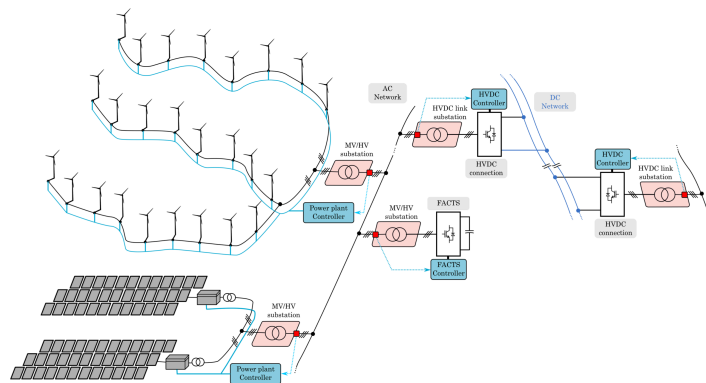


# Control of power-electronics-dominated power systems

**Course description:** Electrical power systems are undergoing transformations at generation, transmission, distribution and demand levels. The massive penetration of renewable energy, the proliferation of storage systems, electric vehicle, Flexible AC Transmissions Systems (FACTS) and DC interconnectors in combination with the phase-out of conventional generation, is leading to a power electronics dominated power system. Although Power Electronics (PE) devices increase the network controllability, it is clear that they are substantially different compared to synchronous generators, fact that poses relevant challenges both at network operation and control levels. The course covers modelling, analysis and control design of Voltage Source Converter (VSC) controllers for future power electronics dominated networks, providing a practical view on their implementation, showing relevant examples and discussing practical cases. Specific topics covered in the course include:

- Future power electronics-dominated power systems. Main applications and challenges.
- Voltage source converter review. Different structures 2L, 3L, Modular Multilevel Converters (MMCs).
- 2L/3L VSCs: Main control blocks. Usual transformations.
- Grid forming converters. Concept definition and main structures. Different control options.
- MMC applications. Control design and implementation.
- Power electronics-dominated system stability and interaction analysis. Linearization of converter and power system dynamics. Eigenvalue analysis. Participation factors.
- Trends in research/industry. New controllers. New interaction analysis methods.



**Lecture / exercise times & locations**

Lectures:	Tuesday	8:00 to 10:00	CAB G52
Exercises:	Tuesday	10:00 to 12:00	CAB G52
Lecturers:	Eduardo Prieto-Araujo	eprieto@ethz.ch	
	Verena Häberle	verenhae@control.ee.ethz.ch	
	Michael Fisher	mfisher@ethz.ch	
	Linbin Huang	linhuang@ethz.ch	

**Prerequisites**

Basic knowledge on power electronics, power systems and control systems. Basic Matlab skills as well as sufficient mathematical maturity.

**Grading**

The class is based on three homework assignments [project oriented] (50%) and a final oral exam (50%).