APPENDIX

A. Parameters of added lines

TABLE III
PARAMETERS OF ADDED LINES.

	Lines	Reactance (p.u.)	Charging susceptance (p.u.)	Rating (MVA)
IEEE 9-bus	4-6	0.3	0.6	300
	4-8	0.2	0.4	350
	6-8	0.25	0.5	250
	5-7	0.15	0.3	200
	5-9	0.1	0.2	250
	7-9	0.25	0.5	200
IEEE 39-bus	2-39	0.0059	0.068	600
	4 -6	0.0112	0.1476	900
	14-18	0.0082	0.1319	600
	19-21	0.0094	0.171	900
	23-27	0.0094	0.171	900
	24-17	0.0082	0.1319	600

B. Diagram of the SciGRID network for Germany

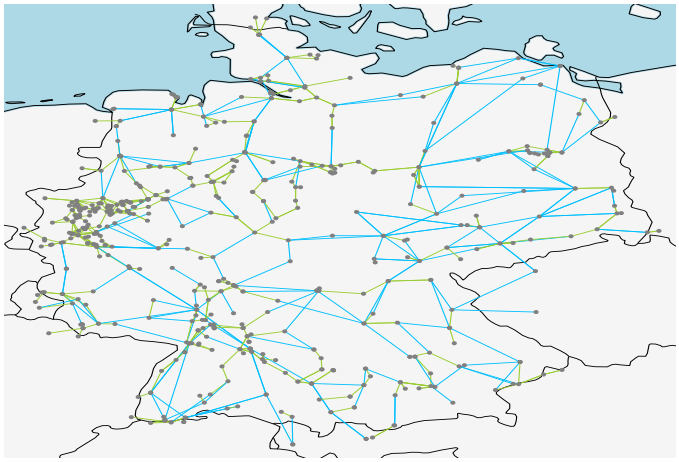

Fig. 18. Diagram of the SciGRID network for Germany. Blue lines are with length larger than 50 km.

C. Dynamic parameters of loads, generators and inverters

TABLE IV
DYNAMIC PARAMETERS OF LOADS, GENERATORS AND INVERTERS.

Type	m_i	d_i	$K_{\mathrm{P},i}$	$K_{\mathrm{I},i}$	τ_i (s)	X'_d (p.u.)
$\mathcal{V}_{\mathrm{S}}$	$m_{0,i}$	$d_{0,i}$	—	—	—	0.3
$\mathcal{V}_{\mathrm{FM}}$	$0.2m_{0,i}$	$0.2d_{0,i}$	—	—	—	0.1
$\mathcal{V}_{\mathrm{FL}}$	$0.2m_{0,i}$	$0.2d_{0,i}$	2.22	61.69	4.502×10^{-3}	0.1
$\mathcal{V}_{\mathrm{L}}$	—	1×10^{-3}	—	—	—	—

* $m_{0,i}=\frac{10\overline{p}_{\mathrm{gen},i}}{\omega_{syn}}$, $d_{0,i}=\frac{\overline{p}_{\mathrm{gen},i}}{2\pi}$. $\overline{p}_{\mathrm{gen},i}$ denotes the maximal active power output of generator/inverter i, and ω_{syn} denotes the synchronous angular speed, taking $2\pi 50$ rad/s . τ_i corresponds to cut-off frequency of filters being $2\pi 35.35$ rad/s which makes dynamic response fast and well-damped for a 50 Hz system [15]. K_{P} and K_{I} are taken from [16]. X'_d is the direct-axis transient reactance of synchronous generators or the equivalent reactance of inverters. The base MVA for X'_d equals to the maximum real power output of the corresponding generator/inverter. ϵ=1×10^{-5}.