

REPowerEU nel PNRR le opportunità per le reti elettriche

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New Challenges for the Electrical Grids

Reliability

Renewables
Storage
Inverter-based Generation
Demand Side Management



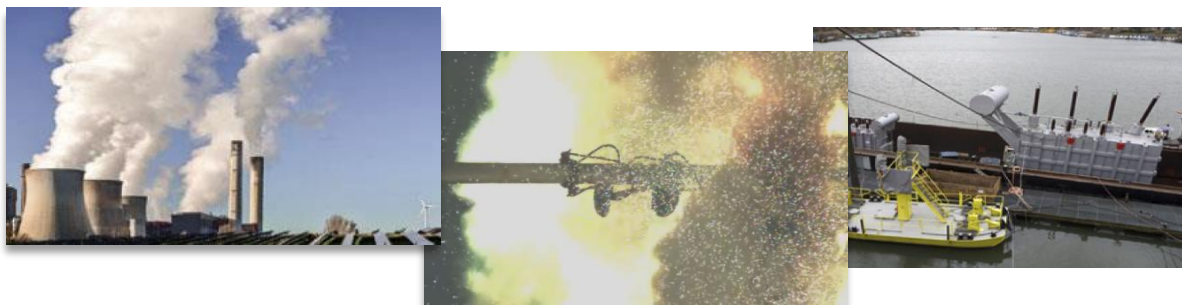
Resiliency

Climate Change
Digitalization
Cyber-security



Sustainability

Environmental Friendly Products
Life Cycle Assessment
Sustainable Supply Chain



The ongoing transition of power systems from conventional generation (synchronous machines) to renewables (inverter-dominated generation) is accompanied by the loss of directly grid-coupled mass inertia

Current inverter-based generation gives low contribution to short-circuit and reactive power

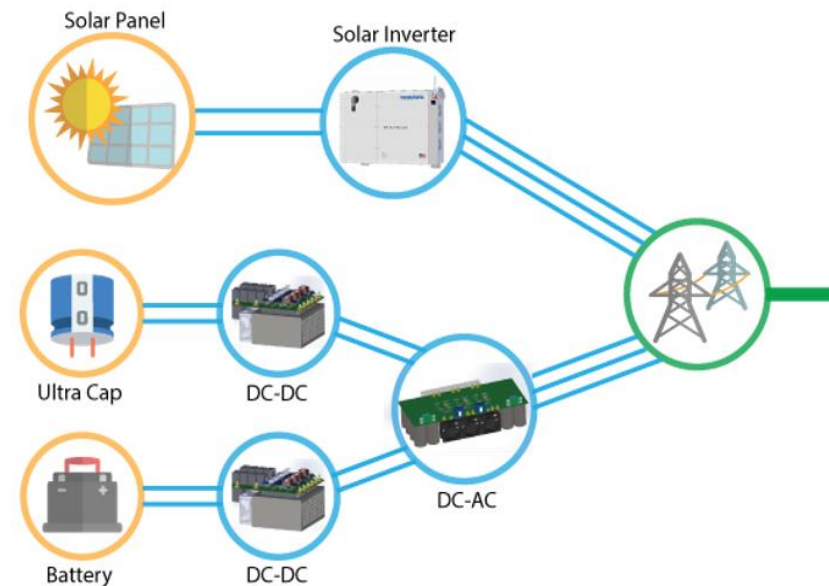
Inverter-based generation needs changing in control systems, i.e. grid forming inverters (frequency and voltage amplitude control)

Synchronous Compensators and E-Statcoms (power electronics) can be used to improve voltage regulation, short-circuit level and inertia

HVDC links with voltage source converter stations can support voltage regulation in connection nodes

Necessity to replace important functions provided by synchronous generation to contrast network instability

***84% share of renewables
in generation mix by 2030***



Resiliency

Heat waves during summer-time determine out-of-services for cables, cable joints, transformers and other grid components

Winter storms with wind and ice at unforeseen latitudes cause more and more failures in overhead lines

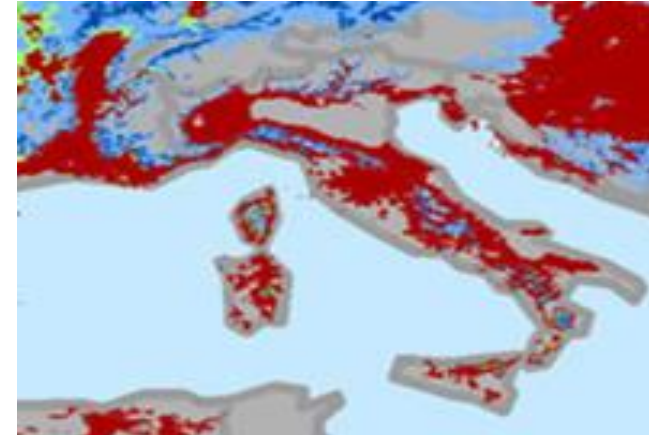
Aging of grid components is difficult to be determined

Pick-up of installed grid components is used to check and assess grid resiliency to extreme events

Digital technologies can help a lot for improving network management, asset monitoring, events simulation and forecasting

Introduction of communication systems and IT technologies expose the network to cyber risks

15-20 heat waves in Italy in the last 10 years



More than 300 wind storm

***Hundreds of cyber-attacks per year
Energy sector 3rd after
communication and defence***

Sustainability

Using materials and processes with no or minimum impact on environment and human health

Assessing the whole life cycle of grid component, from production to disposal, in order to define proper circularity metrics

On-going researches on greenhouse gases address clear paths for safety replacement

Still unclear outcomes for emerging technologies

Life cycle assessment and circularity metrics must be extended to the whole supply chain

Properly monitoring the supply chain in light of systemic approaches (*upstream and downstream suppliers*)

***Global Warming Potential of SF₆
is 23.500 times higher than CO₂***



***10 kg of CO₂
and 2 m³ of water
for extracting
1 Kg of Lithium***

