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Power Engineering Advanced Research Laboratory [PEARL]

System Support Services from Hydrogen Electrolysis Plants

EPICS Workshop- CSIRO Energy Centre, Newcastle

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28 January 2026

Outline

- Motivation and Background
- Role of Electrolysers in Modern Power Systems
- Key Challenges
- Experimental Modelling and Validation
- Key Takeaways

Motivation and Background

Rapid deployment of **MW-scale** electrolysis plants

Project	Yuri Project (WA)	REFHYNE (Germany)	HySynergy (Denmark)	GIGASTACK (UK)
Electrolyser Capacity	10 MW	10 MW	20 MW	100 MW

The electrolyser's ability to participate in **grid support services**

- **Flexible load** operation capability
- **Fast response** capability
- **Power electronic control** strategies

Economic incentive of electrolysers providing flexible services

- Grid **services markets**
- Avoiding **curtailment** of excess renewable energy

Role of Electrolysers in Modern Power Systems

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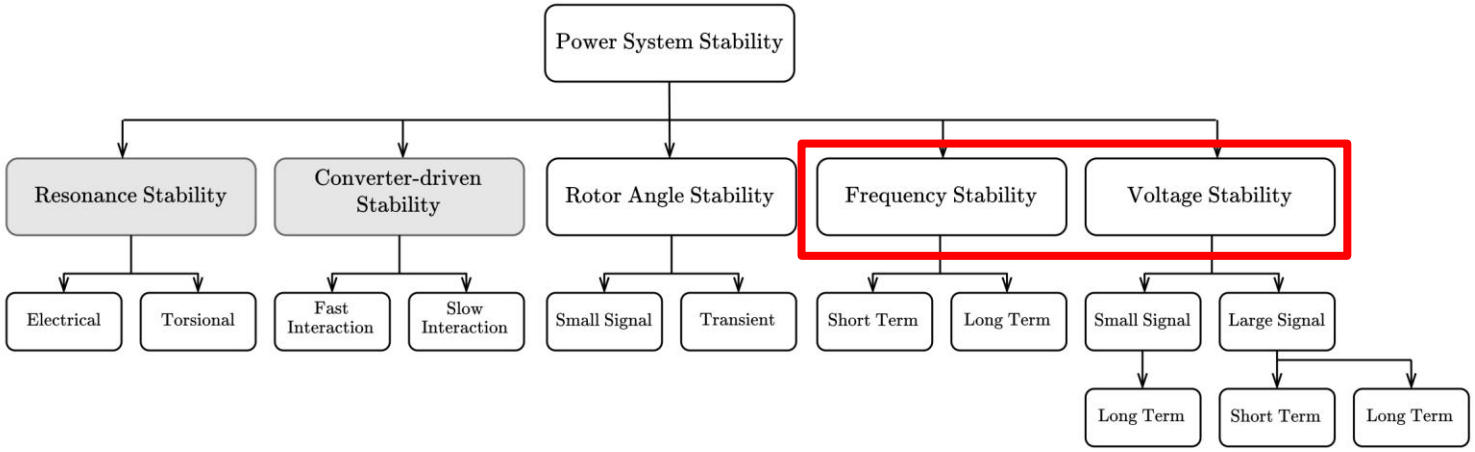
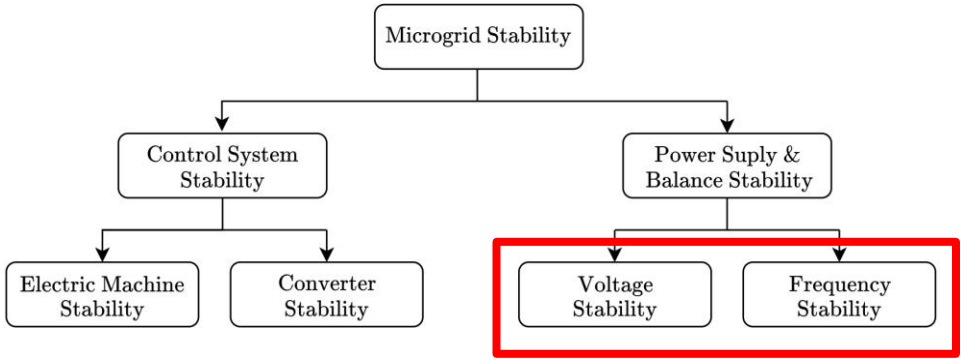


Extended classification of power system stability.



Classification of microgrid stability.

Power System Support Services from Hydrogen Electrolysers

Active power- frequency Support

Rapid active power modulation

Reactive power- voltage Support

Converter-based reactive power control capability

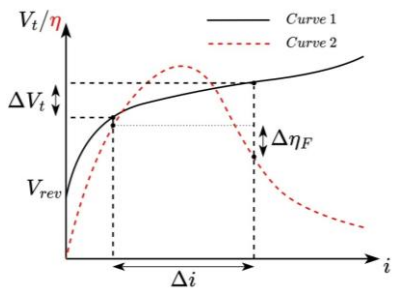
Key Challenges

? Electrolysers are not Ideal controllable loads

Operational Constraints

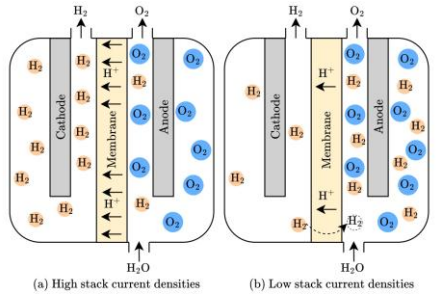
Stack nonlinearities

Linear control assumptions become inaccurate



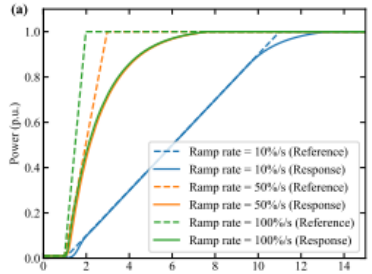
Partial Load Limit

Limits **downward power modulation** for frequency support



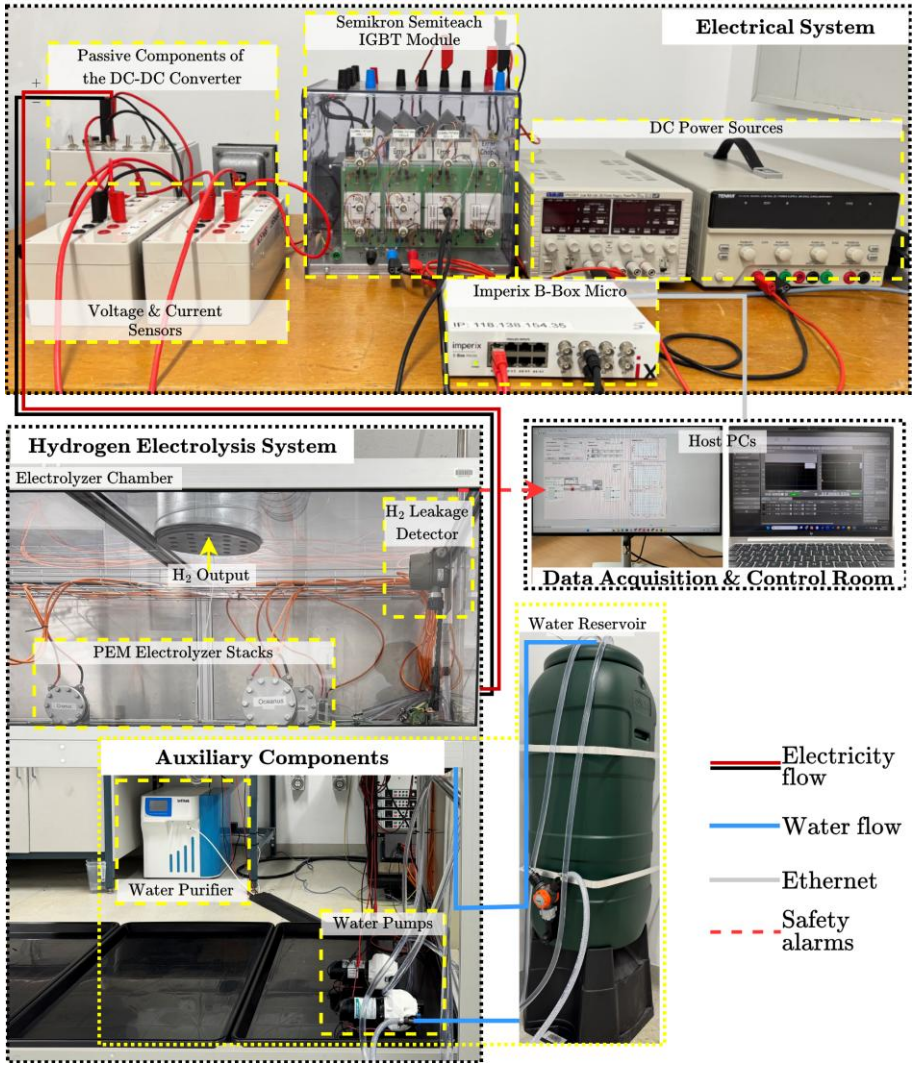
Ramp Rate Limit

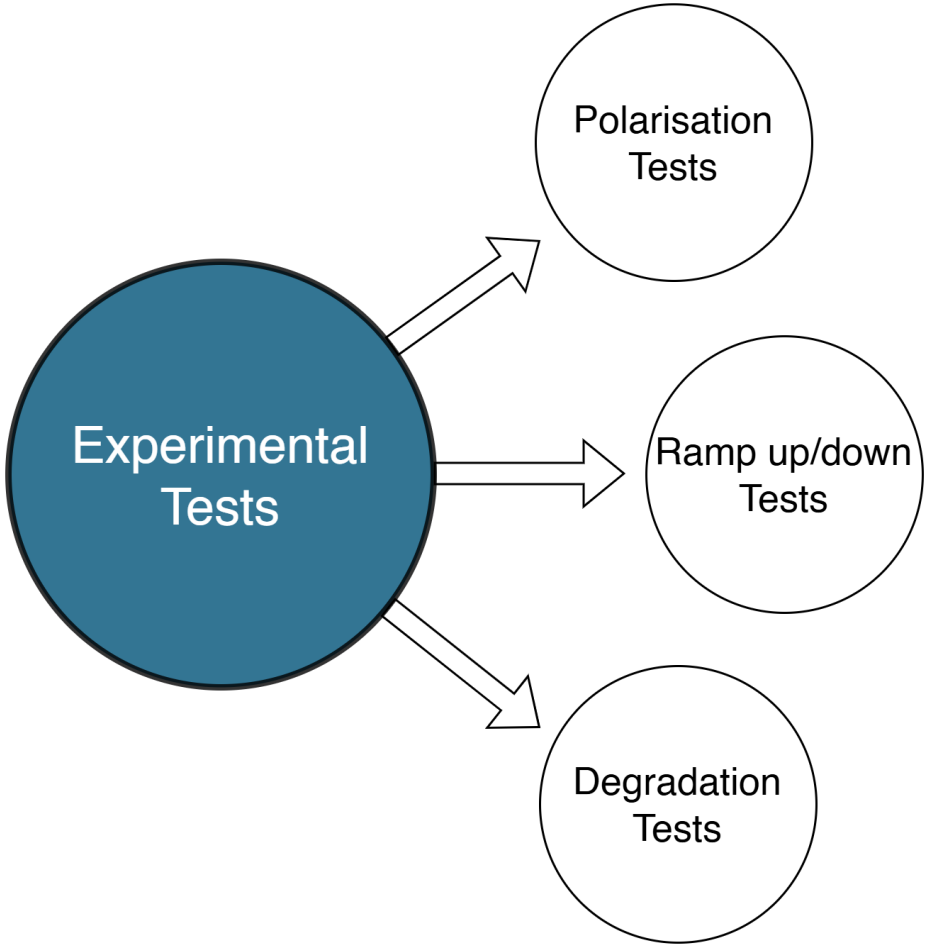
Limits the **speed of frequency support** during disturbances



N. Taranin,, "On the Ramp-Rate Limitation of Electrolysis Plants: Modeling Fundamentals and System-Level Impact Analysis," in *IEEE Transactions on Sustainable Energy*

Experimental Modelling and Validation





Key Takeaways

- **Electrolysers can provide grid support services** through fast, converter-based control.
- **Practical constraints** strongly influence the electrolyser's grid support and must be considered in control and system-level studies.
- **Experimental validation** is essential for realistic modelling and control design.
- **Lab-validated models** enable credible system-level assessment, supporting the integration of electrolysers into inverter-dominated power systems.