Renewables go EV

Cost-effective. Grid-friendly. Designed for the future.

VI. ELEKTRIK TESITAT ULUSAL KONGRE

Izmir, 18.10.2019

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ENERCON
ENERGY FOR THE WORLD

AGENDA

1. E-Mobility & Charging Technologies
2. E-Charger 600
3. Grid Integration & FACTS Capabilities
4. Summary and Specifications

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1. **E-Mobility & Charging Technologies**
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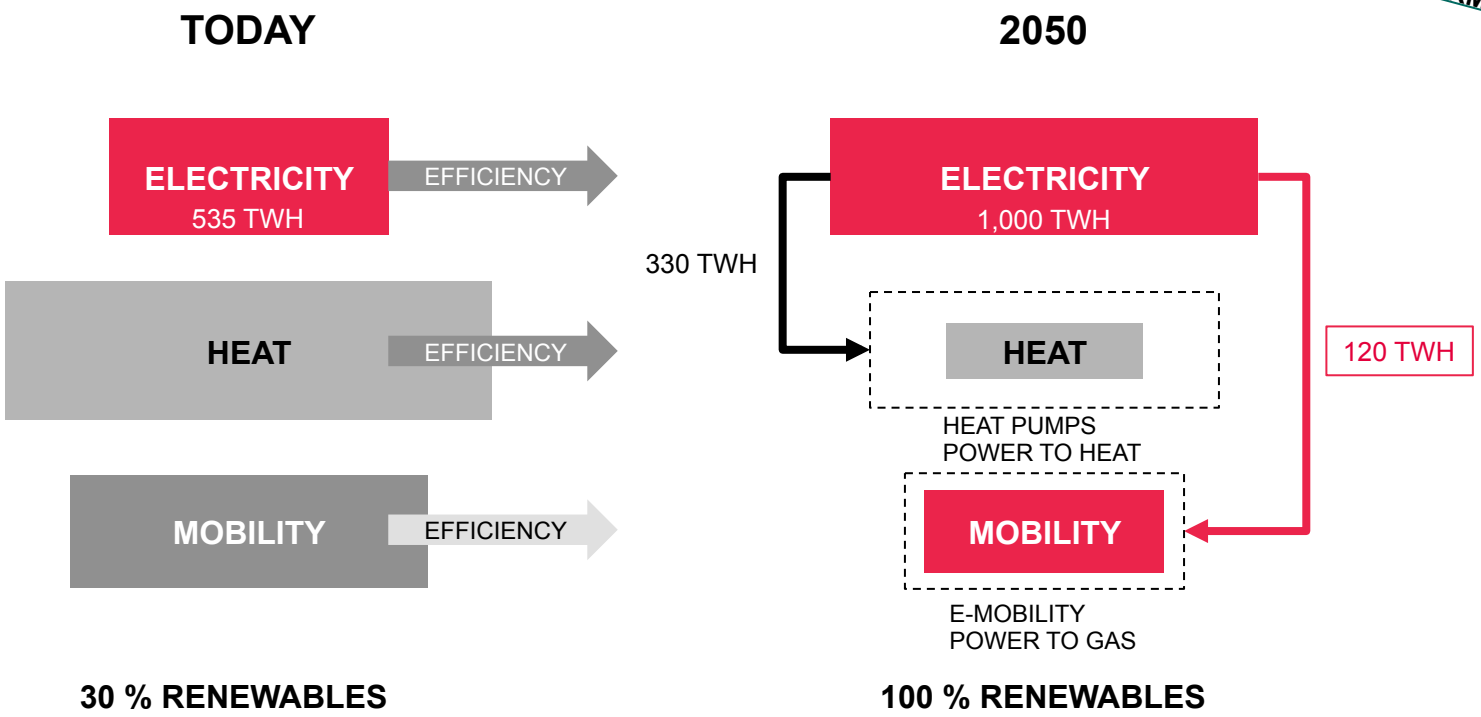
BACKGROUND – RENEWABLES TO GROW BY FACTOR OF SIX

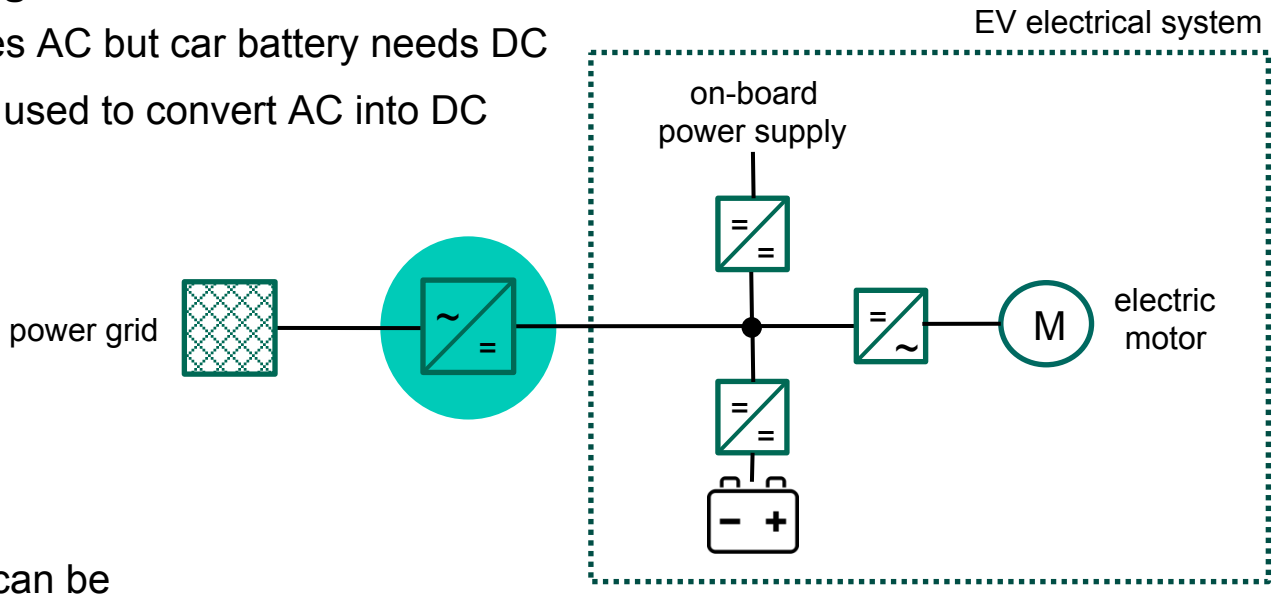
EXAMPLE GERMANY



Source: Fraunhofer IWES, „Geschäftsmodell Energiewende“, 2014

Conductive charging

- Power grid supplies AC but car battery needs DC
- Power electronics used to convert AC into DC



- AC/DC converter can be
  - part of the car = on-board charger → „AC charging“
  - part of the stationary charging station = off-board charger → „DC charging“

BACKGROUND E-MOBILITY – CHARGING TECHNOLOGIES

HIGH POWER CHARGING
DC MORE THAN 100 kW

CCS up to350 kW | CHAdeMO up to 200 kW | Supercharger Up to145 kW

ENERCON 350 kW, DOWNWARD COMPATIBLE

0:10 h

250 kW, TESLA ONLY

0:25 h

FAST CHARGING
AC AND DC UP TO 100 kW

Typ 2 up to 43 kW | CCS up to 100 kW | CHAdeMO up to 100 kW

50 kW, MOST CARS TODAY

1:15 h

NORMAL CHARGING
AC UP TO 22 kW

Schuko up to 3,7 kW | Typ 1 up to 7,4 kW | Typ 2 up to 22 kW

2:40 h

12:00 h

DURATION FOR 60 kWh, e.g.

EV 60 kWh BATTERY
DC CCS

Note: Restricting element is the charging power of the car‘s battery (today 50 kW, cars with 100 kW announced for 2019/20)

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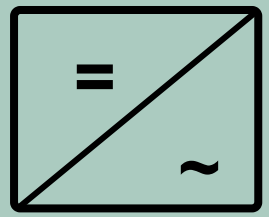
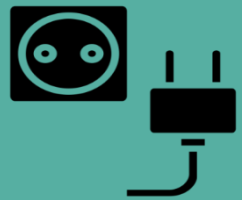
Leader in development and manufacturing of power electronics and controls

Primary Energy Source

Power Conversion



Power System



E-CHARGER 600 – COMPONENTS

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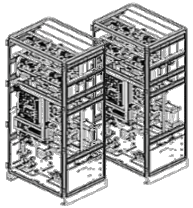
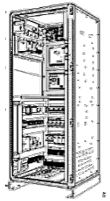


2 Inverter Cabinets (AC/DC)



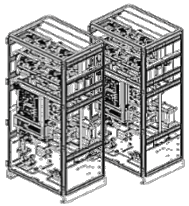
Control Cabinet

Cooling Component (Heat-Exchanger)

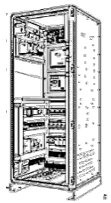
MV-Station

Distance between container and Charging Points up to 100m

Cooperation with Power Innovation



12 DC/DC Converter Modules



Intelligent Power Distribution

Communication to Vehicle

MODULARITY – MULTIPLE CHARGING CONFIGURATIONS

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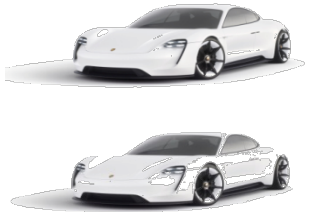
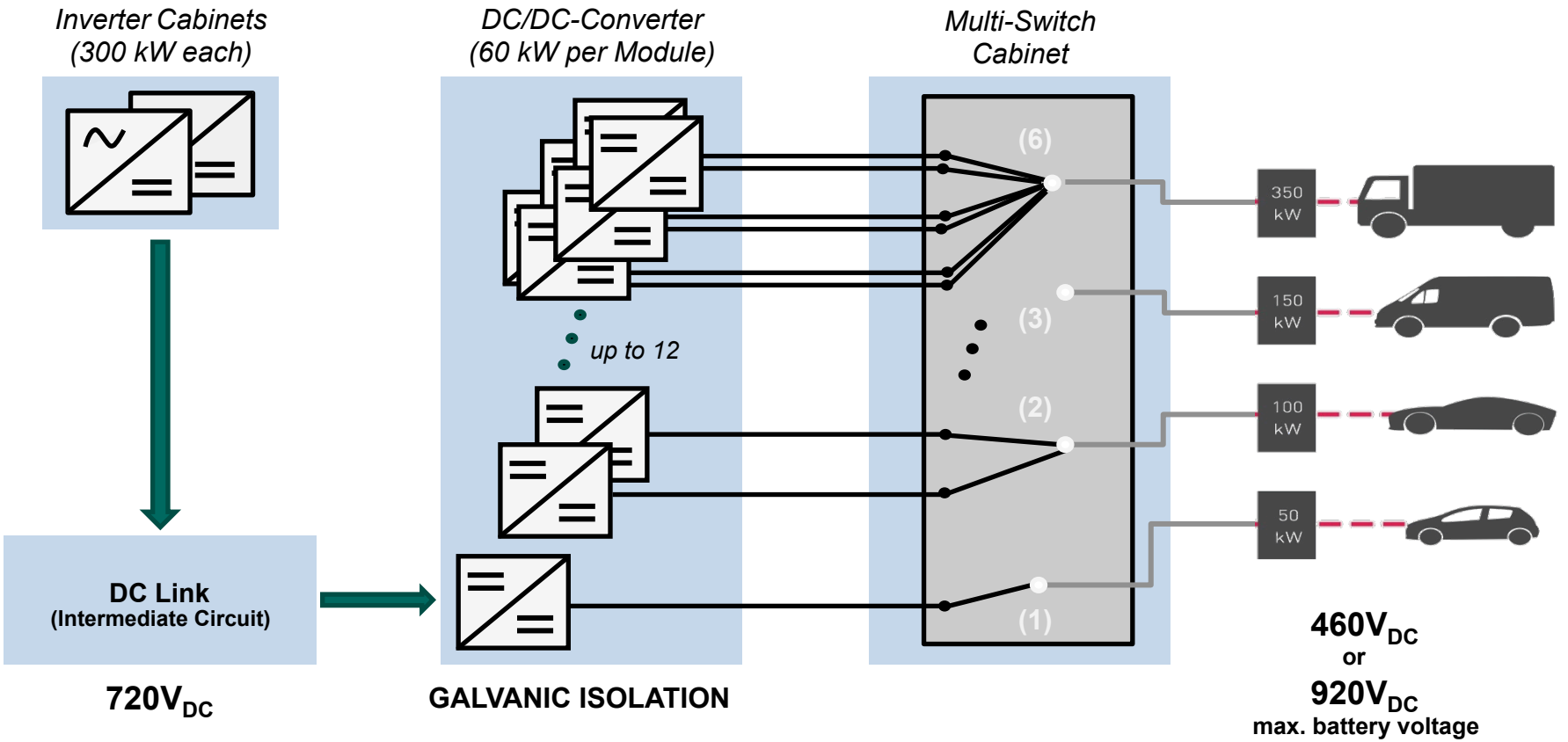


Power Distribution:	2 × 300 kW	OR	4 × 150 kW	OR	1 × 350 kW 1 × 150 kW 2 × 50 kW

USP – INTELLIGENT POWER DISTRIBUTION



ENERCON WEC & E-Charger - EXAMPLE

WLTP: Worldwide harmonized Light vehicles Test Procedure

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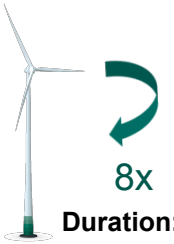
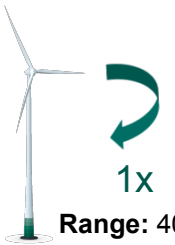
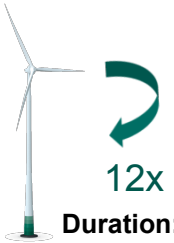
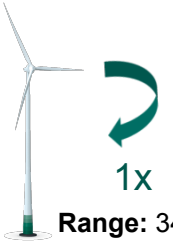
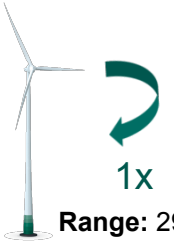
	Full charge 3.5 MW WEC	Charging per rotation 3.5 MW WEC
 **BMW i3** **Battery:** 42,2 kWh **Range (WLTP):** 310 km	 8x **Duration:** 43s	 1x **Range:** 40km
 **Nissan Leaf** **Battery:** 62 kWh **Range (WLTP):** 385 km	 12x **Duration:** 64s	 1x **Range:** 34km
 **Tesla Model S** (100D) **Battery:** 100 kWh **Range (WLTP):** 539 km	 19x **Duration:** 103s	 1x **Range:** 29km

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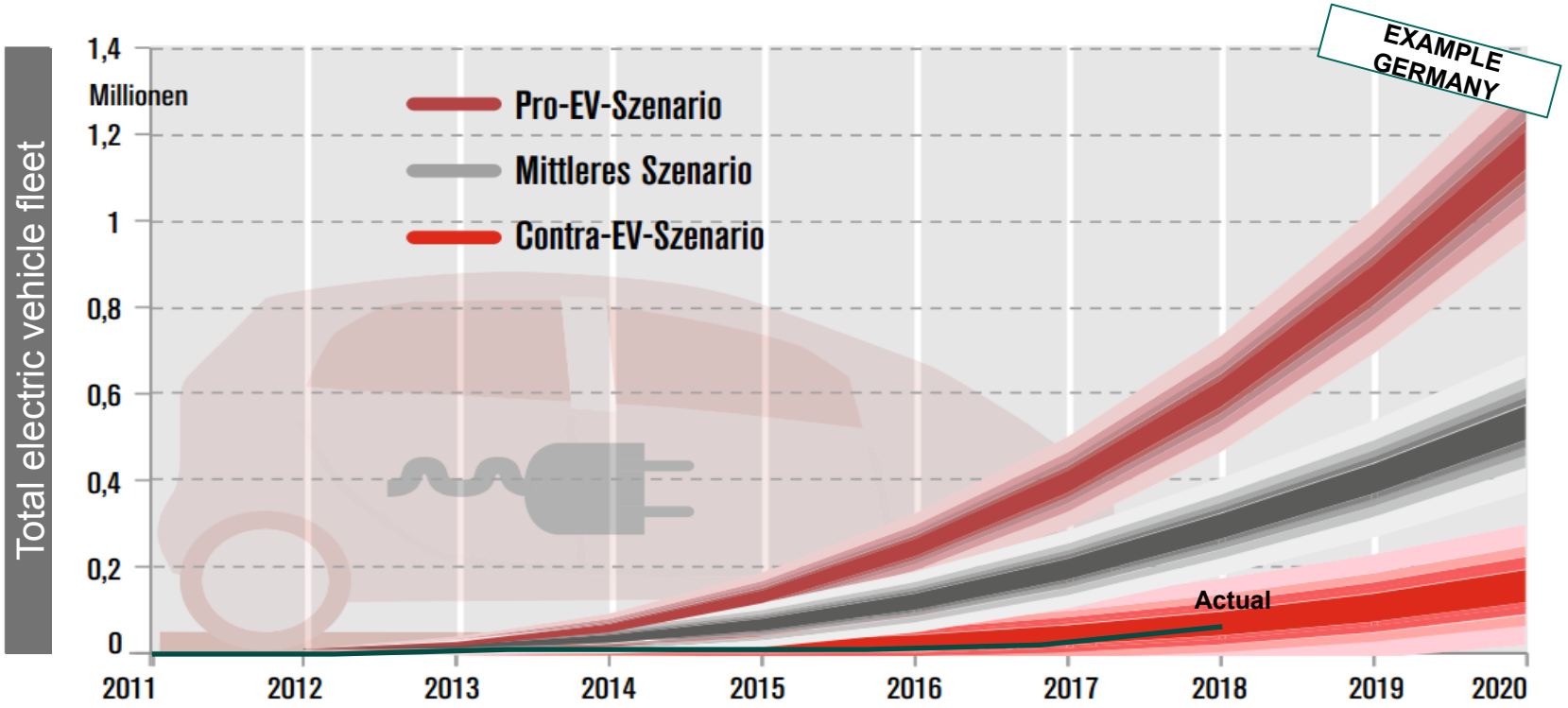
UNCERTAINTY IN MARKET UPTAKE

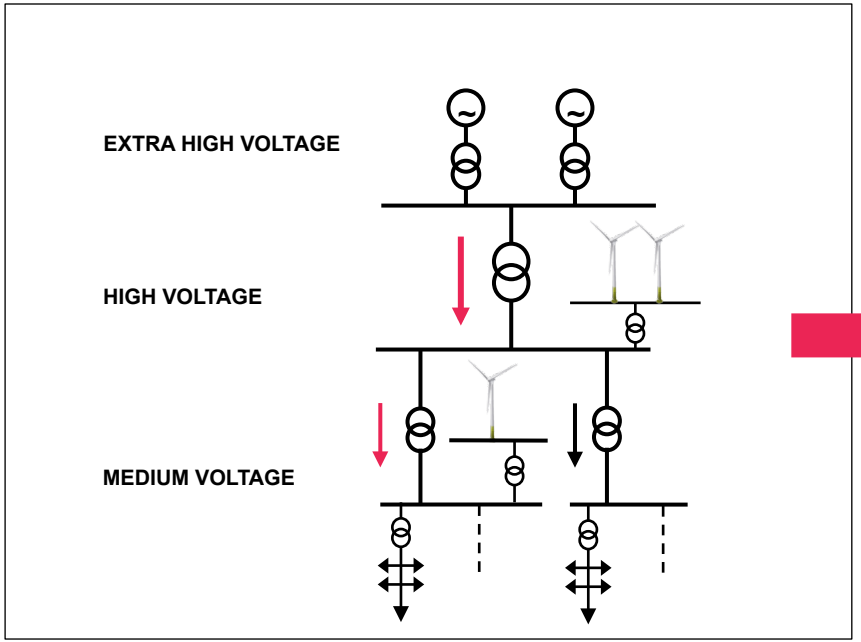


Actual	2.307	4.541	7.114	12.156	18.948	25.502	34.022	53.861

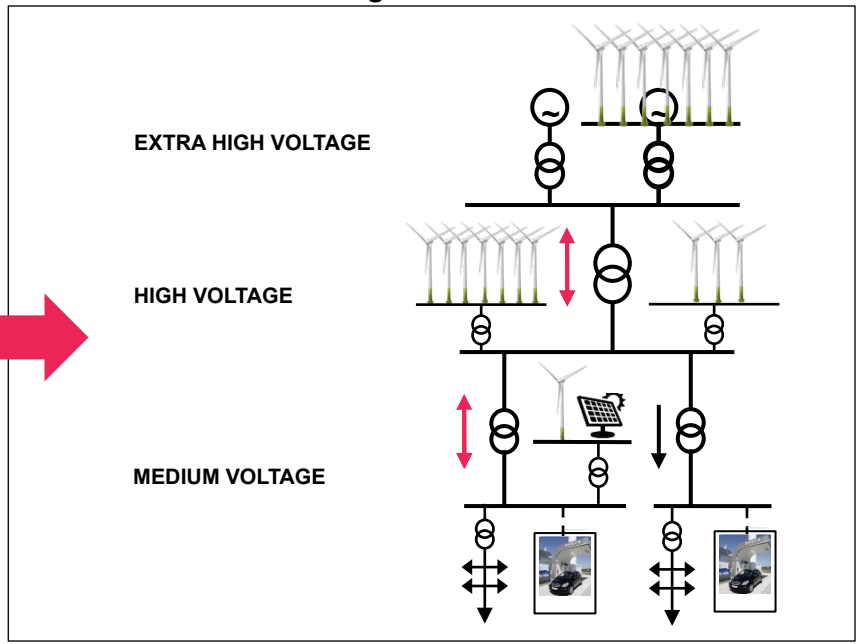
Source: Nationale Plattform Elektromobilität, „Elektromobilität in Deutschland“, 2013
Kraftfahrtbundesamt, „Jahresbilanz des Fahrzeugbestandes am 1. Januar 2018“

GRID INTEGRATION – INTRODUCTION

YESTERDAY: **strong-grids for energy supply, top-down structure**

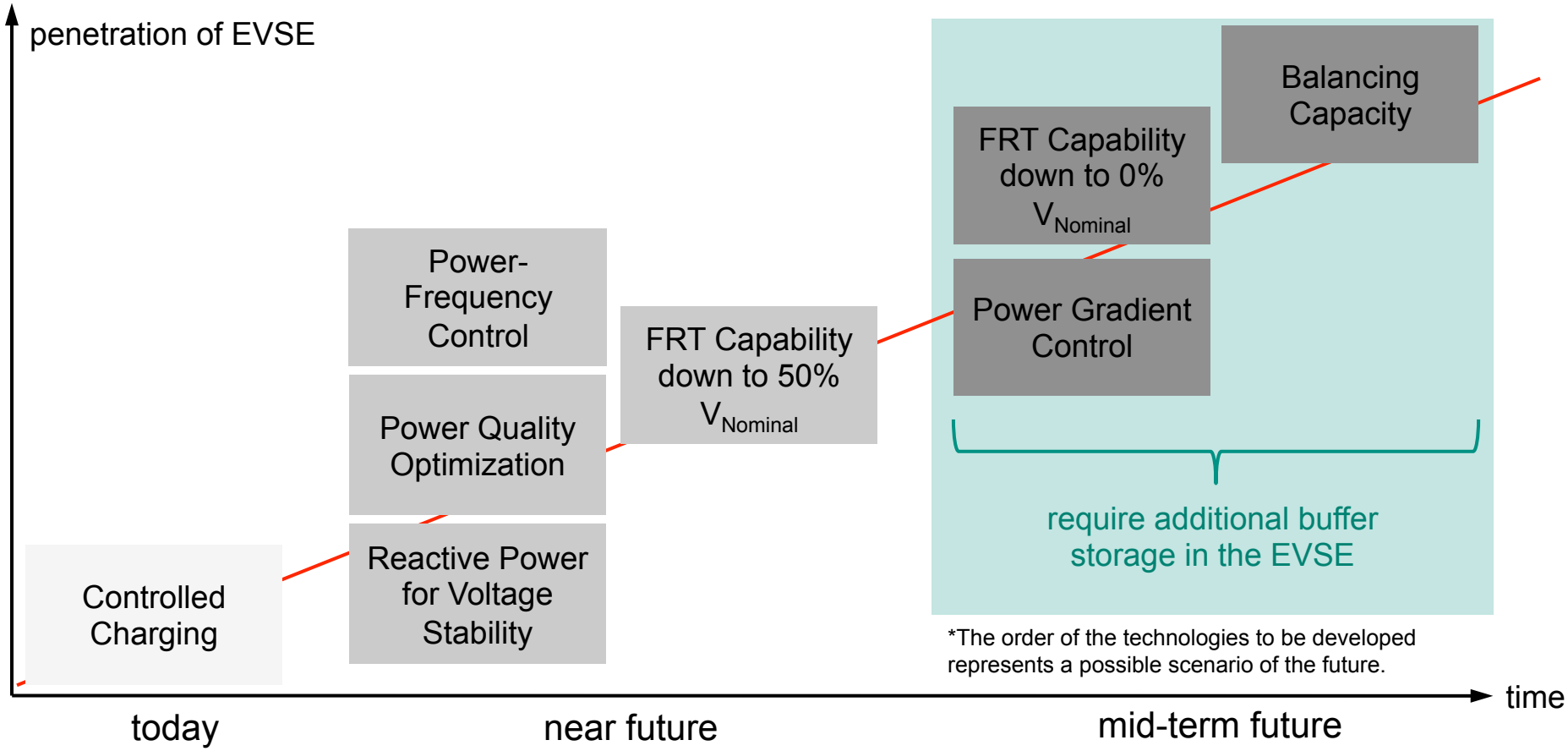


TODAY/ FUTURE: Grid structure with power electronics at all grid levels



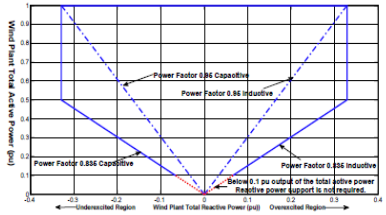
- Integration of more Renewable Energy Sources (RES)
- Energy supply systems are converting from centralised to decentralised structures
- Bidirectional power flow
- Integration of new type of loads (EV charging infrastructure)

TECHNOLOGY ROADMAP – GRID INTEGRATION

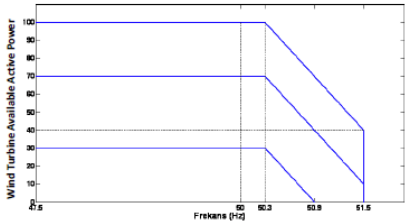


EXPECTED LEVELS OF GRID INTEGRATION

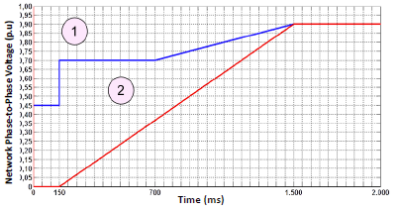
- EVSE are connected to the grid via power electronics – similar to RES
- Requirements for generators like WECs that are perceived to be standard in modern grid codes are e. g.



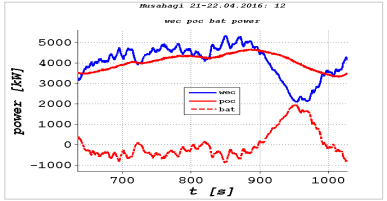
Reactive Power Capability for Voltage Stability



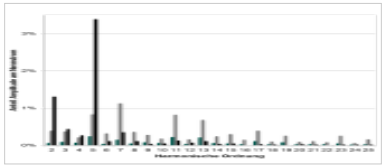
Power-Frequency Control P(f)



Fault Ride Through (FRT) Capability

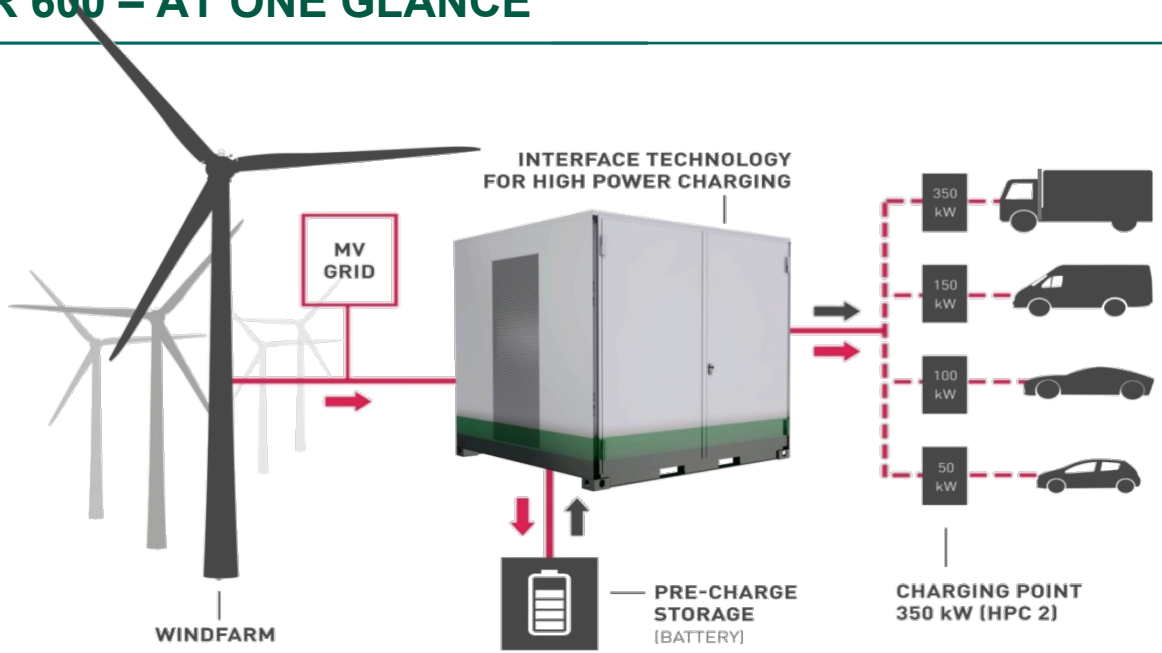


Optional Gradient Control



Power Quality Optimization / Minimized Harmonic Currents

E-CHARGER 600 – AT ONE GLANCE



100% GREEN

- 100% green energy from ENERCON
- Direct integration of renewable resources

GRID FRIENDLY

- ENERCON grid technology (FACTS) enables more charging point in the existing grid
- Buffer battery lowers cost of grid connection and grid usage

COST EFFICIENT

- Four charging points per power electronics unit, instead of one
- Starting configuration suited for existing cars
- Scalable platform for future requirements

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EXPECTED LEVELS OF GRID INTEGRATION – SUMMARY

- Integration of EV to the electricity grid creates some challenges
  - potential overloading of lines and transformers
  - phase unbalances and harmonics
  - potential undervoltage
- By implementing the right grid integration features these challenges can be met
- To achieve a stable and efficient infrastructure all stakeholders need to work together
  - Grid operators should define requirements in an early stage
  - OEMs should provide their EVs/ EVSEs to be able to meet grid integration requirements
  - Digitization should be used to leverage synergies for EV users and grid operators

E-Charger 600 – Unique Selling Points

MODULAR SYSTEM
+ System grows as needed:
  Start with 300 kW per container
+ Upgrade in 60 kW steps
+ Defer investments
+ High availability due to built-in redundancy

USER FRIENDLY INTERFACE
+ Large 15“ display
+ Operator branding possible
+ Individual advertisements possible

INTEGRATED PAYMENT SYSTEM
+ Credit-/Debit-card payment on board – no further cost for OCPP back-end provider
+ User unit data can be accesses as web-server

FLEXIBLE CONFIGURATION
+ Up to 100 m distance between container and user unit
+ Flexible choice of CCS (200 A/500 A), CHAdeMO

INTELLIGENT POWER DISTRIBUTION
+ 4 user units with 350 kW each require 600 kW grid connection only
+ CAPEX and OPEX reduced

GRID-FRIENDLY OPERATION
+ European grid-connection requirements of 2021 already implemented
+ Battery-buffer available from 2020 onwards

EXISTING SERVICE ORGANIZATION
+ 6.500 employees worldwide ready to service the E-Charger 600

PROJECT MANAGEMENT CAPABILITIES
+ Delivery of bespoke turnkey solutions including smaller scale systems
+ Leasing available

E-CHARGING PARK – Example in Germany

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- **Future-proof through combined charging infrastructure (AC / DC charging)**
- **Modern payment methods (NFC, RFID, PayPal, credit card)**
- **Suitable for all cars, commercial vehicles and trucks**
- **Individual complete solutions for architecture and infrastructure**
- **Visitor- and family- friendly location concepts**
- **Regional image and advertising medium**
- **Sustainable through electricity from renewable energies**
- **Cooperative financing and operator models**