

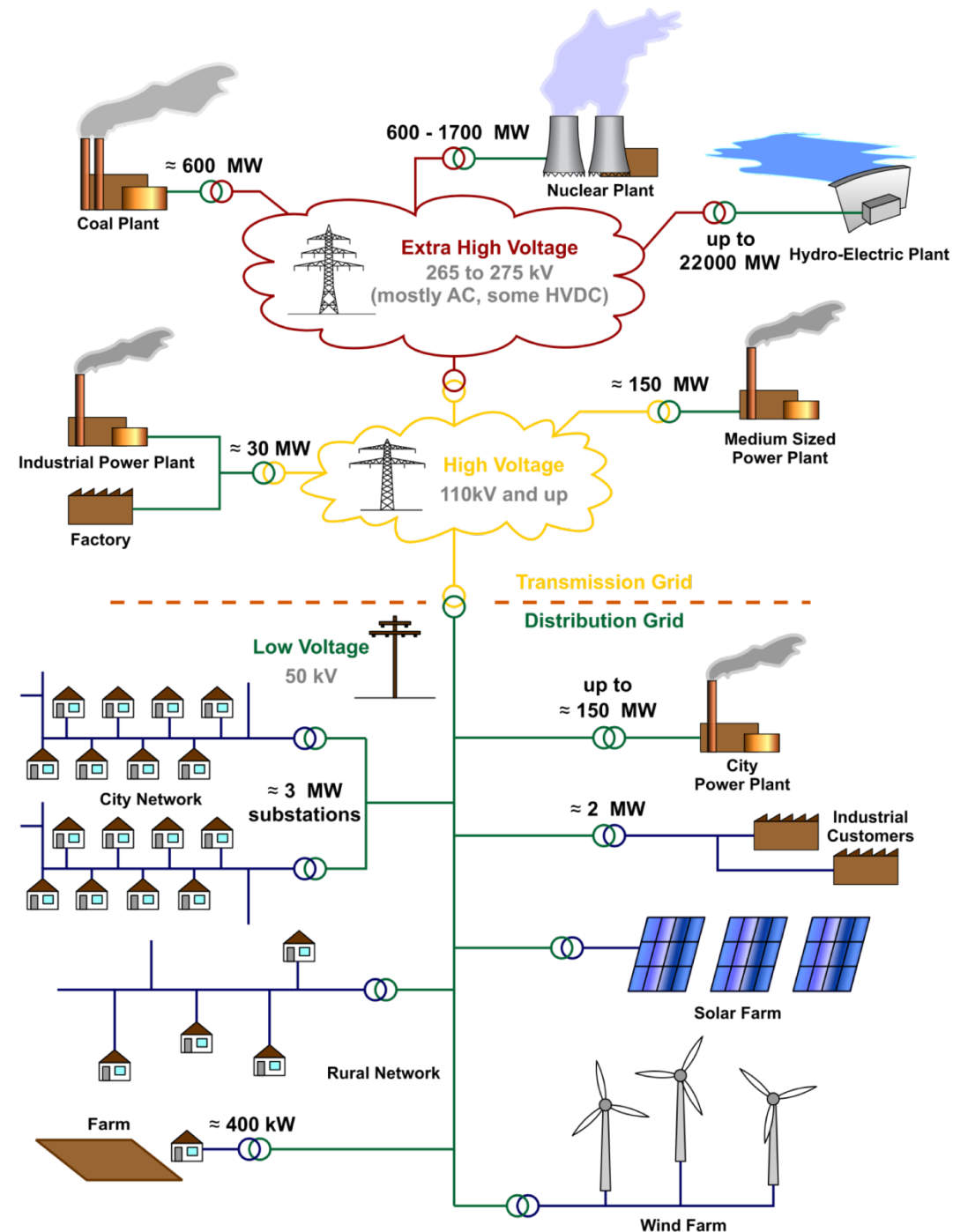
■ Introduction - Power grid and his operation

- **Electrical (power) grid** - interconnected network of power lines and associated equipment used to deliver electricity from producers to consumers.
- **Production (Generation):** typically done in power plants (e.g. coal, nuclear, water based)
 - often far away from consumers, long distance is caused by several factors, such as economy, health, security, environmental.
- **Electricity delivery** - generally occurs at two levels
 - **Transmission:** carries the power for long distances (e.g. hundreds of kilometers) and uses higher voltages for more effective transmission
 - **Distribution:** focused on delivery for individual consumers and uses lower voltages for safer and easier distribution.
- **Electricity consumption**

■ Power grid & distributed energy resources (DER)

- The typical chain in power grid is generation -> transmission -> distribution -> consumption.
- Besides this traditional concept there exist concept of **distributed energy resources (DER)**.
- Here, the power is generated close to the consumption point, e.g. in the same building.
- Typically, these resources are small and environment friendly.
- They typically use solar energy, natural gas, or wind.

- Basic scheme of electric power grid with energy generation, transmission, distribution, consumption and DER
- Exact voltage naming and exact split point between transmission/distribution can differ, based on country



- Example of schematical view of real transmission power grid of central Europe

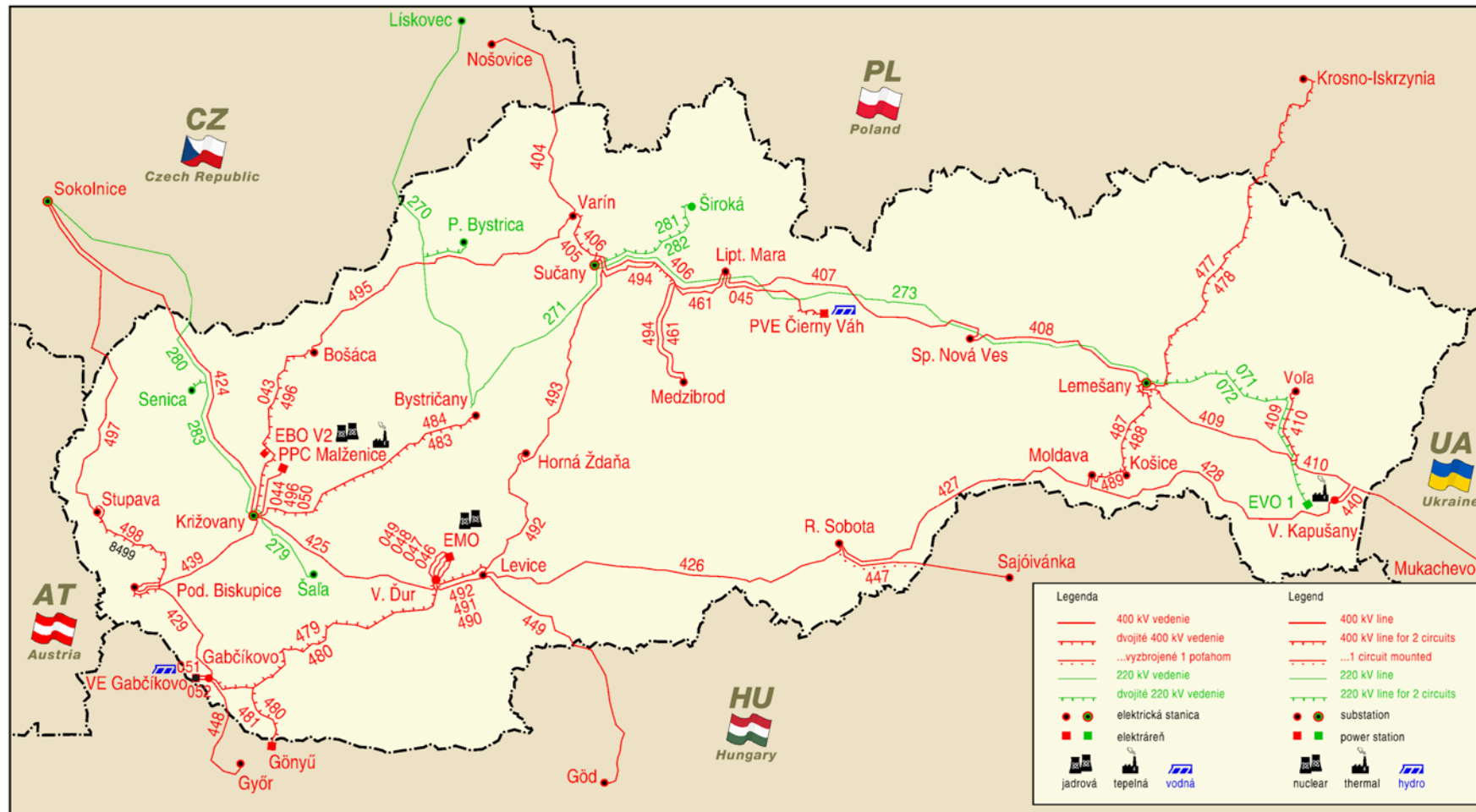


■ Example of transmission power grid - exact positioning on map



Slovenská elektrizačná
prenosová sústava, a.s.

Mapa Prenosovej sústavy Slovenskej republiky Map of Power System of The Slovak Republic



■ Power grid and his operation

- The transmission part in each country is operated by **transmission system operators** (TSO)
- The distribution is performed by **distribution system operators** (DSO).
 - The distribution operators can be **regional** (above 100 000 consumption points) or **local**
 - In Europe, there are above 3500 DSO companies.
 - In some countries (e.g. as Czechia, Slovakia, Hungary) three largest DSO deliver more than 60% of power.

■ DSO situation in EU

	Country	Code	Number of DSOs	Number of legally unbundled DSOs
	Austria	AT	126	11
	Belgium	BE	16	12
	Bulgaria	BG	4	4
	Croatia	HR	1	1
	Cyprus	CY	1	1
	Czech Rep.	CZ	290	3
	Denmark	DK	40	10 ⁴
	Estonia	EE	34	1
	Finland	FI	77	9
	France	FR	144	6
	Germany	DE	883	80
	Greece	GR	1	1
	Hungary	HU	6	6
	Ireland	IE	1	1
	Italy	IT	128	8
	Latvia	LV	11	1
	Lithuania	LT	6	1
	Luxembourg	LU	4	1
	Malta	MT	1	0 ⁵
	The Netherlands	NL	6	6
	Norway	NO	119	7
	Poland	PL	184	5
	Portugal	PT	13 ⁶	1
	Romania	RO	51	8
	Slovakia	SK	3	3
	Slovenia	SI	1	1 ⁷
	Spain	ES	354	5
	Sweden	SE	170	6
	Switzerland	CH	630	0
	United Kingdom	UK	14	6

Low concentration	Medium concentration	High concentration	Very high concentration
Mainly small, local DSOs. The three largest DSOs usually deliver less than 50% of distributed power	A mix of DSOs, with the three largest accounting for more than 60% of distributed power	One dominant DSO (more than 80% of distributed power) and several local DSOs	One DSO company

