Benchmark
PyPSA and SMS++

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This document showcases the latest benchmark between PyPSA and SMS++.
It showcases the successful use of SMS++ with PyPSA networks,
given the low difference in the comparison of the results with promising performances by SMS++.

Benchmark test cases

Case	Sector-coupled	Buses	Loads	Generators	Lines	Links	Multi-links	Storage units	Stores
1n_1c_1g		1	1	1	0	0	0	0	0
1n_1c_1g_1h		1	1	1	0	0	0	1	0
1n_1c_1gext		1	1	1 ext	0	0	0	0	0
2n_1c_1g_1b_2l		2	1	1	0	2	0	0	1
2n_1c_1gext_1bext_2l		2	1	1 ext	0	2	0	0	1 ext
2n_1c_1gext_1bext_2lext		2	1	1 ext	0	2 ext	0	0	1 ext
2n_2c_1g_1lext		2	2	1	0	1 ext	0	0	0
3n_3c_1gext_1h_1bext_2l		3	3	1 ext	1	2	0	0	1 ext
3n_3c_2gext_1l_1ml		3	3	2 ext	0	1	1 (2 branches)	0	0
3n_3c_2gext_1lext_1mlext		3	3	2 ext	0	1 ext	1 (2 branches) ext	0	0
inv_1n_1c_1g_ext		1	1	1	0	0	0	0	0
inv_2n_1c_1g_1b_ext		2	1	1	0	2	0	0	1 ext
sector_1n_1cn_1gn	X	1	1 (negative)	1 (negative)	0	0	0	0	0
sector_1n_1cn_1gnext	X	1	1 (negative)	1 (negative) ext	0	0	0	0	0

* ext: enabled for capacity expansion

Instances available at https://github.com/SPSUnipi/pypsa2smspp_instances

Benchmark test cases

Case	Mode	Computational time			Objective function [bln €]		
		PyPSA [s]	SMS++ [s]	Difference [%]	PyPSA [bln €]	SMS++ [bln €]	Relative error [%]
1n_1c_1g	Dispatch with UCBlock	0.336429	0.572185	70.076	0.4368	0.4368	-6.00E-08
1n_1c_1g_1h	Dispatch with UCBlock	0.753658	0.704466	-6.5271	0.0396	0.0396	2.00E-08
1n_1c_1gext	Capacity expansion with UCBlock	0.483282	0.442076	-8.52628	0.3987	0.3987	-4.00E-08
2n_1c_1g_1b_2l	Dispatch with UCBlock	0.679743	0.62327	-8.30799	0.4087	0.4087	-6.00E-08
2n_1c_1gext_1bext_2l	Capacity expansion with UCBlock	0.90643	0.626978	-30.83	0.3825	0.3825	1.10E-07
2n_1c_1gext_1bext_2lext	Capacity expansion with UCBlock	1.043614	0.631701	-39.4699	0.0886	0.0886	-1.00E-08
2n_2c_1g_1lext	Capacity expansion with UCBlock	0.560253	0.555579	-0.83427	0.6647	0.6647	-4.00E-08
3n_3c_1gext_1h_1bext_2l	Capacity expansion with UCBlock	1.376645	0.766674	-44.3085	0.3726	0.3726	-1.00E-07
3n_3c_2gext_1l_1ml	Capacity expansion with UCBlock	0.633558	0.584751	-7.70364	1.3224	1.3224	3.70E-07
3n_3c_2gext_1lext_1mlext	Capacity expansion with UCBlock	0.679555	0.618596	-8.97043	0.0030	0.0030	-1.30E-07
inv_1n_1c_1g_ext	Capacity expansion with InvestmentBlock	0.490176	0.506794	3.390211	0.4084	0.4084	-0.00249
inv_2n_1c_1g_1b_ext	Capacity expansion with InvestmentBlock	0.857221	0.635444	-25.8716	0.3957	0.3957	0
sector_1n_1cn_1gn	Capacity expansion with UCBlock	0.346284	0.432947	25.02657	-0.0001	-0.0001	-5.00E-08
sector_1n_1cn_1gnext	Capacity expansion with UCBlock	0.393792	0.447732	13.69759	0.0003	0.0003	-1.70E-07

Instances available at https://github.com/SPSUnipi/pypsa2smspp_instances

PyPSA-Eur test cases

Case	Mode	Computational time			Objective function [bln €]		
		PyPSA [s]	SMS++ [s]	Difference [%]	PyPSA [bln €]	SMS++ [bln €]	Relative error [%]
base_s_2_elec_1h	Capacity Expansion with UCBlock	24.5	65.4	167.4	11.96	11.96	0.00
base_s_5_elec_1h	Capacity Expansion with UCBlock	523.0	190.4	-63.6	12.27	12.27	0.00
base_s_10_elec_1h	Capacity Expansion with UCBlock	930.3	319.8	-65.6	12.32	12.32	-0.03
base_s_20_elec_1h	Capacity Expansion with UCBlock	1400.4	1003.5	-28.3	12.44	12.42	-0.11
base_s_30_elec_1h	Capacity Expansion with UCBlock	7834.3	1955.1	-75.0	12.42	12.41	-0.08
base_s_50_elec_1h	Capacity Expansion with UCBlock	15071.9	3165.4	-79.0	12.48	12.46	-0.13

Instances of power systems executed using PyPSA-Eur with 2, 5, 10, 20, 30, and 50 nodes

Available at https://github.com/SPSUnipi/pypsa2smspp_instances