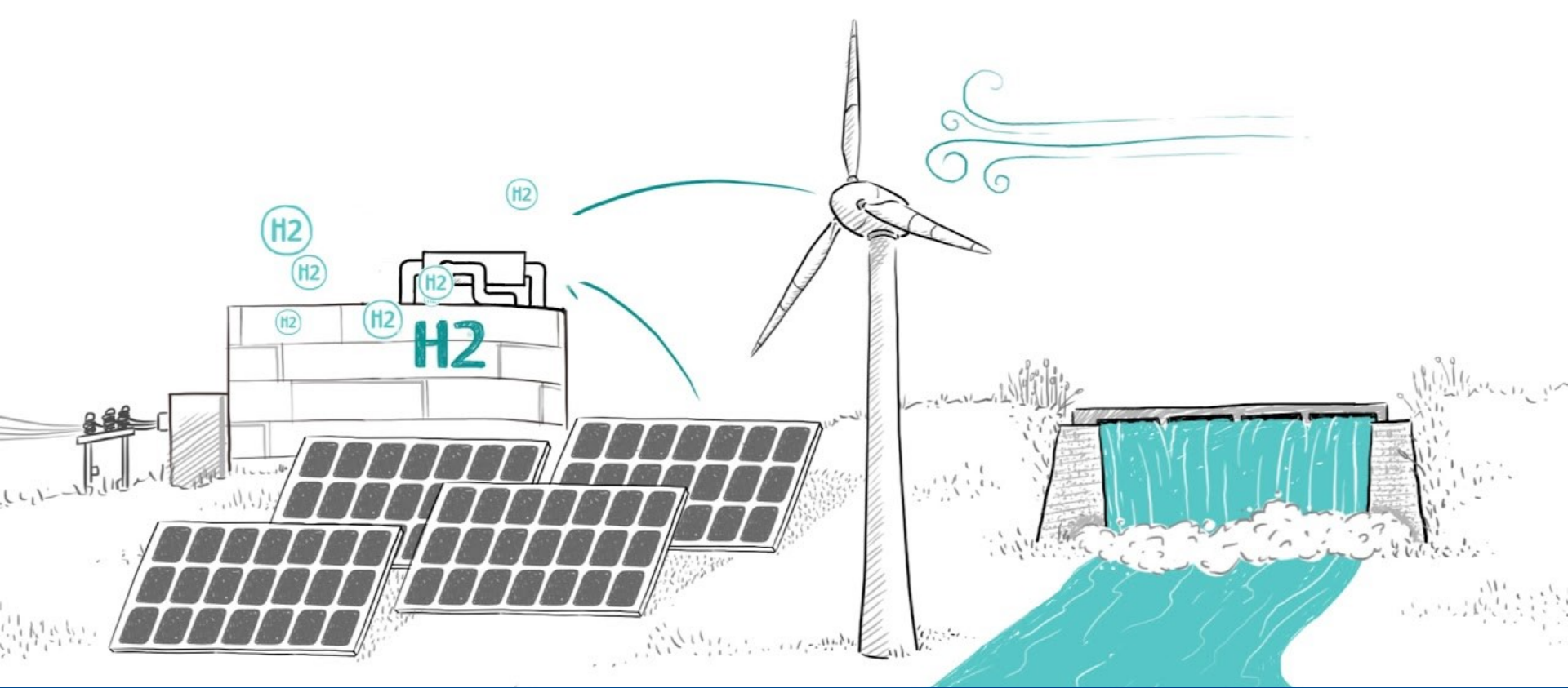
Reduction of maintenance and repair costs

- Within the full maintenance contract
 - Confront the OEM with detailed analysis results on a regular basis
 - Reaction times
 - Weaknesses of WTG components -> retrofits
- Negotiation about alternative maintenance concepts

Reduction of costs for technical operations

- Insourcing of the operation of the substations
- Insurance contract: establishing a risk community
- Reorganization of the security services





Wind Energy in Austria

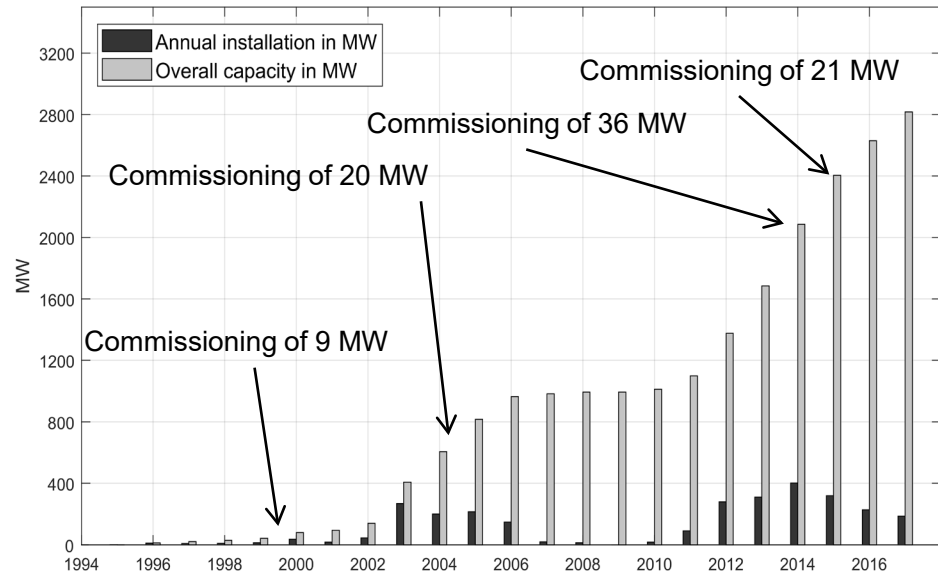
Wind Energy in Austria

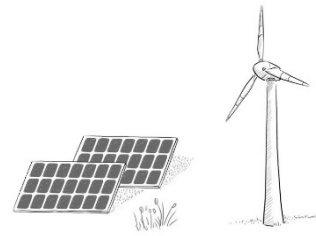


Green electricity law (Ökostromgesetz) to promote wind energy was ratified in year 2002

Highlights (end 2016)

- 1.191 WTGs in operation
- 2.632 MW total installed wind capacity
- 5,8 TWh annual energy production
(9,3% of the annual demand)
- 3,7 billion Tons CO₂ avoided per year
- ~5.000 employees in wind sector





The Austrian Green Electricity Promotion System

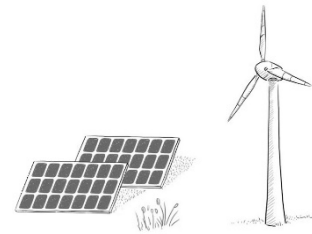
The Austrian clearing and Settlement Agency **OeMAG** is responsible for closing subsidy contracts, purchasing of the energy, allocation to traders, balancing energy management , clearing and billing.

Revenue situation of the Austrian wind farms

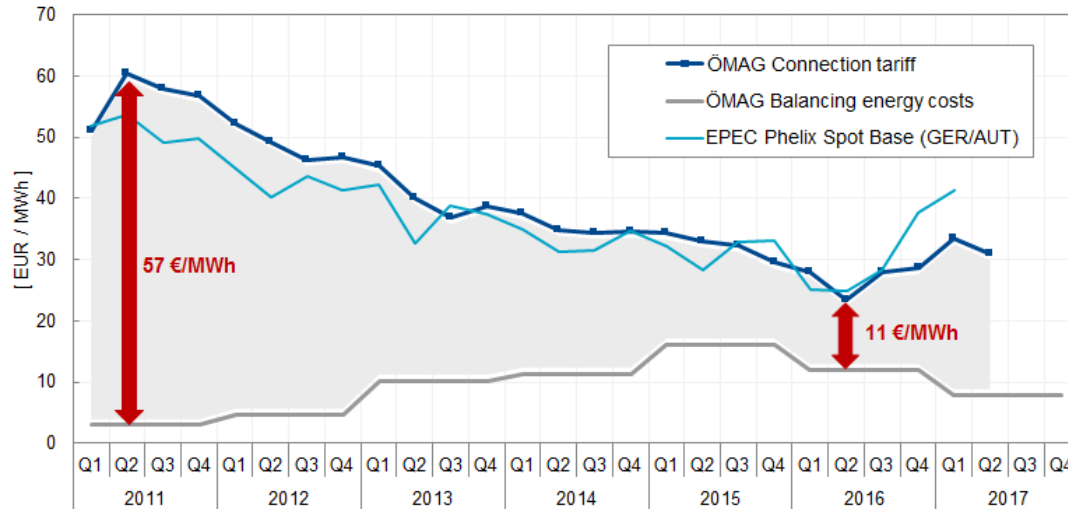
VERBUND	Type	Commissioning year	Feed in tarif	End of tarif
WP Bruck an der Leitha	5 x E66	2000	75,8 €/MWh	2010
WP Hollern	9 x E66	2004/05	78,0 €/MWh	2017
WP Petronell-Carnuntum	11 x E66	2004/05	78,0 €/MWh	2017
WP Hollern II	5 x E101	2014	95,0 €/MWh	2027
WP Petronell II	7 x E101	2014	95,0 €/MWh	2027
WP Bruck-Göttlesbrunn	7 x E101	2015	95,0 €/MWh	2028

- End of tariff for Bruck an der Leitha after 10th year of operation, Hollern and Petronell after 13th year
- After the 10th year of operation WP Bruck was traded by OeMAG connection tariff (*Marktanschlussstarif*)

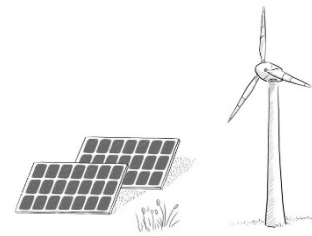
OeMAG- Connection Tariff






Development after fixed feed in tariff



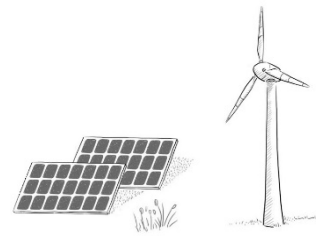
Declining market prices for energy and high costs for balancing energy within the Ökostrom balancing group cause declining revenues of over 80%.



Full Maintenance Contract vs. Service Contract

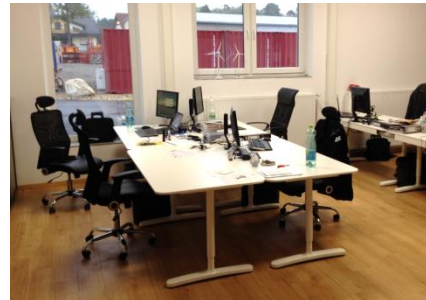
	Full maintenance contract ENERCON-EPK (<i>Enercon Partner Konzept</i>)	Inourced maintenance with Service- and support contract
 Costs	<ul style="list-style-type: none"> Increasing remuneration with operational year Remuneration quite high after 15th year of operation 	<ul style="list-style-type: none"> Lump sum + costs for spare parts, consumables and repair works + personnel costs and tools for repairs
 Economic risk	<ul style="list-style-type: none"> Availability warranty Power performance warranty Sound power level warranty 	<ul style="list-style-type: none"> Risk for component failures and downtimes of the WTG is borne by the operator Alternative: MB & BU-insurance
 Advantages	<ul style="list-style-type: none"> Remuneration independent from number and type of failures and component exchange rates 	<ul style="list-style-type: none"> Remuneration independent from number and type of defect WTG components

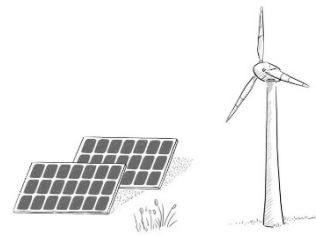
Wind Power @ VERBUND Grow Up



Development of an internal Service Organization

- Self-maintenance of 25 WTGs by five technicians since mid of 2016
 - Responsible for inspections, scheduled maintenances and repairs
- Professional training at the OEM and training on the job together with service technicians of the OEM
- Establishment of a new office and warehouse near the wind farms
- Implementation of safety regulation, working orders, electrical norms, ISO 14001, waste management...

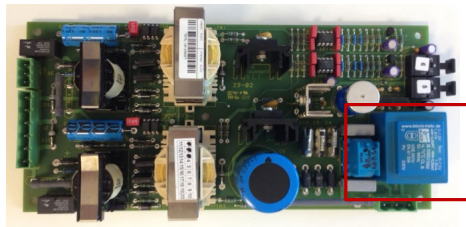




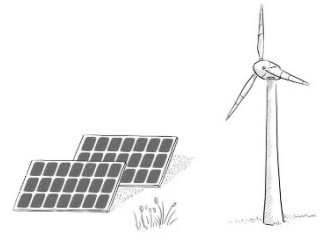
Cost Savings through Repair of Defect Components

Different philosophies between the OEM and VERBUND

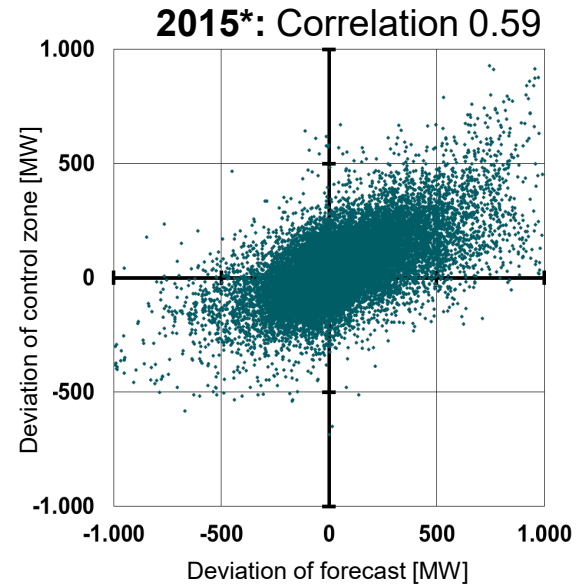
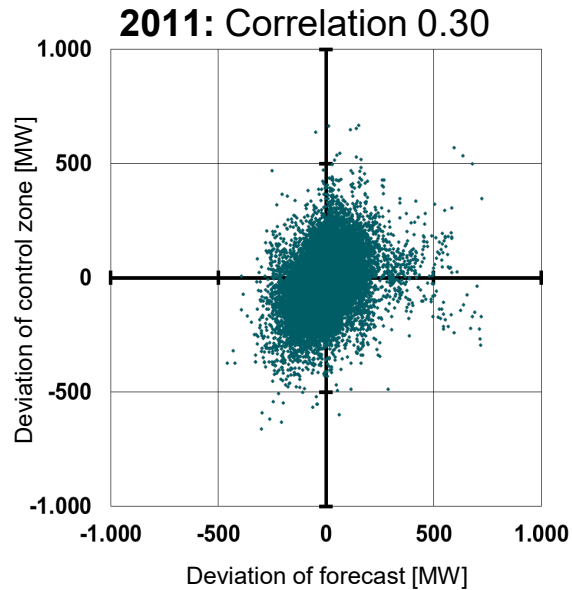
- **Repair strategy OEM:**
 - Goal: High time based availability
 - Exchange of complete *printed circuit boards* (PCB) and major components
 - Check and repair at internal service centres
- **Repair strategy VERBUND:**
 - Goal: High monetary availability
 - Repair time during times with low revenues not critical
 - Cost effective repair at PCB level
 - Repair of single components on PCB to save money



Market Situation in Austria

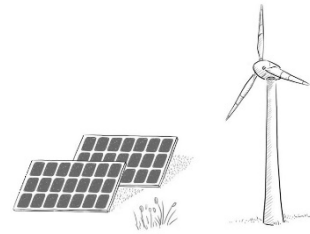


Correlation of the OeMAG wind forecast deviation and the deviation of the control zone



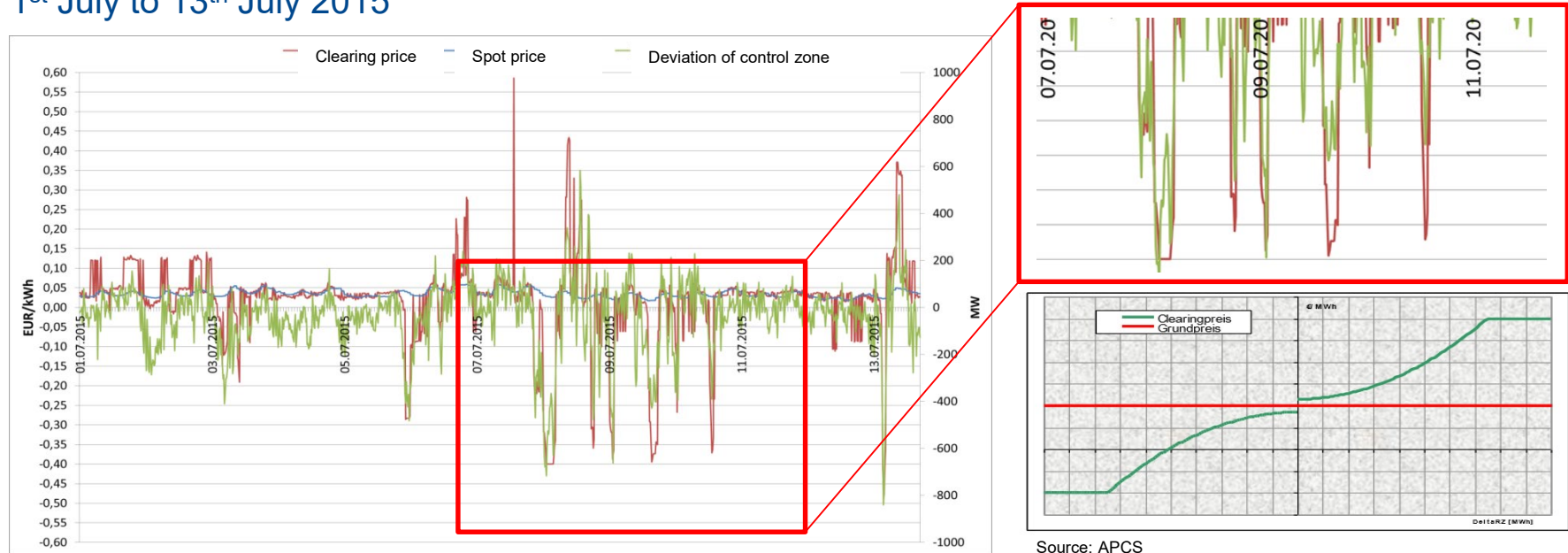
Source: www.apg.at/de/markt

*) January to September 2015



Clearing Price vs. Deviation of Control Zone

1st July to 13th July 2015



Source: APCS

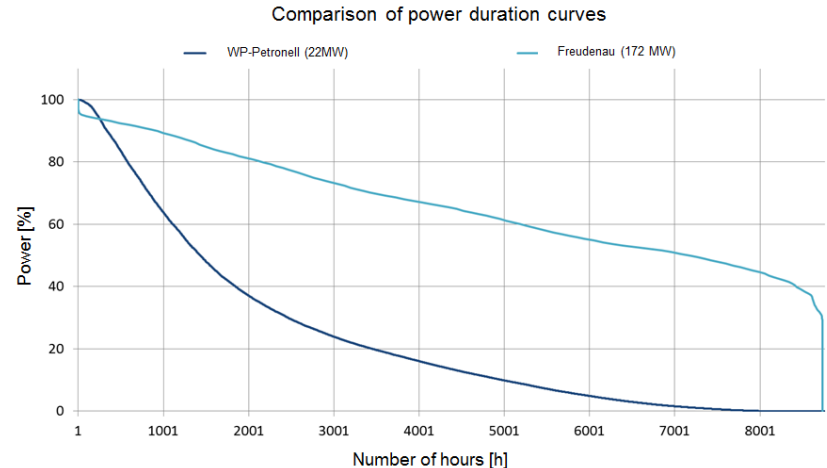
Not only revenues (and penalties) on the spot market count but also balancing efforts have to be taken into account

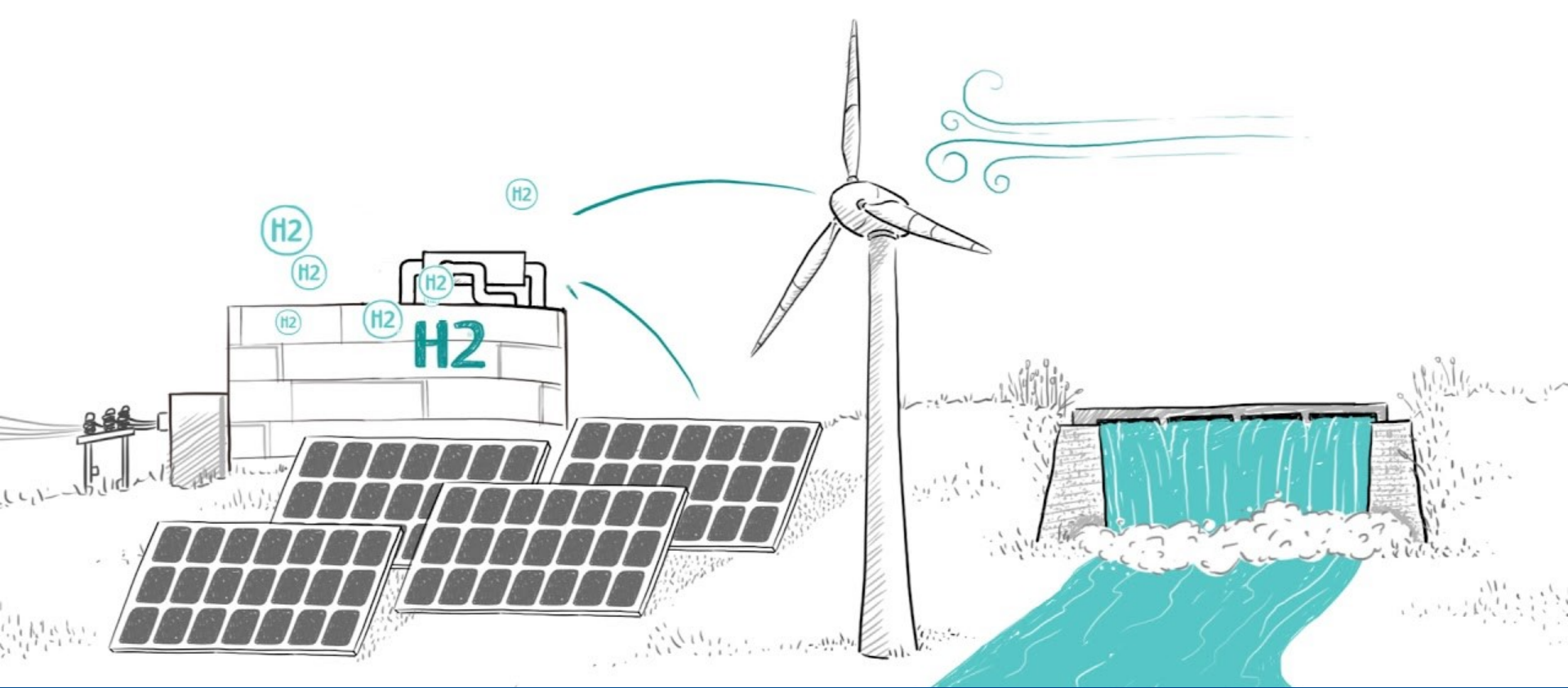
Participation in Tenders for Control Energy to Increase Revenues

How and to what extent can wind energy participate?

- Prequalification according to framework conditions in Operation Handbook ENTSO-E, Policy 1 mandatory
- Long term control power products (secondary control) difficult to offer due to volatile wind production
 - Fall back hydro power plants for reserve capacity (Synergies within VERBUND)
- Prequalification for negative reserve power only

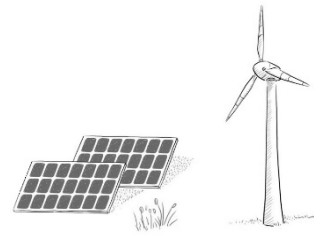
- Wind energy capable for tertiary control power
 - Minimum bid of 5 MW
 - Tendering of 4 hour time slices
 - Capacity charge and commodity price
 - Provision of service within 15 min





Conclusions and Outlook

Conclusions and Outlook



- Type of promotion system has high impact on the market integration of wind energy
- Reduction of OPEX as key element to become economically competitive with other generation units
 - Full maintenance contracts are comfortable but very expensive
 - Responsibilities of operators have to be increased once cost reduction should take place
 - Insourcing of complete maintenance activities as ultimate step to build up know how of your own assets
- Continuous monitoring and improvements of power production forecasts are mandatory
 - Strong correlation between balancing energy costs and characteristic weather classes
 - Optimization steps may vary significantly dependent on the specific market situations
- Utilising full renewable potential can be an advantage
 - Provision of negative control power
 - Excess energy for sector coupling

Contact

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