

GRID EMT

SIMULATION INITIATIVE

RE-INTEGRATE: Large Load Models

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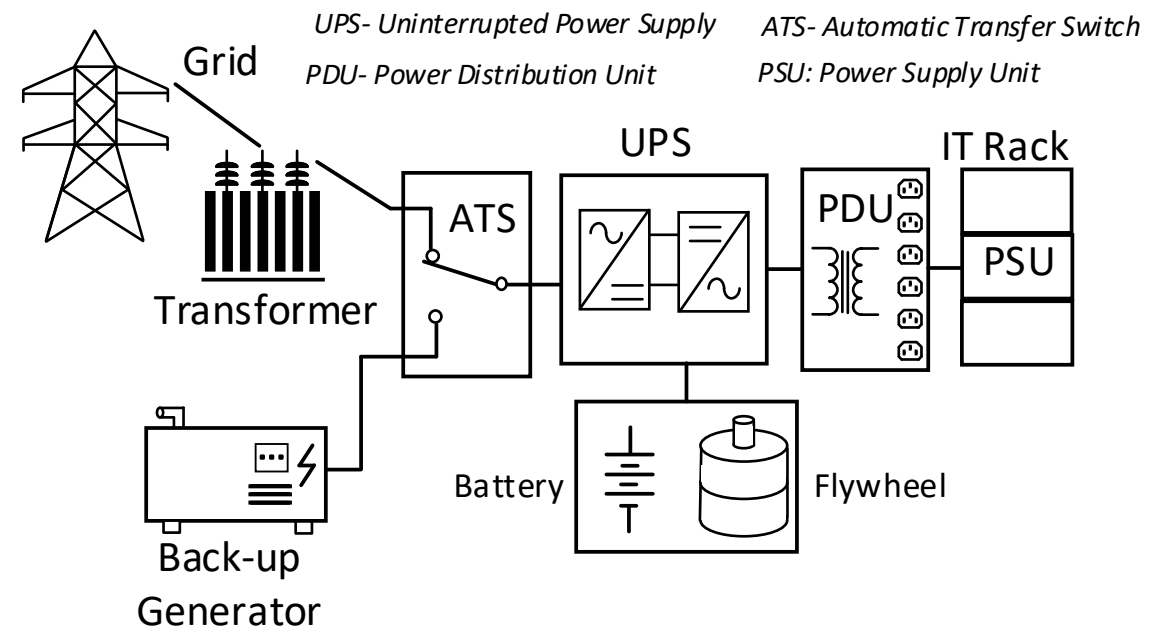
August 19, 2026



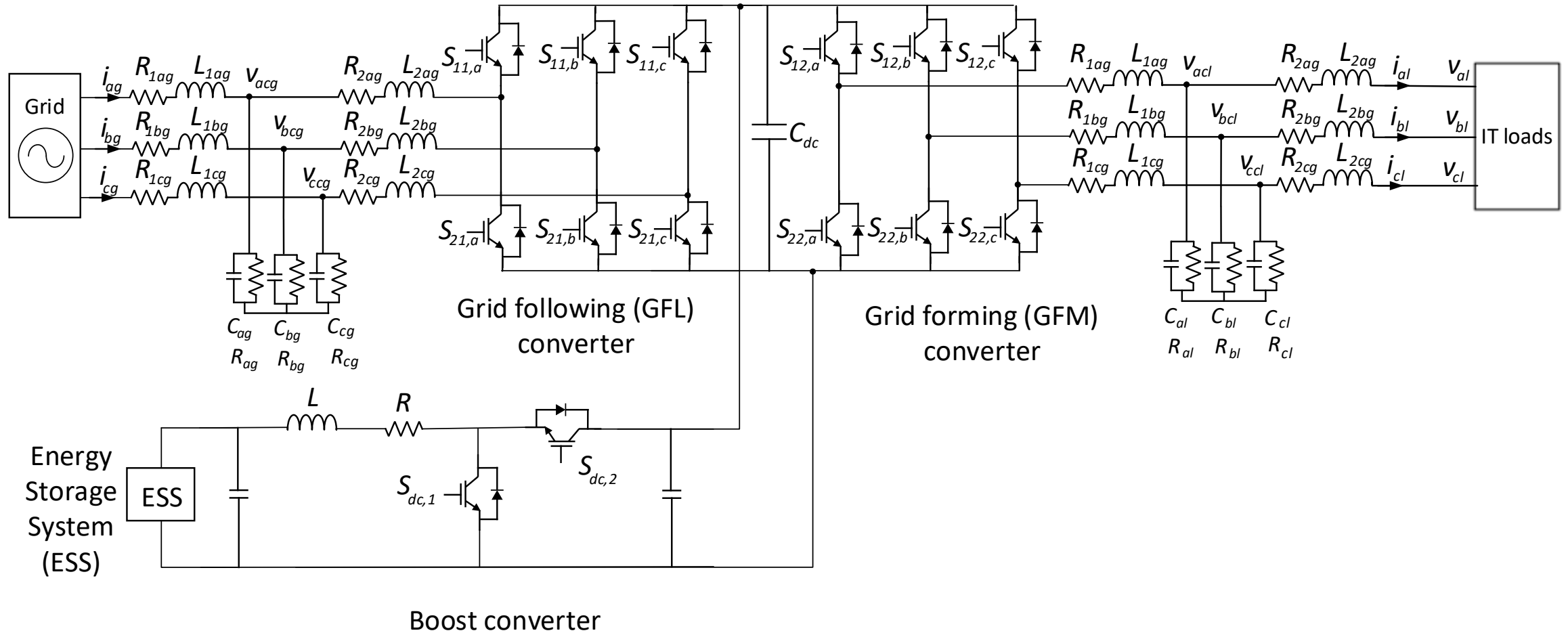
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Motivation

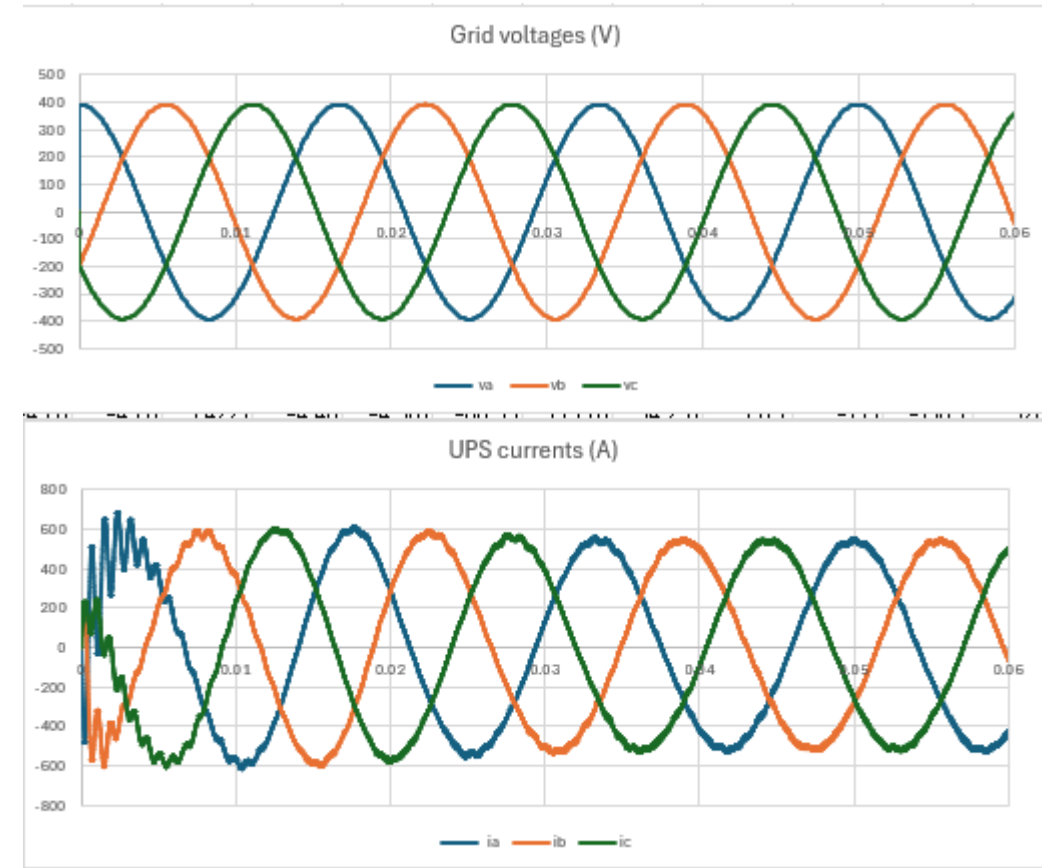
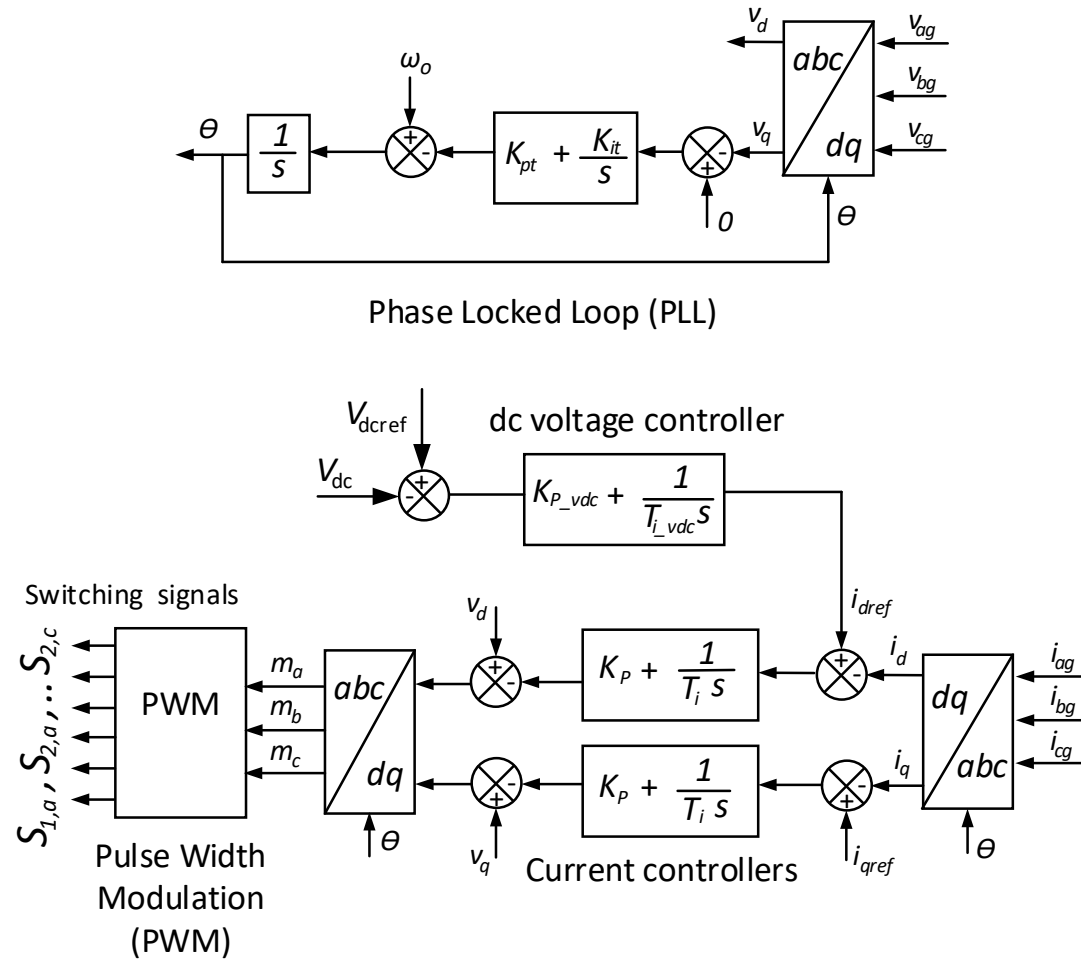
- Develop high-fidelity, detailed EMT models for data center components in RE-INTEGRATE.
- Develop switched models for power electronic converters, including boost converters, boost PFCs, UPS systems, DC/AC converters, AC/DC converters, and diode rectifiers.
- Develop disaggregated and semi-aggregated detailed EMT models for data center and crypto-mining plants.



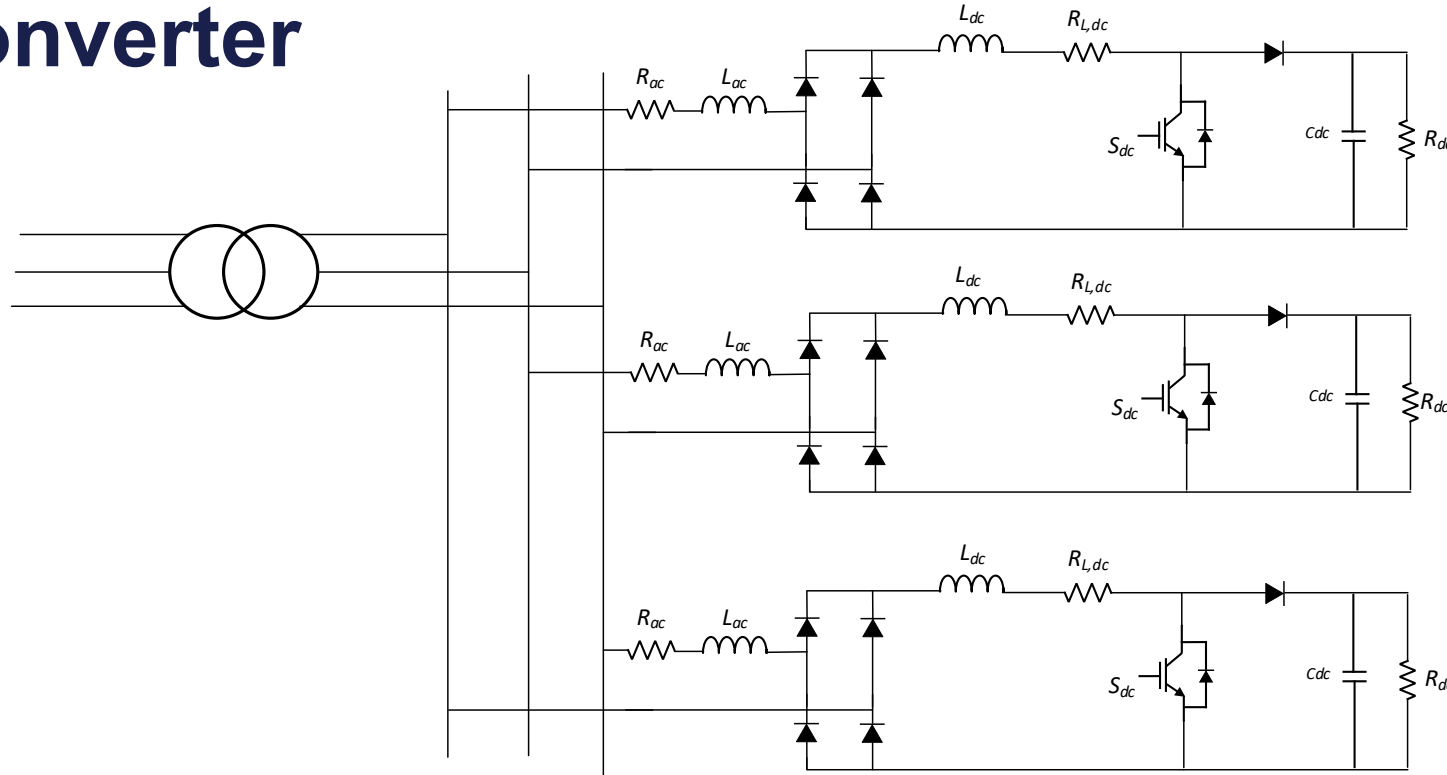
Uninterrupted Power Supply (UPS)



UPS: GFL Converter Controller and Results



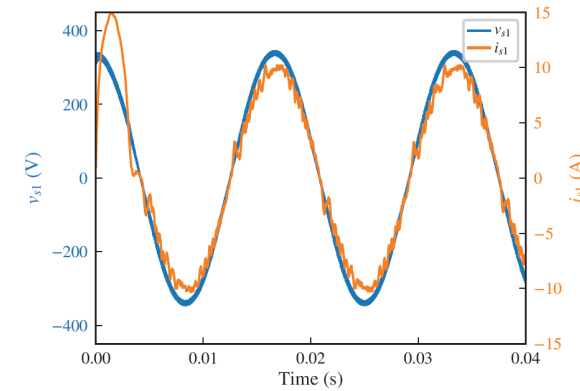
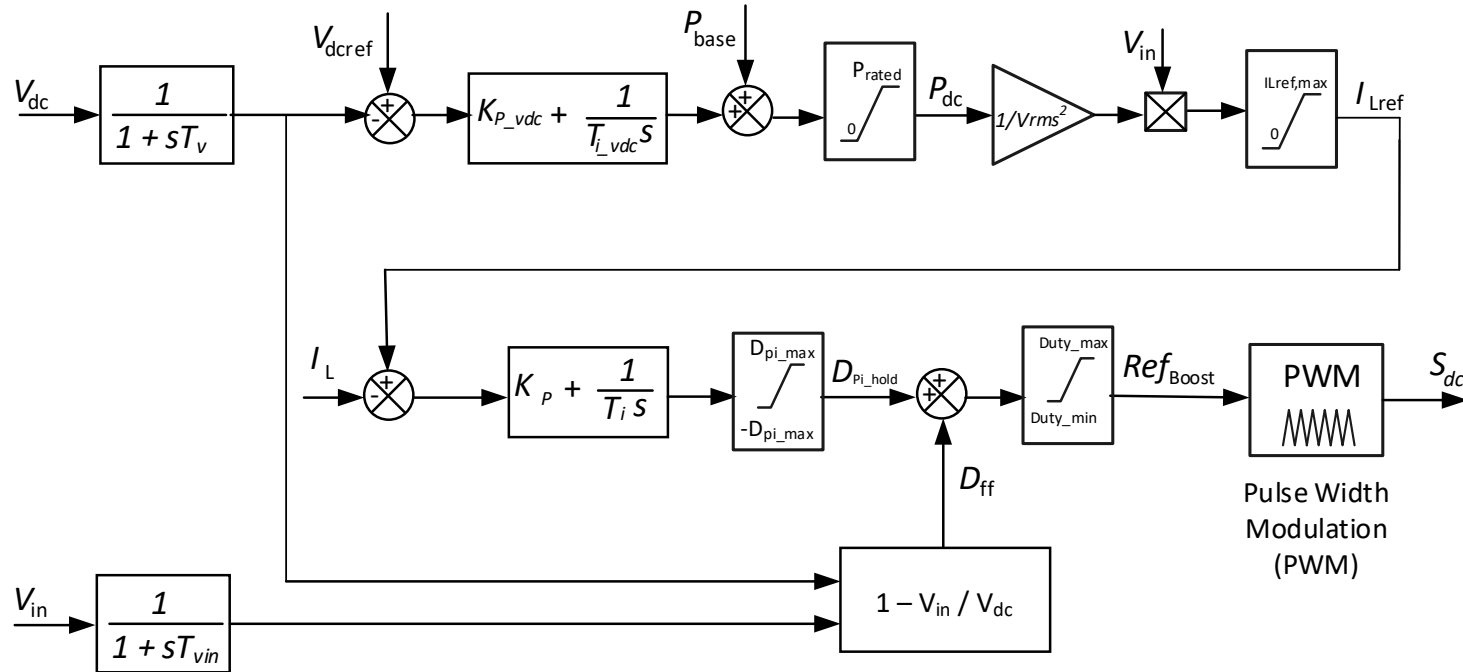
Power Supply Unit (PSU): Boost Power Factor Correction (PFC) Converter



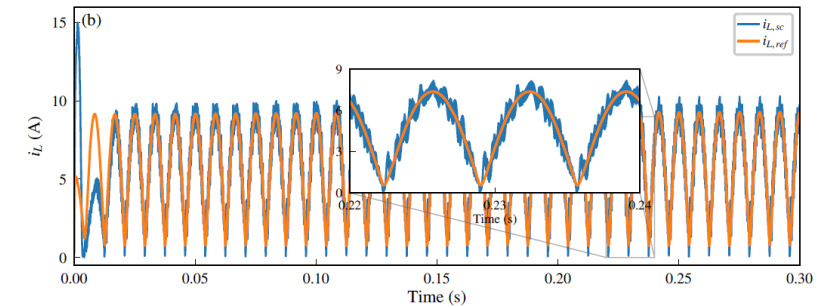
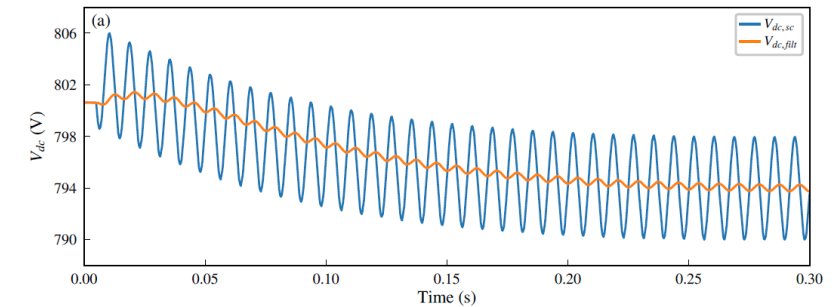
P. Hoang, S. Hasan, Q. Xia, and S. Debnath, "RE-INTEGRATE EMT Simulation Platform: A Multiphase Use Case," *IECON 2026 – 52nd Annual Conference of the IEEE Industrial Electronics Society, Doha, Qatar* (accepted for publication).



Boost PFC Controller and Results



The Boost PFC converter model in RE-INTEGRATE runs 2.5 times faster than a traditional simulator

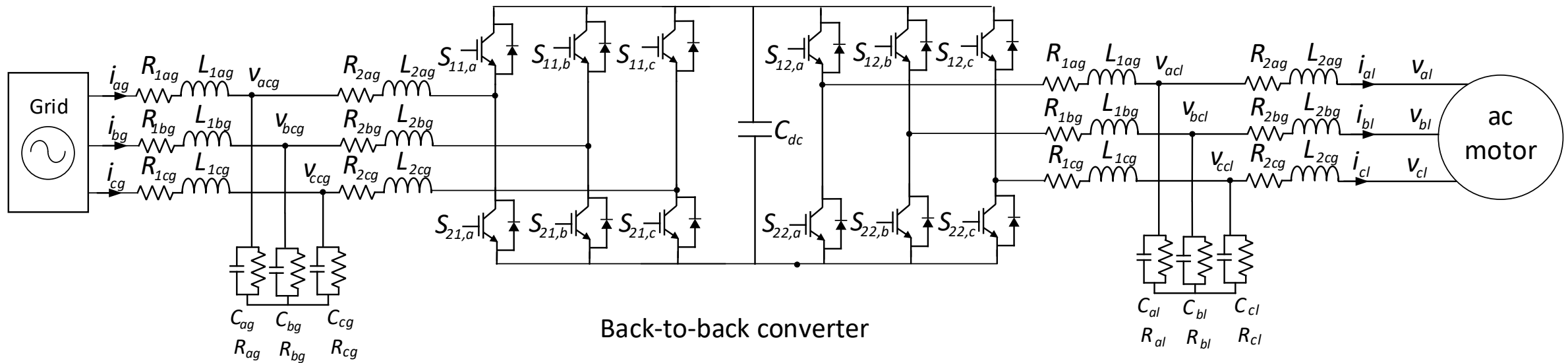


K. Ahmed, S. Hasan, and S. Debnath, "RE-INTEGRATE: Electromagnetic Transient Modeling and Benchmarking of Single-Phase Front-End Converters for Data-Center Application," *IECON 2026 – 52nd Annual Conference of the IEEE Industrial Electronics Society, Doha, Qatar* (accepted for publication).

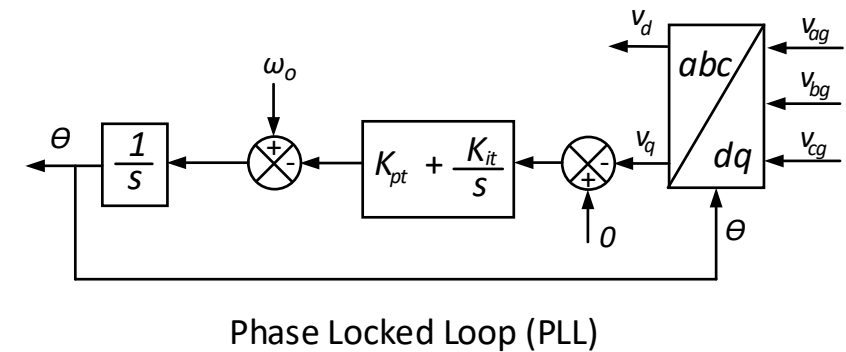
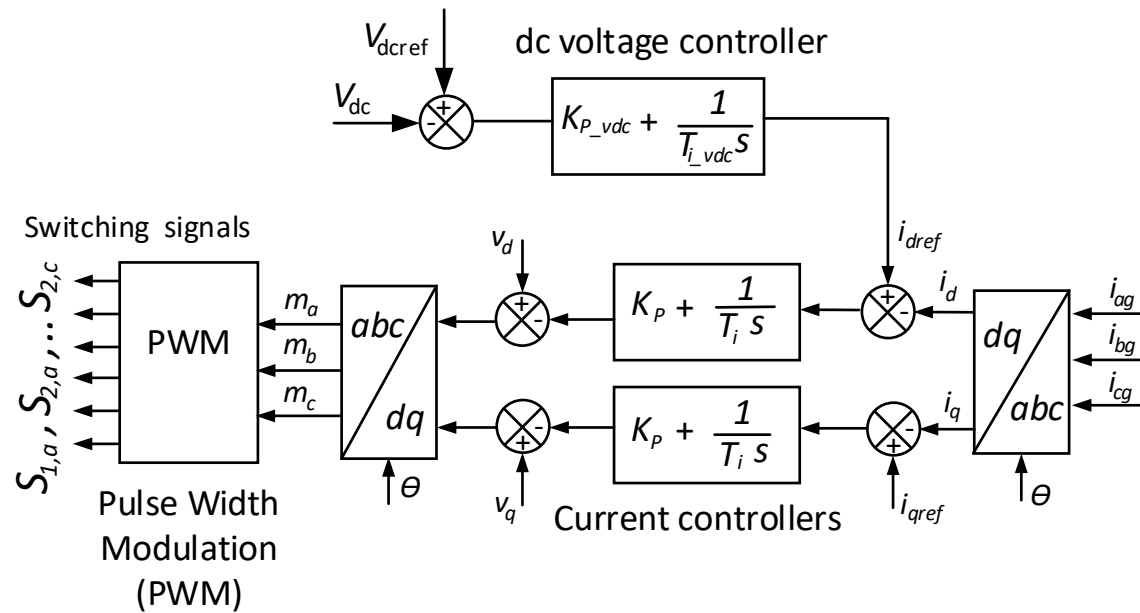


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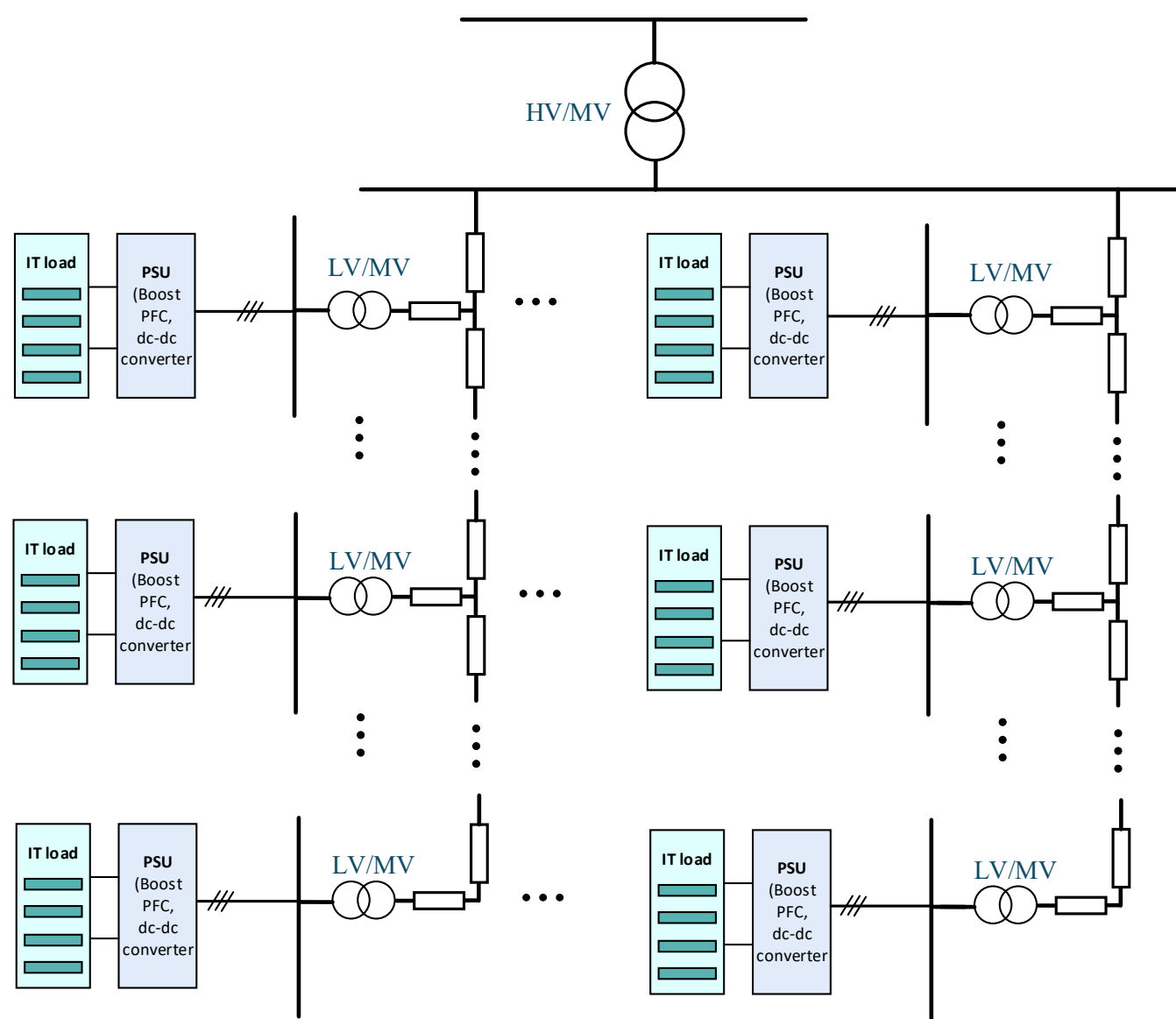
Variable Frequency Drive (VFD) for Cooling



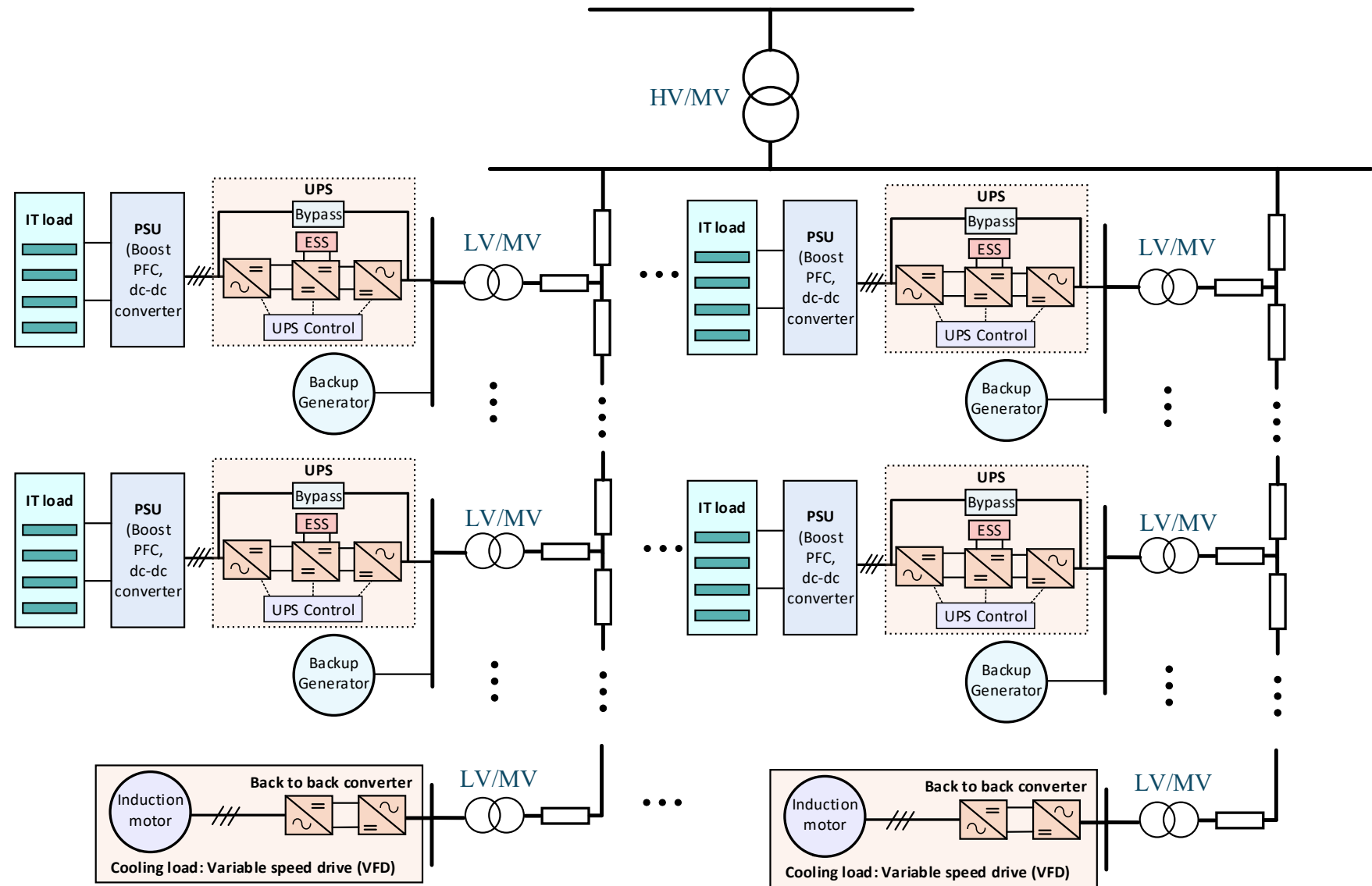
VFD Controller (Grid Side)



Disaggregated Crypto-Miner Plant



Future Work: Disaggregated Data Center Plant



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Conclusions/Next Steps

- High-fidelity detailed EMT models are developed for large load plant
- The models are used to developed disaggregated and semi-aggregated large-load plant models.
- Next Steps
 - Different protection features will be included in the component models.
 - Real-world large-load models will be developed for event replication.



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Thank You

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