Call for Papers

IEEE Transactions on Power Electronics (TPEL)

Special Section on Grid-Forming Technologies under Converter and Resource Constraints

Scheduled Publication Time: October 2026

Summary

Deployments of power electronics are rapidly growing in electric power systems of all scale to improve grid controllability, efficiency, and integrate renewable generation and storage. Grid-forming (GFM) inverter-based resources (IBRs) provide critical functions (e.g., frequency and voltage control) for grid stability and resilience and are widely expected to replace legacy generators as the foundation of power systems.

However, the short-term energy and overload capability required for GFM converters to replicate the stabilizing features of legacy generation pose a major barrier to adoption. Therefore, enabling GFM functions under converter hardware constraints (e.g., current limits, modulation/duty cycle constraints) and energy resource (e.g., PV, wind) constraints is essential to realize the vision of reliable and resilient power electronic grids. While the field of GFM IBRs is witnessing rapid advancements and deployments of GFM energy storage systems, economic and reliable operation of future grids requires GFM functions from a wide range of assets (e.g., renewables, HVDC). Realizing this vision will require hardware and control innovations that, among other functionalities, increase overload capacity and its utilization, seamlessly integrate short-term energy storage, and explicitly manage resource constraints.

Objective of the special section

The objectives of this Special Section are to (i) encourage the dissemination of new concepts, ideas, and challenges in GFM technologies with significant converter and resource constraints, and (ii) to provide an integrated view of new developments in this general topic area spanning device, converter, thermal management, and control innovation that are not well integrated today. Papers describing novel GFM applications are also welcome.

Relevant subtopics

Topics of interest include, but are not limited to:

- Advanced models of converter hardware constraints as well as resource constraints and their use for improved control design
- GFM control for intermittent and variable resources without energy storage
- Novel methods for modeling and analysis of GFM dynamics under constraints

- Analysis of system needs, design of standards / grid-codes, and experimental verification methods for grid-code compliances for GFM IBRs
- Validation, testing, and online-monitoring of grid-forming converters
- Device- and converter-level cooling and thermal management solutions to increase converter overload capability
- Innovative power converter topologies that integrate short-term energy storage
- Modulation and control techniques for GFM converters with low switching frequency
- Advanced controls and converter protection for reliable and resilient fault ride through
- Co-design of modulation techniques, cooling solutions, passive filters, and controls to maximize IBR capabilities under converter and resource constraints

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Estimated number of submissions

Based on the number of active researchers in this field and our experience with past special sections on closely related topics (e.g., in IEEE TPWRD), we expect approximately 40 submissions.

Commitment to promote the special issue

We will promote the special issue through our wide professional network, social media, and through consortia and centers that work on related topics such as UNIFI (UW-Madison, UMN, UAF, NC State) and EPICS (Imperial, JHU).