

Paris Session 2022



Hybrid Grid Forming and Grid Following Converter

B4 PS1 & PS3 – S.1

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Group Discussion Meeting

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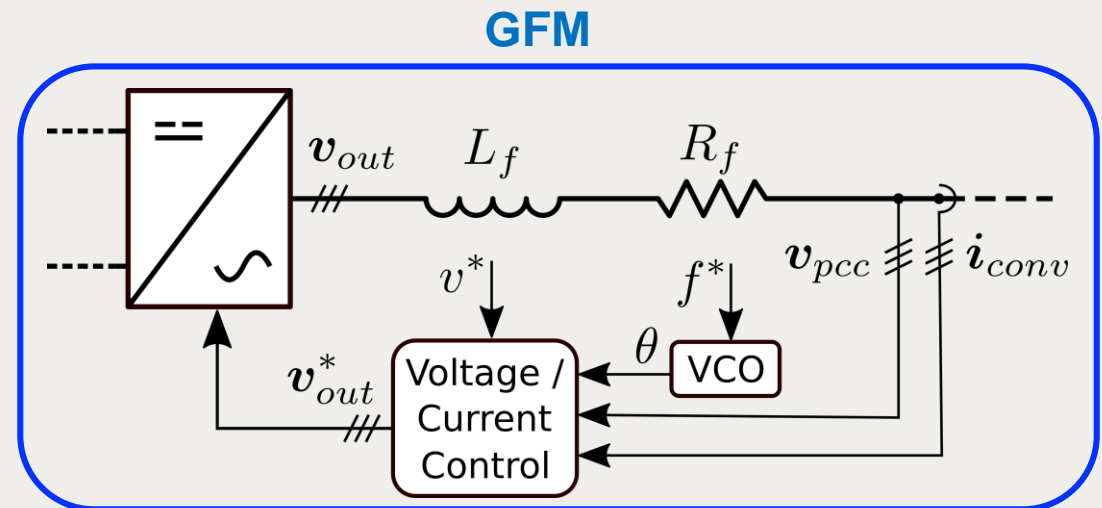
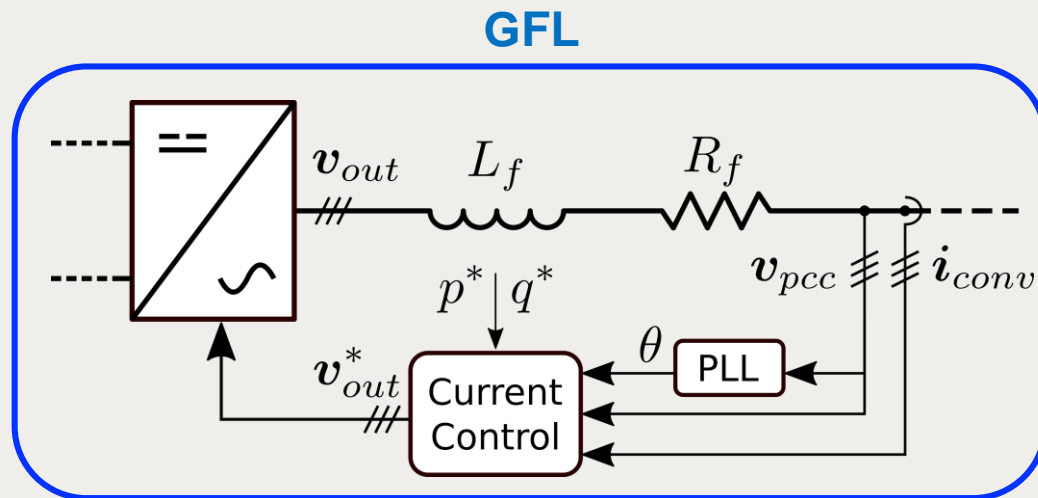
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S1: Challenges for large integration of PE-based ancillary services?

Some important points should be listed:

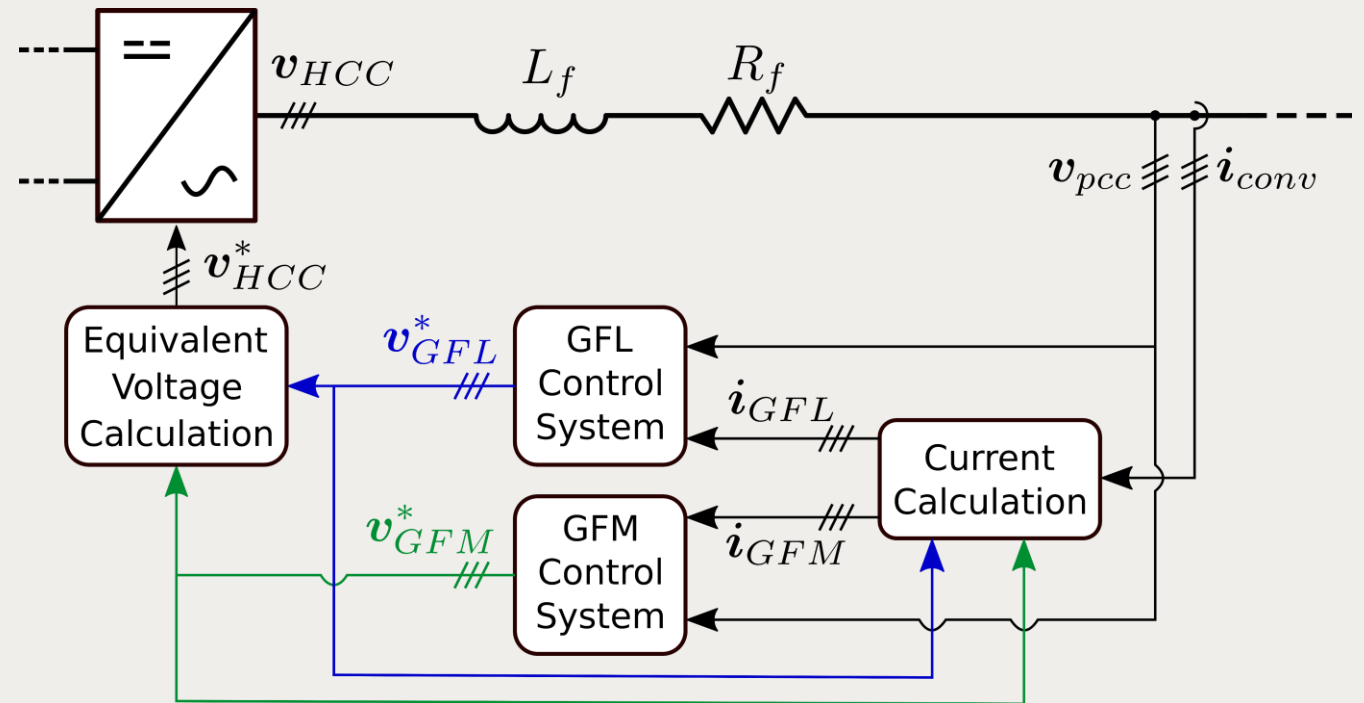
- **GFL**: a grid should exist, and it needs a PLL to synchronize with it (delayed frequency support);
- **GFM**: a grid may not exist, and it has an internal Voltage Controlled Oscillator to generate its own operating frequency (instant frequency support);
- **Challenge for large integration of renewables**: minimum amount of GFM required to maintain grid stability.



Proposal: Hybrid Controlled Converter (HCC)*: GFL and GFM in the same converter

To overcome the problem of high integration of renewables: **HCC** may be the solution.

- The **HCC** operates as a **GFL** in parallel with a **GFM**, all the time (seamless transition between operating modes);
- **HCC** normally has **GFL behavior** guaranteeing MPPT (maximum power tracking);
- **HCC** can show **GFM behavior**, providing immediate frequency support when needed.



Conclusion: Hybrid Controlled Converter (HCC) with GFL and GFM in the same converter may solve the problem

Dynamic response of a full-converter wind turbine with **Synthetic Inertia** (SI) after a step change in the system load

Case 1: usual **GFL** converter

- The PLL must detect the frequency drop, and then the SI is activated;

Case 2: **HCC**

- ✓ The **GFM-part** provides immediate support with sharp active power increase while the SI is not activated yet;
- ✓ RoCoF is reduced with **HCC**;
- ✓ With **HCC** minimum frequency is smaller.

