INTERCONNECTED MICROGRIDS THROUGH MULTIPORT CONVERTER

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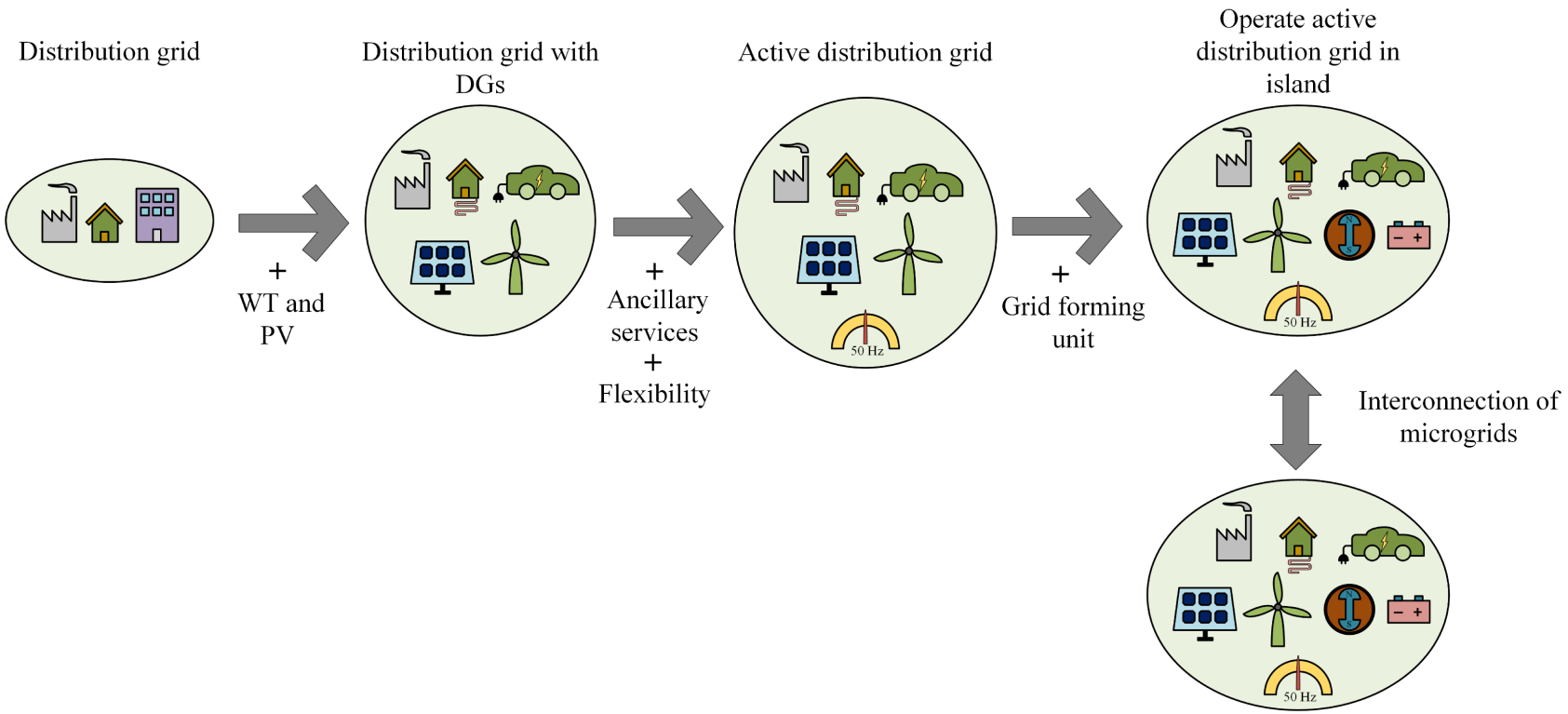
Evolution of Distribution Grid



Reliability Requirement - Sweden

Load interval (MW)	Interruption time under normal recovery conditions (hour)	Interruption time under abnormal recovery conditions (hour)
2 < P ≤ 5	12	**24**
5 < P ≤ 20	8	**24**
20 < P ≤ 50	2	**24**
P > 50	2	**12**

The delivery of electricty is **not considered as of good quality**,
if the number of unplanned long interruption (>3 min) year > **11 times/year** at the connection point

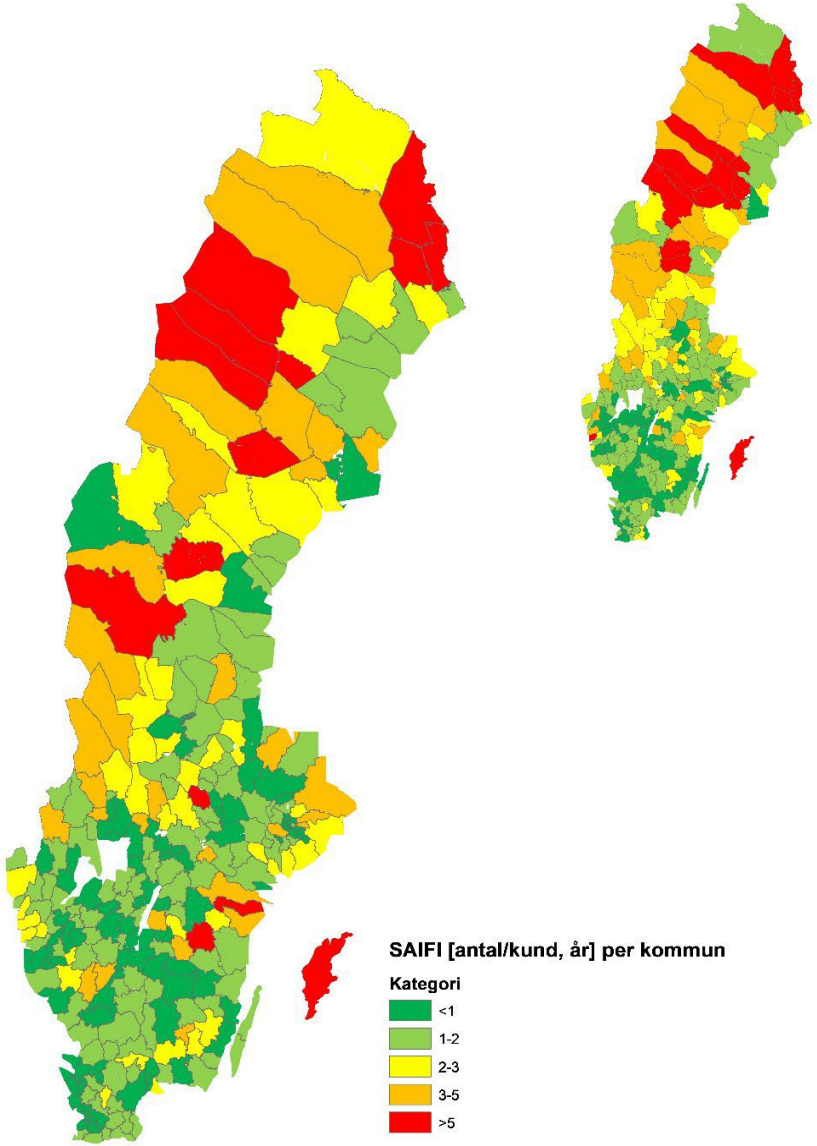
https://ei.se/sv/for-energiforetag/el/Leveranssakerhet-och-spanningskvalitet/

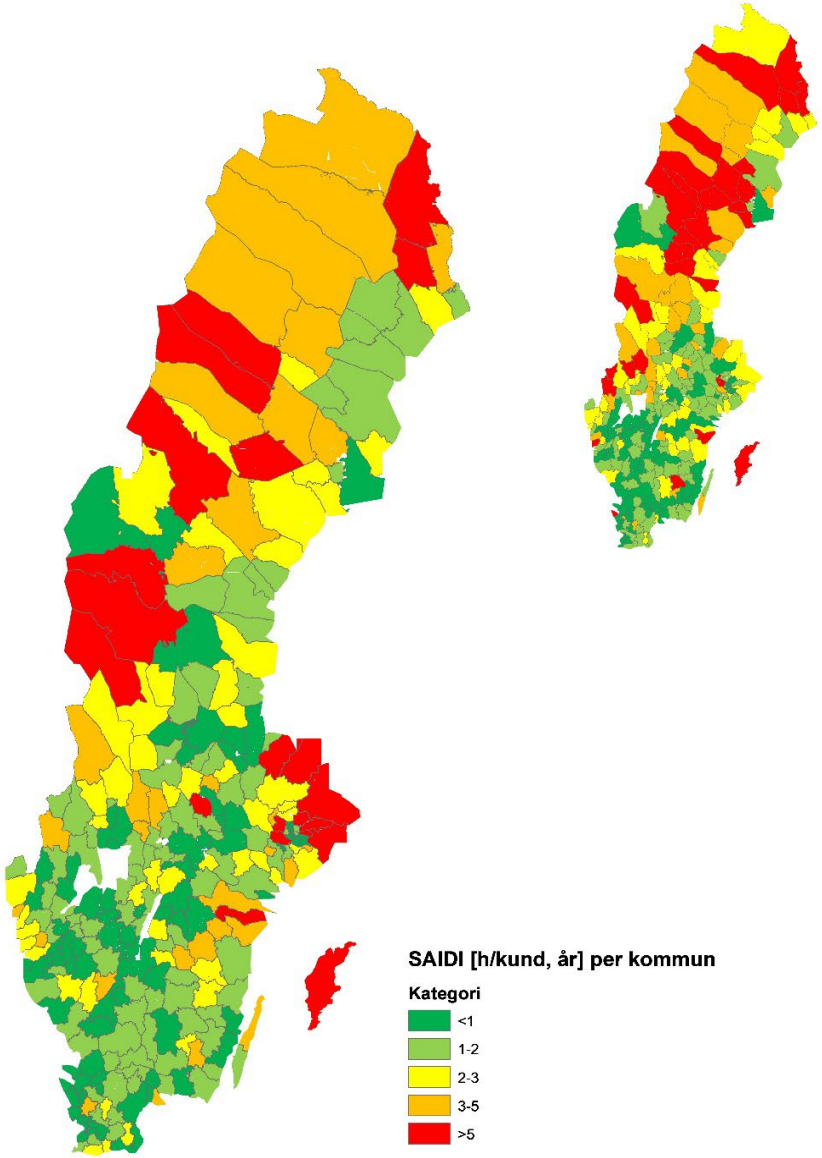
Interruption Statistics 2019: by local grid company

The number (percentage) of customers within each evaluated unit (redovisningsenherterna)

REL	>24 h	>24 h & >11 interruptions
REL00909	34,896 (4.49%)	1,710 (0.22%)
REL00008	7,538 (94.20%)	0
REL03018	6,412 (4.89%)	2,250 (1.72%)
REL03008	2,505 (0.30%)	51 (0.01%)
REL00133	489 (2.92%)	0
REL00572	303 (0.26%)	8 (0.01%)

SAIFI & SAIDI 2018 & 2019 in Sweden



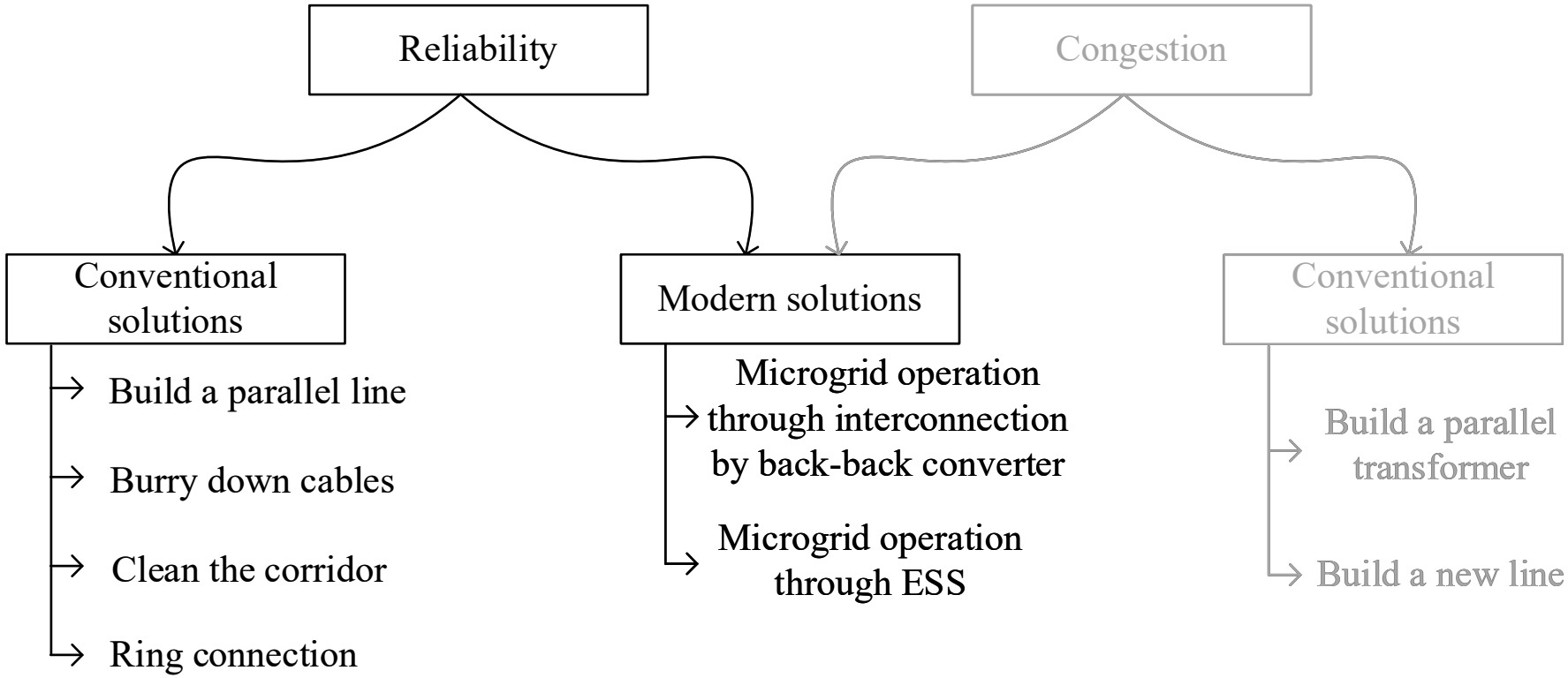


Ei, *Supply Safety in Sweden*, 2019

Other Distribution Grid Issues

- Local grid capacity congestion
- Reduced voltage quality
- Grid Losses
- Environmental aspects

Solutions to Reliability & Congestion



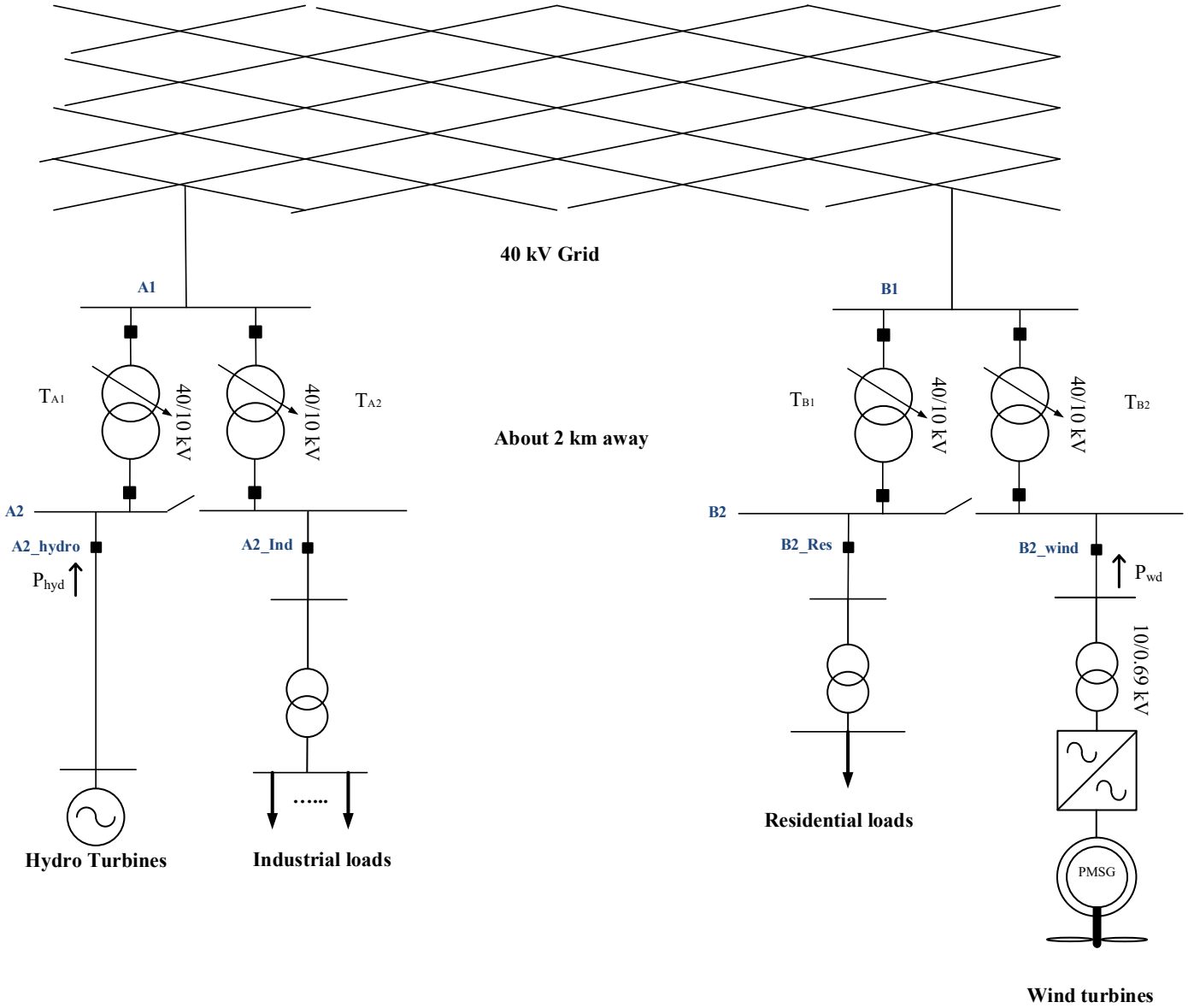
Barriers for Microgrid Solution in Sweden

- Island mode not allowed
- Ownership of Energy Storage
  - by DSO: limitation of functions
  - by third party: lack of financial incentives
- New knowledge & experience needed takes time

M. Arvidsson, M. Hessman, K. Koit, T. Lindberg and O. N. Hurtig, *On drivers, barriers and design parameters for implementation of microgrids in the Swedish power grid*, Bachelor thesis, Chalmers University of Technology, May 2021

A Case Study for Interconnected Microgrid

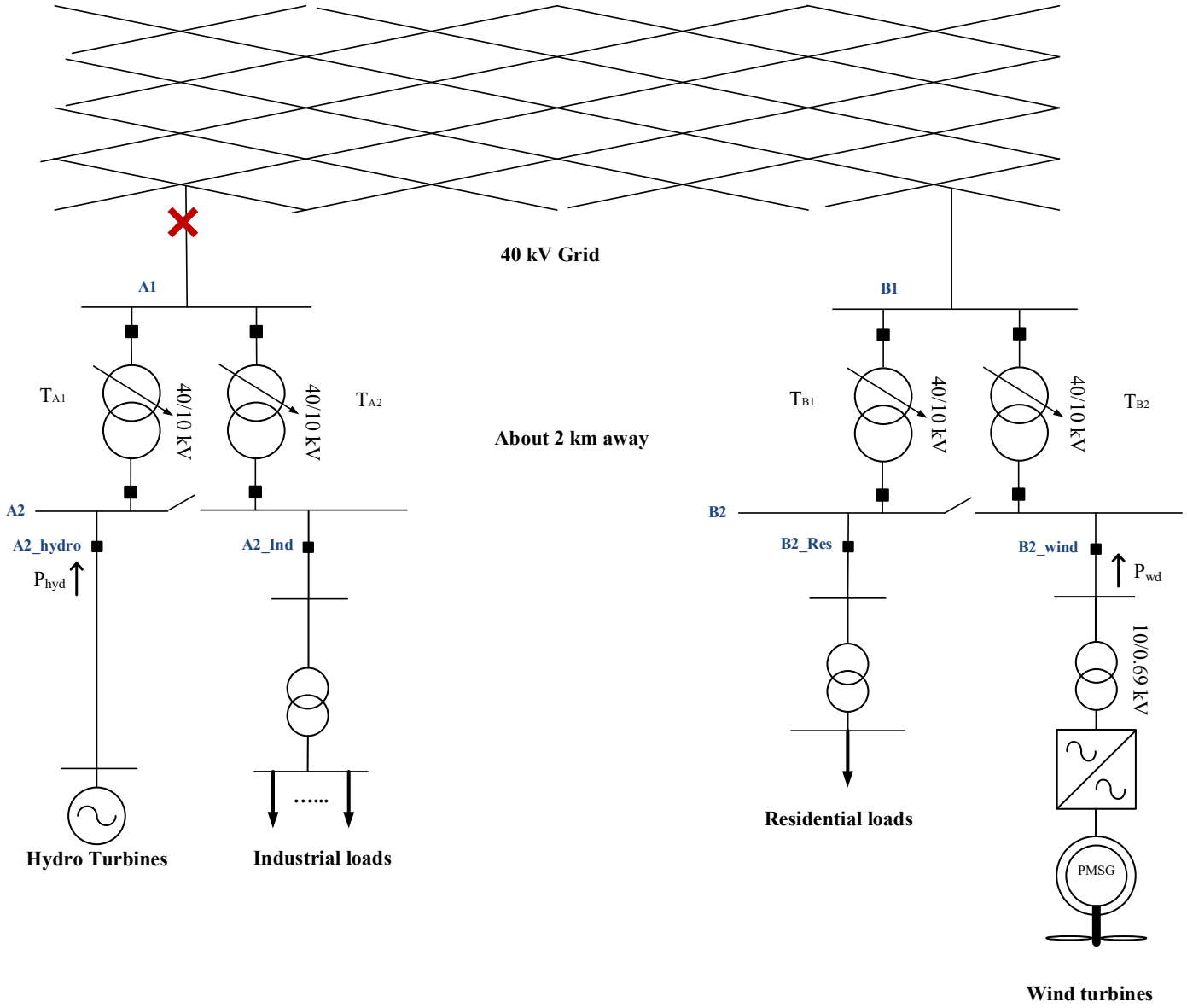
MG-Hydro



MG-Wind

Supply Interruption in MG-Hydro

MG-Hydro



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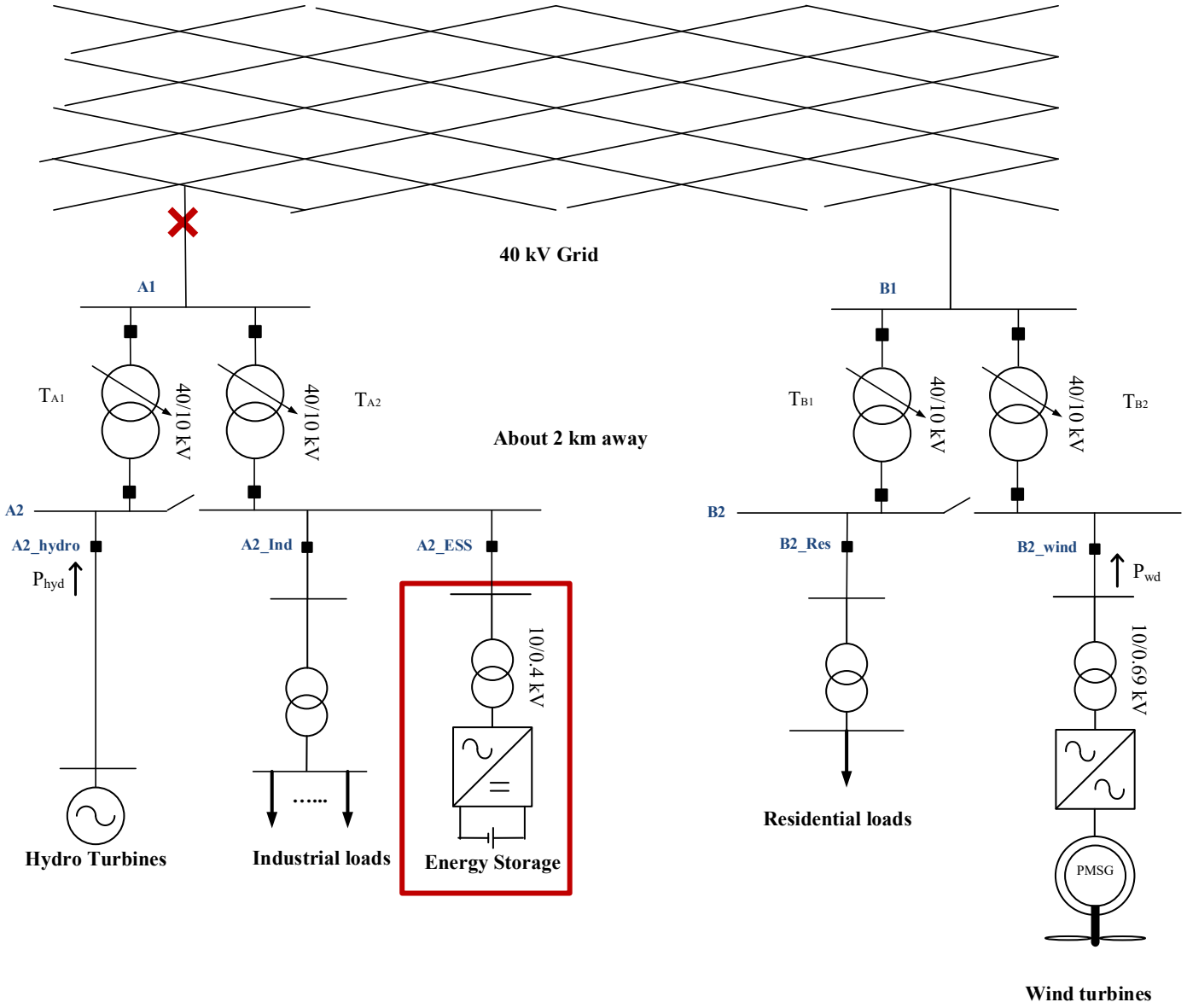

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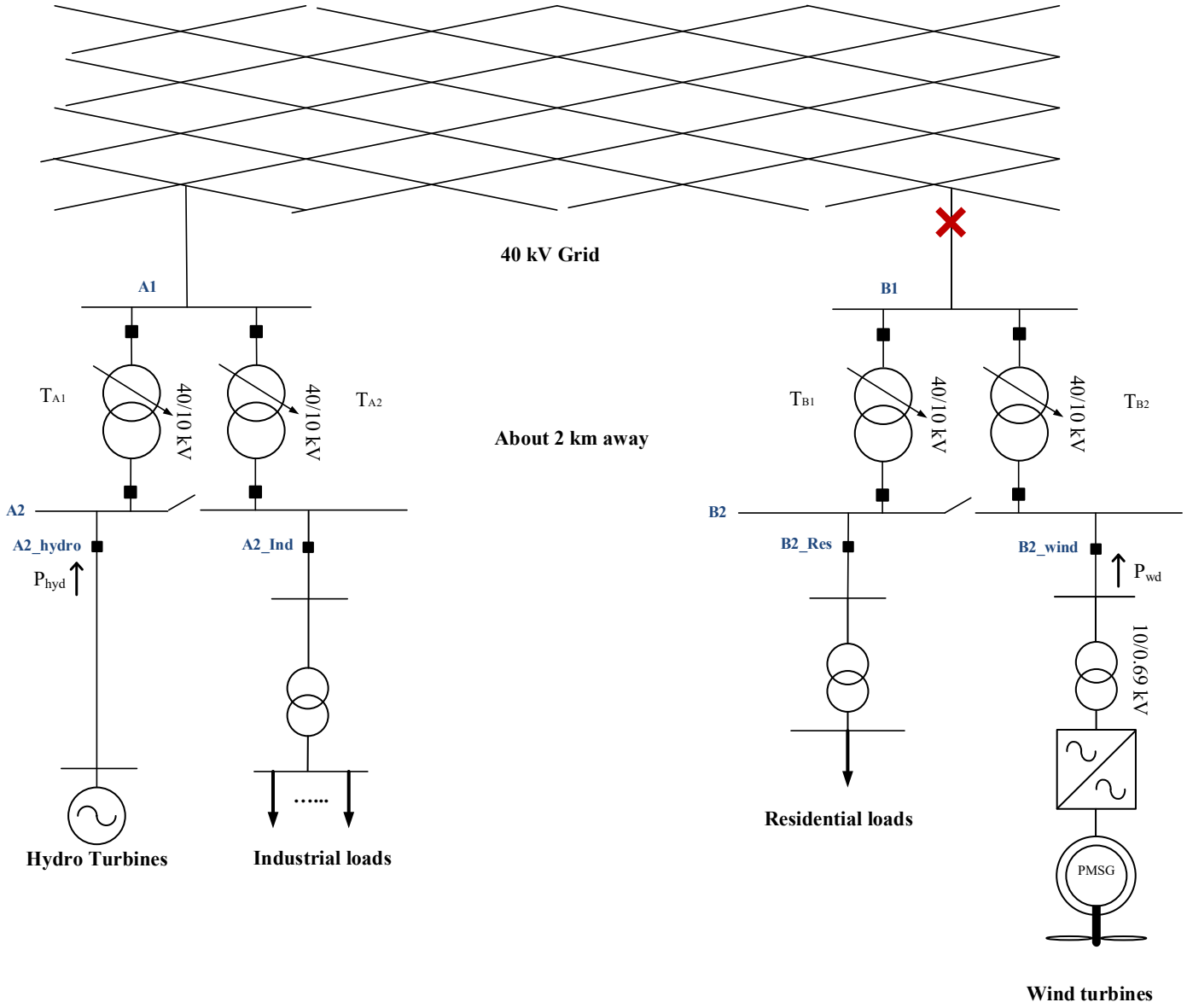
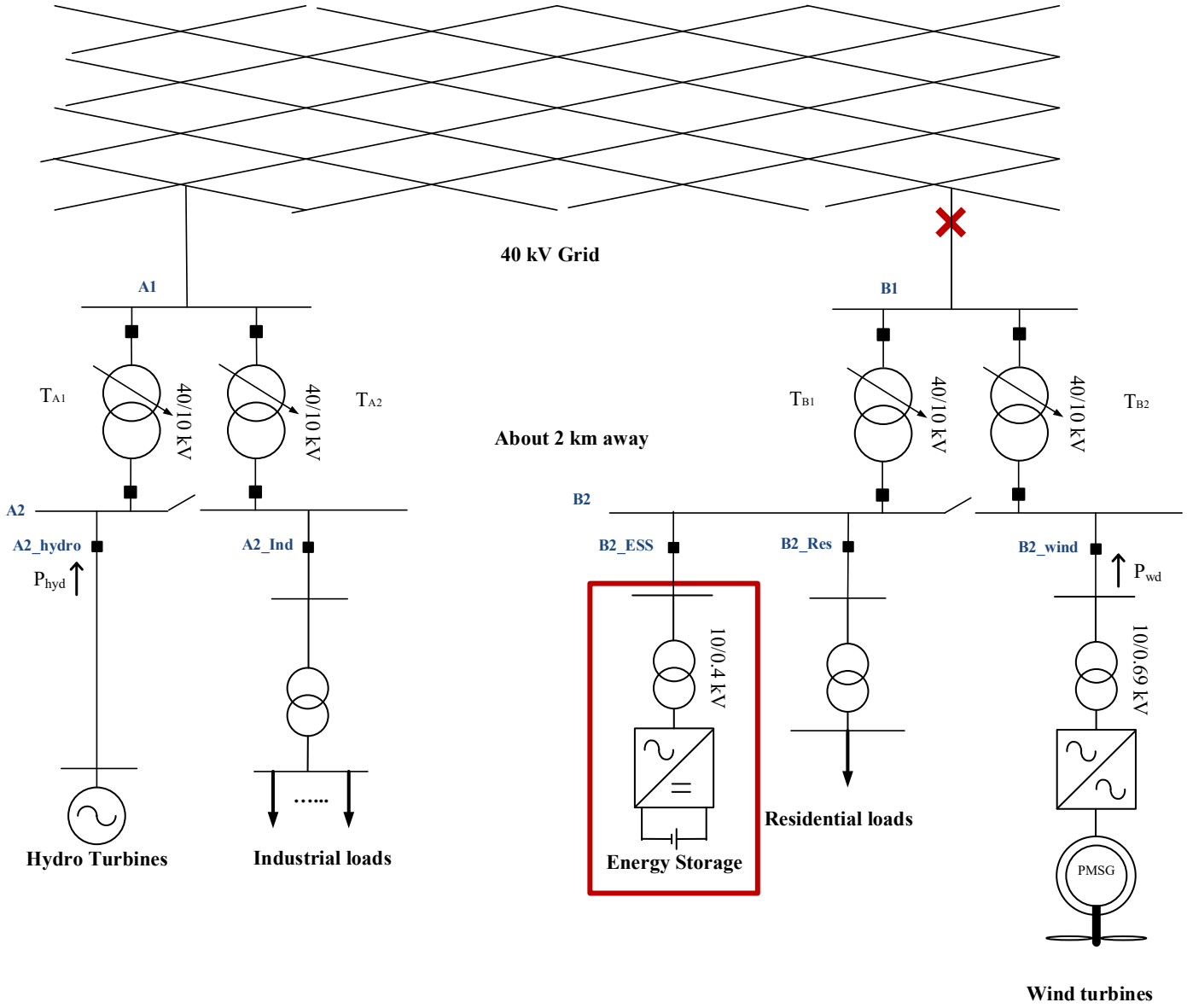
MG-Hydro



MG-Wind

Supply Interruption in MG-Wind

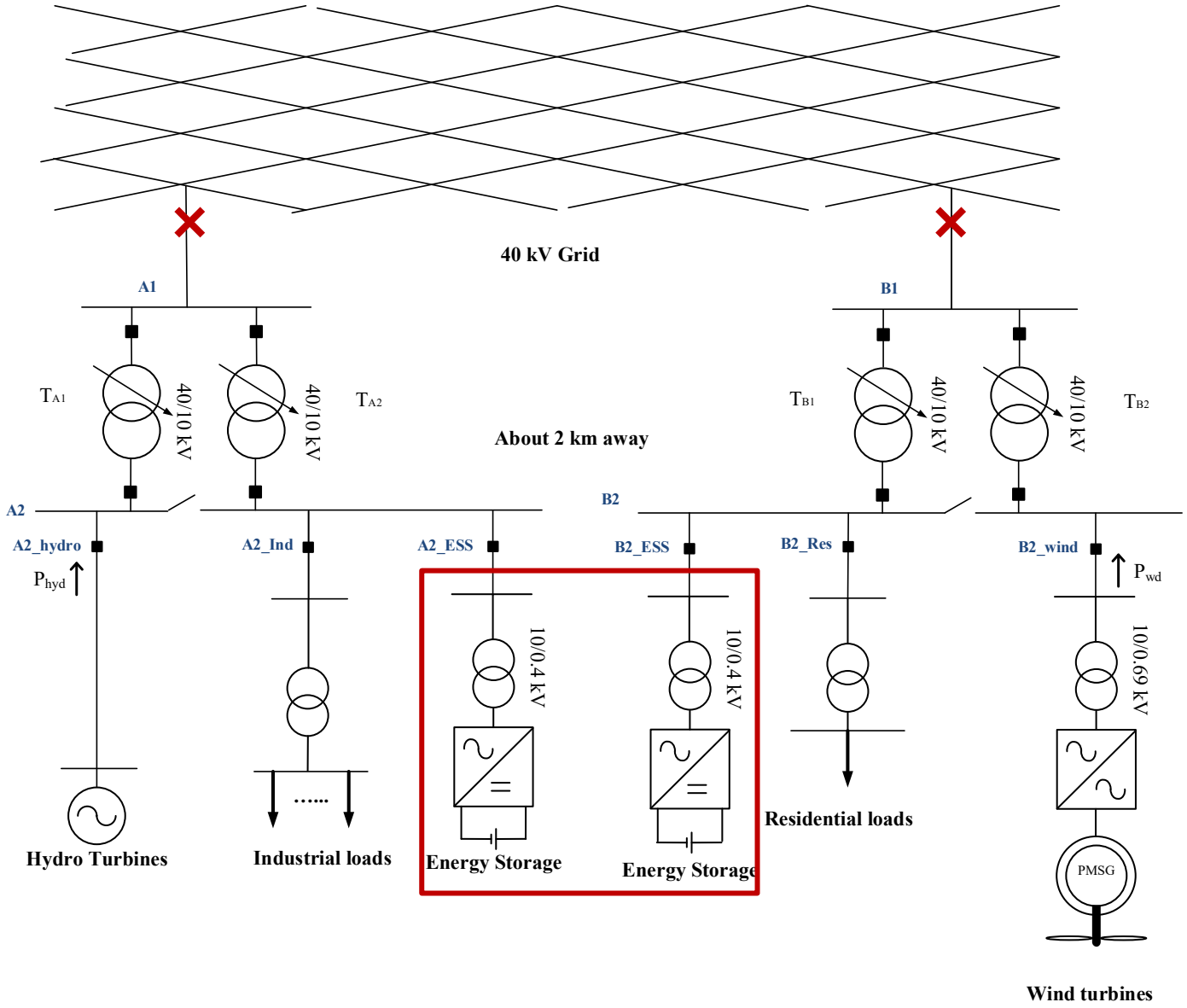
MG-Hydro



MG-Wind

Resulting Energy Storage for Each Microgrid

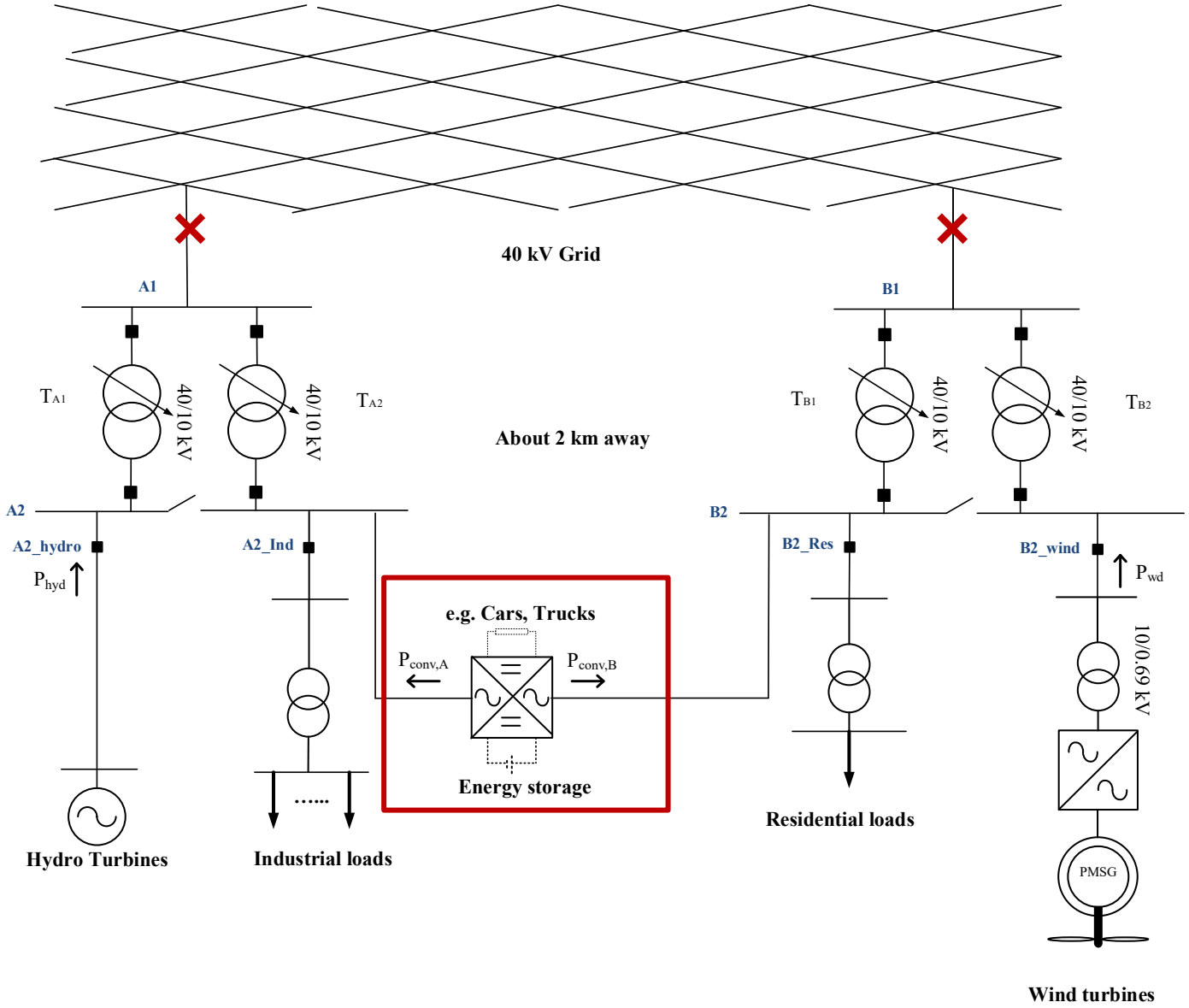
MG-Hydro



MG-Wind

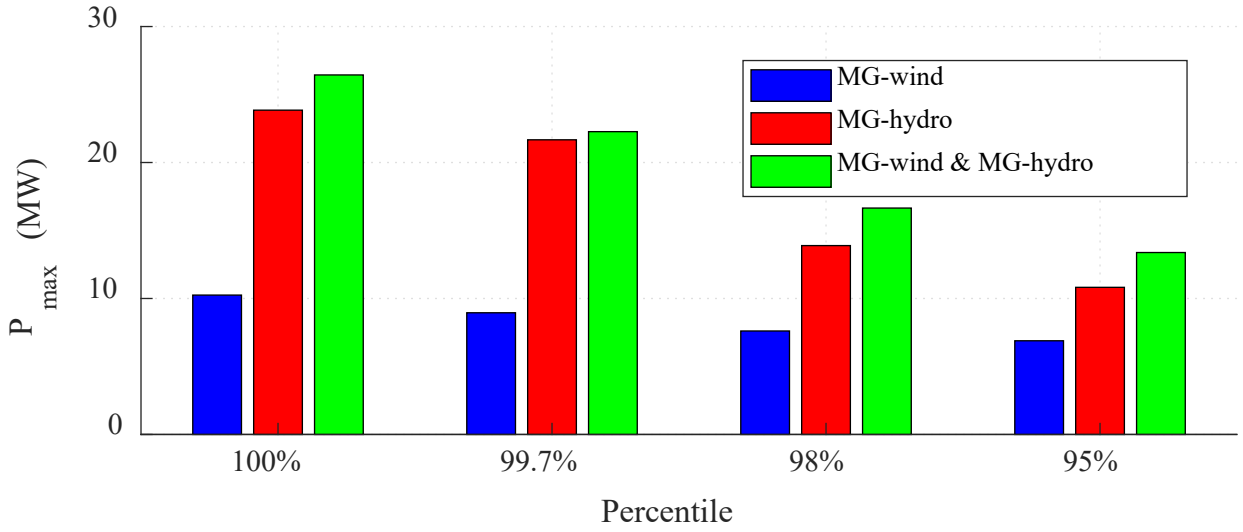
Interconnected Microgrid

MG-Hydro



MG-Wind

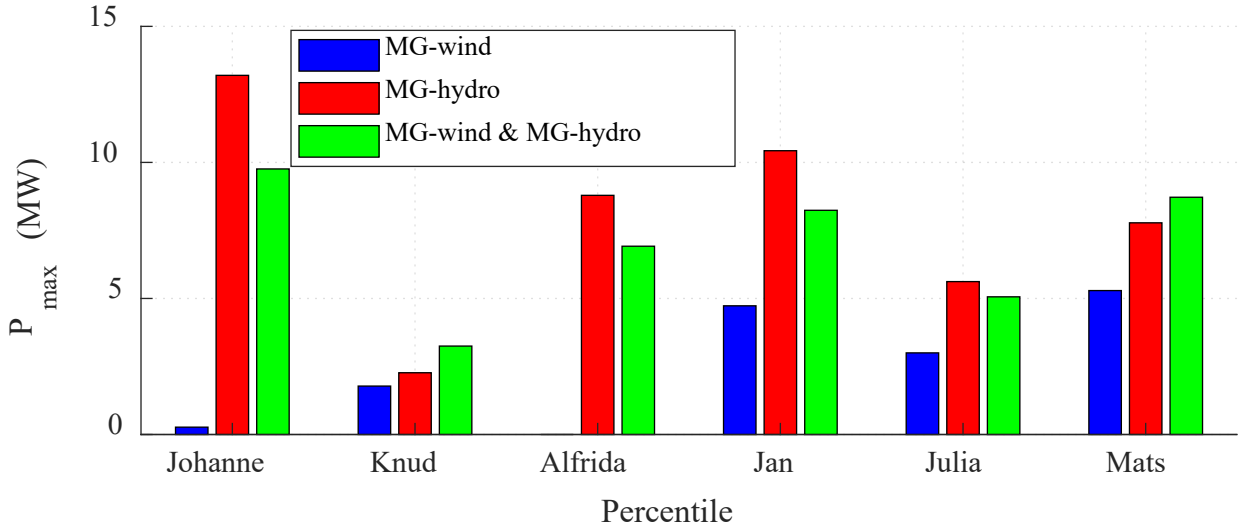
Hourly Balancing Power - 1 h Island Operation in 2018



22% – 27% of power reduction for ESS
with interconnected operation @ interruption of both MGs

M. Arvidsson, M. Hessman, K. Koit, T. Lindberg and O. N. Hurtig, *On drivers, barriers and design parameters for implementation of microgrids in the Swedish power grid*, Bachelor thesis, Chalmers University of Technology, May 2021

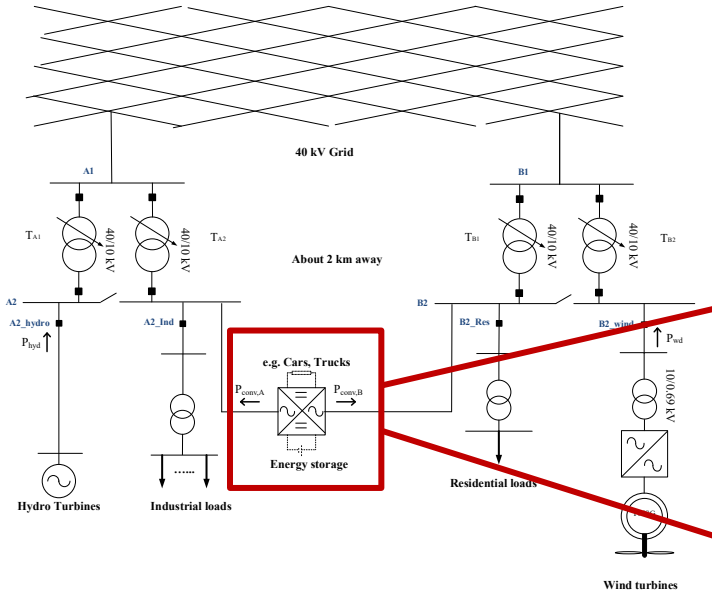
Hourly Balancing Power – Storms (2018-2019)

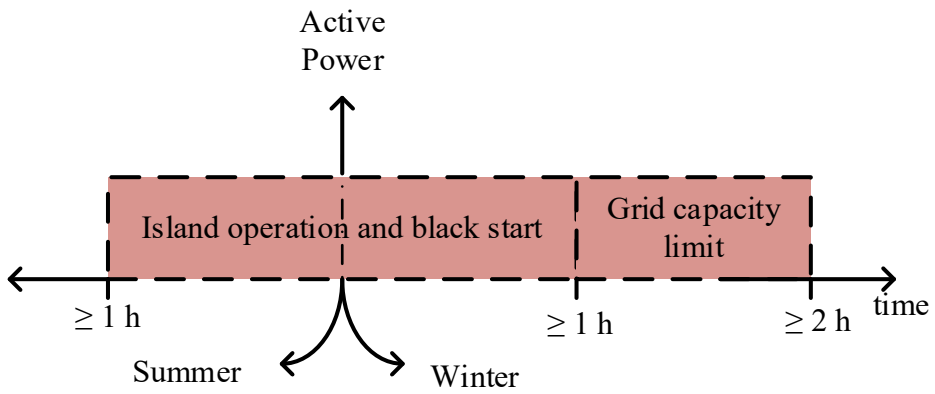


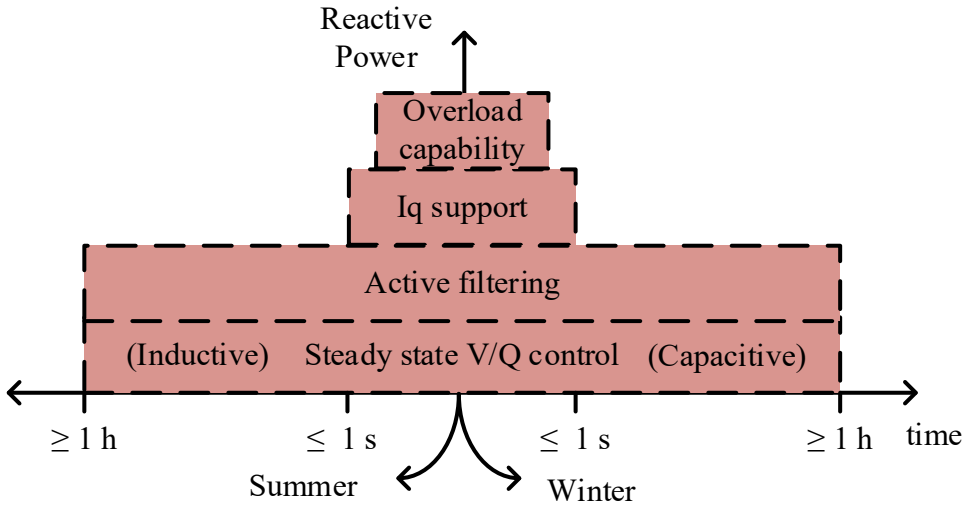
22% – 46% of power reduction for ESS
with interconnected operation @ interruption of both MGs

M. Arvidsson, M. Hessman, K. Koit, T. Lindberg and O. N. Hurtig, *On drivers, barriers and design parameters for implementation of microgrids in the Swedish power grid*, Bachelor thesis, Chalmers University of Technology, May 2021

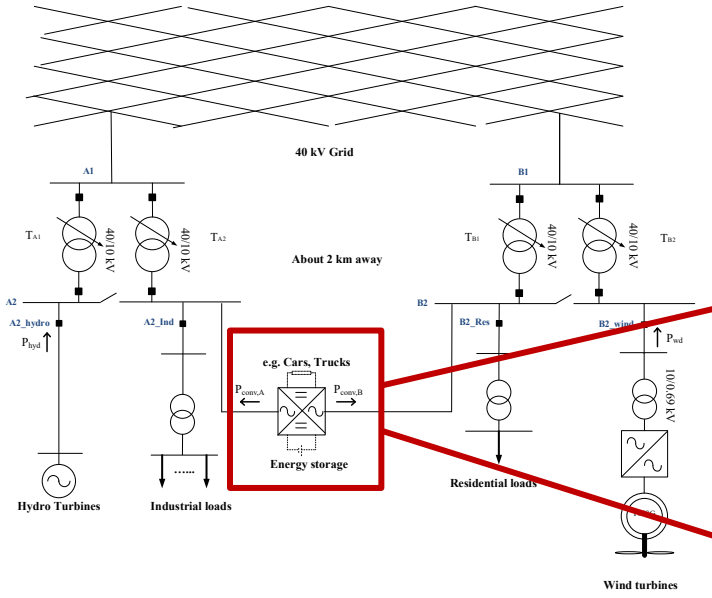
Functions Split of Multiport Converter Without Energy Storage

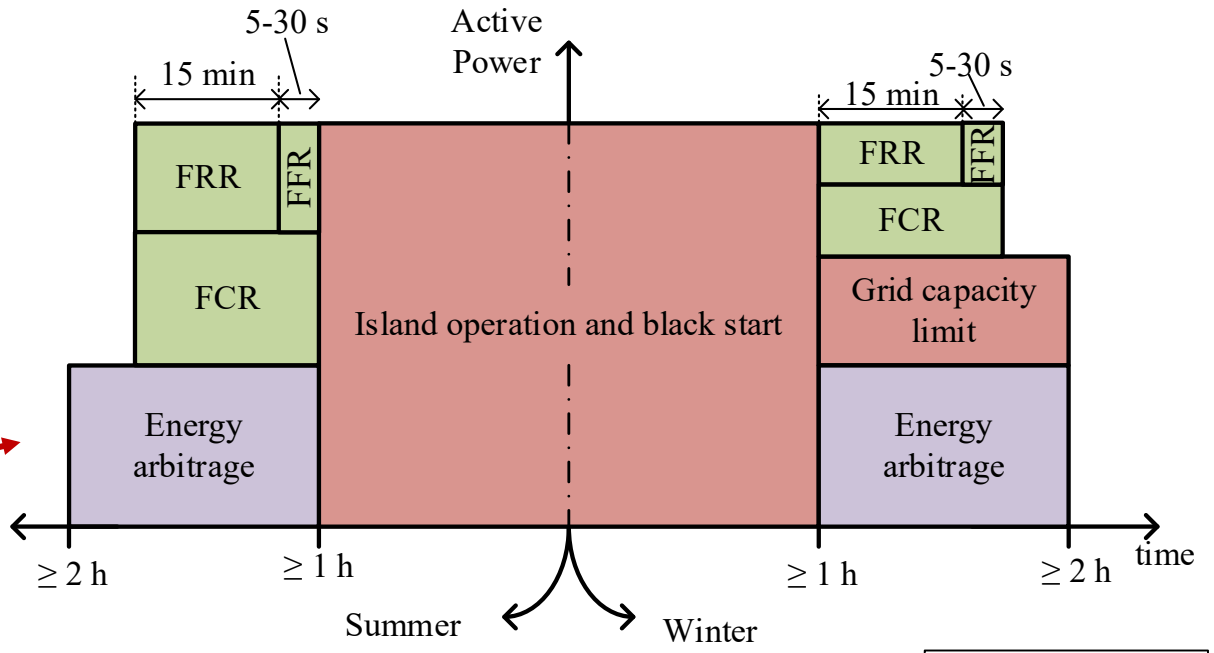


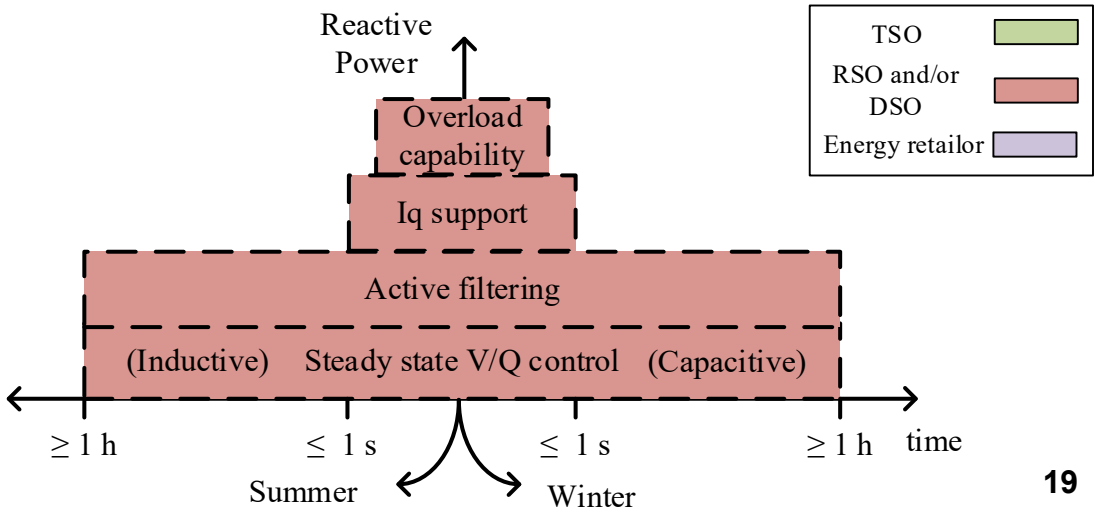




Functions Split of Multiport Converter With Energy Storage

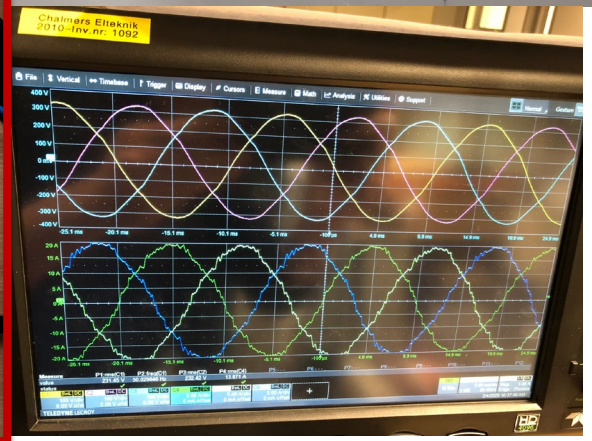






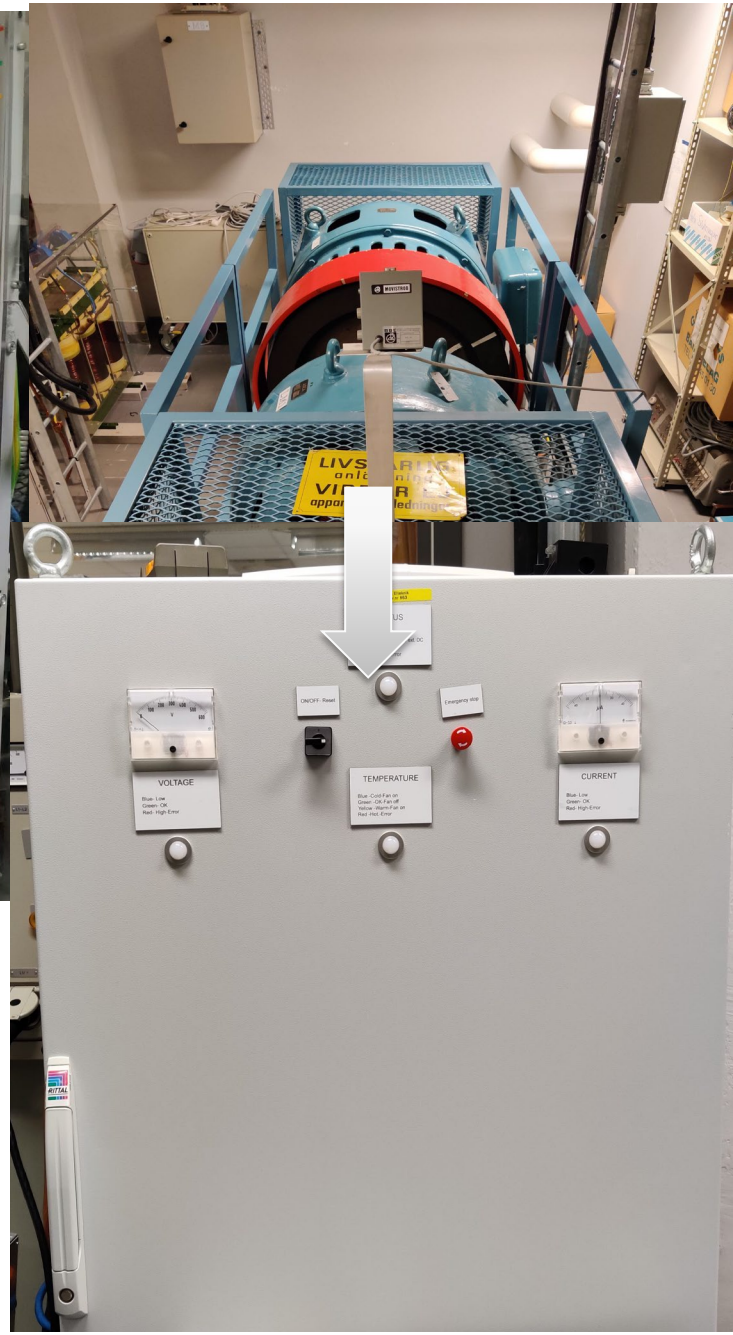
MultiportGrid project, WP1 led by Lisa Görasson, Chalmers University of Technology, Sweden

MultiportGrid project, WP2 led by Oriol Gomis, UPC, Spain



WP5, field data collection, led by Mattias Persson, RISE

WP6, Lab and field test, All



ERA-Net Smart Energy Systems

Multiportgrid Team

2020-2023