

THE GLOBAL ENERGY CHALLENGE – A CORPORATE VIEW, ZURICH, APRIL 3RD, 2017

Power systems of the future

ABB's view

Gerhard Salge, Global Head of Technology, ABB Power Grids division

Power systems of the future

Changing power generation balance

Power generation

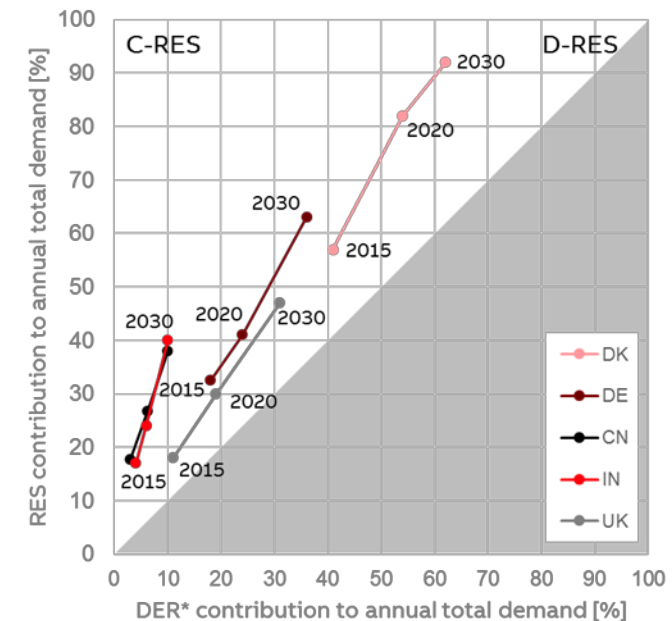
Power balance tipping towards renewables, driven by policy & disruptive technology cost reduction

Main growth in variable renewables such as wind and solar

Two growth paths

- Mainly centralized renewables
- Mainly distributed renewables

Centralized vs decentralized

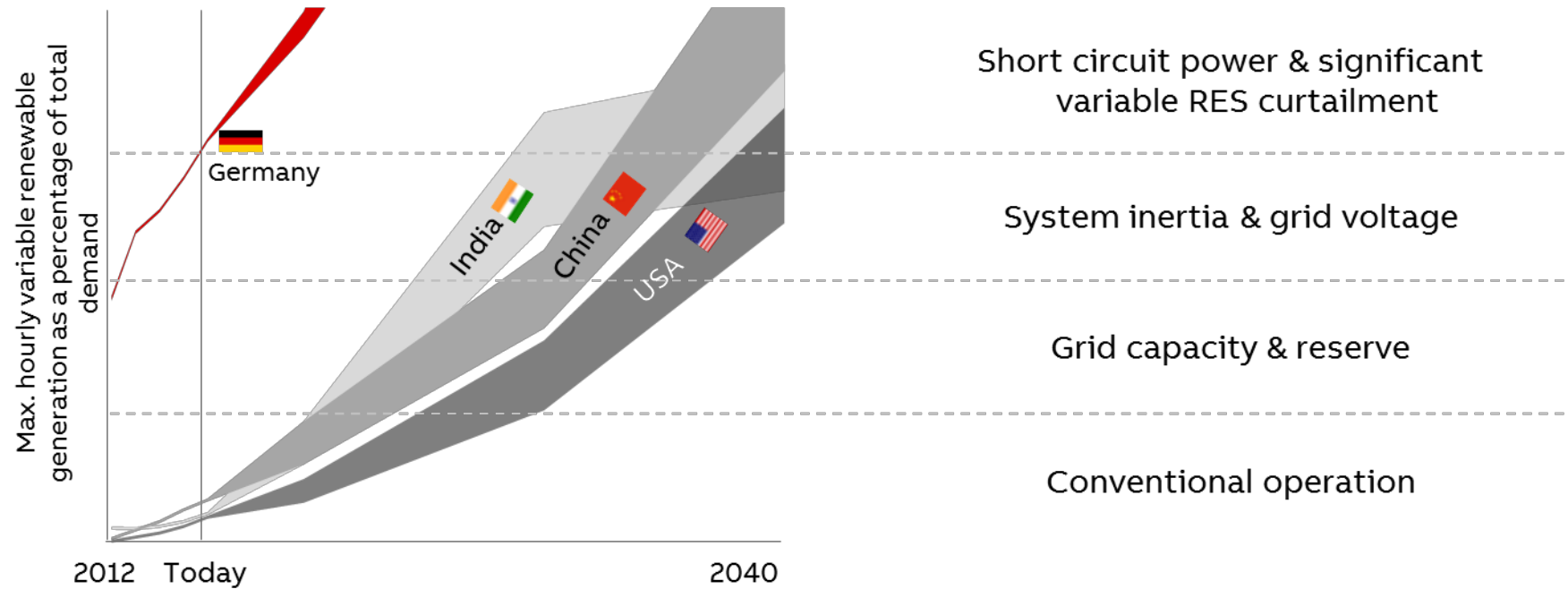


Renewables expected to be dominant source for electrical power generation

Power systems of the future

Grid – enabler or bottleneck ...

Technical challenges countries encounter

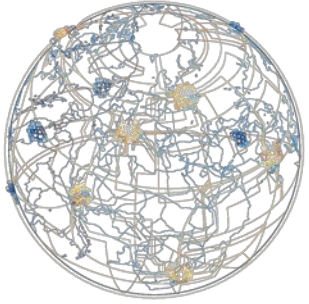


Grid investments and technologies required to address challenges

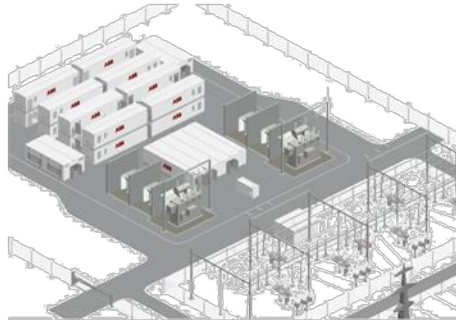
Power systems of the future

Elements of the evolving grid

Grid interconnection



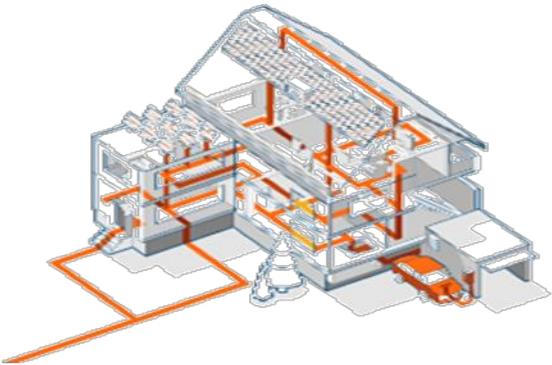
Energy storage



Digitalization



Micro- and Nanogrids



Power quality



New business models



NETFLIX

Power systems of the future

Grid interconnection

Opportunities

Renewable integration across regions

- Fluctuations during the day
- Seasonal variations

Optimal use of reserve and peaking capacities

Diversification of electricity supply

Reduction of wholesale electricity price volatility

Strengthening grid operation in case of fault conditions

Increase capacity utilization factor
of conventional generation

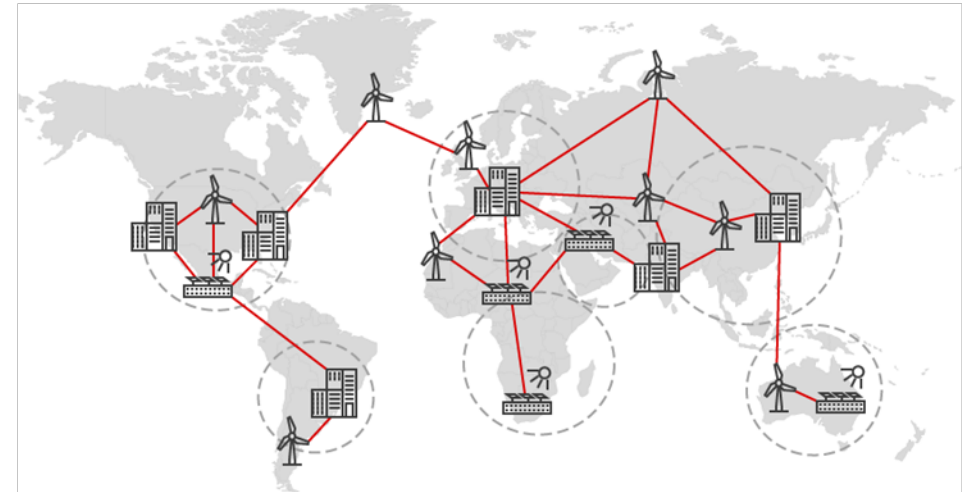
Challenges

Political factors

Economic framework

Technological capabilities

Coordinated operation (global harmonization of standards, grid codes and operational practices)



Power systems of the future

Grid interconnection: Ultra High Voltage

World's most powerful UHVDC link

Chiangji-Guquan, China

1100kV DC

12000MW

>3000km



World's first multi-terminal UHVDC

North-East Agra, India

800kV DC

6000MW

>1700km



World's first UHVDC grid

SGCC pilot project in China

Project phase 2018 – 2020

Rated up to $\pm 500\text{kV}/3000\text{MW}$



Power systems of the future

Microgrids and integration of renewables

Resilient and cost-effective technology

Grid code compliant integration of wind & solar

Stabilizing weak grids

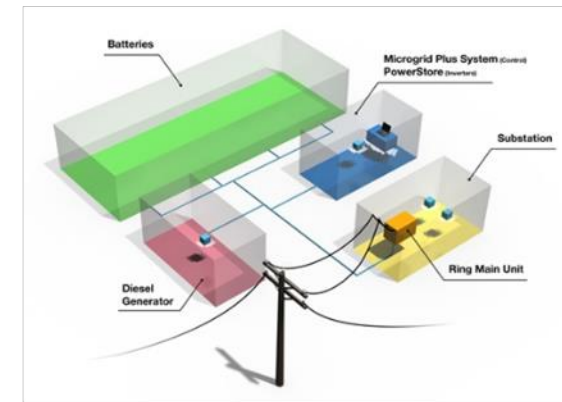
Microgrids acting as one controllable generator or load

Access to power in remote locations



Kodiak Island, Alaska, USA

- Wind (9MW)
- Diesel
- Flywheel (2 x 1MW)



AusNet, Victoria, Australia

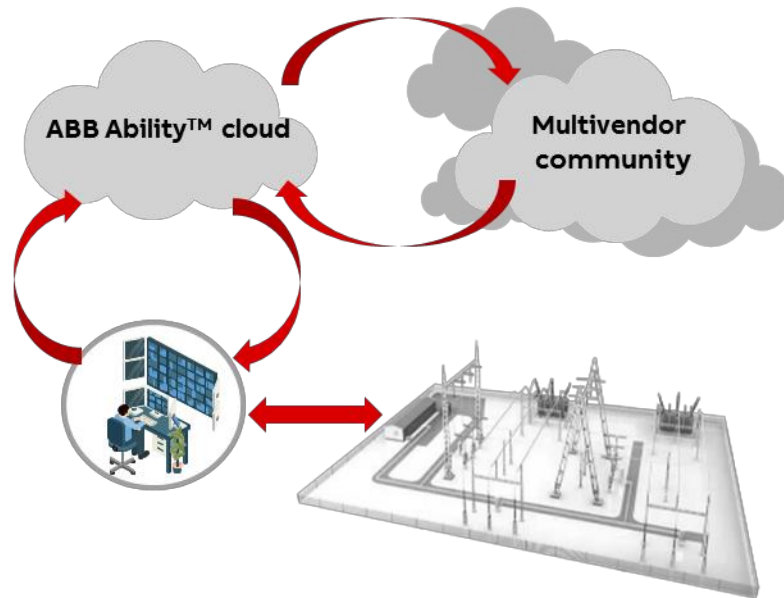
- Weak grid support
- Diesel (1MW)
- Battery (1MWh)

Power systems of the future

Digitalization – Managing the future power systems

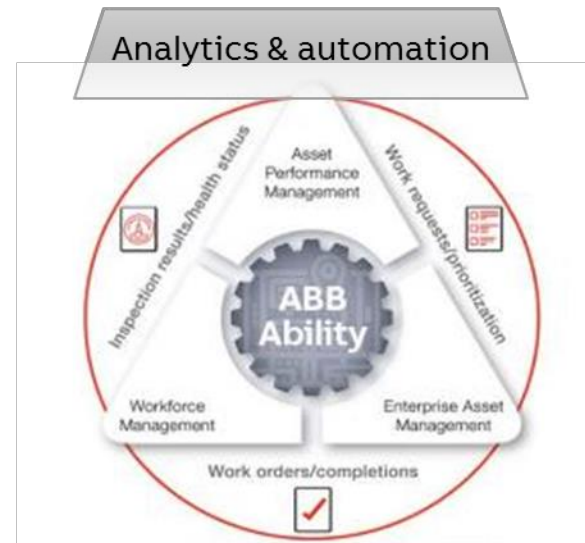
Digital Substation

Flexibility and speed in planning & operation



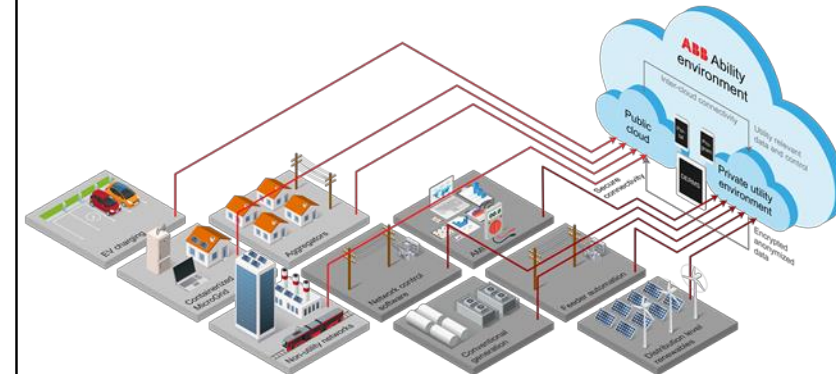
Connected asset life-cycle management

Reduced maintenance time and frequency
Reduced downtime
Optimized planning and replacements



Digital Distribution

Distributed Energy Resource Management
Hosting and efficient utilization of all devices connected to distribution grid



Power systems of the future – an evolutionary vision

Interconnected system of regional grids with fluctuating demand and generation patterns

Renewables will take major share in electrical power generation

Disruptive elements

Photovoltaics

Batteries

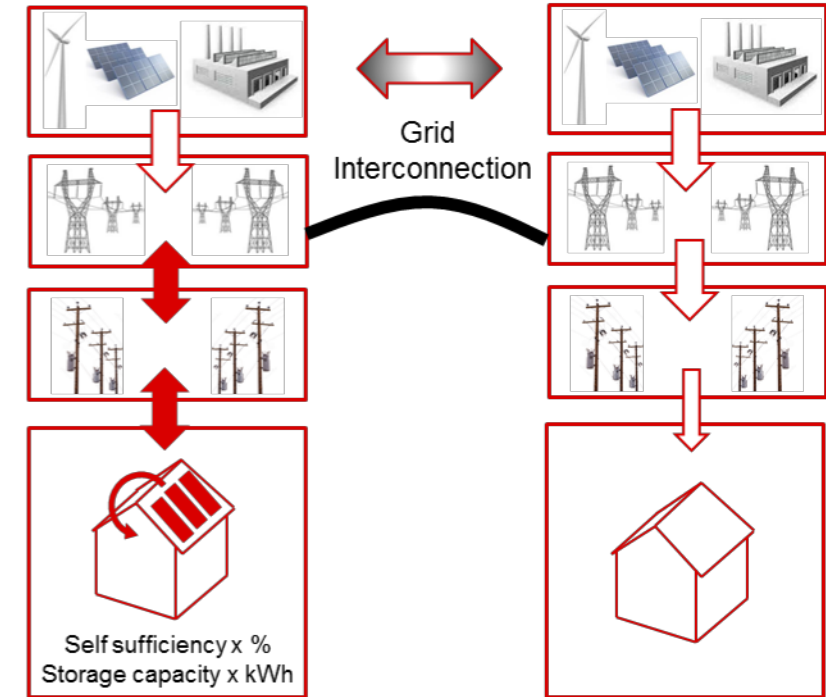
Digitalization

Distributed generation with changing consumer & supplier patterns

Distribution grid role changing

Transmission backbone essential

New business & operational models





ABB