# REvision2021 - Technology Pathway for 2050

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**POWERING GOOD FOR SUSTAINABLE ENERGY**

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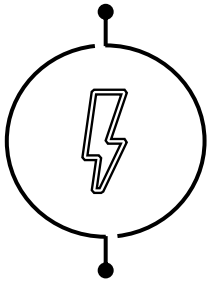
# The world is changing fast: is the technology available to support the energy transition?

## The Energy Revolution

**Decarbonization** of power production
+
**Electrification** of industry, transportation and infrastructure



## The Digital Revolution

**Connection of every asset**
+
**Data as key** to better outcomes

## Megatrends

- More regulatory compliance
- More market integration and trading
- More concentration of population
- Digitalization
- Aging infrastructure and workforce

## Impact

### Generation

- More generation
- From fossil fuel… to renewables
- More distributed energy

### Consumers

- Cleaner industrial processes
- From fossil fuel… to e-mobility
- More datacenters to be powered

## Technology development

- HVDC Light +/- 640 kV, 3.6 GW
- Offshore HVDC Light +/- 525 kV, 2 GW
- Hybrid DC Breaker 350 kV, 20 kA
- Interoperabilty
- Multi-terminal HVDC
- PowerTwin

**The world requires differentiated solutions**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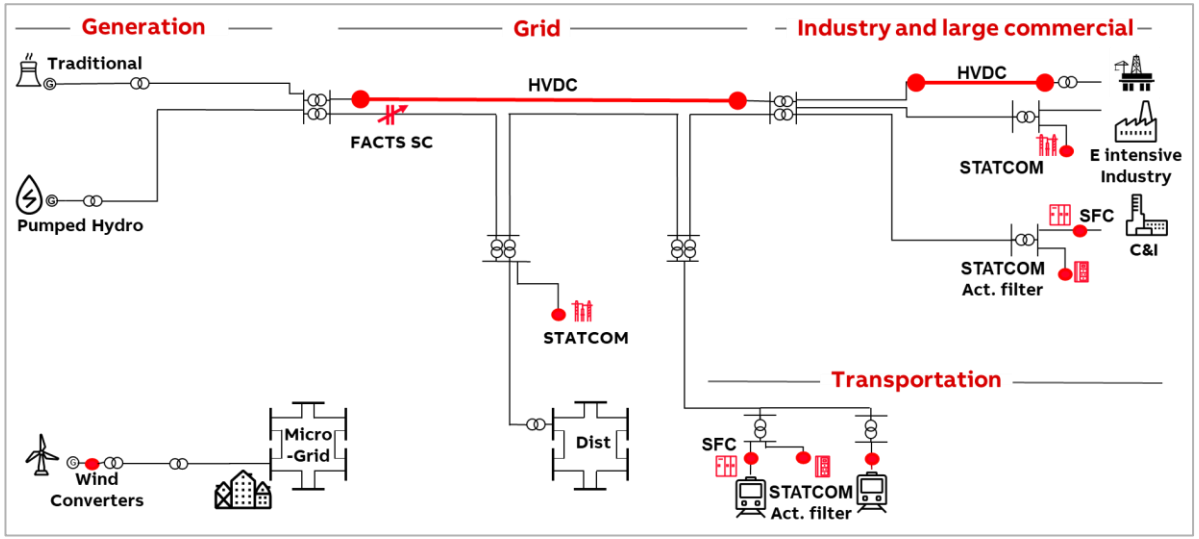
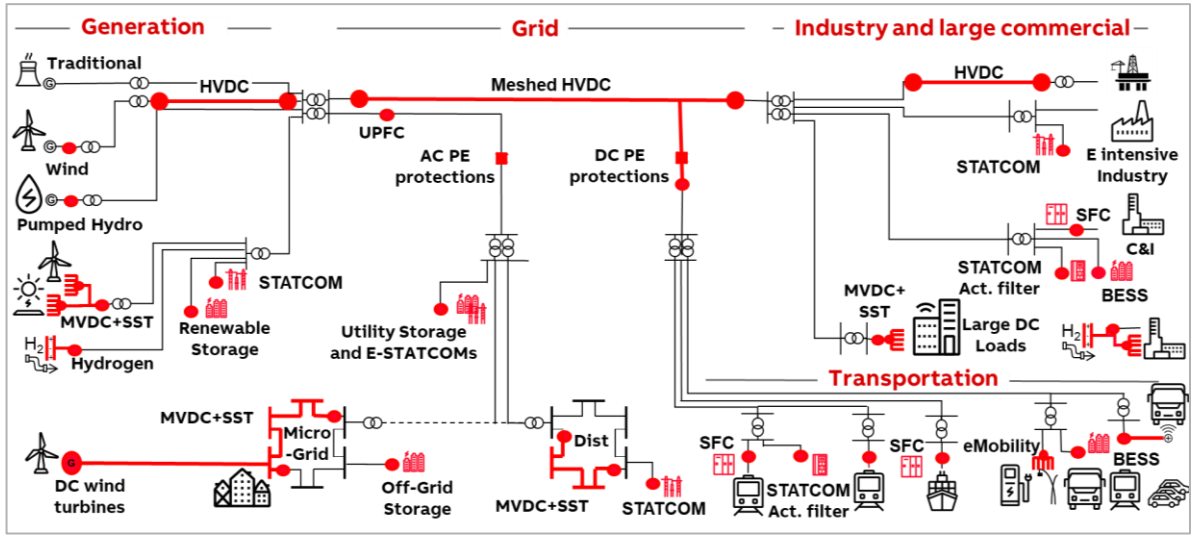
# Future Power Systems – Technology trends

## Past … The conventional utility grid




**Power Electronics a niche application**

## Future … The carbon-neutral future is electric




**Power Electronics across the total Power Grids**

**Power Electronics coupled with Digital enables electricity to be the backbone of the carbon-neutral future**

1 Power Electronics market includes all Power Electronics products, systems and services delivered by HAPG

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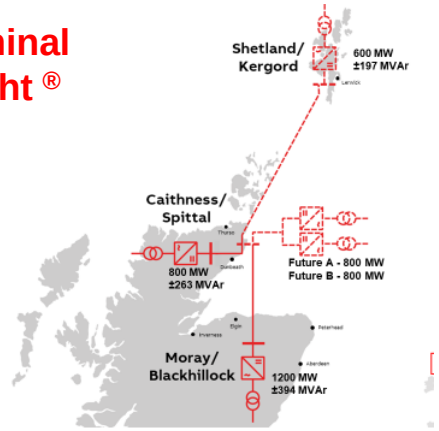
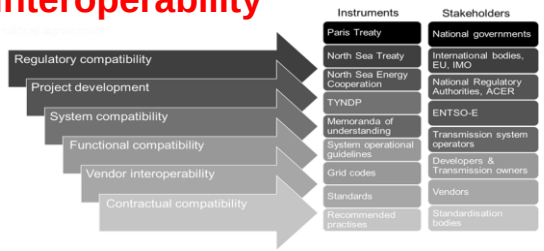
# HVDC – unlocks the future energy system

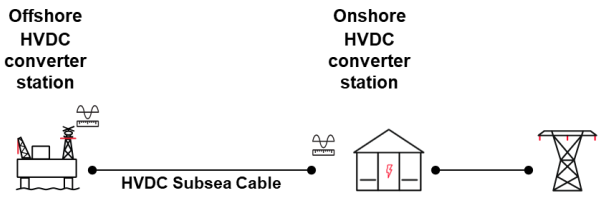
## Multi-terminal HVDC Light ®



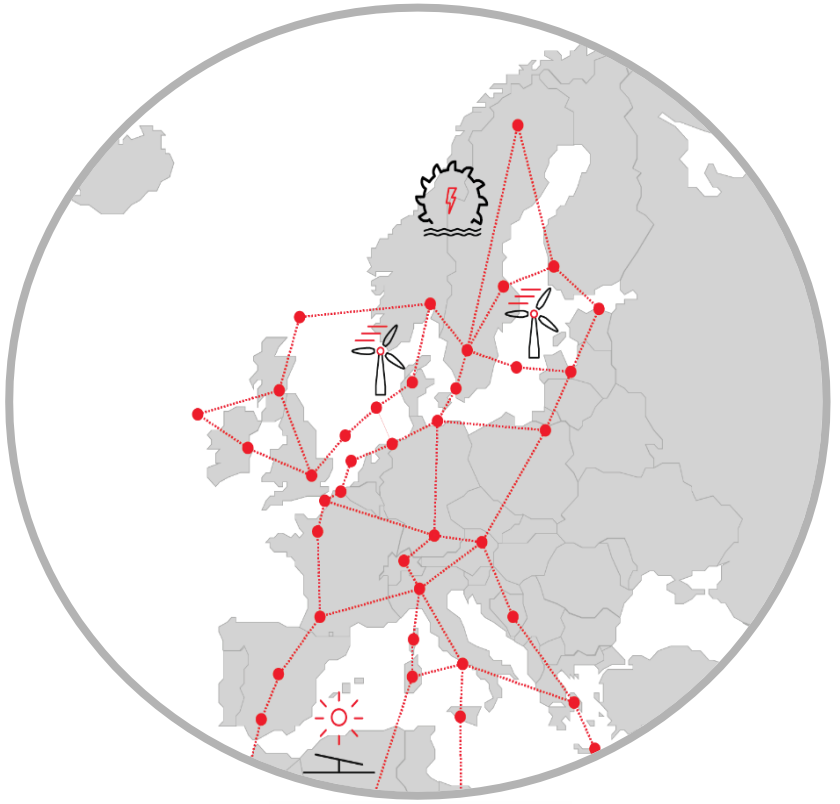

## Interoperability



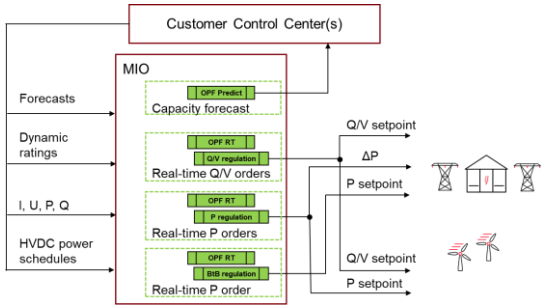

## Offshore HVDC Connections




## Vision 2050 HVDC Grid



## Master Controller Interconnector Operation


## Hybrid DC Breaker


**HVDC enables technical solutions – Political / regulatory enablers need to follow**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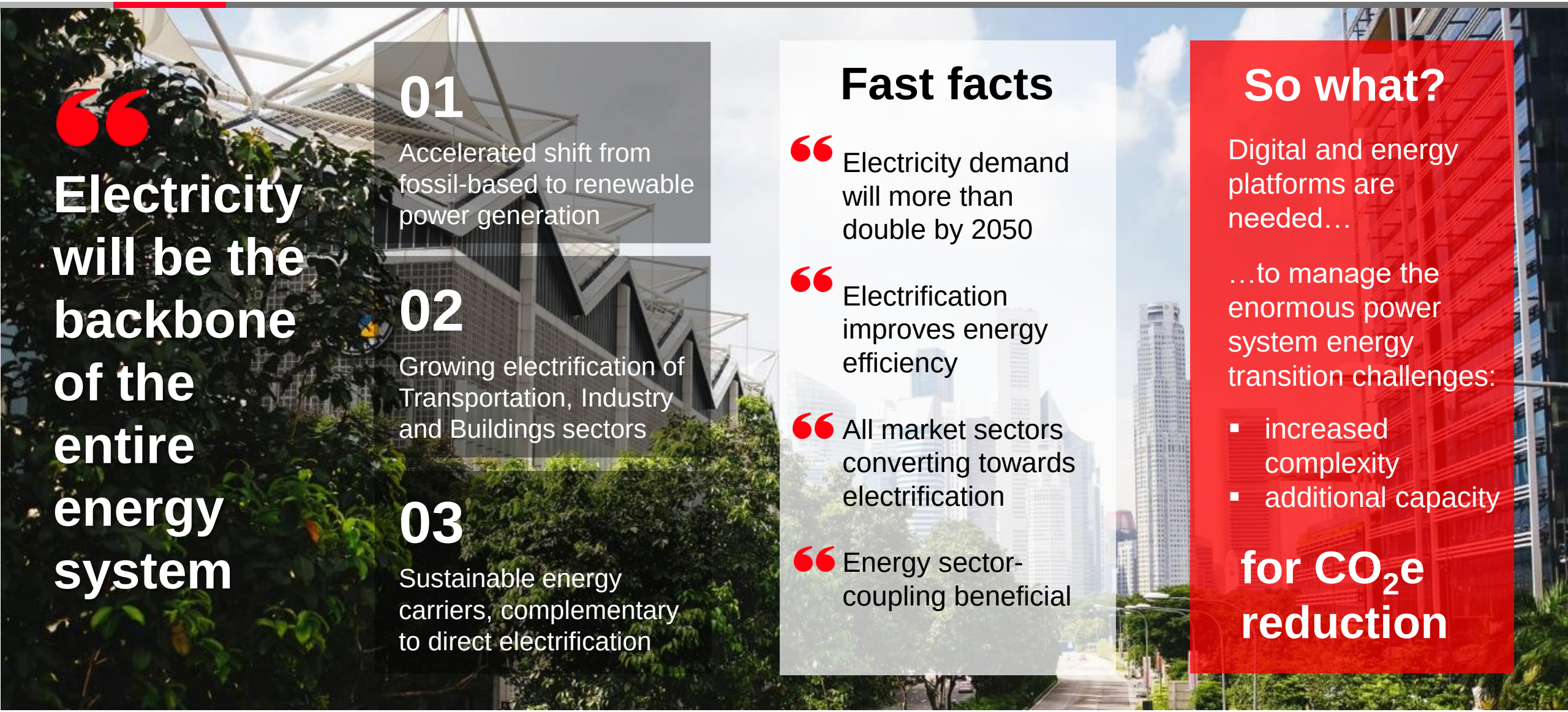
# Energy system 2050: towards a carbon-neutral vision



**Electricity will be the backbone of the entire energy system**

**01**
Accelerated shift from fossil-based to renewable power generation

**02**
Growing electrification of Transportation, Industry and Buildings sectors

**03**
Sustainable energy carriers, complementary to direct electrification

## Fast facts

- Electricity demand will more than double by 2050
- Electrification improves energy efficiency
- All market sectors converting towards electrification
- Energy sector-coupling beneficial

## So what?

Digital and energy platforms are needed…

…to manage the enormous power system energy transition challenges:

- increased complexity
- additional capacity

**for $CO_2e$ reduction**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