

Tecnologia ENERCON no suporte de redes electricas

ENERCON Sales - Grid Integration

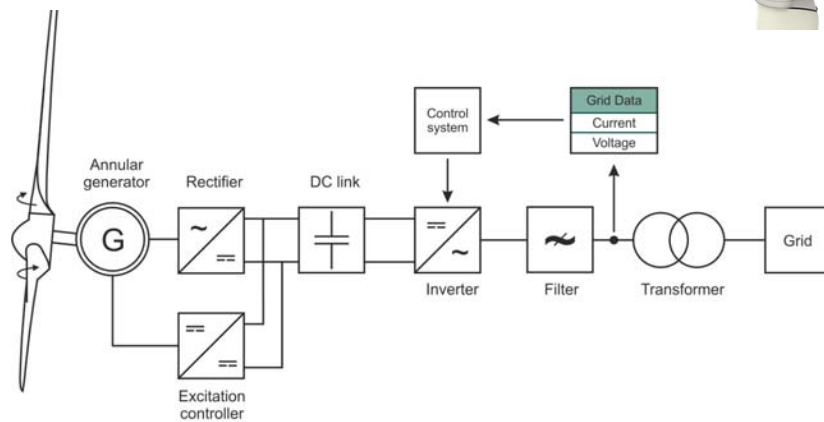
Nuno Taveira


25 Outubro 2017, Lisboa

Basic Electrical Design

Key characteristics


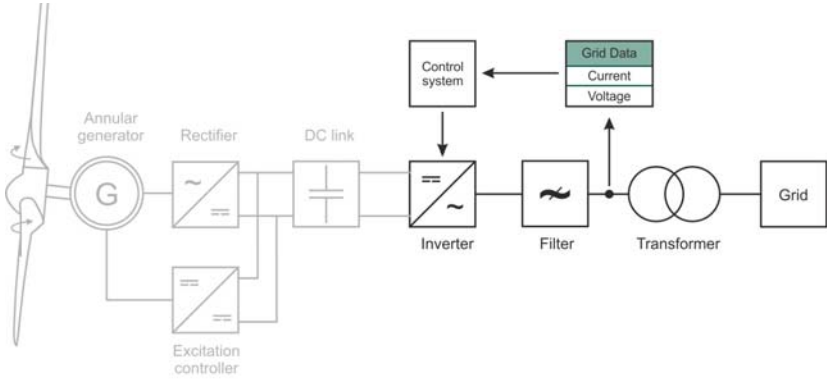
- ☑ Type 4 Wind Turbine Generator (WTG), with no gearbox
- ☑ Full scale power converters decouple annular generator from the grid




Basic Electrical Design 

Key characteristics

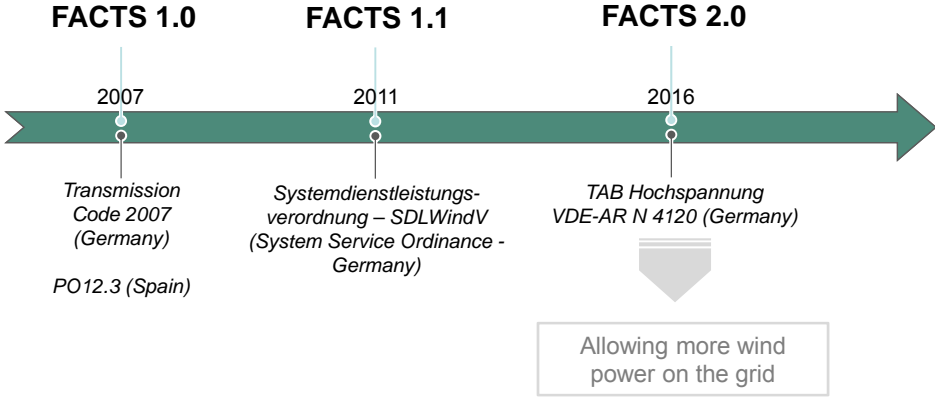
- ☑ Type 4 Wind Turbine Generator (WTG), with no gearbox
- ☑ Full scale power converters decouple annular generator from the grid
- ☑ Performance on grid mainly determined by inverter(s) (current source)

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Basic Electrical Design 

History of FACTS control systems at ENERCON



Securing compliance with future grid codes & market requirements

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Drivers for System Services

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Paradigm Shift in Power System Operation

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Drivers for System Services

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Challenges With Performance Characteristics of Renewable Generation

- ☑ **Reduction in system inertia**

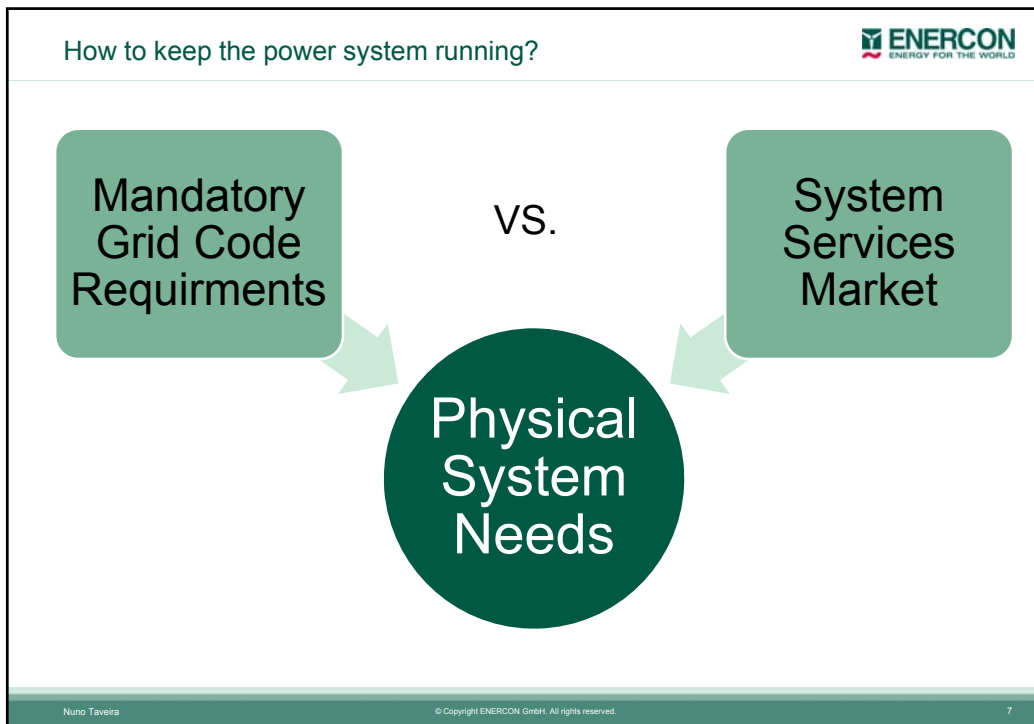
 - RoCoF
 - Frequency containment
- ☑ **Voltage management**

 - Reduced voltage support in case of short circuits
 - Voltage control induced dips
- ☑ **System strength**

 - Fault current for protections
 - Fault level for converter stable operation
- ☑ **Need for flexibility**

 - System balancing

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How to keep the power system running?

The table compares 'Grid Code Requirements' and 'System Services' based on 'System Requirement'. The ENERCON logo is in the top right corner.

Grid Code Requirements Vs. System Services

- Grid codes set out the minimum **system requirements** that a generator must be capable of when connecting to the transmission / distribution grid
- System services** are **additional system supports** that the system needs to maintain security of supply

	System Requirement
Frequency Control	Shutdown by protections or P-limitation @overfrequency
Voltage Control	Provision of Q to compensate own injection
Fault Ride Through	Remain connected during grid fault
Power Quality	Injection with very low level of Harmonics
Voltage Asymmetry	Injection of a symmetrical current

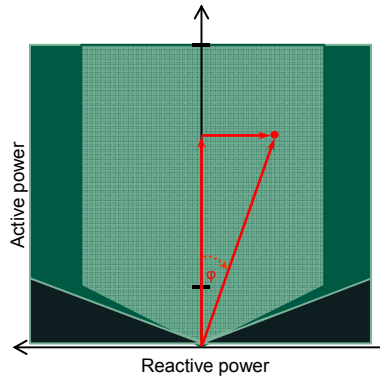
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Delivery of System Services by ENERCON (1/4)



Reactive power capability

- ☑ Active power output depends on wind
- ☑ Reactive power output depends on inverter number and control type
- ☑ Basis for the Voltage control by the wind farms (ex: demo Enercon/REN/EDPr in 2016)
- ☑ Optional STATCOM → reactive power output independent of the wind conditions



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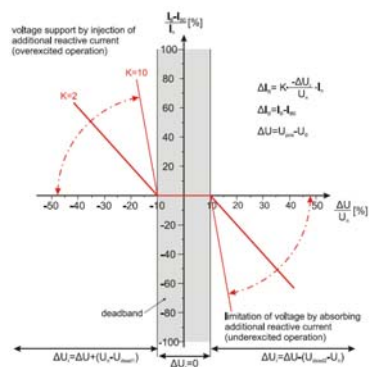
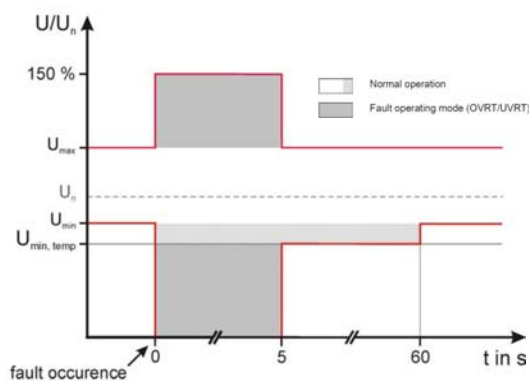
9

Delivery of System Services by ENERCON (2/4)



Fault Ride Through

- ☑ All current ENERCON WEC types can ride through:
 - Symmetrical and asymmetrical faults
 - Under- and overvoltage events for up to 5 seconds per event
 - Optionally with reactive current injection during the fault



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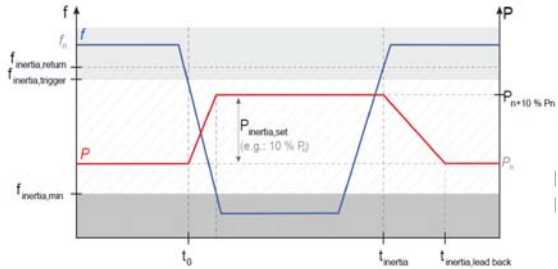
10

Delivery of System Services by ENERCON (3/4)



ENERCON Inertia Emulation

- ☑ Emulates inherent inertial response of synchronous generators
- ☑ Extraction of kinetic energy stored in the rotating masses
- ☑ Temporary increase of active power output by an adjustable percentage (4 – 10%) of nominal active power output
- ☑ No curtailment in normal operation necessary → no loss of yield

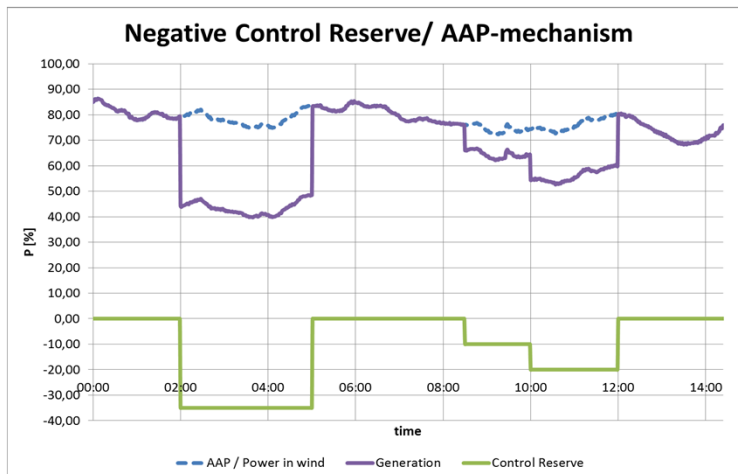


Delivery of System Services by ENERCON (4/4)




Available Active Power signal

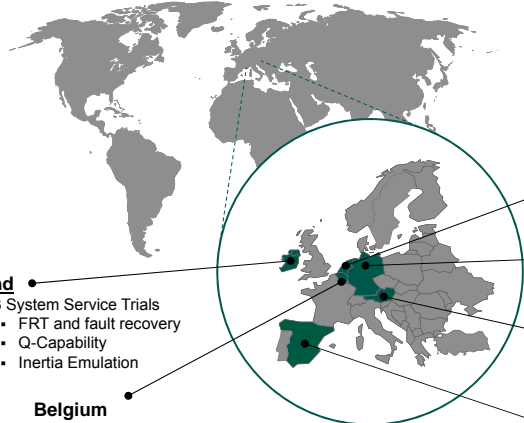
- ☑ Basis for the Power-frequency control in $f <$ (primary or secondary reserve)




Delivery of System Services by ENERCON



Active System Services Markets for ENERCON





Ireland

- DS3 System Service Trials
 - FRT and fault recovery
 - Q-Capability
 - Inertia Emulation

Belgium

- Pilot Project R2 Down
 - Available Active Power Signal

The Netherlands

- Frequency Containment Reserve (FCR) R1
 - Available Active Power Signal

Germany

- Frequency Containment Reserve (FCR) R2
 - Available Active Power Signal

Austria

- Frequency Containment Reserve (FCR) R3
 - Available Active Power Signal

Spain


- "Servicios de Ajuste"
 - Mercado de operaciones (d+1)

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13

ENERCON Storage system – Smart container

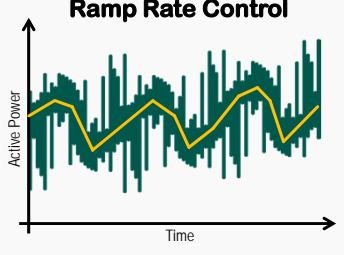


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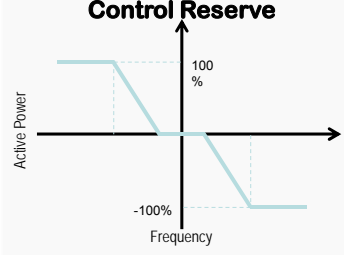






Ramp Rate Control



Control Reserve



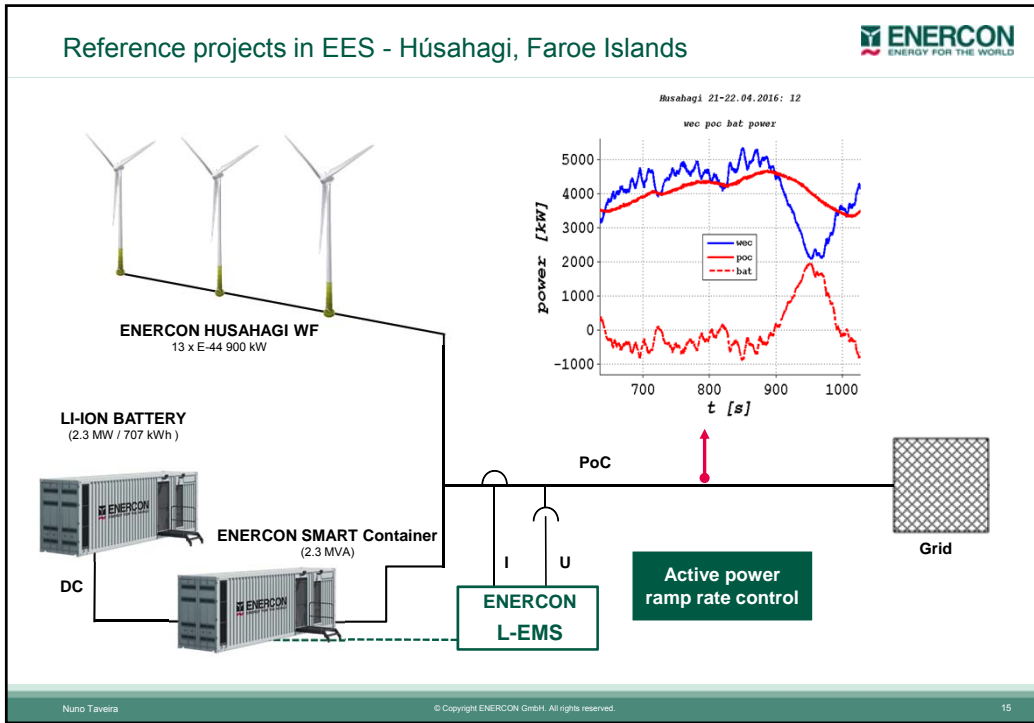



**BATTERY STORAGE
(EES)**

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14



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