TSO2020 Closing Event

Activity 2: The role of P2G conversion in the stabilization of electrical power systems

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Co-financed by the European Union
Connecting Europe Facility

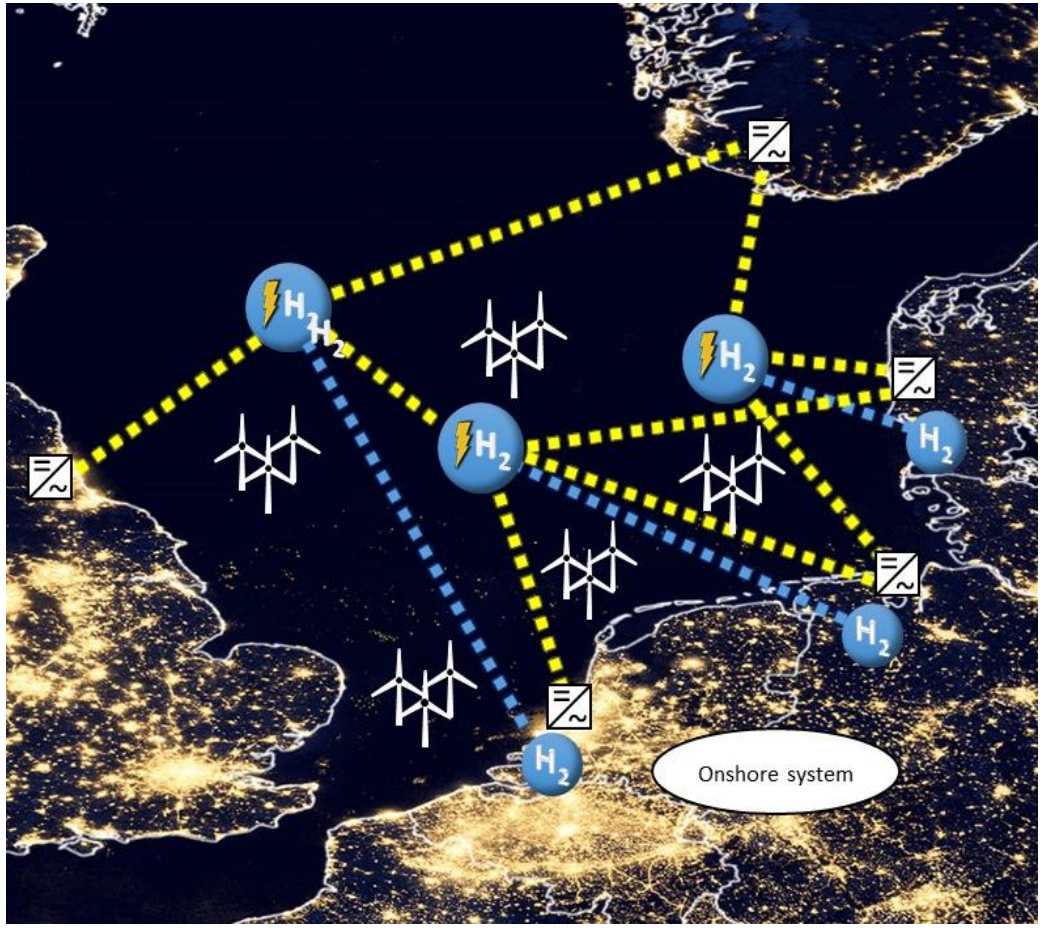
“Affordable and reliable transition to 100% clean electricity supply is not feasible without hydrogen infrastructure”

Prof. Mart van der Meijden

OUTLINE

1. Scope of Activity 2
2. Approach
3. Results
4. Conclusions
5. Outlook

1.1 MOTIVATION OF ACTIVITY 2



Urgency: Stability & reliability of energy systems at risk!

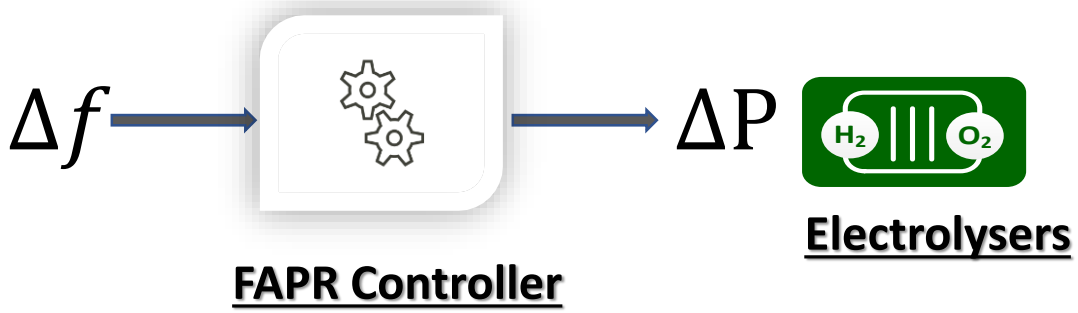
	AC	AC/DC
STABILITY	✓	↯
CONTROL	✓	↯
CLEAN	↯	✓

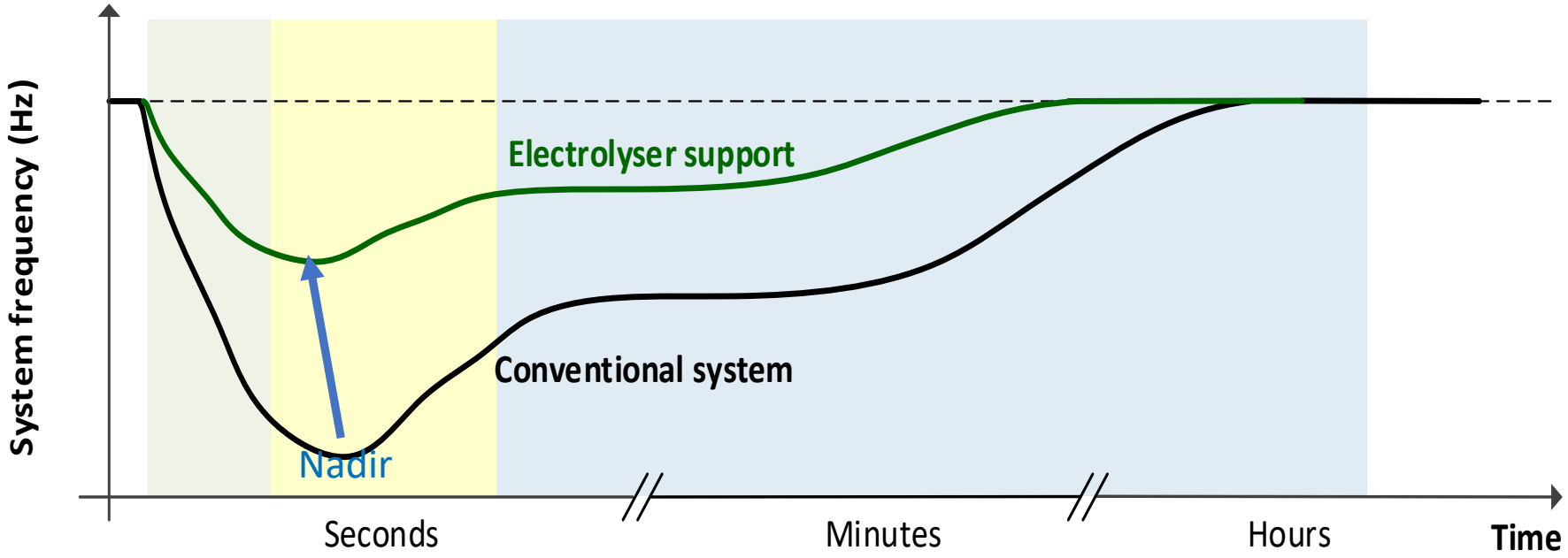
Focus

	duration
▪ Dynamic stability	microseconds
▪ Balancing	minutes
▪ Day-night storage	hours
▪ Seasonal storage	days
▪ Dunkel Flaute Elfstedentocht	weeks

2.1 APPROACH: RESEARCH GOAL

Investigation of the performance and impact of fast active power regulation (FAPR) control strategies implemented on renewable energy hubs (incl. MW-scale controllable electrolysers)



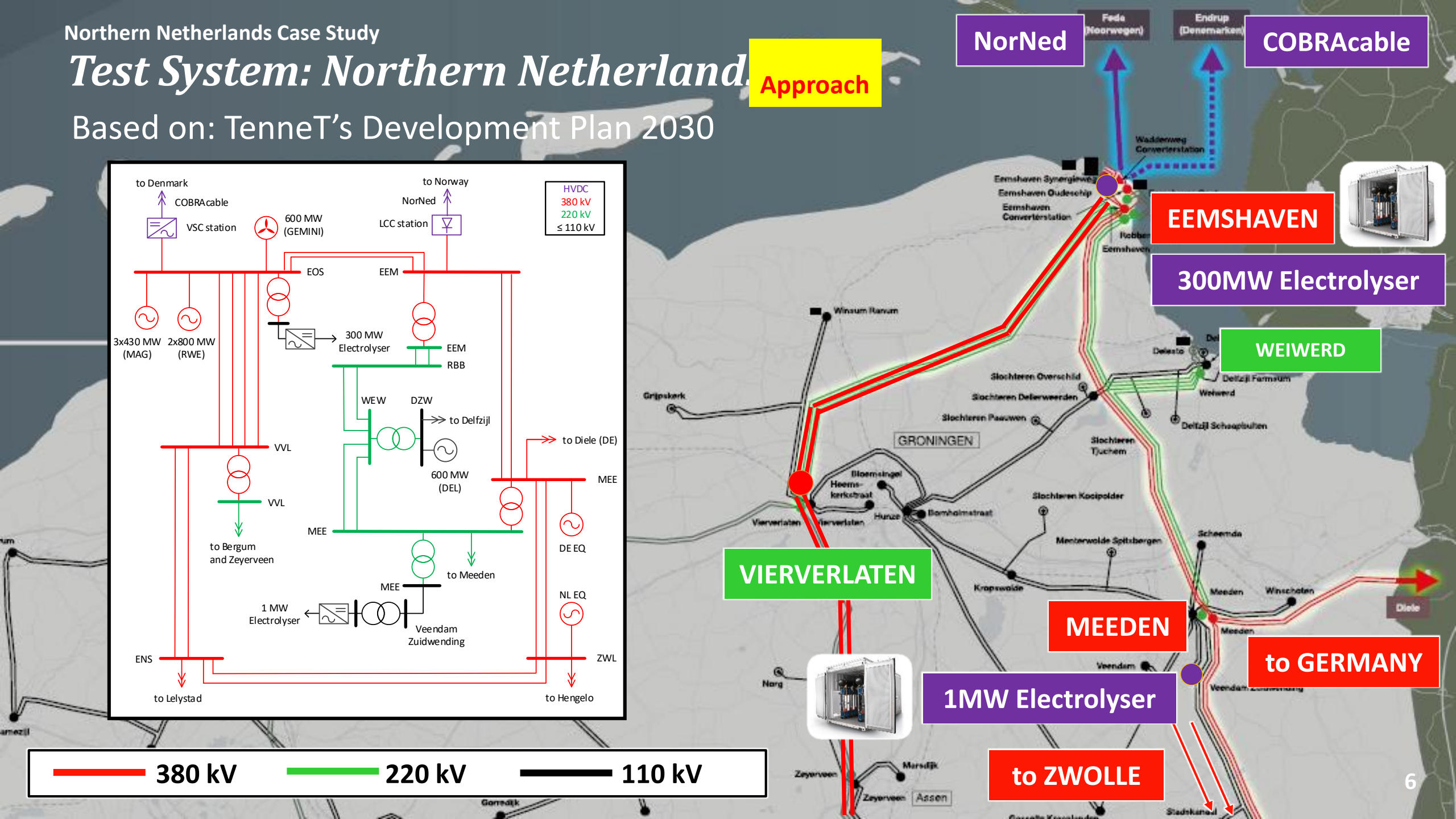


Northern Netherlands Case Study

Test System: Northern Netherlands

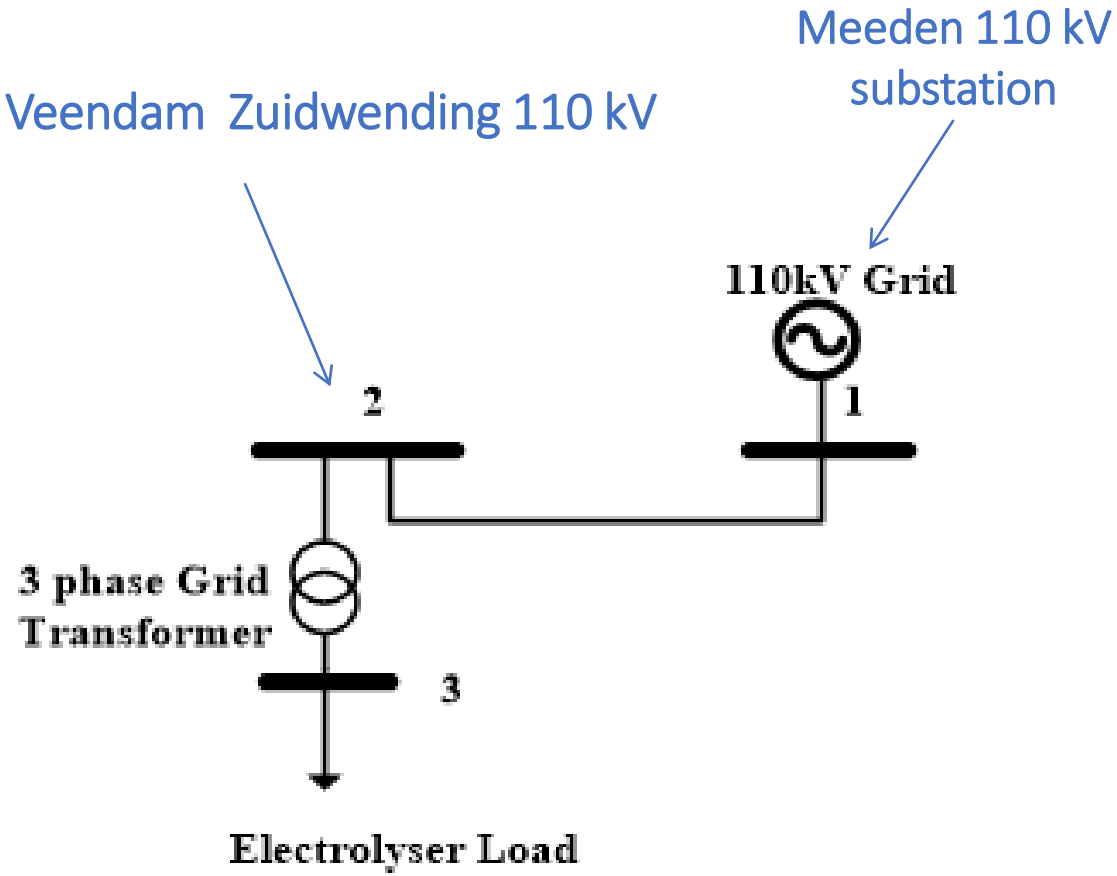
Based on: TenneT's Development Plan 2030

Approach

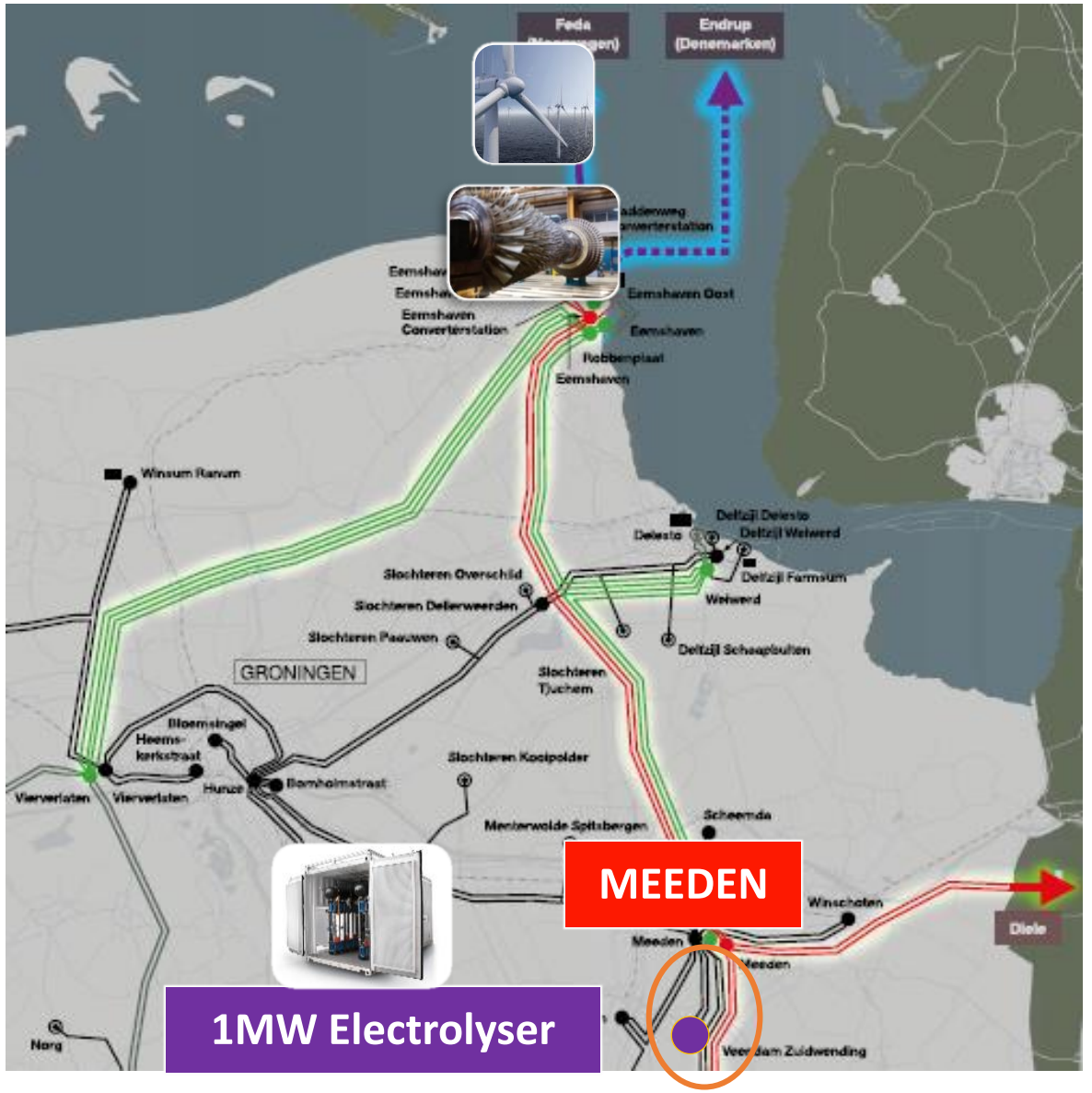


380 kV 220 kV 110 kV

3.1VALIDATION ELECTROLYSER MODEL (VEENDAM-ZUIDWENDING)

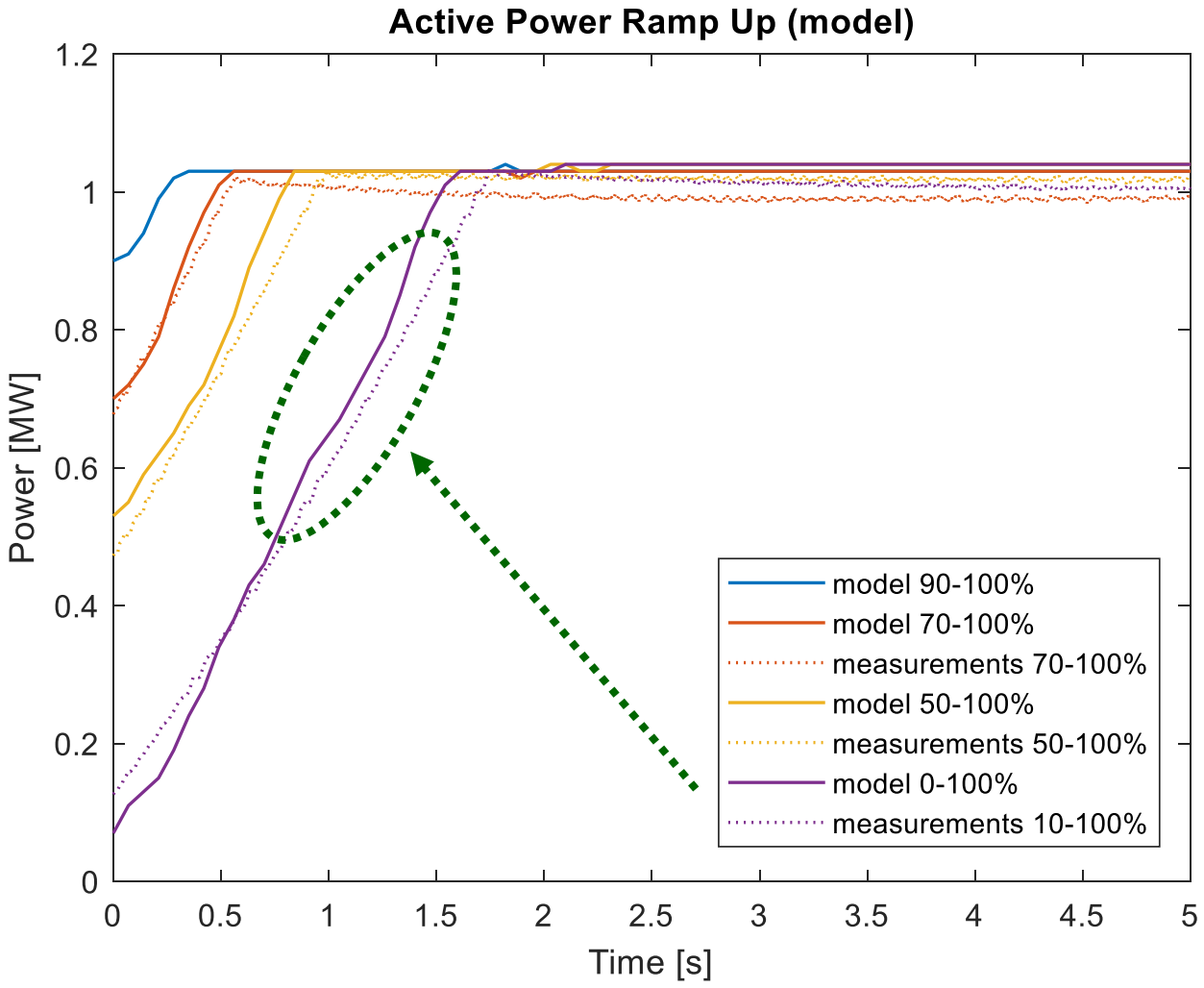


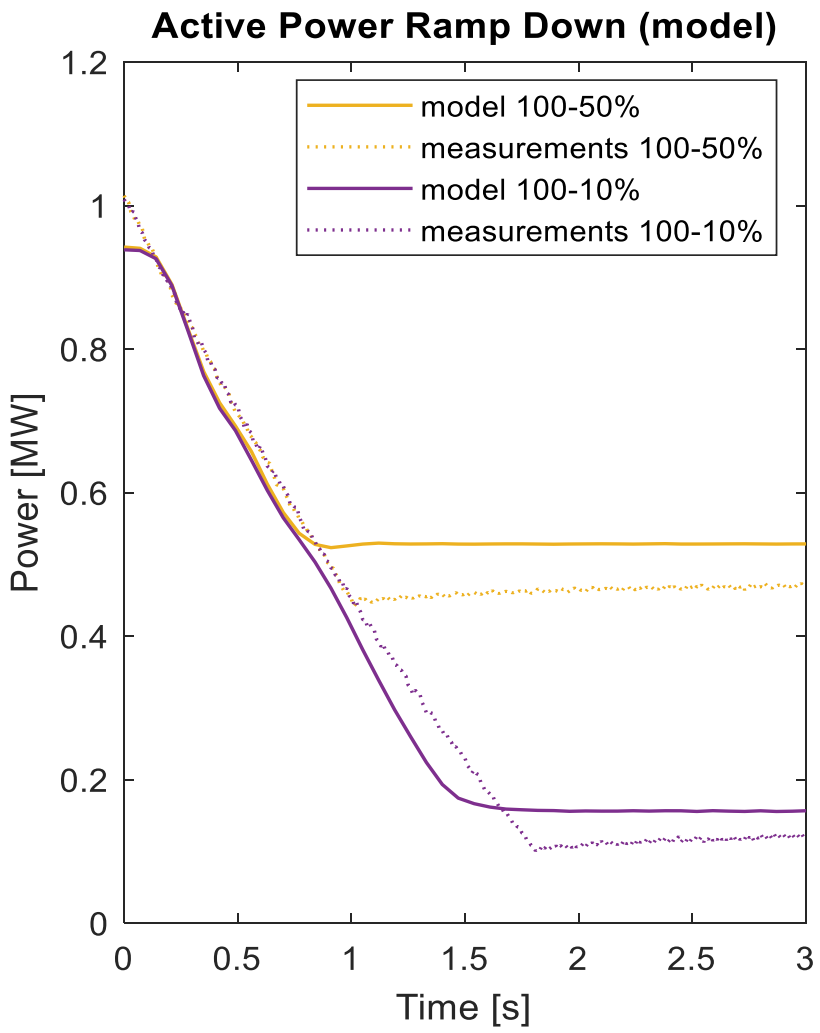
1 MW electrolyser
Veendam Zuidwending



3.1VALIDATION ELECTROLYSER MODEL (VEENDAM-ZUIDWENDING)

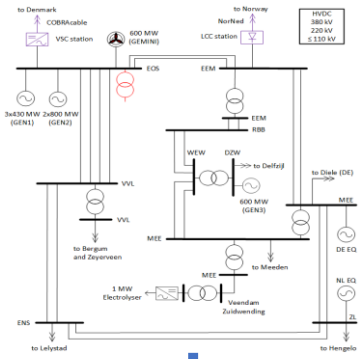
Generic 1-MW electrolyser model:





The generic electrolyser model is able to accurately follow the measurements.

3.2 RESULTS: CONTROL STRATEGIES FOR PEM ELECTROLYSER



Frequency

50 (Hz)

RTT

VSP based FAPR Controller

(V and *f*)

I_{d_Ref}

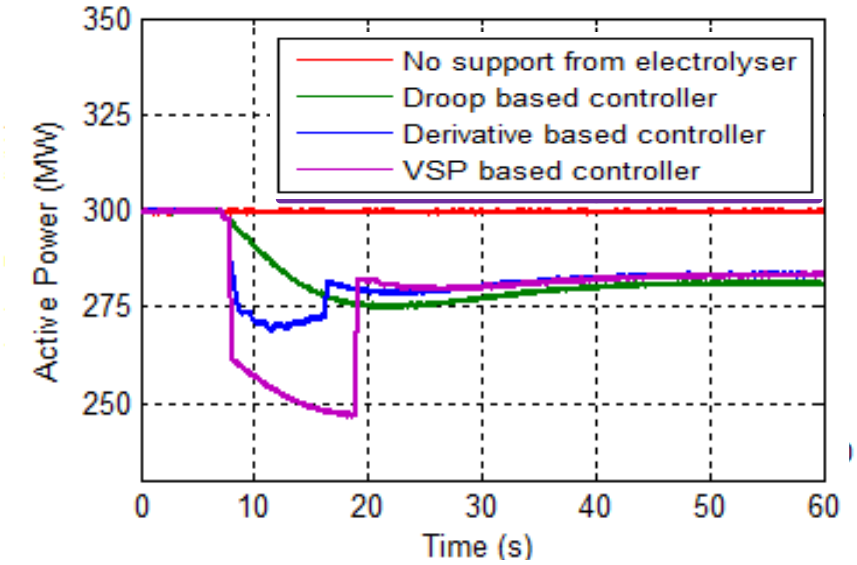
(V and *f*)

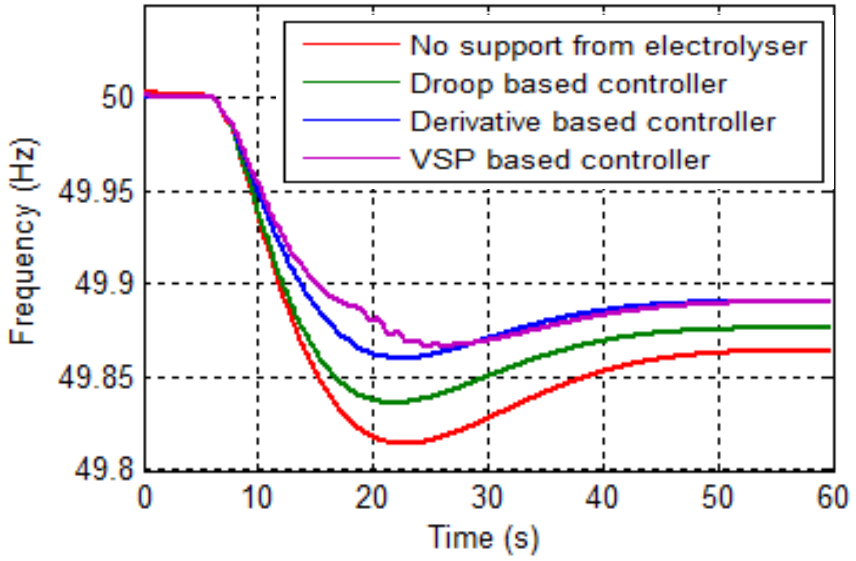
DC Power

Electrolyser

AC-DC-AC
Grid Emulator

AC-DC
Electrolyser converter





PEM: Proton-Exchange Membrane

4 CONCLUSIONS

- The synergy between the electrical system and the hydrogen system unlocks potential for new control principles to safeguard operational flexibility of the electrical system.

- Electrolyser's demand side response can significantly enhance the dynamic performance (milliseconds) of the electrical system, increasing its resiliency.

- Power rating, location, and optimal controller design are key parameters for effective stability support by electrolysers.

5 OUTLOOK

- New control principles for stabilization of low inertia chaotic systems (e.g. renewable hubs) should be urgently developed to accelerate the energy transition.

Thank you for participating!