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Ministero
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Italiadomani
PIANO NAZIONALE
DI RIPRESA E RESILIENZA

NEST
NETWORK FOR ENERGY SUSTAINABLE TRANSITION

NEST SPOKE 5

Network for Energy
Sustainable Transition

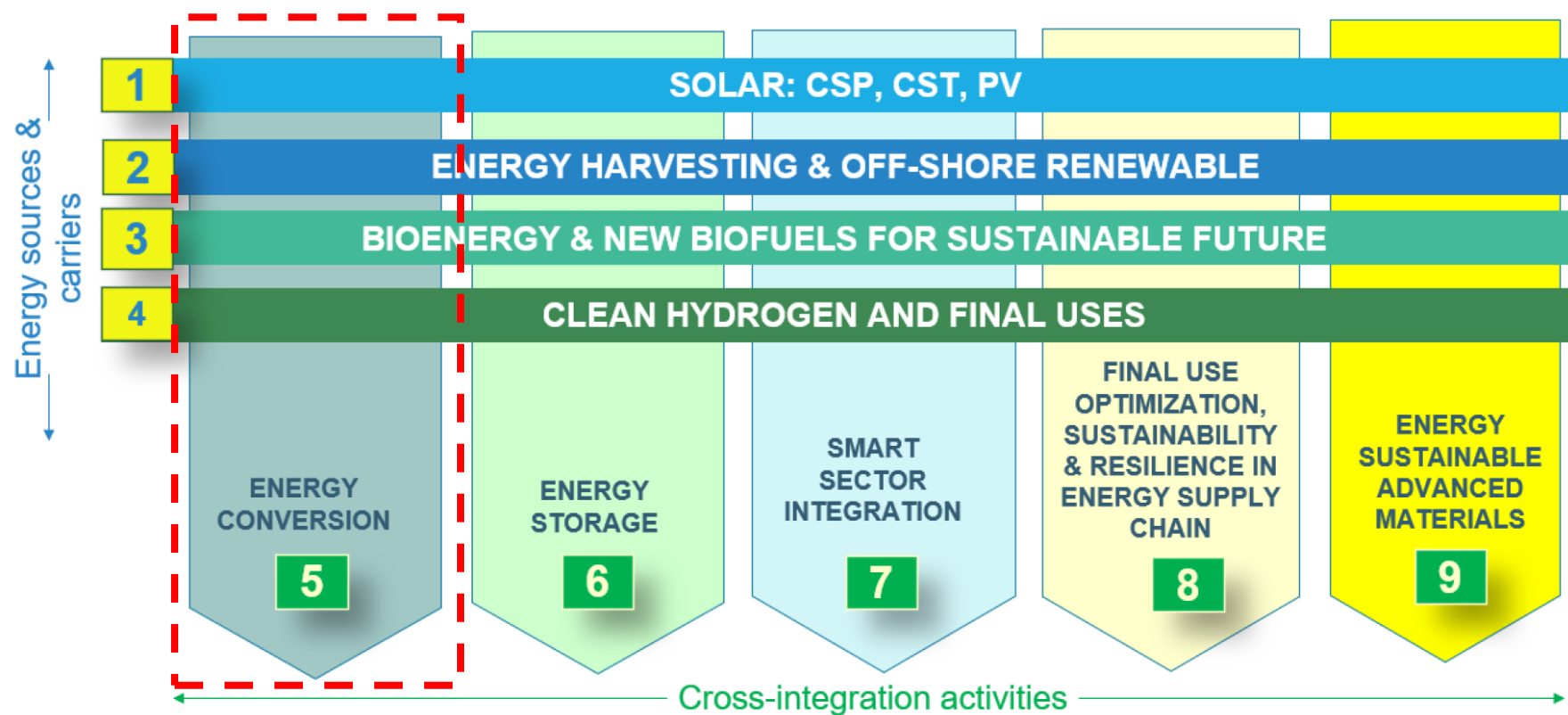
REVIEW MEETING

May 30th 2023



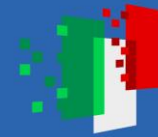


Spoke 5 – Energy Conversion (UNIPD Team: P. Mattavelli, G. Spiazzi, N. Bianchi, A. Bevilacqua, L. Martinelli)

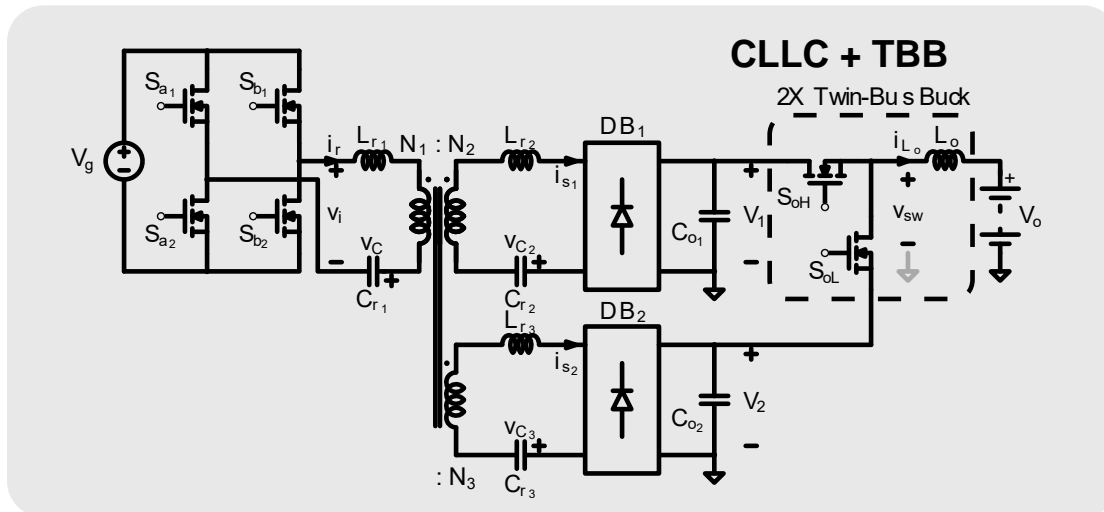


Participants

- Politecnico di Milano
- Università degli studi di Padova
- Università di Pisa
- Università Napoli Federico II
- Politecnico di Bari
- Università degli studi di Bologna
- Università di Roma, La Sapienza
- Nuovo Pignone Tecnologie
- Idea75

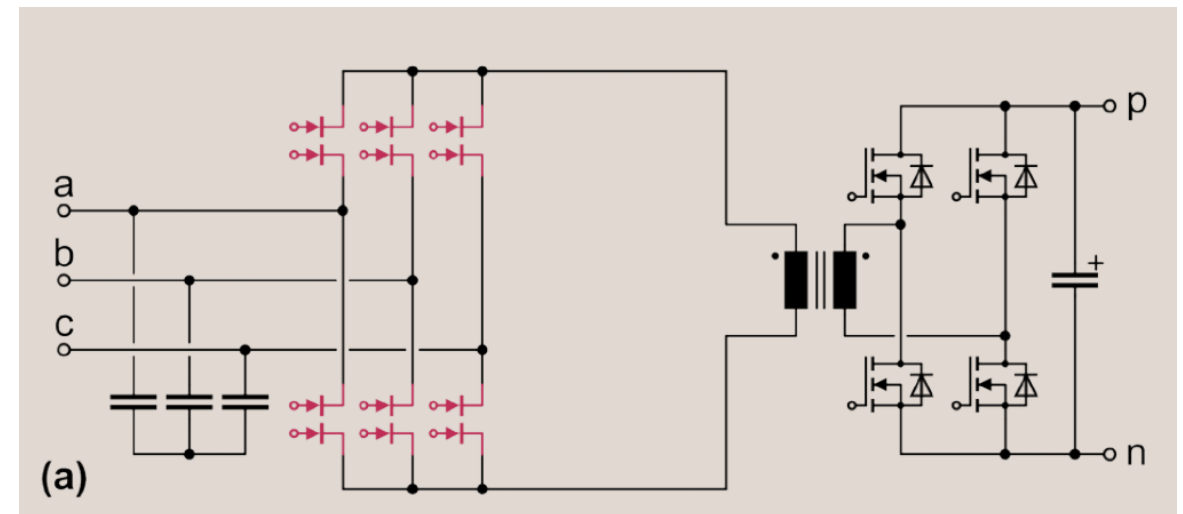


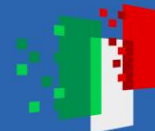
Task 5.1.1 - Integration of AC interface by means of bidirectional GaN devices



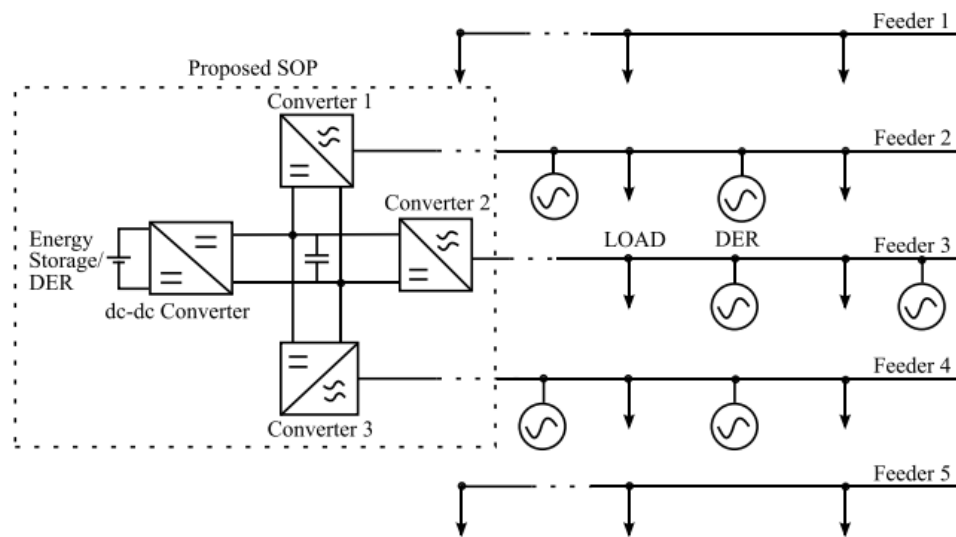
Integration with AC front-end:

- Option 1: use an AC-DC + DC/AC stage.
- Option 2: use an AC/AC stage exploiting structures of the kind shown on the right.

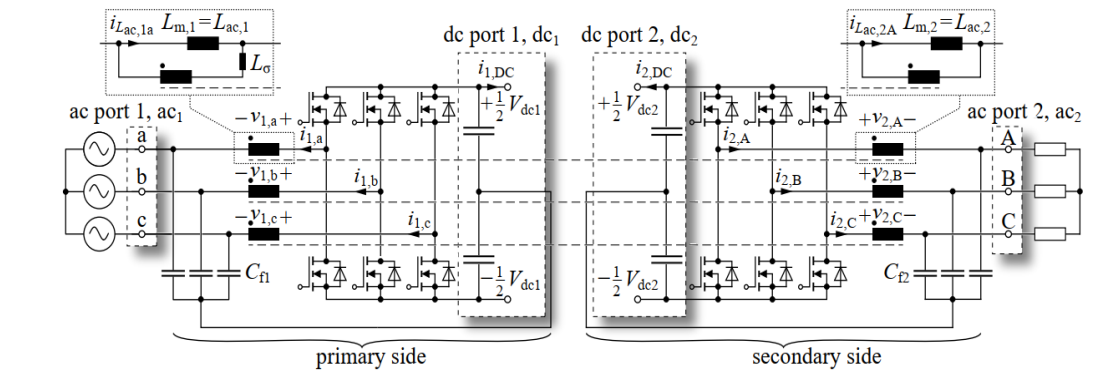




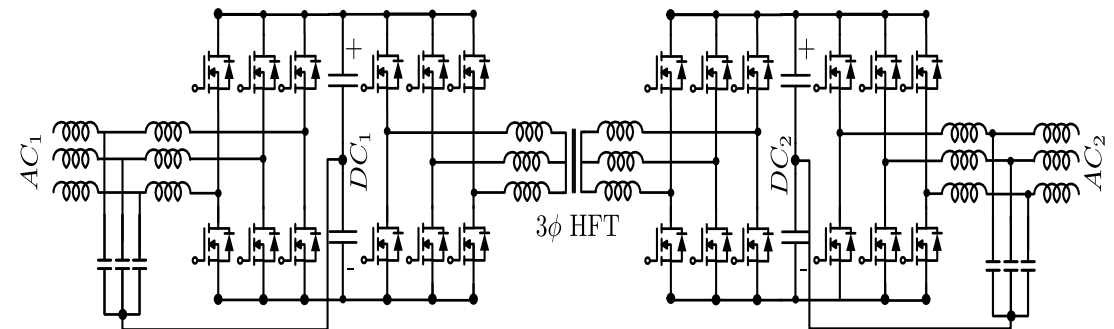
Task 5.1.1 - Multi-port converters for Soft-Open Point applications



SOP based on back-to-back VSI



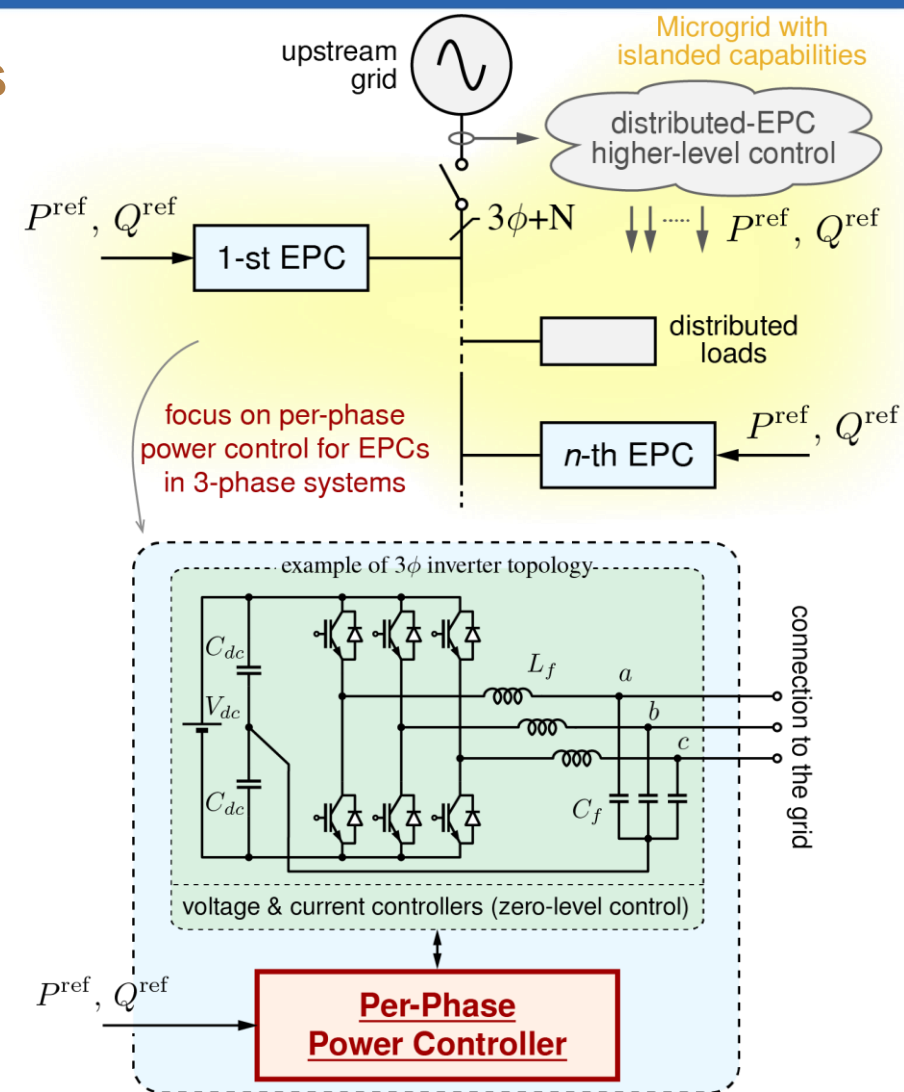
Dual Three-Phase Active Bridge



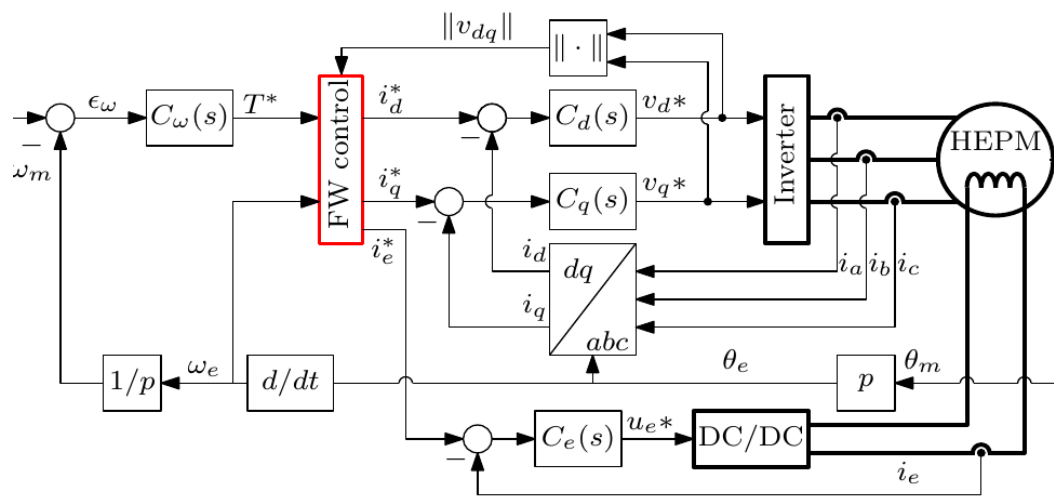
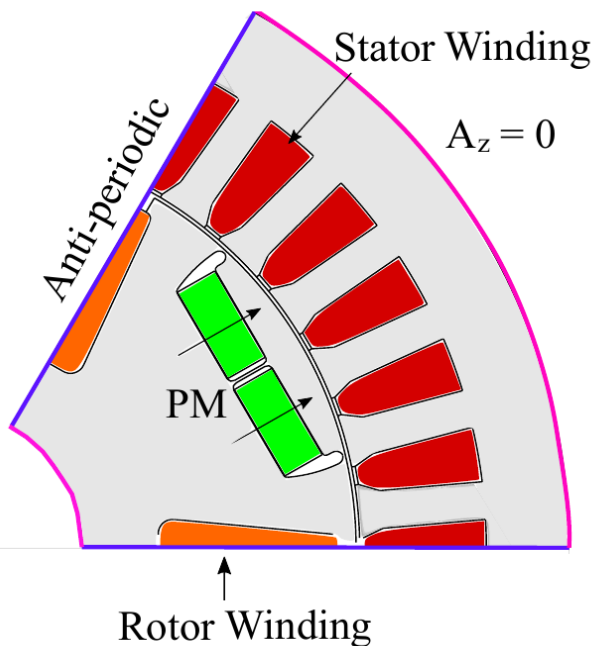
VSI + DualActive Bridge

Task 5.1.2 – Grid friendly Power Electronics Converters

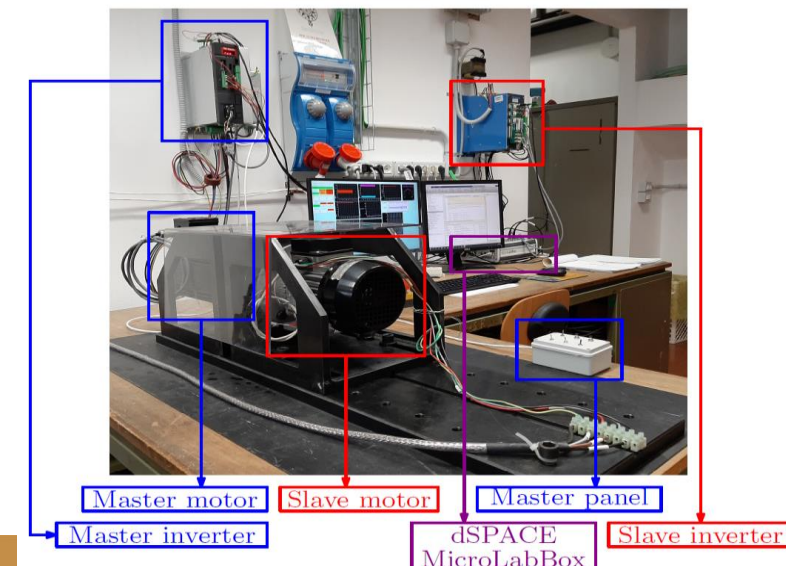
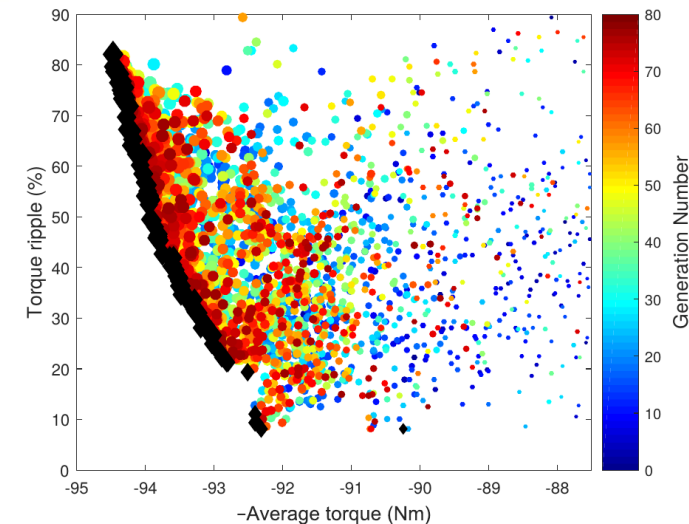
- Desired features:
 - **Dissipative and damped operation** in presence of dynamic transients
 - **islanded capability**: supports the grid voltage by output power adaptation via P - f , Q - V droop characteristics.
 - **grid-tied operation**: makes the output power fixed to allow power control.
 - **seamless transitions** between the two operating modes.
 - **unbalance compensation and unbalance load supply capability**.



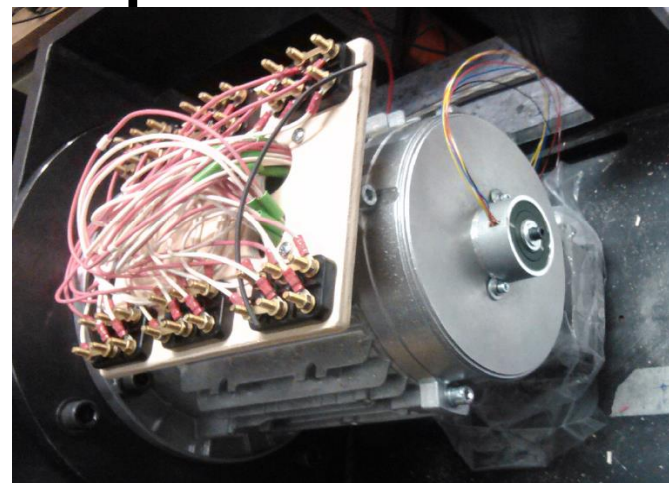
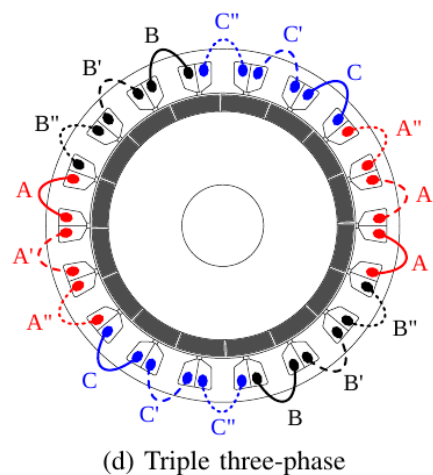
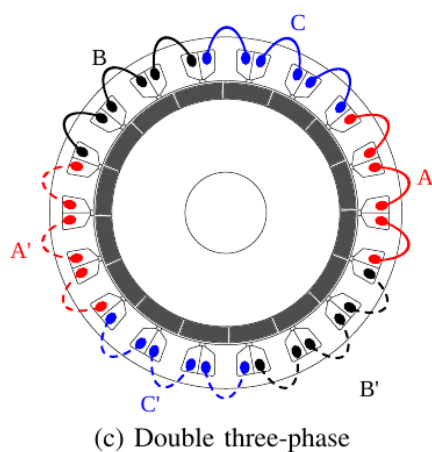
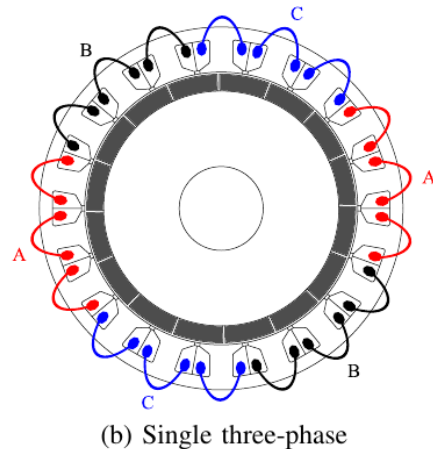
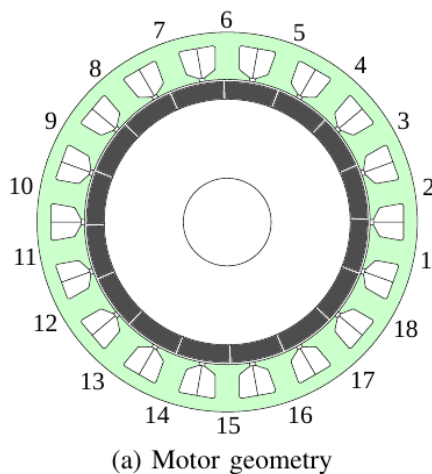
Hybrid-excited PM machine



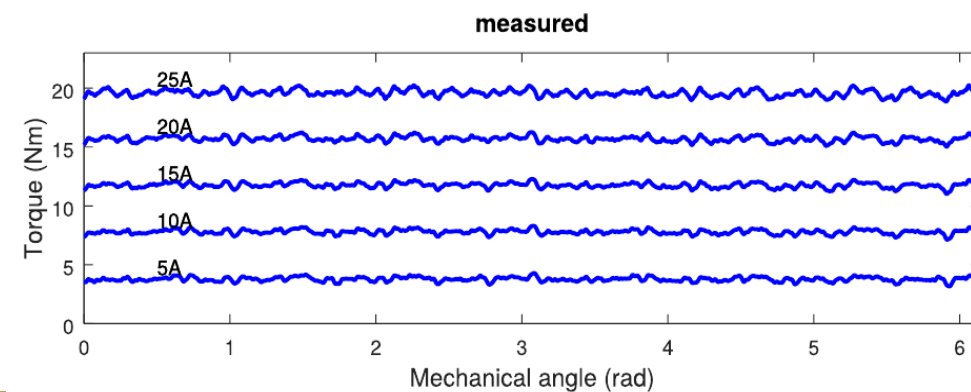
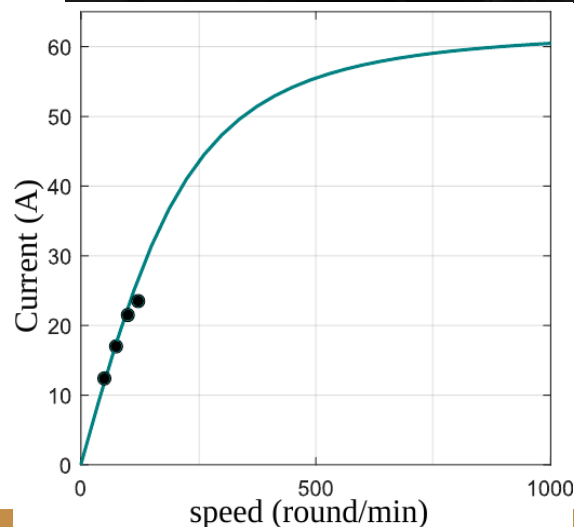
Rotor with PMs and excitation winding to modulate the rotor flux: geometry optimization, control and tests



Multi-three-phase machines



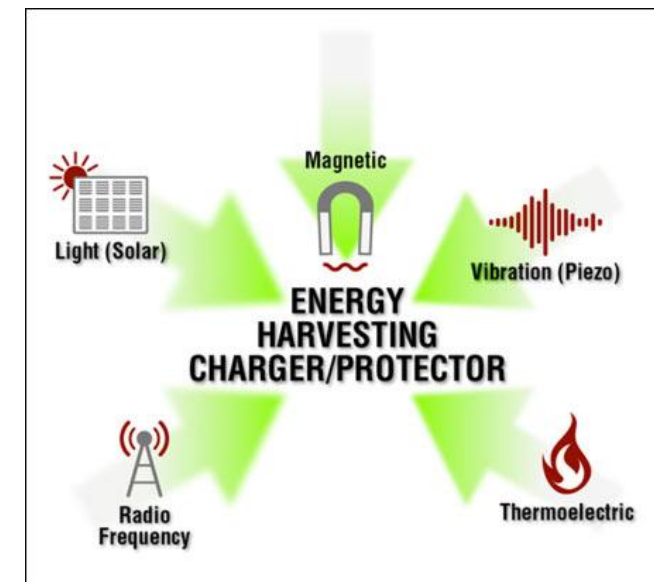
Analysis of topologies to improve torque behaviour and to increase fault-tolerance



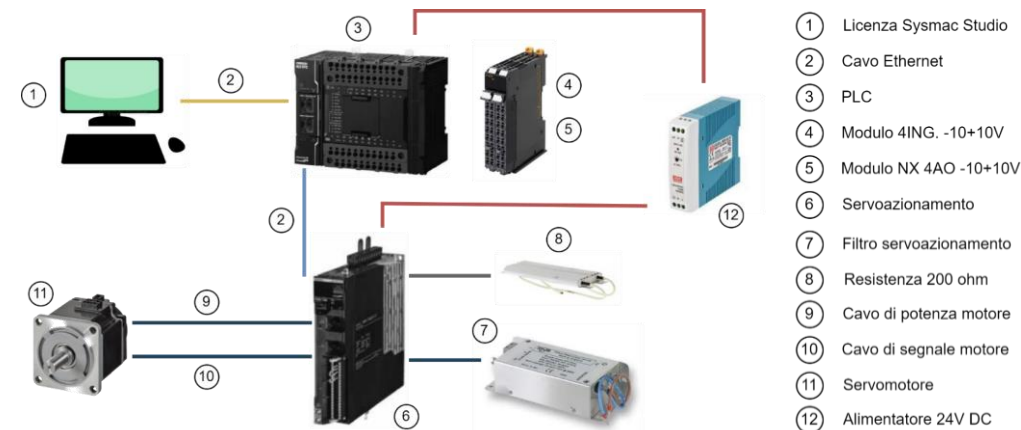
Task 5.1.4 - Integrated dc-dc converters for energy scavenging

Plan of the activities

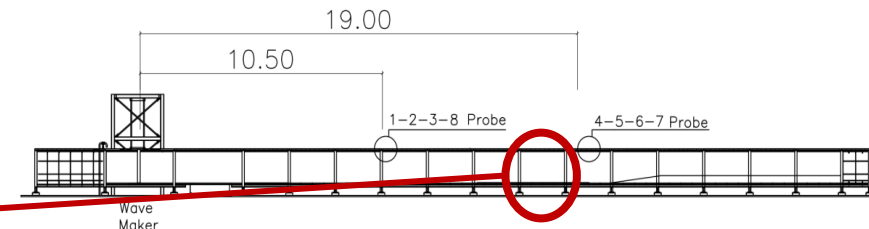
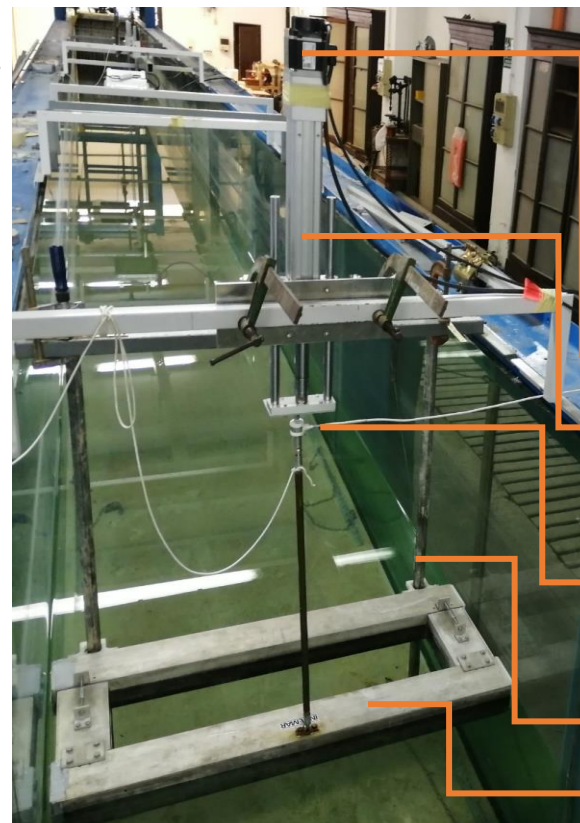
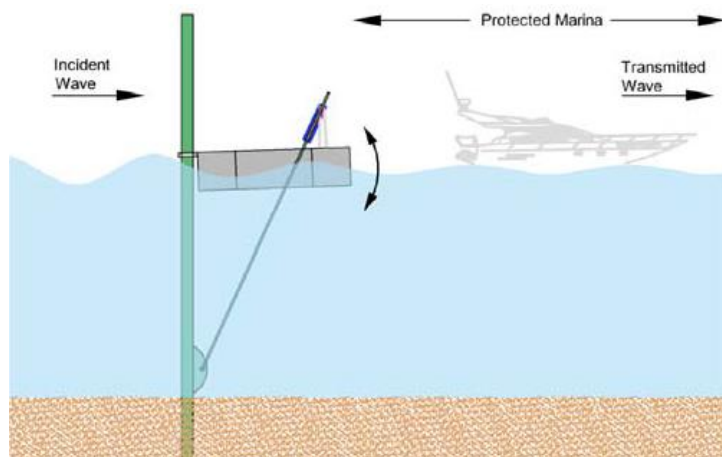
- Review of the state-of-the-art
- Definition of the architecture of the integrated dc-dc converter for energy scavenging
- Transistor-level design and simulation of the dc-dc converter
- Layout implementation of the dc-dc converter; chip tape-out
- Experimental characterization of the developed prototypes



Task 5.1.5 – Energy Conversion for wave applications – HIL tests in wave lab



- ① Licenza Sysmac Studio
- ② Cavo Ethernet
- ③ PLC
- ④ Modulo 4ING. -10+10V
- ⑤ Modulo NX 4AO -10+10V
- ⑥ Servoazionamento
- ⑦ Filtro servoazionamento
- ⑧ Resistenza 200 ohm
- ⑨ Cavo di potenza motore
- ⑩ Cavo di segnale motore
- ⑪ Servomotore
- ⑫ Alimentatore 24V DC



Servo (three phase)

Linear actuator (ball screws)

Load cell & displacement meter

Mooring piles

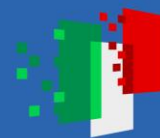
Wave attenuator in scale 1:20



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NEST
NETWORK FOR ENERGY SUSTAINABLE TRANSITION

WP5

ENERGY CONVERSION



Spoke 5 – Timing

Prof. Giampaolo Manzolini
Politecnico di Milano

