High cost of slow energy transitions for emerging countries: On the case of Egypt's pathway options

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SUPPLEMENTARY MATERIAL

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1. Detailed methods

1.1. Data collection and preparation

This section includes tables and notes outlining the sources and calculations used during the data collection and preparation phase.

Table 1.1 Egypt's administrative governorates and their zonal grouping [1,2].

Governorate	Zone	Population share (2020)	Area share
Cairo	Greater Cairo	16%	0.4%
Kaliobia			
Alexandria	West Delta	12%	17.7%
Matrouh			
Behera			
Dakahlia	Middle Delta	22%	1.2%
Damietta			
Gharbia			
Kafr El Shiekh			
Monufia			
Sharkia	East Delta	11%	8.0%
Ismailia			
Port Said			
Suez			
North Sinai			
South Sinai			
Giza	Lower Middle Egypt	16%	3.0%
Fayoum			
Beni Suef			
Menia	Upper Middle Egypt	11%	49.3%
Asyut			
El Wadi El Gidid			
Sohag	Upper Egypt	12%	20.4%
Qena			
Luxor			
Aswan			
Red Sea			

Table 1.2 Population projection [1,2].

Region	2020	2025	2030	2035	2040	2045	2050
Greater Cairo	16 179 565	17 664 808	19 104 200	20 607 467	22 190 103	23 771 948	25 290 077
West Delta	12 682 959	13 847 223	14 975 544	16 153 936	17 394 545	18 634 533	19 824 576
Middle Delta	22 159 296	24 193 463	26 164 833	28 223 685	30 391 240	32 557 712	34 636 919
East Delta	11 290 799	12 327 265	13 331 735	14 380 780	15 485 211	16 589 091	17 648 507
Lower Middle Egypt	16 655 758	18 184 714	19 666 470	21 213 981	22 843 196	24 471 598	26 034 408
Upper Middle Egypt	11 100 936	12 119 974	13 107 553	14 138 957	15 224 817	16 310 134	17 351 735
Upper Egypt	12 264 687	13 390 554	14 481 664	15 621 194	16 820 888	18 019 983	19 170 779
Total	**102 334 000**	**111 728 000**	**120 832 000**	**130 340 000**	**140 350 000**	**150 355 000**	**159 957 000**

Note 1.1 Data collection methods for different energy sectors.

Power sector:

- Electricity demand:
  - Total electricity demand for the whole country as of 2019/20 were obtained from the annual report of the Egyptian Electricity Holding Company (EEHC) [3].
  - Breakdown of total demand by governorate and sector were based on the statistics from the Electricity & Energy Annual Bulletin by the Central Agency for Public Mobilization and Statistics (CAPMAS) [4].
  - Hourly demand profiles were synthetically generated based on the method described in Toktarova et al. [5].
  - Future projection until 2050 was based on the International Energy Agency's basic electricity demand projection for North Africa using a compound average annual growth rate of 3% [6].
- Installed generation capacities:
  - Installed fossil and renewable power capacities were obtained from annual reports of the EEHC and the New & Renewable Energy Authority [3,7].
- Transmission lines:
  - Existing transmission line capacities were acquired from from the Egyptian Electricity Transmission Company's website [8].
  - Transmission lines lengths were computed based on the virtual distances between the demand centers identified earlier using QGIS [9].
- Electricity prices:
  - Current electricity prices for different end-users were obtained from the Egyptian Electric Utility & Consumer Protection Regulatory Agency's website for the year 2020 [10].
  - Current prices were converted from Egyptian Pounds to Euros using the yearly average exchange rate from Egyptian Pounds to US Dollars and then from US Dollars to Euros for the year 2020 [11].
  - Electricity prices projection until 2050 was based on the methodology in [12,13].

Heat sector:

- Heat demand:
  - Country-level demand of space heating (SHD), domestic hot water (DHW), industrial process heat (IHD), and traditional biomass cooking and heating (BCH) from 2020 to 2050 were based on the results from Keiner et al. [14].
  - Breakdown of SHD and DHW by zone was based on the share of the total population in each zone [2].
  - Breakdown of BCH by zone was based on the share of the rural population in each zone [2] ans was assumed to be phased-out by 2050.
  - Breakdown of IHD by zone was based on the size of the industry in each zone, in terms of 1000 Egyptian Pounds [15,16].
  - Hourly demand profiles were also based on the results from Keiner et al. [14].

Transport sector:

- Road demand – Light duty vehicles (LDV):
  - LDV road demand in passenger-km for the year 2010 was obtained from the report done by the Japan International Cooperation Agency in cooperation with the Egyptian Transport Planning Authority [17].
  - The demand for the year 2020 was calculated via multiplying the demand in 2010 by the growth rate of the number of LDVs in Egypt over that period based on the numbers reported in [18] and [19], respectively.

  - Breakdown of LDV demand by zone was based on the share of the total number of LDVs in each zone [19].

- Road demand – 2-3 wheelers (2-3W):
  - Number of licensed 2-3Ws by governorate was obtained from the Statistical Yearbook for Transport and Communication issued by CAPMAS [19].
  - The occupancy factor of a 2-3W was assumed to be 1.1 [17] and the average annual travelling distance was assumed to be 7000 km [20].
  - The number of licensed 2-3Ws was multiplied by their occupancy factor and average annual travelling distance to get the demand in terms of passenger-km.

- Road demand – Buses:
  - The number of passengers, bus trips, and annual travelled distances in each governorate for the year 2017 were obtained from the annual bulletin of statistics for public transport issued by CAPMAS for intra- and inter-city buses [21].
  - The number of passengers was first divided by the number of bus trips to obtain the average number of passengers per trip. This was then multiplied by the travelled distance to obtain the demand in passenger-km (p-km).
  - The demand level for the year 2020 was calculated via the same method used for LDVs based on the numbers from [19] and [22].

- Road demand – Medium (MDV) and heavy duty vehicles (HDV):
  - The same sources and methods used for LDVs were used to calculate the demand of MDVs and HDVs in ton-km (t-km) [17–19].

- Rail demand:
  - Rail transport in Egypt includes passenger metros and trams within cities, intercity passenger trains, and intercity cargo trains.
  - The same sources and methods used for buses were used to calculate the rail demand in terms of p-km and t-km [19,21,22].

- Marine demand:
  - Marine transport in Egypt includes river and sea transport.
  - River transport demand by governorate for passengers and goods was obtained from the Annual Bulletin of Statistics for River Transport Sector issued by CAPMAS in terms of p-km and t-km, respectively [23].
  - Country-level sea transport demand in p-km and t-km was obtained from the results of a study done by Khalili et al. [20].
  - Breakdown by zone for sea passenger transport was done according to the share of the number of passengers arriving and departing from each port based on the figures published by the Egyptian Maritime Transport Authority [24].
  - Breakdown by zone for sea freight transport was done according to the share of the amount of cargo handled in each port based on the figures published in [24] as well.

- Aviation demand:
  - Country-level passenger and freight statistics were obtained from the International Civil Aviation Organization statistics for 2019 [25].
  - Breakdown by zone for passenger and freight air transport was done based on the share of the total number of passengers [19] and the share of the total amount of cargo handled in each cargo center [26], respectively.

- Transport demand projection:
  - Demand projections for all previous transport demand types follow the same trend as that reported for Egypt by Khalili et al. [20] for the Best Policy Scenario (BPS).

Desalination sector:

- Desalination demand:
  - Current demand and its future projection until 2050 for the BPS were calculated based on the method outlined by Caldera and Breyer [27].
  - The projection of the demand until 2050 for the Current Policy Scenario (CPS) was based on the announced desalination projects [28,29].
- Installed desalination capacities:
  - Current installed capacities were obtained from the Global Water Intelligence's desalination database: DesalData [30].

Table 1.3 Projected specific energy demand by transport mode and vehicle type [20].

Mode and vehicle type	Unit	2020	2025	2030	2035	2040	2045	2050
LDV ICE	[kWh_{th}/km]	0.747	0.686	0.617	0.565	0.521	0.443	0.365
LDV BEV	[kWh_{el}/km]	0.165	0.148	0.130	0.122	0.113	0.104	0.096
LDV FCEV	[kWh_{H2}/km]	0.269	0.226	0.217	0.200	0.200	0.165	0.156
LDV PHEV	[kWh_{th}/km]	0.187	0.151	0.136	0.124	0.115	0.097	0.080
LDV PHEV	[kWh_{el}/km]	0.124	0.115	0.102	0.095	0.088	0.081	0.075
2-3W ICE	[kWh_{th}/km]	0.143	0.143	0.143	0.143	0.143	0.143	0.143
2-3W BEV	[kWh_{el}/km]	0.050	0.050	0.050	0.050	0.050	0.050	0.050
BUS ICE	[kWh_{th}/km]	4.023	3.957	3.890	3.826	3.762	3.700	3.638
BUS BEV	[kWh_{el}/km]	1.808	1.744	1.680	1.621	1.563	1.508	1.455
BUS FCEV	[kWh_{H2}/km]	2.987	2.853	2.720	2.598	2.482	2.371	2.265
BUS PHEV	[kWh_{th}/km]	2.012	1.918	1.945	1.913	1.881	1.850	1.819
BUS PHEV	[kWh_{el}/km]	0.904	0.872	0.840	0.810	0.782	0.754	0.727
MDV ICE	[kWh_{th}/km]	2.270	2.144	2.023	1.904	1.796	1.685	1.571
MDV BEV	[kWh_{el}/km]	0.836	0.747	0.668	0.618	0.572	0.529	0.490
MDV FCEV	[kWh_{H2}/km]	1.362	1.286	1.214	1.142	1.078	1.011	0.943
MDV PHEV	[kWh_{th}/km]	1.362	1.286	1.214	1.142	1.078	1.011	0.943
MDV PHEV	[kWh_{el}/km]	0.334	0.299	0.267	0.247	0.229	0.212	0.196
HDV ICE	[kWh_{th}/km]	3.253	3.009	2.784	2.571	2.378	2.192	2.013
HDV BEV	[kWh_{el}/km]	1.671	1.494	1.336	1.236	1.144	1.058	0.979
HDV FCEV	[kWh_{H2}/km]	1.952	1.805	1.670	1.543	1.427	1.315	1.208
HDV PHEV	[kWh_{th}/km]	2.277	2.106	1.949	1.800	1.664	1.534	1.409
HDV PHEV	[kWh_{el}/km]	0.501	0.448	0.401	0.371	0.343	0.318	0.294
Rail passenger liquid fuel	[kWh_{th}/p-km]	0.104	0.102	0.101	0.099	0.098	0.096	0.094
Rail passenger electrical	[kWh_{el}/p-km]	0.065	0.063	0.060	0.058	0.055	0.053	0.050
Rail freight liquid fuel	[kWh_{th}/t-km]	0.063	0.060	0.058	0.056	0.054	0.052	0.050
Rail freight electrical	[kWh_{el}/t-km]	0.032	0.030	0.028	0.026	0.024	0.022	0.019
Marine passenger liquid fuel	[kWh_{th}/p-km]	0.657	0.634	0.611	0.605	0.598	0.592	0.586
Marine passenger electrical	[kWh_{el}/p-km]	0.319	0.323	0.325	0.325	0.325	0.325	0.325
Marine passenger liquid hydrogen	[kWh_{H2}/p-km]	-	-	0.565	0.521	0.483	0.472	0.461
Marine passenger LNG	[kWh_{th}/p-km]	0.657	0.634	0.611	0.605	0.598	0.592	0.586
Marine freight liquid fuel	[kWh_{th}/t-km]	0.041	0.039	0.038	0.038	0.037	0.037	0.036
Marine freight electrical	[kWh_{el}/t-km]	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Marine freight liquid hydrogen	[kWh_{H2}/t-km]	-	-	0.035	0.032	0.030	0.029	0.029
Marine freight LNG	[kWh_{th}/t-km]	0.041	0.039	0.038	0.038	0.037	0.037	0.036
Aviation passenger liquid fuel	[kWh_{th}/p-km]	0.517	0.490	0.466	0.442	0.419	0.398	0.377
Aviation passenger electrical	[kWh_{el}/p-km]	0.194	0.184	0.175	0.166	0.157	0.149	0.142
Aviation passenger liquid hydrogen	[kWh_{H2}/p-km]	-	-	0.335	0.318	0.302	0.286	0.271
Aviation freight liquid fuel	[kWh_{th}/t-km]	0.134	0.128	0.121	0.115	0.109	0.104	0.098
Aviation freight electrical	[kWh_{el}/t-km]	-	-	-	-	-	-	-
Aviation freight liquid hydrogen	[kWh_{H2}/t-km]	-	-	0.087	0.083	0.079	0.075	0.071

Table 1.4 Projected shares of passenger demand by transport mode and vehicle type for the BPS variations – country average [20].

Passenger mode and vehicle type	2020	2025	2030	2035	2040	2045	2050
Road – LDV – BEV	0.0 %	9.1 %	20.4 %	38.0 %	55.6 %	66.9 %	76.0 %
Road – LDV – FCEV	0.0 %	0.1 %	1.0 %	2.0 %	5.0 %	10.0 %	10.0 %
Road – LDV – ICE	100.0 %	87.8 %	68.6 %	50.0 %	29.4 %	13.1 %	4.0 %
Road – LDV – PHEV	0.0 %	3.0 %	10.0 %	10.0 %	10.0 %	10.0 %	10.0 %
Road – BUS – BEV	0.0 %	10.0 %	20.0 %	50.0 %	80.0 %	90.0 %	90.0 %
Road – BUS – FCEV	0.0 %	0.1 %	0.1 %	0.1 %	0.1 %	0.1 %	0.1 %
Road – BUS – ICE	100.0 %	89.1 %	78.0 %	46.4 %	14.8 %	3.7 %	2.9 %
Road – BUS – PHEV	0.0 %	0.8 %	1.9 %	3.5 %	5.1 %	6.2 %	7.0 %
Road – 2-3W – BEV	0.0 %	11.3 %	25.5 %	47.5 %	69.5 %	83.7 %	95.0 %
Road – 2-3W – ICE	100.0 %	88.7 %	74.5 %	52.5 %	30.5 %	16.3 %	5.0 %
Rail – electricity	7.7 %	18.2 %	29.9 %	47.6 %	65.2 %	77.3 %	87.2 %
Rail – liquid fuel	92.3 %	81.8 %	70.1 %	52.4 %	34.8 %	22.7 %	12.8 %
Marine – electricity	0.0 %	0.6 %	1.1 %	2.8 %	5.6 %	7.8 %	8.9 %
Marine – hydrogen	0.0 %	0.0 %	1.0 %	3.0 %	10.0 %	25.0 %	45.0 %
Marine – liquid fuel	99.5 %	98.4 %	95.9 %	91.2 %	79.4 %	57.2 %	26.1 %
Marine – LNG	0.5 %	1.0 %	2.0 %	3.0 %	5.0 %	10.0 %	20.0 %
Aviation – electricity	0.0 %	0.0 %	0.0 %	1.2 %	4.7 %	10.5 %	18.7 %
Aviation – hydrogen	0.0 %	0.0 %	0.0 %	2.3 %	9.3 %	21.0 %	37.4 %
Aviation – liquid fuel	100.0 %	100.0 %	100.0 %	96.5 %	86.0 %	68.5 %	43.9 %

Table 1.5 Projected share of freight demand by transport mode and vehicle type for the BPS variations [20].

Freight mode and vehicle type	2020	2025	2030	2035	2040	2045	2050
Road MDV ICE	100.0 %	88.6 %	74.6 %	51.5 %	26.4 %	13.4 %	3.0 %
Road MDV BEV	0.0 %	9.5 %	21.5 %	40.0 %	58.5 %	70.5 %	80.0 %
Road MDV FCEV	0.0 %	1.0 %	2.0 %	5.0 %	10.0 %	10.0 %	10.0 %
Road MDV PHEV	0.0 %	0.8 %	1.9 %	3.5 %	5.1 %	6.2 %	7.0 %
Road HDV ICE	100.0 %	88.0 %	77.0 %	46.0 %	12.0 %	4.0 %	3.0 %
Road HDV BEV	0.0 %	8.0 %	15.0 %	30.0 %	50.0 %	50.0 %	50.0 %
Road HDV FCEV	0.0 %	2.0 %	5.0 %	20.0 %	30.0 %	30.0 %	30.0 %
Road HDV PHEV	0.0 %	2.0 %	3.0 %	4.0 %	8.0 %	16.0 %	17.0 %
Rail – electricity	0.0 %	10.4 %	23.5 %	43.6 %	63.8 %	76.8 %	87.2 %
Rail – liquid fuel	100.0 %	89.6 %	76.5 %	56.4 %	36.2 %	23.2 %	12.8 %
Marine – electricity	0.0 %	0.6 %	1.1 %	2.8 %	5.6 %	7.2 %	8.3 %
Marine – hydrogen	0.0 %	0.0 %	1.0 %	3.0 %	10.0 %	25.0 %	45.0 %
Marine – liquid fuel	99.5 %	98.4 %	95.9 %	91.2 %	79.4 %	57.8 %	26.7 %
Marine – LNG	0.5 %	1.0 %	2.0 %	3.0 %	5.0 %	10.0 %	20.0 %
Aviation – electricity	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
Aviation – hydrogen	0.0 %	0.0 %	0.0 %	2.3 %	9.3 %	21.0 %	37.4 %
Aviation – liquid fuel	100.0 %	100.0 %	100.0 %	97.7 %	90.7 %	79.0 %	62.6 %

Table 1.6 Power, heat, transport, and desalination demand projections [6,14,20,27].

Energy service demand	**Unit**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Power demand	[TWh]	132.36	157.33	187.27	222.59	264.02	312.53	369.22
Heat demand	[TWh_{th}]	328	351	379	404	416	411	388
Industrial process heat demand	[TWh_{th}]	75.89	94.72	128.02	163.65	193.06	209.99	214.02
Domestic hot water demand	[TWh_{th}]	31.65	37.97	42.59	46.45	50.33	54.22	58.02
Space heating demand	[TWh_{th}]	206.78	205.63	198.67	186.81	169.69	146.25	116.05
Biomass cooking and heating	[TWh_{th}]	13.58	12.23	10.01	6.77	3.32	0.88	0.00
Transport demand								
Road LDV passenger transport	[mil p-km]	197 006	322 118	523 600	810 474	1 183 943	1 664 159	2 218 828
Road 2-3W passenger transport	[mil p-km]	36 390	57 995	91 984	139 236	197 686	264 781	334 404
Road BUS passenger transport	[mil p-km]	79 718	118 238	173 837	243 927	310 409	330 171	329 670
Road MDV freight transport	[mil t-km]	26 814	43 356	69 536	106 259	152 145	205 330	265 427
Road HDV freight transport	[mil t-km]	113 957	184 257	295 520	451 589	646 599	872 630	1 128 035
Rail passenger transport	[mil p-km]	72 943	113 915	176 461	259 978	357 519	460 475	562 761
Rail freight transport	[mil t-km]	2 226	3 513	5 537	8 400	12 081	16 597	22 185
Marine passenger transport	[mil p-km]	1 838	2 408	3 311	4 677	6 612	9 155	12 270
Marine freight transport	[mil t-km]	1 078 604	1 565 165	2 286 085	3 228 380	4 302 172	5 412 350	6 545 109
Aviation passenger transport	[mil p-km]	26 454	44 055	74 321	114 682	177 794	249 704	321 719
Aviation freight transport	[mil t-km]	483	795	1 315	2 090	3 170	4 438	5 790
Desalination demand	[1000 m^3/day]	634	2 075	6 248	15 342	26 851	34 324	37 285

1.2. Techno-economic assumptions

This section includes tables outlining the technical and financial assumptions used in the LUT-ESTM for different generation, storage and transmission technologies, and fuels.

Table 1.7 Financial and technical assumptions of energy system technologies used.

Technologies	Parameter	Unit	2020	2025	2030	2035	2040	2045	2050	Ref.
PV fixed tilted	Capex	€/kW$_{el}$	432	336	278	237	207	184	166	[31–33]
	Opex fix	€/(kW$_{el}$·a)	7.76	6.51	5.66	5	4.47	4.04	3.7	
	Opex var	€/kWh$_{el}$	0	0	0	0	0	0	0	
	Lifetime	years	30	35	35	35	40	40	40	
PV rooftop – residential	Capex	€/kW$_{el}$	1045	842	715	622	551	496	453	[32,33]
	Opex fix	€/(kW$_{el}$·a)	9.13	7.66	6.66	5.88	5.26	4.75	4.36	
	Opex var	€/kWh$_{el}$	0	0	0	0	0	0	0	
	Lifetime	years	30	35	35	35	40	40	40	
PV rooftop – commercial	Capex	€/kW$_{el}$	689	544	456	393	345	308	280	[32,33]
	Opex fix	€/(kW$_{el}$·a)	9.13	7.66	6.66	5.88	5.26	4.75	4.36	
	Opex var	€/kWh$_{el}$	0	0	0	0	0	0	0	
	Lifetime	years	30	35	35	35	40	40	40	
PV rooftop – industrial	Capex	€/kW$_{el}$	512	397	329	281	245	217	197	[32,33]
	Opex fix	€/(kW$_{el}$·a)	9.13	7.66	6.66	5.88	5.26	4.75	4.36	
	Opex var	€/kWh$_{el}$	0	0	0	0	0	0	0	
	Lifetime	years	30	35	35	35	40	40	40	
PV single-axis tracking	Capex	€/kW$_{el}$	475	370	306	261	228	202	183	[32–34]
	Opex fix	€/(kW$_{el}$·a)	8.54	7.16	6.23	5.5	4.92	4.44	4.07	
	Opex var	€/kWh$_{el}$	0	0	0	0	0	0	0	
	Lifetime	years	30	35	35	35	40	40	40	
Wind onshore	Capex	€/kW$_{el}$	1150	1060	1000	965	940	915	900	[35–37]
	Opex fix	€/(kW$_{el}$·a)	23	21.2	20	19.3	18.8	18.3	18	
	Opex var	€/kWh$_{el}$	0	0	0	0	0	0	0	
	Lifetime	years	25	25	25	25	25	25	25	

Hydro Reservoir/ Dam	Capex	€/kW_{el}	1650	1650	1650	1650	1650	1650	1650	[36]
	Opex fix	€/(kW_{el}·a)	49.5	49.5	49.5	49.5	49.5	49.5	49.5	
	Opex var	€/kWh_{el}	0.003	0.003	0.003	0.003	0.003	0.003	0.003	
	Lifetime	years	50	50	50	50	50	50	50	
Hydro Run-of-River	Capex	€/kW_{el}	2560	2560	2560	2560	2560	2560	2560	[36]
	Opex fix	€/(kW_{el}·a)	76.8	76.8	76.8	76.8	76.8	76.8	76.8	
	Opex var	€/kWh_{el}	0.005	0.005	0.005	0.005	0.005	0.005	0.005	
	Lifetime	years	50	50	50	50	50	50	50	
Geothermal Power	Capex	€/kW_{el}	4970	4720	4470	4245	4020	3815	3610	[36,38]
	Opex fix	€/(kW_{el}·a)	80	80	80	80	80	80	80	
	Opex var	€/kWh_{el}	0	0	0	0	0	0	0	
	Lifetime	years	30	30	30	30	30	30	30	
CSP (solar field, parabolic trough)	Capex	€/kW_{th}	344.5	303.6	274.7	251.1	230.2	211.9	196	[39,40]
	Opex fix	€/(kW_{th}·a)	7.9	7	6.3	5.8	5.3	4.9	4.5	
	Opex var	€/kWh_{th}	0	0	0	0	0	0	0	
	Lifetime	years	25	25	25	25	25	25	25	
Residential Solar Heat Collectors - space heating	Capex	€/kW_{th}	1214	1179	1143	1071	1000	929	857	[41]
	Opex fix	€/(kW_{th}·a)	14.8	14.8	14.8	14.8	14.8	14.8	14.8	
	Opex var	€/kWh_{th}	0	0	0	0	0	0	0	
	Lifetime	years	25	25	30	30	30	30	30	
Residential Solar Heat Collectors - hot water	Capex	€/kW_{th}	485	485	485	485	485	485	485	[41]
	Opex fix	€/(kW_{th}·a)	4.85	4.85	4.85	4.85	4.85	4.85	4.85	
	Opex var	€/kWh_{th}	0	0	0	0	0	0	0	
	Lifetime	years	15	15	15	15	15	15	15	
Steam turbine (CSP)	Capex	€/kW_{el}	968	946	923	902	880	860	840	[42]
	Opex fix	€/(kW_{el}·a)	19.4	18.9	18.5	18	17.6	17.2	16.8	
	Opex var	€/kWh_{el}	0	0	0	0	0	0	0	
	Lifetime	years	25	25	25	30	30	30	30	
	Efficiency	coeff	0.38	0.40	0.43	0.43	0.43	0.43	0.43	

CCGT	Capex	€/kW$_{el}$	775	775	775	775	775	775	775	[43]
	Opex fix	€/(kW$_{el}$·a)	19.375	19.375	19.375	19.375	19.375	19.375	19.375	
	Opex var	€/kWh$_{el}$	0.002	0.002	0.002	0.002	0.002	0.002	0.002	
	Lifetime	years	35	35	35	35	35	35	35	
	Efficiency	coeff	0.58	0.58	0.58	0.59	0.60	0.60	0.60	
CCGT + CCS	Capex	€/kW$_{el}$	2565	2272.5	1980	1845	1710	1640	1570	[43]
	Opex fix	€/(kW$_{el}$·a)	81	72	63	58.5	54	52	50	
	Opex var	€/kWh$_{el}$	0	0	0	0	0	0	0	
	Lifetime	years	35	35	35	35	35	35	35	
	Efficiency	coeff	0.52	0.53	0.53	0.53	0.54	0.54	0.55	
OCGT	Capex	€/kW$_{el}$	475	475	475	475	475	475	475	[36]
	Opex fix	€/(kW$_{el}$·a)	14.25	14.25	14.25	14.25	14.25	14.25	14.25	
	Opex var	€/kWh$_{el}$	0.011	0.011	0.011	0.011	0.011	0.011	0.011	
	Lifetime	years	35	35	35	35	35	35	35	
	Efficiency	coeff	0.40	0.42	0.43	0.44	0.44	0.44	0.45	
Int Combust Generator	Capex	€/kW$_{el}$	385	385	385	385	385	385	385	[37]
	Opex fix	€/(kW$_{el}$·a)	11.5	11.5	11.5	11.5	11.5	11.5	11.5	
	Opex var	€/kWh$_{el}$	0.0047	0.0047	0.0047	0.0047	0.0047	0.0047	0.0047	
	Lifetime	years	30	30	30	30	30	30	30	
	Efficiency	coeff	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Int Combust Generator Modern Multifuel	Capex	€/kW$_{el}$	569	553	537	522	506	491	475	[37]
	Opex fix	€/(kW$_{el}$·a)	6.2	6.2	6.2	6.2	6.2	6.2	6.2	
	Opex var	€/kWh$_{el}$	0.011	0.011	0.011	0.011	0.011	0.011	0.011	
	Lifetime	years	30	30	30	30	30	30	30	
	Efficiency	coeff	0.47	0.47	0.47	0.47	0.47	0.47	0.47	
Coal Power Plant	Capex	€/kW$_{el}$	1600	1600	1600	1600	1600	1600	1600	[36]
	Opex fix	€/(kW$_{el}$·a)	20	20	20	20	20	20	20	
	Opex var	€/kWh$_{el}$	0.001	0.001	0.001	0.001	0.001	0.001	0.001	
	Lifetime	years	45	45	45	45	45	45	45	
	Efficiency	coeff	0.43	0.43	0.43	0.43	0.43	0.43	0.43	

Biomass - New Fluidised Bed Boiler	Capex	€/kW_{el}	2620	2475	2330	2195	2060	1945	1830	[36]
	Opex fix	€/(kW_{el}·a)	47.2	44.6	41.9	39.5	37.1	35	32.9	
	Opex var	€/kWh_{el}	0.0038	0.0038	0.0038	0.0038	0.0038	0.0038	0.0038	
	Lifetime	years	25	25	25	25	25	25	25	
	Efficiency	coeff	0.36	0.37	0.37	0.38	0.38	0.39	0.39	
CHP NG	Capex	€/kW_{el}	880	880	880	880	880	880	880	[36]
	Opex fix	€/(kW_{el}·a)	74.8	74.8	74.8	74.8	74.8	74.8	74.8	
	Opex var	€/kWh_{el}	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024	
	Lifetime	years	30	30	30	30	30	30	30	
	Efficiency el	coeff	0.51	0.52	0.53	0.53	0.54	0.54	0.55	
	Efficiency he	coeff	0.37	0.37	0.38	0.38	0.39	0.39	0.39	
CHP Oil	Capex	€/kW_{el}	880	880	880	880	880	880	880	[36]
	Opex fix	€/(kW_{el}·a)	74.8	74.8	74.8	74.8	74.8	74.8	74.8	
	Opex var	€/kWh_{el}	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024	
	Lifetime	years	30	30	30	30	30	30	30	
	Efficiency el	coeff	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
	Efficiency he	coeff	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
CHP Coal	Capex	€/kW_{el}	2030	2030	2030	2030	2030	2030	2030	[36]
	Opex fix	€/(kW_{el}·a)	46.7	46.7	46.7	46.7	46.7	46.7	46.7	
	Opex var	€/kWh_{el}	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	
	Lifetime	years	40	40	40	40	40	40	40	
	Efficiency el	coeff	0.41	0.42	0.43	0.44	0.44	0.45	0.45	
	Efficiency he	coeff	0.43	0.44	0.45	0.45	0.46	0.47	0.47	
CHP Biomass	Capex	€/kW_{el}	3400	3300	3200	3125	3050	2975	2900	[44]
	Opex fix	€/(kW_{el}·a)	97.6	94.95	92.3	90.8	89.3	87.8	86.3	
	Opex var	€/kWh_{el}	0.0038	0.0038	0.0037	0.0037	0.0038	0.0038	0.0038	
	Lifetime	years	25	25	25	25	25	25	25	
	Efficiency el	coeff	0.30	0.30	0.30	0.29	0.29	0.29	0.29	
	Efficiency he	coeff	0.65	0.65	0.65	0.65	0.65	0.64	0.64	

CHP Biogas	Capex	€/kW$_{el}$	429.2	399.6	370	340.4	325.6	310.8	296	[41]
	Opex fix	€/(kW$_{el}$·a)	17.168	15.984	14.8	13.616	13.024	12.432	11.84	
	Opex var	€/kWh$_{el}$	0.001	0.001	0.001	0.001	0.001	0.001	0.001	
	Lifetime	years	30	30	30	30	30	30	30	
	Efficiency el	coeff	0.34	0.37	0.40	0.42	0.44	0.44	0.44	
	Efficiency he	coeff	0.43	0.47	0.50	0.52	0.55	0.55	0.55	
Municipal Solid Waste Incinerator	Capex	€/kW$_{el}$	5630	5440	5240	5030	4870	4690	4540	[36]
	Opex fix	€/(kW$_{el}$·a)	253.35	244.8	235.8	226.35	219.15	211.05	204.3	
	Opex var	€/kWh$_{el}$	0.0069	0.0069	0.0069	0.0069	0.0069	0.0069	0.0069	
	Lifetime	years	30	30	30	30	30	30	30	
	Efficiency el	coeff	0.26	0.26	0.26	0.26	0.26	0.26	0.26	
	Efficiency he	coeff	0.71	0.71	0.71	0.71	0.71	0.71	0.71	
DH Rod Heating	Capex	€/kW$_{th}$	100	100	75	75	75	75	75	[41]
	Opex fix	€/(kW$_{th}$·a)	1.47	1.47	1.47	1.47	1.47	1.47	1.47	
	Opex var	€/kWh$_{th}$	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	
	Lifetime	years	35	35	35	35	35	35	35	
	Efficiency	coeff	1	1	1	1	1	1	1	
DH Heat Pump	Capex	€/kW$_{th}$	660	618	590	568	554	540	530	[44]
	Opex fix	€/(kW$_{th}$·a)	2	2	2	2	2	2	2	
	Opex var	€/kWh$_{th}$	0.0018	0.0017	0.0017	0.0016	0.0016	0.0016	0.0016	
	Lifetime	years	25	25	25	25	25	25	25	
	COP	coeff	3.3	3.4	3.5	3.6	3.6	3.7	3.7	
DH NG Heating	Capex	€/kW$_{th}$	75	75	100	100	100	100	100	[41]
	Opex fix	€/(kW$_{th}$·a)	2.775	2.775	3.7	3.7	3.7	3.7	3.7	
	Opex var	€/kWh$_{th}$	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	
	Lifetime	years	35	35	35	35	35	35	35	
	Efficiency	coeff	0.97	0.97	0.97	0.97	0.97	0.97	0.97	
DH Oil Heating	Capex	€/kW$_{th}$	75	75	100	100	100	100	100	[41]
	Opex fix	€/(kW$_{th}$·a)	2.775	2.775	3.7	3.7	3.7	3.7	3.7	
	Opex var	€/kWh$_{th}$	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	
	Lifetime	years	35	35	35	35	35	35	35	
	Efficiency	coeff	0.97	0.97	0.97	0.97	0.97	0.97	0.97	

DH Coal Heating	Capex	€/kW$_{th}$	75	75	100	100	100	100	100	[41]
	Opex fix	€/(kW$_{th}$·a)	2.775	2.775	3.7	3.7	3.7	3.7	3.7	
	Opex var	€/kWh$_{th}$	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	
	Lifetime	years	35	35	35	35	35	35	35	
	Efficiency	coeff	0.97	0.97	0.97	0.97	0.97	0.97	0.97	
DH Biomass Heating	Capex	€/kW$_{th}$	75	75	100	100	100	100	100	[41]
	Opex fix	€/(kW$_{th}$·a)	2.8	2.8	3.7	3.7	3.7	3.7	3.7	
	Opex var	€/kWh$_{th}$	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	
	Lifetime	years	35	35	35	35	35	35	35	
	Efficiency	coeff	0.97	0.97	0.97	0.97	0.97	0.97	0.97	
DH Geothermal Heat	Capex	€/kW$_{th}$	3642	3384	3200	3180	3160	3150	3146	[45]
	Opex fix	€/(kW$_{th}$·a)	133	124	117	116	115	115	115	
	Opex var	€/kWh$_{th}$	0	0	0	0	0	0	0	
	Lifetime	years	22	22	22	22	22	22	22	
	Efficiency	coeff	0.97	0.97	0.97	0.97	0.97	0.97	0.97	
Local Rod Heating	Capex	€/kW$_{th}$	100	100	100	100	100	100	100	[41]
	Opex fix	€/(kW$_{th}$·a)	2	2	2	2	2	2	2	
	Opex var	€/kWh$_{th}$	0.001	0.001	0.001	0.001	0.001	0.001	0.001	
	Lifetime	years	30	30	30	30	30	30	30	
	Efficiency	coeff	1	1	1	1	1	1	1	
Local Heat Pump	Capex	€/kW$_{th}$	780	750	730	706	690	666	650	[36]
	Opex fix	€/(kW$_{th}$·a)	15.6	15	7.3	7.1	6.9	6.7	6.5	
	Opex var	€/kWh$_{th}$	0	0	0	0	0	0	0	
	Lifetime	years	20	20	20	20	20	20	20	
	COP	coeff	4.7	4.9	5.0	5.1	5.2	5.4	5.4	
Local NG Heating	Capex	€/kW$_{th}$	800	800	800	800	800	800	800	[41]
	Opex fix	€/(kW$_{th}$·a)	27	27	27	27	27	27	27	
	Opex var	€/kWh$_{th}$	0	0	0	0	0	0	0	
	Lifetime	years	22	22	22	22	22	22	22	
	Efficiency	coeff	0.95	0.95	0.95	0.95	0.95	0.95	0.95	

Local Oil Heating	Capex	€/kW$_{th}$	440	440	440	440	440	440	440	[41]
	Opex fix	€/(kW$_{th}$·a)	18	18	18	18	18	18	18	
	Opex var	€/kWh$_{th}$	0	0	0	0	0	0	0	
	Lifetime	years	20	20	20	20	20	20	20	
	Efficiency	coeff	0.95	0.95	0.95	0.95	0.95	0.95	0.95	
Local Biomass Heating	Capex	€/kW$_{th}$	675	675	750	750	750	750	750	[41]
	Opex fix	€/(kW$_{th}$·a)	2	2	3	3	3	3	3	
	Opex var	€/kWh$_{th}$	0	0	0	0	0	0	0	
	Lifetime	years	20	20	20	20	20	20	20	
	Efficiency	coeff	1.03	1.03	1.08	1.08	1.08	1.13	1.13	
Local Biogas Heating	Capex	€/kW$_{th}$	800	800	800	800	800	800	800	[41]
	Opex fix	€/(kW$_{th}$·a)	27	27	27	27	27	27	27	
	Opex var	€/kWh$_{th}$	0	0	0	0	0	0	0	
	Lifetime	years	22	22	22	22	22	22	22	
	Efficiency	coeff	0.95	0.95	0.95	0.95	0.95	0.95	0.95	
Water Electrolysis	Capex	€/kW$_{el.LHV}$	563	411	313	267	243	219	204	[46]
	Capex	€/kW$_{H2,LHV}$	803	586	446	381	347	313	291	
	Opex fix	€/kW$_{H2,LHV}$·a	28.1	20.5	15.6	13.3	12.1	11.0	10.2	
	Opex var	€/kWh$_{H2,LHV}$	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	
	Lifetime	years	30	30	30	30	30	30	30	
	Efficiency	coeff$_{LHV}$	0.701	0.701	0.701	0.701	0.701	0.701	0.701	
CO_2 direct air capture	Capex	€/(tCO_2·a)	730	481	338	281	237	217	199	[47,48]
	Opex fix	€/(tCO_2·a)	29.2	19.2	13.5	11.2	9.5	8.7	8	
	Opex var	€/kgCO_2	0	0	0	0	0	0	0	
	Lifetime	years	20	25	25	30	30	30	30	
	CO_2 scrubbing efficiency	kWh$_{el}$/tCO_2	250	237	225	213	203	192	182	
		kWh$_{th}$/tCO_2	1750	1618	1500	1387	1286	1189	1102	
Methanation	Capex	€/kW$_{SNG,LHV}$	558	409	309	274	251	227	211	[46]
	Opex fix	€/(kW$_{SNG,LHV}$·a)	25.7	18.8	14.2	12.6	11.5	10.4	9.7	
	Opex var	€/MWh$_{SNG,LHV}$	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	
	Lifetime	years	30	30	30	30	30	30	30	
	CO_2 input	kgCO_2/kWh$_{th}$	0.198	0.198	0.198	0.198	0.198	0.198	0.198	
	Efficiency	Coeff$_{LHV}$	0.821	0.821	0.821	0.821	0.821	0.821	0.821	

Biogas Digester	Capex	€/kW$_{th,LHV}$	811	784	755	725	702	676	654	[49]
	Opex fix	€/(kW$_{th,LHV}$·a)	32.5	31.4	30.2	29	28.1	27	26.2	
	Opex var	€/kWh$_{th,LHV}$	0	0	0	0	0	0	0	
	Lifetime	years	20	20	20	25	25	25	25	
Biogas Upgrade	Capex	€/kW$_{th}$	322	300	278	255	244	233	222	[49]
	Opex fix	€/(kW$_{th}$·a)	25.8	24	22.2	20.4	19.5	18.7	17.8	
	Opex var	€/kWh$_{th}$	0	0	0	0	0	0	0	
	Lifetime	years	20	20	20	20	20	20	20	
	Efficiency	coeff	0.98	0.98	0.98	0.98	0.98	0.98	0.98	
Fischer-Tropsch unit	Capex	€/kW$_{FTLiq,LHV}$	1017	1017	1017	1017	915	915	915	[48]
	Opex fix	€/kW$_{FTLiq,LHV}$	30.5	30.5	30.5	30.5	27.5	27.5	27.5	
	Opex var	€/kWh$_{FTLiq,LHV}$	0	0	0	0	0	0	0	
	Lifetime	years	30	30	30	30	30	30	30	
	CO_2 input	kgCO_2/kWh$_{th}$	0.305	0.305	0.305	0.305	0.305	0.305	0.305	
	Efficiency	coeff$_{LHV}$	0.692	0.692	0.692	0.692	0.692	0.692	0.692	
Steam Methane Reforming	Capex	€/kW$_{H2,LHV}$	570	570	570	570	570	570	570	[50]
	Opex fix	€/kW$_{H2,LHV}$	25.1	25.1	25.1	25.1	25.1	25.1	25.1	
	Opex var	€/kWh$_{H2,LHV}$	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	
	Lifetime	years	30	30	30	30	30	30	30	
	Efficiency	coeff$_{LHV}$	0.76	0.76	0.76	0.76	0.76	0.76	0.76	
Gas Liquefaction	Capex	€/kW$_{Liq,LHV}$	201	201	201	201	201	201	201	[51]
	Opex fix	€/kW$_{Liq,LHV}$	7	7	7	7	7	7	7	
	Opex var	€/kWh$_{Liq,LHV}$	0	0	0	0	0	0	0	
	Lifetime	years	25	25	25	25	25	25	25	
	Efficiency	coeff$_{LHV}$	0.987	0.987	0.987	0.987	0.987	0.987	0.987	
	Electricity consumption	kWh$_{el}$/ kWh$_{th,LNG,LHV}$	0.036	0.036	0.036	0.036	0.036	0.036	0.036	

H_2 liquefaction	Capex	€/$kW_{Liq,LHV}$	420	420	420	206	179	170	162	[52–54]
	Opex fix	€/$kW_{Liq,LHV}$	16.8	16.8	16.8	8.2	7.2	6.8	6.5	
	Opex var	€/$kWh_{Liq,LHV}$	0	0	0	0	0	0	0	
	Lifetime	years	30	30	30	30	30	30	30	
	Efficiency	$coeff_{LHV}$	0.983	0.983	0.983	0.983	0.983	0.983	0.983	
	Electricity consumption	kWh_{el}/ $kWh_{th,LH2,LHV}$	0.220	0.220	0.220	0.164	0.149	0.134	0.119	
Battery utility- scale Storage	Capex	€/kWh_{el}	234	153	110	89	76	68	61	[31,32,55,56]
	Opex fix	€/(kWh_{el}·a)	3.28	2.6	2.2	2.05	1.9	1.77	1.71	
	Opex var	€/kWh_{el}	0	0	0	0	0	0	0	
	Lifetime	years	20	20	20	20	20	20	20	
	Round-trip	coeff	0.91	0.92	0.93	0.94	0.95	0.95	0.95	
Battery utility-scale Interface	Capex	€/kW_{el}	117	76	55	44	37	33	30	[31,32,55]
	Opex fix	€/(kW_{el}·a)	1.64	1.29	1.1	1.01	0.93	0.86	0.84	
	Opex var	€/kWh_{el}	0	0	0	0	0	0	0	
	Lifetime	years	20	20	20	20	20	20	20	
Battery PV prosumer residential Storage	Capex	€/kWh_{el}	462	308	224	182	156	140	127	[31,32,56]
	Opex fix	€/(kWh_{el}·a)	5.08	4	3.36	3.09	2.81	2.8	2.54	
	Opex var	€/kWh_{el}	0	0	0	0	0	0	0	
	Lifetime	years	20	20	20	20	20	20	20	
	Round-trip	coeff	0.91	0.92	0.93	0.94	0.95	0.95	0.95	
Battery PV prosumer residential Interface	Capex	€/kW_{el}	231	153	112	90	76	68	62	[31,32]
	Opex fix	€/(kW_{el}·a)	2.54	1.99	1.68	1.53	1.37	1.36	1.24	
	Opex var	€/kWh_{el}	0	0	0	0	0	0	0	
	Lifetime	years	20	20	20	20	20	20	20	
Battery PV prosumer commercial Storage	Capex	€/kWh_{el}	366	240	175	141	121	108	98	[31,32,56]
	Opex fix	€/(kWh_{el}·a)	4.39	3.6	2.98	2.68	2.54	2.38	2.25	
	Opex var	€/kWh_{el}	0	0	0	0	0	0	0	
	Lifetime	years	20	20	20	20	20	20	20	
	Round-trip	coeff	0.91	0.92	0.93	0.94	0.95	0.95	0.95	

Battery PV prosumer commercial Interface	Capex	€/kW$_{el}$	183	119	88	70	59	53	48	[31,32]
	Opex fix	€/(kW$_{el}$·a)	2.2	1.79	1.5	1.33	1.24	1.17	1.1	
	Opex var	€/kWh$_{el}$	0	0	0	0	0	0	0	
	Lifetime	years	20	20	20	20	20	20	20	
Battery PV prosumer industrial Storage	Capex	€/kWh$_{el}$	278	181	131	105	90	80	72	[31,32,56]
	Opex fix	€/(kWh$_{el}$·a)	3.89	3.08	2.62	2.42	2.25	2.08	1.94	
	Opex var	€/kWh$_{el}$	0	0	0	0	0	0	0	
	Lifetime	years	20	20	20	20	20	20	20	
	Round-trip	coeff	0.91	0.92	0.93	0.94	0.95	0.95	0.95	
Battery PV prosumer industrial Interface	Capex	€/kW$_{el}$	139	90	66	52	44	39	35	[31,32]
	Opex fix	€/(kW$_{el}$·a)	1.95	1.53	1.32	1.2	1.1	1.01	0.95	
	Opex var	€/kWh$_{el}$	0	0	0	0	0	0	0	
	Lifetime	years	20	20	20	20	20	20	20	
PHES Storage	Capex	€/kWh$_{el}$	7.7	7.7	7.7	7.7	7.7	7.7	7.7	[36]
	Opex fix	€/(kWh$_{el}$·a)	1.335	1.335	1.335	1.335	1.335	1.335	1.335	
	Opex var	€/kWh$_{el}$	0	0	0	0	0	0	0	
	Lifetime	years	50	50	50	50	50	50	50	
	Round-trip	coeff	0.85	0.85	0.85	0.85	0.85	0.85	0.85	
PHES Interface	Capex	€/kW$_{el}$	650	650	650	650	650	650	650	[36]
	Opex fix	€/(kW$_{el}$·a)	0	0	0	0	0	0	0	
	Opex var	€/kWh$_{el}$	0	0	0	0	0	0	0	
	Lifetime	years	50	50	50	50	50	50	50	
A-CAES Storage	Capex	€/kWh$_{el}$	75	65.3	57.9	53.6	50.8	47	43.8	[36]
	Opex fix	€/(kWh$_{el}$·a)	1.16	0.99	0.87	0.81	0.77	0.71	0.66	
	Opex var	€/kWh$_{el}$	0	0	0	0	0	0	0	
	Lifetime	years	40	40	40	40	40	40	40	
	Round-trip	coeff	0.59	0.65	0.70	0.70	0.70	0.70	0.70	
A-CAES Interface	Capex	€/kW$_{el}$	540	540	540	540	540	540	540	[36]
	Opex fix	€/(kW$_{el}$·a)	17.5	17.5	17.5	17.5	17.5	17.5	17.5	
	Opex var	€/kWh$_{el}$	0	0	0	0	0	0	0	
	Lifetime	years	40	40	40	40	40	40	40	

Thermal energy storage (TES)	Capex	€/kWh$_{th}$	41.8	32.7	26.8	23.3	21	19.3	17.5	[41]
	Opex fix	€/(kWh$_{th}$·a)	0.63	0.49	0.4	0.35	0.32	0.29	0.26	
	Opex var	€/kWh$_{th}$	0	0	0	0	0	0	0	
	Lifetime	years	25	25	25	30	30	30	30	
	Round-trip	coeff	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
Hydrogen Storage	Capex	€/kWh$_{th,LHV}$	0.28	0.28	0.28	0.28	0.28	0.28	0.28	[57]
	Opex fix	€/(kWh$_{th,LHV}$·a)	0.0112	0.0112	0.0112	0.0112	0.0112	0.0112	0.0112	
	Opex var	€/kWh$_{th,LHV}$	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	
	Lifetime	years	30	30	30	30	30	30	30	
	Round-trip	coeff	1	1	1	1	1	1	1	
Hydrogen Storage Interface	Capex	€/kW$_{th,LHV}$	100	100	100	100	100	100	100	[57]
	Opex fix	€/(kW$_{th,LHV}$·a)	4	4	4	4	4	4	4	
	Opex var	€/kW$_{th,LHV}$	0	0	0	0	0	0	0	
	Lifetime	years	15	15	15	15	15	15	15	
CO_2 Storage	Capex	€/ton	142	142	142	142	142	142	142	[58]
	Opex fix	€/(ton·a)	9.94	9.94	9.94	9.94	9.94	9.94	9.94	
	Opex var	€/ton	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	
	Lifetime	years	30	30	30	30	30	30	30	
	Round-trip	coeff	1	1	1	1	1	1	1	
CO_2 Storage Interface	Capex	€/ton/h	0	0	0	0	0	0	0	[58]
	Opex fix	€/(ton/h·a)	0	0	0	0	0	0	0	
	Opex var	€/ton	0	0	0	0	0	0	0	
	Lifetime	years	50	50	50	50	50	50	50	
Gas Storage	Capex	€/kWh$_{th}$	0.05	0.05	0.05	0.05	0.05	0.05	0.05	[57]
	Opex fix	€/(kWh$_{th}$·a)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	
	Opex var	€/kWh$_{th}$	0	0	0	0	0	0	0	
	Lifetime	years	50	50	50	50	50	50	50	
	Round-trip	coeff	1	1	1	1	1	1	1	
Gas Storage Interface	Capex	€/kW$_{th}$	100	100	100	100	100	100	100	[57]
	Opex fix	€/(kW$_{th}$·a)	4	4	4	4	4	4	4	
	Opex var	€/kW$_{th}$	0	0	0	0	0	0	0	
	Lifetime	years	15	15	15	15	15	15	15	

District Heat Storage	Capex	€/kWh_{th}	40	30	30	25	20	20	20	[41]
	Opex fix	€/(kWh_{th}·a)	0.6	0.45	0.45	0.375	0.3	0.3	0.3	
	Opex var	€/kWh_{th}	0	0	0	0	0	0	0	
	Lifetime	years	25	25	25	30	30	30	30	
	Round-trip	coeff	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
Reverse Osmosis Seawater Desalination	Capex	€/(m^3/day)	960	835	725	630	550	480	415	[59]
	Opex fix	€/(m^3/day)	38.4	33.4	29	25.2	22	19.2	16.6	
	Consumption	kWh_{th}/m^3	0	0	0	0	0	0	0	
	Lifetime	years	25	30	30	30	30	30	30	
	Consumption	kWh_{el}/m^3	3.6	3.35	3.15	3	2.85	2.7	2.6	
Multi Stage Flash Standalone	Capex	€/(m^3/day)	2000	2000	2000	2000	2000	2000	2000	[59]
	Opex fix	€/(m^3/day)	100	100	100	100	100	100	100	
	Consumption	kWh_{th}/m^3	85	85	85	85	85	85	85	
	Lifetime	years	25	25	25	25	25	25	25	
	Consumption	kWh_{el}/m^3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
Multi Stage Flash Cogeneration	Capex	€/(m^3/day)	3069	3069	3069	3069	3069	3069	3069	[51]
	Opex fix	€/(m^3/day)	121.4	121.4	121.4	121.4	121.4	121.4	132.1	
	Consumption	kWh_{th}/m^3	202.5	202.5	202.5	202.5	202.5	202.5	202.5	
	Lifetime	years	25	25	25	25	25	25	25	
	Consumption	kWh_{el}/m^3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
Multi Effect Distillation Standalone	Capex	€/(m^3/day)	1200	1044	906.3	787.5	687.5	600	518.8	[59]
	Opex fix	€/(m^3/day)	39.6	34.44	29.91	25.99	22.69	19.8	17.12	
	Consumption	kWh_{th}/m^3	51	44	38	32	28	28	28	
	Lifetime	years	25	25	25	25	25	25	25	
	Consumption	kWh_{el}/m^3	1.5	1.5	1.5	1.5	1.5	1.5	1.5	
Multi Effect Distillation Cogeneration	Capex	€/(m^3/day)	2150	2150	2150	2150	2150	2150	2150	[51]
	Opex fix	€/(m^3/day)	61.69	61.69	61.69	61.69	61.69	61.69	68.81	
	Consumption	kWh_{th}/m^3	168	168	168	168	168	168	168	
	Lifetime	years	25	25	25	25	25	25	25	
	Consumption	kWh_{el}/m^3	1.5	1.5	1.5	1.5	1.5	1.5	1.5	

Water Storage	Capex	€/m^3	64.59	64.59	64.59	64.59	64.59	64.59	64.59	[59]
	Opex fix	€/m^3	1.29	1.29	1.29	1.29	1.29	1.29	1.29	
	Opex var	€/m^3	0	0	0	0	0	0	0	
	Lifetime	years	50	50	50	50	50	50	50	
HVDC Transmission Line	Capex	€/(kW·km)	0.9233	0.9233	0.9233	0.9233	1.0467	1.0467	1.0467	[60–62]
	Opex fix	€/(kW·km)	0.0015	0.0015	0.0015	0.0015	0.0019	0.0019	0.0019	
	Opex var	€/(kWh·km)	0	0	0	0	0	0	0	
	Lifeteime	year	50	50	50	50	50	50	50	
	Efficiency	coeff	0.964	0.964	0.964	0.964	0.984	0.984	0.984	
HVDC Transmission Line (Cable)	Capex	€/(kW·km)	1.2333	1.2333	1.2333	1.2333	1.3667	1.3667	1.3667	[60–62]
	Opex fix	€/(kW·km)	0.0012	0.0012	0.0012	0.0012	0.0014	0.0014	0.0014	
	Opex var	€/(kWh·km)	0	0	0	0	0	0	0	
	Lifeteime	year	50	50	50	50	50	50	50	
	Efficiency	coeff	0.964	0.964	0.964	0.964	0.984	0.984	0.984	
HVDC Transmission Line (Overhead)	Capex	€/(kW·km)	0.2	0.2	0.2	0.2	0.3	0.3	0.3	[60–62]
	Opex fix	€/(kW·km)	0.002	0.002	0.002	0.002	0.003	0.003	0.003	
	Opex var	€/(kWh·km)	0	0	0	0	0	0	0	
	Lifeteime	year	50	50	50	50	50	50	50	
	Efficiency	coeff	0.934	0.934	0.934	0.934	0.984	0.984	0.984	
HVAC Transmission Line	Capex	€/(kW·km)	0.4576	0.4576	0.4576	0.4576	0.4576	0.4576	0.4576	[60–62]
	Opex fix	€/(kW·km)	0.0029	0.0029	0.0029	0.0029	0.0029	0.0029	0.0029	
	Opex var	€/(kWh·km)	0	0	0	0	0	0	0	
	Lifeteime	year	50	50	50	50	50	50	50	
	Efficiency	coeff	0.906	0.906	0.906	0.906	0.906	0.906	0.906	
Converter Station	Capex	€/(kW)	150	150	150	150	180	180	180	[60–62]
	Opex fix	€/(kW)	1.5	1.5	1.5	1.5	1.8	1.8	1.8	
	Opex var	€/(kWh)	0	0	0	0	0	0	0	
	Lifeteime	year	50	50	50	50	50	50	50	
	Efficiency	coeff	0.986	0.986	0.986	0.986	0.986	0.986	0.986	

Table 1.8 Self-discharge rates of storage technologies.

Technology	Self-discharge [%/h]	Ref.
Battery	0	[56]
PHES	0	[36]
A-CAES	0.1	[36]
TES	0.2	[56]
Gas storage	0	[56]

Table 1.9 Financial assumptions for the fossil fuel price and GHG emission cost.

Component	Unit	2020	2025	2030	2035	2040	2045	2050	Ref.
Coal	€/MWh_{th}	7.7	8.4	9.2	10.2	11.1	11.1	11.1	[62]
Oil	€/MWh_{th}	35.24	39.82	44.40	43.94	43.48	43.48	43.48	[63]
Natural gas	€/MWh_{th}	22.2	30	32.7	36.1	40.2	40.2	40.2	[62]
Uranium	€/MWh_{th}	2.6	2.6	2.6	2.6	2.6	2.6	2.6	[62]
GHG emissions	€/CO_{2eq}	28	52	61	68	75	100	150	[62]

Table 1.10 Well-to-wheel GHG emissions by fuel type.

Fuel	GHG emissions [tCO_{2eq}/MWh_{th}]	Ref.
Coal	0.389	[64]
Oil	0.387	[64]
Natural gas	0.283	[65]

Table 1.11 Electricity retail prices by sector – country average [10,12,13].

Sector	Unit	2020	2025	2030	2035	2040	2045	2050
Residential	[€/MWh]	49.76	63.50	81.05	103.44	132.02	153.04	177.42
Commercial	[€/MWh]	70.99	71.99	91.88	116.74	141.67	164.23	190.39
Industrial	[€/MWh]	62.66	79.97	102.06	129.49	150.70	174.70	202.53

Table 1.12 Lower and upper capacitiy limits of renewable energy in Egypt [66–70].

Lower and upper capacity limits – Renewable energy							
Solar PV optimally tilted [GW]	Solar PV single-axis tracking [GW]	Wind onshore [GW]	Hydro Run-of-River [GW]	Hydro reservoir (dam) [GW]	CSP (solar thermal) [GW]	Geothermal heat [GW]	Bioenergy [TWh/a]
1.9-7920.0	0.0-5432.0	1.4-339.5	0.2-0.3	2.7-4.0	0.0-9093.7	0.0-31.9	0.0-174.9

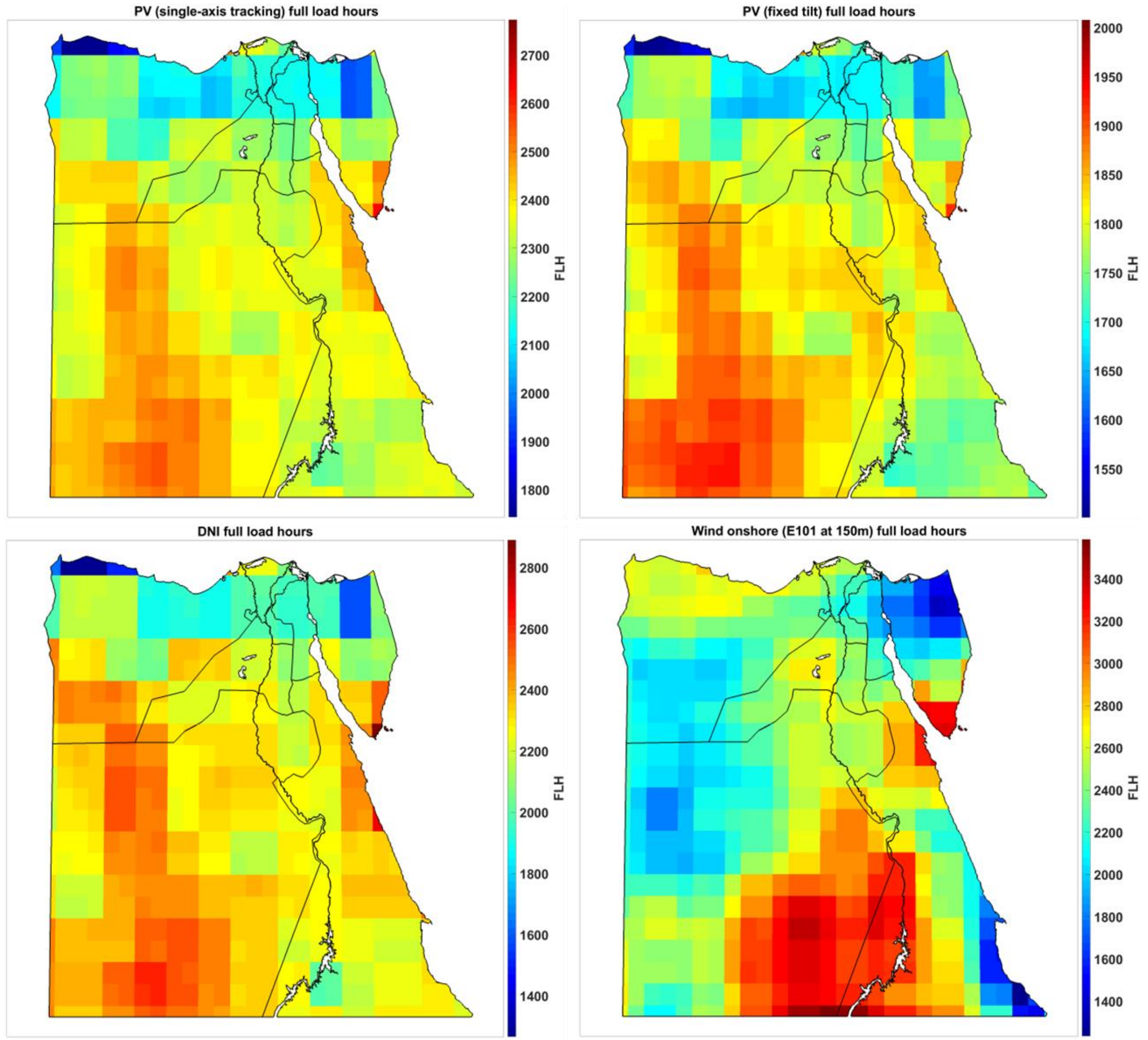

Figure 1.1 Aggregated feed-in profiles for single-axis tracking (top left) and optimally tilted solar PV (top right), solar CSP field (bottom left), and wind power plants (bottom right).

1.3. Scenario definitions

All the BPS variations have a renewable energy target of 100% from total primary energy demand by 2050. This does not apply to the BPSnoF since the main goal of simulating that scenario is to see how the energy system would transform under pure market forces without any interventions. The CPS has a medium-term RE target of 42% by 2035 from electricity generation only based on the latest anounced governmental targets [7]. Initially, the remaining share of power generation coming from fossil fuels included coal [71], but that was overturned when Egypt joined several other countries in a coal ban pledge in the COP26 at Glasgow [72]. The target for nuclear power in the CPS and the DPS is based on the announced nuclear power plant project that is estimated to be commissioned by 2026 [73]. Apart from the power sector, the transport sector has a target for EVs to have a 5% market share by 2040. Other modes of transport have no announced targets. The desalination sector target is based on the announced desalination projects [28,29]. The heat sector has no announced targets. There are no announced targets beyond 2035 for the power sector and 2040 for the transport sector. Thus, the targets for 2050 were assumed based on the trend of the previous years. The assumptions used for the DPS fall midway between the BPS and the CPS across all sectors. The following table summarises the most important assumptions.

Table 1.13 Characteristics of the applied energy transition scenarios.

Scenario	**RE target**	**RE annual growth limit**	**Inter-zonal electricity trade**	**CO_2 emissions cost [€/tCO_2]**	**Fischer-Tropsch**
BPS-HT	2050: 100%	2020-2030: 3% 2030-2050: 4%	Not limited	2020: 28 2025: 52 2030: 61 2035: 68 2040: 75 2045: 100 2050: 150	Yes; 100% from liquid hydrocarbons demand by 2050
BPS-4-HT	same as BPS-HT	4%	Not limited	same as BPS-HT	same as BPS-HT
BPS-LT	same as BPS-HT	same as BPS-HT	Limited	same as BPS-HT	same as BPS-HT
BPSnoF	None	same as BPS-HT	Not limited	None	No
DPS	2050: 75% RE and 5% nuclear power from electricity generation	Based on generation share per time-step	Not limited	same as BPS-HT	Yes; 43% from liquid hydrocarbons demand by 2050
CPS	2035: 42% RE and 8% nuclear power from electricity generation 2050: 55% RE and 5% nuclear power from electricity generation	Based on generation share per time-step	Not limited	None	No

2. Simulation results

2.1. Capacities and generation

Table 2.1 Installed power, heat, and storage capacities for Egypt from 2020 to 2050 for the BPS-HT. Values are subject to rounding errors.

	Technology	Unit	2020	2025	2030	2035	2040	2045	2050
Power capacities	PV fixed-tilted	GW_{el}	1.9	1.9	1.9	1.9	29.5	478.6	498.2
	PV single-axis tracking	GW_{el}	0.0	11.2	27.6	51.9	501.4	501.4	501.4
	PV prosumers	GW_{el}	0.1	1.3	6.3	16.7	39.3	58.0	81.8
	Wind onshore	GW_{el}	1.4	15.5	25.5	30.2	30.2	30.2	30.2
	Hydro run-of-river	GW_{el}	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Hydro reservoir (dam)	GW_{el}	2.7	4.0	4.0	4.0	4.0	4.0	4.0
	Biomass PP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass CHP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Waste-to-energy CHP	GW_{el}	0.0	0.2	0.4	0.6	0.6	0.6	0.6
	Biogas CHP	GW_{el}	0.0	0.0	0.0	0.1	0.1	0.6	0.7
	Geothermal electricity	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CSP ST	GW_{el}	0.0	0.4	4.3	30.5	30.9	30.9	30.5
	ST others	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CCGT	GW_{el}	32.5	31.0	30.4	30.4	29.7	23.7	18.7
	OCGT	GW_{el}	20.5	67.0	63.5	65.5	165.5	164.8	160.8
	Methane CHP	GW_{el}	0.0	0.0	0.2	0.2	0.2	0.2	0.2
	ICE	GW_{el}	1.1	0.8	0.5	0.4	0.4	0.2	0.0
	Oil CHP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal PP hard coal	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal CHP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Nuclear PP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total power capacities	**GW_{el}**	**60.4**	**133.6**	**164.9**	**232.6**	**832.1**	**1293.3**	**1327.2**
	CSP SF for power	GW_{th}	0.0	2.9	35.8	229.9	230.0	230.9	222.1
Heat capacities	CSP SF for heat	GW_{th}	0.0	12.2	31.6	66.4	66.2	65.3	59.0
	Solar thermal heat	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Geothermal heat DH	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass CHP	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass DH	GW_{th}	0.0	0.0	0.0	0.0	0.1	0.1	0.1
	Biomass IH	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	1.6
	Waste-to-energy CHP	GW_{th}	0.0	0.1	0.1	0.2	0.2	0.2	0.2
	Biogas CHP	GW_{th}	0.0	0.0	0.0	0.1	0.1	0.5	0.6
	Biogas IH	GW_{th}	0.0	0.1	0.1	0.1	0.1	0.1	1.0
	Electric heating DH	GW_{th}	0.0	1.0	1.0	1.0	1.1	1.8	4.2
	Electric heating IH	GW_{th}	33.6	83.0	81.8	80.3	87.2	80.5	80.6
	Heat pump DH	GW_{th}	0.0	0.0	0.0	0.4	2.4	2.5	2.5
	Heat pump IH	GW_{th}	0.0	35.8	50.0	66.5	88.7	82.7	72.2
	Methane CHP	GW_{th}	0.0	0.0	0.3	0.3	0.3	0.3	0.3
	Methane DH	GW_{th}	4.8	4.2	3.7	3.5	3.2	2.0	1.3
	Methane IH	GW_{th}	46.6	30.7	25.4	19.2	0.0	0.0	1.1
	Oil CHP	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Oil DH	GW_{th}	8.7	7.8	6.9	6.5	6.0	5.2	3.8
	Oil IH	GW_{th}	203.6	43.6	36.9	18.6	0.0	0.0	1.0
	Coal CHP	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal DH	GW_{th}	2.6	2.3	2.1	1.9	1.7	1.4	1.0
	Total heat capacities	**GW_{th}**	**299.9**	**220.8**	**239.9**	**265.0**	**257.3**	**242.6**	**230.5**

Table 2.1. (continued) Installed power, heat, and storage capacities for Egypt from 2020 to 2050 for the BPS-HT. Values are subject to rounding errors.

	Technology	**Unit**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Storage capacities	Battery	GWh	0.0	3.8	5.1	101.9	344.7	922.4	1 023.5
	Battery prosumers	GWh	0.0	0.0	6.0	29.5	69.3	100.5	126.7
	PHES	GWh	0.0	19.2	19.2	38.4	38.4	38.4	38.4
	A-CAES	GWh	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TES HT	GWh	0.0	38.2	222.1	1 032.6	1 032.6	1 041.2	1 012.2
	TES DH	GWh	0.1	0.0	0.0	0.2	51.3	48.7	51.9
	Gas (CH_4) storage	GWh	0.0	3.9	5.8	624.4	1 062.0	8 040.9	9 884.6
	Gas (H_2) storage	GWh	0.0	0.6	0.7	1.1	4 295.9	57 288.1	57 288

Table 2.2 Installed power, heat, and storage capacities for Egypt from 2020 to 2050 for the BPS-4-HT. Values are subject to rounding errors.

	Technology	Unit	2020	2025	2030	2035	2040	2045	2050
Power capacities	PV fixed-tilted	GW_{el}	1.9	1.9	1.9	35.6	520.1	814.8	820.8
	PV single-axis tracking	GW_{el}	0.0	20.0	43.9	206.7	284.8	284.8	306.0
	PV prosumers	GW_{el}	0.1	1.3	6.3	16.7	39.3	58.0	81.8
	Wind onshore	GW_{el}	1.4	16.2	44.7	51.0	51.0	51.0	51.0
	Hydro run-of-river	GW_{el}	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Hydro reservoir (dam)	GW_{el}	2.7	4.0	4.0	4.0	4.0	4.0	4.0
	Biomass PP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass CHP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Waste-to-energy CHP	GW_{el}	0.0	0.2	0.4	0.6	0.6	0.6	0.6
	Biogas CHP	GW_{el}	0.0	0.0	0.0	0.0	0.2	0.8	0.9
	Geothermal electricity	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CSP ST	GW_{el}	0.0	0.4	0.4	0.7	0.8	0.8	0.4
	ST others	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CCGT	GW_{el}	32.5	31.0	30.4	30.4	29.7	23.7	18.7
	OCGT	GW_{el}	20.5	66.9	63.4	95.4	93.5	92.8	88.8
	Methane CHP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	ICE	GW_{el}	1.1	0.8	0.5	0.4	0.4	0.2	0.0
	Oil CHP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal PP hard coal	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal CHP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Nuclear PP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total power capacities	GW_{el}	**60.4**	**142.9**	**196.1**	**441.6**	**1024.5**	**1331.5**	**1373.0**
	CSP SF for power	GW_{th}	0.0	2.6	3.1	3.9	5.4	5.5	1.2
Heat capacities	CSP SF for heat	GW_{th}	0.0	12.2	28.6	36.1	34.5	34.4	24.0
	Solar thermal heat	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Geothermal heat DH	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass CHP	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass DH	GW_{th}	0.0	0.0	0.0	0.0	0.1	0.1	0.1
	Biomass IH	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	1.6
	Waste-to-energy CHP	GW_{th}	0.0	0.1	0.1	0.2	0.2	0.2	0.2
	Biogas CHP	GW_{th}	0.0	0.0	0.0	0.0	0.1	0.6	0.7
	Biogas IH	GW_{th}	0.0	0.1	0.1	0.1	0.1	0.1	1.0
	Electric heating DH	GW_{th}	0.0	1.1	2.1	2.1	2.3	2.9	8.6
	Electric heating IH	GW_{th}	33.6	83.0	81.8	80.3	87.2	80.5	80.6
	Heat pump DH	GW_{th}	0.0	0.0	0.0	1.0	4.2	4.6	4.8
	Heat pump IH	GW_{th}	0.0	35.8	50.0	66.5	88.7	82.7	72.2
	Methane CHP	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Methane DH	GW_{th}	4.8	4.2	3.7	3.5	3.2	2.0	1.3
	Methane IH	GW_{th}	46.6	30.7	25.4	19.2	0.0	0.0	1.1
	Oil CHP	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Oil DH	GW_{th}	8.7	7.8	6.9	6.5	6.0	5.2	3.8
	Oil IH	GW_{th}	203.6	43.6	36.9	18.6	0.0	0.0	1.0
	Coal CHP	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal DH	GW_{th}	2.6	2.3	2.1	1.9	1.7	1.4	1.0
	Total heat capacities	GW_{th}	**299.9**	**220.9**	**237.7**	**236.0**	**228.3**	**214.7**	**202.0**
Storage capacities	Battery	GWh	0.0	3.8	12.4	310.2	721.7	1 221.2	1 368.7
	Battery prosumers	GWh	0.0	0.0	6.0	29.5	69.3	100.5	126.7
	PHES	GWh	0.0	19.2	38.4	38.4	38.4	38.4	38.4
	A-CAES	GWh	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	TES HT	GWh	0.0	37.2	99.7	135.6	136.2	140.2	118.2
	TES DH	GWh	0.1	0.0	0.0	20.1	49.6	55.8	66.7
	Gas (CH_4) storage	GWh	0.0	5.0	5.1	921.1	2 262.0	8 847.1	14 580.2
	Gas (H_2) storage	GWh	0.0	0.8	0.9	10 349.3	22 660.4	49 122.8	49 122.9

Table 2.3 Installed power, heat, and storage capacities for Egypt from 2020 to 2050 for the BPS-LT. Values are subject to rounding errors.

	Technology	Unit	2020	2025	2030	2035	2040	2045	2050
Power capacities	PV fixed-tilted	GW_{el}	1.9	1.9	1.9	1.9	43.6	478.7	577.7
	PV single-axis tracking	GW_{el}	0.0	19.7	46.9	92.0	482.9	492.5	492.5
	PV prosumers	GW_{el}	0.1	1.3	6.3	16.7	39.3	58.0	81.8
	Wind onshore	GW_{el}	1.4	7.4	9.7	12.6	17.9	18.1	18.1
	Hydro run-of-river	GW_{el}	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Hydro reservoir (dam)	GW_{el}	2.7	4.0	4.0	4.0	4.0	4.0	4.0
	Biomass PP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass CHP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Waste-to-energy CHP	GW_{el}	0.0	0.2	0.4	0.6	0.6	0.6	0.6
	Biogas CHP	GW_{el}	0.0	0.0	0.0	0.2	0.2	0.3	0.4
	Geothermal electricity	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CSP ST	GW_{el}	0.0	0.5	2.8	24.6	29.7	35.9	35.4
	ST others	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CCGT	GW_{el}	32.5	37.2	37.1	37.1	36.3	30.3	25.3
	OCGT	GW_{el}	20.5	62.1	59.5	70.8	151.5	150.8	146.8
	Methane CHP	GW_{el}	0.0	0.0	0.6	1.7	1.7	1.7	1.7
	ICE	GW_{el}	1.1	0.8	0.5	0.4	0.4	0.2	0.0
	Oil CHP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal PP hard coal	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal CHP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Nuclear PP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total power capacities	**GW_{el}**	**60.4**	**135.4**	**169.8**	**262.8**	**808.4**	**1271.3**	**1384.5**
	CSP SF for power	GW_{th}	0.0	3.4	23.3	189.3	219.7	266.8	258.6
Heat capacities	CSP SF for heat	GW_{th}	0.0	12.3	29.2	65.8	74.8	79.4	71.9
	Solar thermal heat	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Geothermal heat DH	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass CHP	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass DH	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass IH	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	1.6
	Waste-to-energy CHP	GW_{th}	0.0	0.1	0.1	0.2	0.2	0.2	0.2
	Biogas CHP	GW_{th}	0.0	0.0	0.0	0.1	0.1	0.3	0.3
	Biogas IH	GW_{th}	0.0	0.1	0.1	0.1	0.1	0.1	1.0
	Electric heating DH	GW_{th}	0.0	1.0	1.0	1.0	1.0	1.0	1.6
	Electric heating IH	GW_{th}	33.6	83.0	81.8	80.3	87.2	80.5	80.6
	Heat pump DH	GW_{th}	0.0	0.0	0.0	0.0	1.6	1.6	1.6
	Heat pump IH	GW_{th}	0.0	35.8	50.0	66.5	88.7	82.7	72.2
	Methane CHP	GW_{th}	0.0	0.0	0.8	2.4	2.4	2.4	2.4
	Methane DH	GW_{th}	4.8	4.2	3.7	3.5	3.2	2.0	1.3
	Methane IH	GW_{th}	46.6	30.7	25.4	19.2	0.0	0.0	1.1
	Oil CHP	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Oil DH	GW_{th}	8.7	7.8	6.9	6.5	6.0	5.2	3.8
	Oil IH	GW_{th}	203.6	43.6	36.9	18.6	0.0	0.0	1.0
	Coal CHP	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal DH	GW_{th}	2.6	2.3	2.1	1.9	1.7	1.4	1.0
	Total heat capacities	**GW_{th}**	**299.9**	**220.9**	**238.0**	**266.1**	**267.0**	**256.8**	**241.6**
Storage capacities	Battery	GWh	0.0	11.0	29.2	199.8	452.4	910.2	990.4
	Battery prosumers	GWh	0.0	0.0	6.0	29.5	69.3	100.5	126.7
	PHES	GWh	0.0	19.2	19.2	36.5	37.3	37.3	38.4
	A-CAES	GWh	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	TES HT	GWh	0.0	40.5	169.1	842.3	971.9	1 149.0	1 110.9
	TES DH	GWh	0.1	0.0	0.0	0.2	54.3	65.1	68.4
	Gas (CH_4) storage	GWh	0.0	0.7	2.7	223.5	603.7	6 512.4	13 719.0
	Gas (H_2) storage	GWh	0.0	0.1	57.9	637.3	16 331.9	57 605.6	57 605.7

Table 2.4 Installed power, heat, and storage capacities for Egypt from 2020 to 2050 for the BPSnoF. Values are subject to rounding errors.

	Technology	Unit	2020	2025	2030	2035	2040	2045	2050
Power capacities	PV fixed-tilted	GW_{el}	1.9	1.9	1.9	1.9	169.7	344.9	530.6
	PV single-axis tracking	GW_{el}	0.0	21.8	45.9	78.9	140.6	140.6	140.6
	PV prosumers	GW_{el}	0.1	1.3	6.3	16.7	39.3	58.0	81.8
	Wind onshore	GW_{el}	1.4	5.8	12.8	30.5	30.5	30.5	30.5
	Hydro run-of-river	GW_{el}	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Hydro reservoir (dam)	GW_{el}	2.7	4.0	4.0	4.0	4.0	4.0	4.0
	Biomass PP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass CHP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Waste-to-energy CHP	GW_{el}	0.0	0.2	0.4	0.6	0.6	0.6	0.6
	Biogas CHP	GW_{el}	0.0	0.0	0.0	0.3	0.3	0.7	0.8
	Geothermal electricity	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CSP ST	GW_{el}	0.0	0.1	0.1	0.2	0.2	0.2	0.2
	ST others	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CCGT	GW_{el}	32.5	31.0	30.4	30.4	29.7	23.7	18.7
	OCGT	GW_{el}	20.5	68.7	65.2	62.5	82.6	81.9	77.9
	Methane CHP	GW_{el}	0.0	0.0	0.6	0.9	0.9	0.9	0.9
	ICE	GW_{el}	1.1	0.8	0.5	0.4	0.4	0.2	0.0
	Oil CHP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal PP hard coal	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal CHP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Nuclear PP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total power capacities	**GW_{el}**	**60.4**	**135.9**	**168.3**	**227.4**	**498.9**	**686.2**	**886.5**
	CSP SF for power	GW_{th}	0.0	0.5	0.5	1.2	1.6	1.3	0.7
Heat capacities	CSP SF for heat	GW_{th}	0.0	10.4	22.8	33.6	37.7	38.0	27.7
	Solar thermal heat	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Geothermal heat DH	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass CHP	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass DH	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass IH	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	1.6
	Waste-to-energy CHP	GW_{th}	0.0	0.1	0.1	0.2	0.2	0.2	0.2
	Biogas CHP	GW_{th}	0.0	0.0	0.0	0.2	0.2	0.6	0.6
	Biogas IH	GW_{th}	0.0	0.1	0.1	0.1	0.1	0.1	1.0
	Electric heating DH	GW_{th}	0.0	1.4	1.4	1.5	1.5	2.9	5.3
	Electric heating IH	GW_{th}	33.6	83.0	81.8	80.3	87.2	80.5	80.6
	Heat pump DH	GW_{th}	0.0	0.0	0.0	0.8	3.6	4.8	6.2
	Heat pump IH	GW_{th}	0.0	35.8	50.0	66.5	88.7	82.7	72.2
	Methane CHP	GW_{th}	0.0	0.0	0.8	1.2	1.2	1.2	1.2
	Methane DH	GW_{th}	4.8	4.2	3.7	3.5	3.2	2.1	1.4
	Methane IH	GW_{th}	46.6	30.7	25.4	19.2	0.0	0.0	1.1
	Oil CHP	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Oil DH	GW_{th}	8.7	7.8	6.9	6.5	6.0	5.2	3.8
	Oil IH	GW_{th}	203.6	43.6	36.9	18.6	0.0	0.0	1.0
	Coal CHP	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal DH	GW_{th}	2.6	2.3	2.1	1.9	1.7	1.4	1.0
	Total heat capacities	**GW_{th}**	**299.9**	**219.4**	**232.0**	**234.1**	**231.3**	**219.7**	**204.9**
Storage capacities	Battery	GWh	0.0	4.4	20.7	112.7	784.9	1 145.4	1 435.3
	Battery prosumers	GWh	0.0	0.0	6.0	29.5	69.3	100.5	126.7
	PHES	GWh	0.0	23.3	30.5	38.4	38.4	38.4	38.4
	A-CAES	GWh	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TES HT	GWh	0.0	29.0	65.4	107.5	119.1	123.6	110.3
	TES DH	GWh	0.1	0.0	0.0	0.1	24.9	24.8	30.5
	Gas (CH_4) storage	GWh	0.0	1.0	1.3	3.0	513.0	1 863.0	1 866.5
	Gas (H_2) storage	GWh	0.0	0.2	0.2	0.5	3 393.4	13 463.3	16 492.9

Table 2.5 Installed power, heat, and storage capacities for Egypt from 2020 to 2050 for the DPS. Values are subject to rounding errors.

	Technology	Unit	2020	2025	2030	2035	2040	2045	2050
Power capacities	PV fixed-tilted	GW_{el}	1.9	4.2	5.1	5.1	5.1	5.1	140.5
	PV single-axis tracking	GW_{el}	0.0	10.1	25.8	104.3	193.1	282.0	524.5
	PV prosumers	GW_{el}	0.1	0.9	4.1	10.8	25.7	44.1	62.4
	Wind onshore	GW_{el}	1.4	10.5	27.7	30.1	36.2	50.8	114.9
	Hydro run-of-river	GW_{el}	0.2	0.2	0.2	0.2	0.2	0.2	0.3
	Hydro reservoir (dam)	GW_{el}	2.7	3.3	3.3	3.3	3.3	4.0	4.0
	Biomass PP	GW_{el}	0.0	0.1	0.1	0.1	0.1	0.1	0.0
	Biomass CHP	GW_{el}	0.0	0.1	0.1	0.1	0.1	0.1	0.0
	Waste-to-energy CHP	GW_{el}	0.0	0.2	0.4	0.6	0.6	0.6	0.6
	Biogas CHP	GW_{el}	0.0	1.8	1.8	1.8	1.8	1.8	1.8
	Geothermal electricity	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	7.6
	CSP ST	GW_{el}	0.0	0.8	1.5	3.0	4.9	9.7	24.9
	ST others	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CCGT	GW_{el}	32.5	71.2	70.6	70.6	69.9	63.9	66.8
	OCGT	GW_{el}	20.5	17.2	13.7	12.4	10.4	9.7	5.7
	Methane CHP	GW_{el}	0.0	0.6	0.7	0.7	0.7	0.7	0.7
	ICE	GW_{el}	1.1	1.6	1.4	2.5	2.5	2.3	2.1
	Oil CHP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal PP hard coal	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal CHP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Nuclear PP	GW_{el}	0.0	0.0	4.8	4.8	4.8	4.8	4.8
	Total power capacities	$\mathbf{GW_{el}}$	**60.4**	**122.8**	**161.4**	**250.3**	**359.3**	**479.8**	**961.4**
	CSP SF for power	GW_{th}	0.0	3.1	5.9	12.5	18.9	33.8	87.1
Heat capacities	CSP SF for heat	GW_{th}	0.0	12.7	24.2	33.2	32.6	47.2	45.8
	Solar thermal heat	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Geothermal heat DH	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass CHP	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass DH	GW_{th}	0.0	1.5	1.6	1.6	1.6	1.6	1.6
	Biomass IH	GW_{th}	0.0	0.1	0.1	0.1	0.2	0.1	0.3
	Waste-to-energy CHP	GW_{th}	0.0	0.1	0.1	0.2	0.2	0.2	0.2
	Biogas CHP	GW_{th}	0.0	1.4	1.4	1.4	1.4	1.4	1.4
	Biogas IH	GW_{th}	0.0	0.1	0.1	0.1	0.1	0.1	0.1
	Electric heating DH	GW_{th}	0.0	1.6	1.7	10.3	16.9	16.9	16.9
	Electric heating IH	GW_{th}	33.6	84.8	81.6	82.9	81.0	74.2	74.2
	Heat pump DH	GW_{th}	0.0	0.3	0.4	0.4	0.4	1.6	2.0
	Heat pump IH	GW_{th}	0.0	16.5	23.7	33.0	33.5	28.9	24.5
	Methane CHP	GW_{th}	0.0	0.9	0.9	0.9	0.9	0.9	0.9
	Methane DH	GW_{th}	4.8	4.3	3.8	3.6	5.4	4.3	3.6
	Methane IH	GW_{th}	46.6	31.8	27.9	22.2	4.4	3.3	2.5
	Oil CHP	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Oil DH	GW_{th}	8.7	7.8	6.9	6.5	6.0	5.2	3.8
	Oil IH	GW_{th}	203.6	56.7	54.0	43.9	56.8	57.3	56.2
	Coal CHP	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal DH	GW_{th}	2.6	2.3	2.1	1.9	1.7	1.5	1.0
	Total heat capacities	$\mathbf{GW_{th}}$	**299.9**	**222.9**	**230.5**	**242.2**	**243.1**	**244.7**	**235.0**
Storage capacities	Battery	GWh	0.0	35.1	35.1	35.1	35.1	49.4	88.5
	Battery prosumers	GWh	0.0	0.0	4.0	19.1	45.2	76.1	96.3
	PHES	GWh	0.0	19.2	19.2	19.2	19.2	19.2	19.2
	A-CAES	GWh	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TES HT	GWh	0.0	33.7	53.8	116.5	117.1	169.5	157.6
	TES DH	GWh	0.1	4.4	12.2	7.8	30.1	31.7	36.4
	Gas (CH_4) storage	GWh	0.0	9.6	9.7	16 914.1	17 910.0	18 290.0	19 766.2
	Gas (H_2) storage	GWh	0.0	9.0	10.2	170.8	361.1	1 058.4	32 350.7

Table 2.6 Installed power, heat, and storage capacities for Egypt from 2020 to 2050 for the CPS. Values are subject to rounding errors.

	Technology	**Unit**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Power capacities	PV fixed-tilted	GW_{el}	1.9	3.5	4.1	4.1	5.2	5.5	3.8
	PV single-axis tracking	GW_{el}	0.0	4.9	17.8	63.9	85.0	107.9	129.9
	PV prosumers	GW_{el}	0.1	0.4	2.0	5.3	9.9	18.4	32.4
	Wind onshore	GW_{el}	1.4	6.2	16.7	33.1	49.8	63.9	78.7
	Hydro run-of-river	GW_{el}	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Hydro reservoir (dam)	GW_{el}	2.7	2.7	3.5	3.5	3.5	3.5	3.5
	Biomass PP	GW_{el}	0.0	0.1	0.1	0.1	0.1	0.1	0.0
	Biomass CHP	GW_{el}	0.0	0.1	0.1	0.1	0.1	0.1	0.0
	Waste-to-energy CHP	GW_{el}	0.0	0.2	0.4	0.6	0.6	0.6	0.6
	Biogas CHP	GW_{el}	0.0	1.8	1.9	1.9	1.9	2.0	2.0
	Geothermal electricity	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CSP ST	GW_{el}	0.0	1.0	2.3	6.8	12.3	15.9	19.4
	ST others	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CCGT	GW_{el}	32.5	57.1	56.6	56.6	55.9	49.9	48.3
	OCGT	GW_{el}	20.5	29.3	25.8	32.1	30.2	29.5	25.5
	Methane CHP	GW_{el}	0.0	0.6	0.6	0.6	0.7	0.7	0.8
	ICE	GW_{el}	1.1	1.6	1.4	1.2	1.3	1.2	1.0
	Oil CHP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal PP hard coal	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal CHP	GW_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Nuclear PP	GW_{el}	0.0	0.0	4.8	4.8	4.8	4.8	4.8
	Total power capacities	**GW_{el}**	**60.4**	**109.6**	**138.2**	**214.8**	**261.5**	**304.1**	**351.0**
	CSP SF for power	GW_{th}	0.0	3.6	8.8	26.9	44.4	57.2	68.8
Heat capacities	CSP SF for heat	GW_{th}	0.0	12.1	21.7	24.0	35.2	39.6	42.6
	Solar thermal heat	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Geothermal heat DH	GW_{th}	0.0	0.0	0.0	0.0	0.1	0.0	0.0
	Biomass CHP	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass DH	GW_{th}	0.0	1.5	1.5	1.5	1.6	1.7	1.8
	Biomass IH	GW_{th}	0.0	0.1	0.1	0.1	0.1	0.1	0.3
	Waste-to-energy CHP	GW_{th}	0.0	0.1	0.1	0.2	0.2	0.2	0.2
	Biogas CHP	GW_{th}	0.0	1.5	1.5	1.5	1.6	1.6	1.6
	Biogas IH	GW_{th}	0.0	0.1	0.1	0.1	0.1	0.1	0.1
	Electric heating DH	GW_{th}	0.0	1.6	1.7	2.7	4.3	5.1	6.0
	Electric heating IH	GW_{th}	33.6	82.2	79.6	80.1	74.3	67.5	67.5
	Heat pump DH	GW_{th}	0.0	0.3	0.3	0.3	0.5	0.5	0.3
	Heat pump IH	GW_{th}	0.0	1.1	2.3	4.7	5.9	6.9	5.8
	Methane CHP	GW_{th}	0.0	0.8	0.9	0.9	0.9	1.0	1.0
	Methane DH	GW_{th}	4.8	4.3	3.8	3.6	3.8	2.8	2.2
	Methane IH	GW_{th}	46.6	34.3	32.0	26.1	9.5	7.0	5.7
	Oil CHP	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Oil DH	GW_{th}	8.7	7.8	6.9	6.5	6.0	5.2	3.8
	Oil IH	GW_{th}	203.6	70.8	68.8	64.7	79.1	77.2	75.9
	Coal CHP	GW_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal DH	GW_{th}	2.6	2.3	2.1	1.9	1.7	1.4	1.0
	Total heat capacities	**GW_{th}**	**299.9**	**220.9**	**223.4**	**218.9**	**224.9**	**217.9**	**215.8**
Storage capacities	Battery	GWh	0.0	30.4	30.4	30.4	30.4	3.9	4.0
	Battery prosumers	GWh	0.0	0.0	2.0	9.2	17.4	31.9	50.6
	PHES	GWh	0.0	19.2	19.2	19.2	19.2	19.2	19.2
	A-CAES	GWh	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TES HT	GWh	0.0	33.6	51.6	77.8	83.1	86.5	108.1
	TES DH	GWh	0.1	4.3	10.9	10.2	40.4	53.5	40.6
	Gas (CH_4) storage	GWh	0.0	9.5	9.7	10.2	12.6	12.7	13.0
	Gas (H_2) storage	GWh	0.0	10.0	10.7	14.2	14.4	14.9	16.3

Table 2.7 Power and heat generation, and storage throughput for Egypt from 2020 to 2050 for the BPS-HT. Values are subject to rounding errors.

	Technology	Unit	2020	2025	2030	2035	2040	2045	2050
Power generation	PV fixed-tilted	TWh_{el}	3.5	3.5	3.5	3.5	53.5	878.5	914.3
	PV single-axis tracking	TWh_{el}	0.0	23.1	55.9	105.8	1049.3	1049.3	1049.3
	PV prosumers	TWh_{el}	0.2	2.4	11.2	29.6	69.8	102.8	145.5
	Wind onshore	TWh_{el}	3.3	44.7	74.2	88.1	88.2	88.4	88.4
	Hydro run-of-river	TWh_{el}	1.0	1.1	1.1	1.1	1.1	1.1	1.1
	Hydro reservoir (dam)	TWh_{el}	14.0	21.0	21.0	21.0	21.0	21.0	21.0
	Biomass PP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass CHP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Waste-to-energy CHP	TWh_{el}	0.0	1.6	3.2	4.9	4.9	4.9	4.9
	Biogas CHP	TWh_{el}	0.0	0.0	0.0	0.5	0.3	1.0	1.4
	Geothermal electricity	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CSP ST	TWh_{el}	0.0	2.6	33.7	234.6	236.4	237.3	231.0
	ST others	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CCGT	TWh_{el}	105.5	145.3	113.6	18.0	14.9	4.9	0.0
	OCGT	TWh_{el}	55.5	35.2	33.4	34.4	67.6	0.1	0.0
	Methane CHP	TWh_{el}	0.0	0.0	1.6	0.9	0.0	0.1	0.0
	ICE	TWh_{el}	3.4	0.4	0.0	0.0	0.0	0.0	0.0
	Oil CHP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal PP hard coal	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal CHP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Nuclear PP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total power generation	$\mathbf{TWh_{el}}$	**186.4**	**280.9**	**352.4**	**542.4**	**1607.0**	**2389.4**	**2456.9**
	CSP SF for power	TWh_{th}	0.0	6.5	83.5	549.4	549.7	551.9	537.2
Heat generation	CSP SF for heat	TWh_{th}	0.0	27.3	73.8	158.7	158.3	156.1	137.2
	Solar thermal heat	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	Geothermal heat DH	TWh_{th}	0.1	0.1	0.1	0.0	0.0	0.0	0.0
	Biomass CHP	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass DH	TWh_{th}	0.0	0.0	0.0	0.0	0.1	0.1	0.0
	Biomass IH	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	2.1
	Waste-to-energy CHP	TWh_{th}	0.0	4.3	8.4	12.3	12.0	11.4	11.5
	Biogas CHP	TWh_{th}	0.0	0.0	0.0	0.6	0.4	1.2	1.6
	Biogas IH	TWh_{th}	0.0	1.2	1.2	1.2	1.2	1.2	1.1
	Electric heating DH	TWh_{th}	0.0	0.6	0.3	0.3	0.6	2.2	6.3
	Electric heating IH	TWh_{th}	28.2	42.6	25.4	18.7	16.4	10.8	17.2
	Heat pump DH	TWh_{th}	0.0	0.0	0.0	2.1	11.8	10.5	14.0
	Heat pump IH	TWh_{th}	0.0	123.1	157.1	182.9	202.4	188.5	155.7
	Methane CHP	TWh_{th}	0.0	0.0	1.1	0.6	0.0	0.1	0.0
	Methane DH	TWh_{th}	18.6	12.2	7.1	3.5	0.2	0.2	0.2
	Methane IH	TWh_{th}	92.9	51.2	33.3	19.2	0.0	0.0	1.2
	Oil CHP	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Oil DH	TWh_{th}	13.1	9.3	5.9	3.3	0.0	0.0	0.0
	Oil IH	TWh_{th}	117.3	25.5	24.2	11.3	0.0	0.0	0.0
	Coal CHP	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal DH	TWh_{th}	21.3	14.5	9.4	5.7	1.0	0.6	0.0
	Total heat generation	$\mathbf{TWh_{th}}$	**291.5**	**311.9**	**347.3**	**420.4**	**404.4**	**382.9**	**348.2**
Storage throughput	Battery	TWh_{el}	0.0	1.4	2.2	36.7	127.3	372.5	379.4
	Battery prosumers	TWh_{el}	0.0	0.0	2.1	9.9	23.1	32.9	54.1
	PHES	TWh_{el}	0.0	3.7	4.3	10.2	11.3	9.5	12.0
	A-CAES	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TES HT	TWh_{th}	0.0	12.9	81.2	399.8	412.2	454.2	423.1
	TES DH	TWh_{th}	0.0	0.0	0.0	0.2	75.7	94.2	93.5
	Gas (CH_4) storage	$TWh_{th,CH4}$	0.0	0.0	0.5	7.0	8.6	24.2	52.9
	Gas (H_2) storage	$TWh_{th,H2}$	0.0	0.0	0.0	0.0	355.1	509.0	492.2

Table 2.8 Power and heat generation, and storage throughput for Egypt from 2020 to 2050 for the BPS-4-HT. Values are subject to rounding errors.

	Technology	Unit	2020	2025	2030	2035	2040	2045	2050
Power generation	PV fixed-tilted	TWh_{el}	3.5	3.5	3.5	64.4	948.7	1490.6	1501.0
	PV single-axis tracking	TWh_{el}	0.0	40.4	89.8	429.3	591.8	591.8	633.9
	PV prosumers	TWh_{el}	0.2	2.4	11.2	29.6	69.8	102.8	145.5
	Wind onshore	TWh_{el}	3.3	46.9	130.2	149.1	149.1	149.3	149.3
	Hydro run-of-river	TWh_{el}	1.0	1.1	1.1	1.1	1.1	1.1	1.1
	Hydro reservoir (dam)	TWh_{el}	14.0	21.0	21.0	21.0	21.0	21.0	21.0
	Biomass PP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass CHP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Waste-to-energy CHP	TWh_{el}	0.0	1.6	3.2	4.9	4.9	4.9	4.9
	Biogas CHP	TWh_{el}	0.0	0.0	0.2	0.1	0.4	1.1	1.5
	Geothermal electricity	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CSP ST	TWh_{el}	0.0	2.3	2.8	3.5	5.1	5.1	1.3
	ST others	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CCGT	TWh_{el}	105.5	126.4	75.7	16.0	10.8	5.5	0.0
	OCGT	TWh_{el}	55.5	35.2	33.3	50.1	21.3	0.1	0.1
	Methane CHP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	ICE	TWh_{el}	3.4	0.4	0.0	0.0	0.0	0.0	0.0
	Oil CHP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal PP hard coal	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal CHP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Nuclear PP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total power generation	**TWh_{el}**	**186.4**	**281.2**	**372.0**	**769.1**	**1824.0**	**2373.3**	**2459.6**
	CSP SF for power	TWh_{th}	0.0	5.7	7.0	8.8	12.2	12.3	3.0
Heat generation	CSP SF for heat	TWh_{th}	0.0	27.2	64.0	80.8	77.3	77.2	53.7
	Solar thermal heat	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	Geothermal heat DH	TWh_{th}	0.1	0.1	0.1	0.0	0.0	0.0	0.0
	Biomass CHP	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass DH	TWh_{th}	0.0	0.0	0.0	0.0	0.1	0.1	0.0
	Biomass IH	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	2.1
	Waste-to-energy CHP	TWh_{th}	0.0	4.3	8.6	12.8	12.2	11.6	11.7
	Biogas CHP	TWh_{th}	0.0	0.0	0.2	0.2	0.4	1.3	1.7
	Biogas IH	TWh_{th}	0.0	1.2	1.2	1.2	1.2	1.2	1.1
	Electric heating DH	TWh_{th}	0.0	0.6	1.2	1.1	2.6	4.2	13.4
	Electric heating IH	TWh_{th}	28.2	42.6	25.4	18.7	16.4	10.8	17.2
	Heat pump DH	TWh_{th}	0.0	0.0	0.0	5.6	18.2	18.6	24.9
	Heat pump IH	TWh_{th}	0.0	123.1	157.1	182.9	202.4	188.5	155.7
	Methane CHP	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Methane DH	TWh_{th}	18.6	12.2	7.1	3.5	0.5	0.2	0.1
	Methane IH	TWh_{th}	92.9	51.2	33.3	19.2	0.0	0.0	1.2
	Oil CHP	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Oil DH	TWh_{th}	13.1	9.3	5.9	3.3	0.1	0.0	0.0
	Oil IH	TWh_{th}	117.3	25.5	24.2	11.3	0.0	0.0	0.0
	Coal CHP	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal DH	TWh_{th}	21.3	14.5	9.5	5.0	2.0	0.5	0.0
	Total heat generation	**TWh_{th}**	**291.5**	**311.8**	**337.8**	**345.6**	**333.4**	**314.2**	**282.9**
Storage throughput	Battery	TWh_{el}	0.0	1.4	5.5	111.5	276.8	483.7	504.5
	Battery prosumers	TWh_{el}	0.0	0.0	2.1	9.9	23.1	32.9	54.1
	PHES	TWh_{el}	0.0	4.2	10.2	11.2	11.8	9.8	11.9
	A-CAES	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TES HT	TWh_{th}	0.0	12.5	33.6	52.3	57.3	61.1	37.3
	TES DH	TWh_{th}	0.0	0.0	0.0	15.1	78.1	98.3	102.0
	Gas (CH_4) storage	$TWh_{th,CH4}$	0.0	0.0	0.2	8.2	10.6	25.1	54.0
	Gas (H_2) storage	$TWh_{th,H2}$	0.0	0.0	0.0	96.4	415.9	503.0	474.7

Table 2.9 Power and heat generation, and storage throughput for Egypt from 2020 to 2050 for the BPS-LT. Values are subject to rounding errors.

	Technology	**Unit**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Power generation	PV fixed-tilted	TWh_{el}	3.5	3.5	3.5	3.5	78.7	870.8	1050.6
	PV single-axis tracking	TWh_{el}	0.0	39.6	94.4	185.0	996.4	1016.9	1016.9
	PV prosumers	TWh_{el}	0.2	2.4	11.2	29.6	69.8	102.8	145.5
	Wind onshore	TWh_{el}	3.3	21.0	27.9	36.2	47.9	48.5	48.5
	Hydro run-of-river	TWh_{el}	1.0	1.1	1.1	1.1	1.1	1.1	1.1
	Hydro reservoir (dam)	TWh_{el}	14.0	21.0	21.0	21.0	21.0	21.0	21.0
	Biomass PP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass CHP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Waste-to-energy CHP	TWh_{el}	0.0	1.6	3.2	4.9	4.9	4.9	4.9
	Biogas CHP	TWh_{el}	0.0	0.0	0.0	0.8	0.5	0.9	1.3
	Geothermal electricity	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CSP ST	TWh_{el}	0.0	3.1	21.8	182.5	211.1	253.9	245.5
	ST others	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CCGT	TWh_{el}	105.5	153.5	140.6	43.1	18.1	7.8	0.1
	OCGT	TWh_{el}	55.5	32.6	31.3	37.2	75.8	0.1	0.1
	Methane CHP	TWh_{el}	0.0	0.0	4.2	9.9	0.0	1.8	0.0
	ICE	TWh_{el}	3.4	0.4	0.0	0.0	0.0	0.0	0.0
	Oil CHP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal PP hard coal	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal CHP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Nuclear PP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total power generation	$\mathbf{TWh_{el}}$	**186.4**	**279.8**	**360.2**	**554.8**	**1525.3**	**2330.5**	**2535.5**
	CSP SF for power	TWh_{th}	0.0	7.7	54.2	429.4	492.1	590.5	570.9
Heat generation	CSP SF for heat	TWh_{th}	0.0	27.4	67.8	149.1	167.5	175.7	160.3
	Solar thermal heat	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	Geothermal heat DH	TWh_{th}	0.1	0.1	0.1	0.0	0.0	0.0	0.0
	Biomass CHP	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass DH	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass IH	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	2.1
	Waste-to-energy CHP	TWh_{th}	0.0	4.3	8.5	12.2	11.7	11.2	11.1
	Biogas CHP	TWh_{th}	0.0	0.0	0.0	1.0	0.6	1.0	1.4
	Biogas IH	TWh_{th}	0.0	1.2	1.2	1.2	1.2	1.2	1.1
	Electric heating DH	TWh_{th}	0.0	0.5	0.2	0.0	0.1	0.4	2.6
	Electric heating IH	TWh_{th}	28.2	42.6	25.4	18.7	16.4	10.8	17.2
	Heat pump DH	TWh_{th}	0.0	0.0	0.0	0.0	10.2	9.6	10.5
	Heat pump IH	TWh_{th}	0.0	123.1	157.1	182.9	202.4	188.5	155.7
	Methane CHP	TWh_{th}	0.0	0.0	3.0	7.1	0.0	1.3	0.0
	Methane DH	TWh_{th}	18.6	12.2	7.1	3.5	0.0	0.1	0.0
	Methane IH	TWh_{th}	92.9	51.2	33.3	19.2	0.0	0.0	1.2
	Oil CHP	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Oil DH	TWh_{th}	13.1	9.3	5.9	3.3	0.0	0.0	0.0
	Oil IH	TWh_{th}	117.3	25.5	24.2	11.3	0.0	0.0	0.0
	Coal CHP	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal DH	TWh_{th}	21.3	14.5	9.4	5.8	0.0	0.3	0.0
	Total heat generation	$\mathbf{TWh_{th}}$	**291.5**	**311.9**	**343.2**	**415.3**	**410.1**	**400.1**	**363.3**
Storage throughput	Battery	TWh_{el}	0.0	3.8	10.3	68.5	164.6	360.0	378.9
	Battery prosumers	TWh_{el}	0.0	0.0	2.1	9.9	23.1	32.9	54.1
	PHES	TWh_{el}	0.0	3.2	5.1	9.6	11.0	11.9	12.6
	A-CAES	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TES HT	TWh_{th}	0.0	13.7	62.5	336.2	389.6	509.7	473.7
	TES DH	TWh_{th}	0.0	0.0	0.0	0.3	83.5	114.1	126.3
	Gas (CH_4) storage	$TWh_{th,CH4}$	0.0	0.0	0.5	5.5	8.4	21.6	53.2
	Gas (H_2) storage	$TWh_{th,H2}$	0.0	0.0	2.9	12.3	310.7	498.5	540.1

Table 2.10 Power and heat generation, and storage throughput for Egypt from 2020 to 2050 for the BPSnoF. Values are subject to rounding errors.

	Technology	**Unit**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Power generation	PV fixed-tilted	TWh_{el}	3.5	3.5	3.5	3.5	307.4	625.5	962.7
	PV single-axis tracking	TWh_{el}	0.0	44.2	92.4	159.2	286.7	286.7	286.7
	PV prosumers	TWh_{el}	0.2	2.4	11.2	29.6	69.8	102.8	145.5
	Wind onshore	TWh_{el}	3.3	16.3	37.0	89.1	89.1	89.3	89.3
	Hydro run-of-river	TWh_{el}	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Hydro reservoir (dam)	TWh_{el}	14.0	21.0	21.0	21.0	21.0	21.0	21.0
	Biomass PP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass CHP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Waste-to-energy CHP	TWh_{el}	0.0	1.6	3.2	4.9	4.9	4.9	4.9
	Biogas CHP	TWh_{el}	0.0	0.0	0.2	1.8	1.2	1.7	1.9
	Geothermal electricity	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CSP ST	TWh_{el}	0.0	0.4	0.4	1.1	1.5	1.2	0.7
	ST others	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CCGT	TWh_{el}	105.5	155.2	141.7	150.5	15.6	15.2	9.4
	OCGT	TWh_{el}	55.5	36.1	34.3	32.9	43.0	2.6	0.6
	Methane CHP	TWh_{el}	0.0	0.0	4.1	5.8	2.8	1.3	0.9
	ICE	TWh_{el}	3.4	0.4	0.0	0.0	0.0	0.0	0.0
	Oil CHP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal PP hard coal	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal CHP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Nuclear PP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total power generation	**TWh_{el}**	**186.4**	**282.1**	**350.0**	**500.4**	**844.0**	**1153.2**	**1524.6**
	CSP SF for power	TWh_{th}	0.0	1.1	1.1	2.7	3.5	3.0	1.6
Heat generation	CSP SF for heat	TWh_{th}	0.0	23.2	51.3	75.6	84.8	85.4	62.6
	Solar thermal heat	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	Geothermal heat DH	TWh_{th}	0.1	0.1	0.1	0.0	0.0	0.0	0.0
	Biomass CHP	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass DH	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass IH	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	2.1
	Waste-to-energy CHP	TWh_{th}	0.0	4.3	8.7	13.2	13.2	13.1	13.0
	Biogas CHP	TWh_{th}	0.0	0.0	0.2	2.3	1.6	2.1	2.4
	Biogas IH	TWh_{th}	0.0	1.2	1.2	1.2	1.2	1.2	1.1
	Electric heating DH	TWh_{th}	0.0	1.7	1.0	1.2	1.5	5.1	11.6
	Electric heating IH	TWh_{th}	28.2	42.6	25.4	18.7	16.4	10.8	17.2
	Heat pump DH	TWh_{th}	0.0	0.0	0.0	3.9	18.0	23.7	32.2
	Heat pump IH	TWh_{th}	0.0	123.1	157.1	182.9	202.4	188.5	155.7
	Methane CHP	TWh_{th}	0.0	0.0	2.9	4.2	2.0	0.9	0.7
	Methane DH	TWh_{th}	18.6	12.2	7.2	3.7	1.7	1.3	0.5
	Methane IH	TWh_{th}	92.9	51.2	33.3	19.2	0.0	0.0	1.2
	Oil CHP	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Oil DH	TWh_{th}	13.1	9.3	5.9	3.3	0.9	0.6	0.3
	Oil IH	TWh_{th}	117.3	25.5	24.2	11.3	0.0	0.0	0.0
	Coal CHP	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal DH	TWh_{th}	21.3	17.0	15.1	12.0	9.3	5.0	3.1
	Total heat generation	**TWh_{th}**	**291.5**	**311.4**	**333.6**	**352.7**	**353.0**	**337.7**	**303.8**
Storage throughput	Battery	TWh_{el}	0.0	1.6	7.6	41.9	290.0	463.0	577.8
	Battery prosumers	TWh_{el}	0.0	0.0	2.1	9.9	23.1	32.9	54.1
	PHES	TWh_{el}	0.0	7.7	9.3	11.8	10.0	11.5	11.3
	A-CAES	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TES HT	TWh_{th}	0.0	9.6	21.2	36.9	41.2	44.3	36.2
	TES DH	TWh_{th}	0.0	0.0	0.0	0.1	11.6	12.0	13.5
	Gas (CH_4) storage	$TWh_{th,CH4}$	0.0	0.0	0.0	0.4	4.9	6.4	31.2
	Gas (H_2) storage	$TWh_{th,H2}$	0.0	0.0	0.0	0.0	47.7	82.4	149.5

Table 2.11 Power and heat generation, and storage throughput for Egypt from 2020 to 2050 for the DPS. Values are subject to rounding errors.

	Technology	Unit	2020	2025	2030	2035	2040	2045	2050
Power generation	PV fixed-tilted	TWh_{el}	3.5	7.5	9.1	9.1	9.1	9.1	257.9
	PV single-axis tracking	TWh_{el}	0.0	20.1	52.2	212.6	394.2	583.8	1104.3
	PV prosumers	TWh_{el}	0.2	1.5	7.3	19.3	45.6	78.2	110.9
	Wind onshore	TWh_{el}	3.3	30.1	80.8	87.9	106.1	149.2	334.1
	Hydro run-of-river	TWh_{el}	1.0	1.0	1.0	1.0	1.0	1.3	1.5
	Hydro reservoir (dam)	TWh_{el}	14.0	17.4	17.4	17.4	17.4	21.0	21.0
	Biomass PP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass CHP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.1	0.0
	Waste-to-energy CHP	TWh_{el}	0.0	1.6	3.2	4.9	4.9	4.9	4.9
	Biogas CHP	TWh_{el}	0.0	0.4	0.1	0.0	0.2	0.9	1.1
	Geothermal electricity	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	62.9
	CSP ST	TWh_{el}	0.0	2.7	5.3	11.7	18.2	32.6	88.7
	ST others	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CCGT	TWh_{el}	105.5	110.6	117.3	137.5	172.4	225.0	414.0
	OCGT	TWh_{el}	55.5	35.0	17.6	5.2	4.3	0.1	0.0
	Methane CHP	TWh_{el}	0.0	1.4	3.8	3.8	2.1	2.5	2.1
	ICE	TWh_{el}	3.4	7.2	5.6	4.2	3.8	3.7	5.2
	Oil CHP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal PP hard coal	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal CHP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Nuclear PP	TWh_{el}	0.0	0.0	35.7	35.7	35.7	35.7	35.7
	Total power generation	**TWh_{el}**	**186.4**	**236.5**	**356.4**	**550.3**	**815.0**	**1148.1**	**2444.3**
	CSP SF for power	TWh_{th}	0.0	6.8	13.1	28.2	43.1	76.8	206.2
Heat generation	CSP SF for heat	TWh_{th}	0.0	28.3	54.3	75.0	74.2	107.2	102.6
	Solar thermal heat	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Geothermal heat DH	TWh_{th}	0.1	0.2	0.3	0.3	0.2	0.0	0.0
	Biomass CHP	TWh_{th}	0.0	0.1	0.0	0.0	0.0	0.2	0.0
	Biomass DH	TWh_{th}	0.0	0.2	0.3	0.0	0.0	0.9	0.4
	Biomass IH	TWh_{th}	0.0	0.2	0.2	0.3	0.5	0.5	2.2
	Waste-to-energy CHP	TWh_{th}	0.0	3.6	8.3	13.3	13.3	13.3	11.3
	Biogas CHP	TWh_{th}	0.0	0.3	0.1	0.0	0.2	1.1	1.2
	Biogas IH	TWh_{th}	0.0	0.7	0.7	0.7	0.7	0.7	0.9
	Electric heating DH	TWh_{th}	0.0	0.5	0.6	3.5	5.9	3.7	0.7
	Electric heating IH	TWh_{th}	28.2	29.6	24.1	18.2	12.6	7.4	2.5
	Heat pump DH	TWh_{th}	0.0	0.0	0.2	0.0	0.1	5.8	8.4
	Heat pump IH	TWh_{th}	0.0	68.4	84.1	100.7	115.5	110.8	99.8
	Methane CHP	TWh_{th}	0.0	0.6	2.6	3.0	1.8	1.8	1.4
	Methane DH	TWh_{th}	18.6	12.5	7.4	7.8	23.6	0.0	0.0
	Methane IH	TWh_{th}	92.9	66.7	66.7	61.3	23.8	16.8	12.8
	Oil CHP	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Oil DH	TWh_{th}	13.1	9.3	5.9	3.3	0.0	0.0	0.0
	Oil IH	TWh_{th}	117.3	78.0	65.5	52.1	67.0	64.3	55.9
	Coal CHP	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal DH	TWh_{th}	21.3	14.8	9.6	5.1	0.0	0.4	0.0
	Total heat generation	**TWh_{th}**	**291.5**	**314.0**	**330.9**	**344.6**	**339.4**	**334.9**	**300.1**
Storage throughput	Battery	TWh_{el}	0.0	12.3	23.8	24.7	25.5	18.4	32.6
	Battery prosumers	TWh_{el}	0.0	0.0	1.4	6.4	15.1	25.0	31.0
	PHES	TWh_{el}	0.0	2.1	6.8	6.3	6.3	4.2	3.4
	A-CAES	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TES HT	TWh_{th}	0.0	15.4	21.2	52.3	46.0	82.3	94.4
	TES DH	TWh_{th}	0.0	9.5	7.5	5.6	19.3	41.2	62.4
	Gas (CH_4) storage	$TWh_{th,CH4}$	0.0	0.0	0.0	72.5	52.7	10.2	13.4
	Gas (H_2) storage	$TWh_{th,H2}$	0.0	0.0	4.8	46.3	99.1	209.4	531.4

Table 2.12 Power and heat generation, and storage throughput for Egypt from 2020 to 2050 for the CPS. Values are subject to rounding errors.

	Technology	Unit	2020	2025	2030	2035	2040	2045	2050
Power generation	PV fixed-tilted	TWh_{el}	3.5	6.2	7.3	7.3	9.2	9.7	6.7
	PV single-axis tracking	TWh_{el}	0.0	9.9	36.0	131.8	173.8	221.6	266.9
	PV prosumers	TWh_{el}	0.2	0.7	3.6	9.4	17.6	32.7	57.6
	Wind onshore	TWh_{el}	3.3	17.3	48.4	96.9	146.3	188.0	231.9
	Hydro run-of-river	TWh_{el}	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Hydro reservoir (dam)	TWh_{el}	14.0	14.4	18.4	18.4	18.4	18.4	18.4
	Biomass PP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biomass CHP	TWh_{el}	0.0	0.0	0.0	0.0	0.1	0.2	0.1
	Waste-to-energy CHP	TWh_{el}	0.0	1.6	3.2	4.9	4.9	4.9	4.9
	Biogas CHP	TWh_{el}	0.0	0.3	0.0	1.6	3.1	4.1	4.4
	Geothermal electricity	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CSP ST	TWh_{el}	0.0	3.2	8.0	25.8	43.5	56.6	70.2
	ST others	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CCGT	TWh_{el}	105.5	99.9	142.3	290.3	337.3	369.6	387.5
	OCGT	TWh_{el}	55.5	50.1	12.6	14.9	13.7	13.4	11.2
	Methane CHP	TWh_{el}	0.0	1.5	4.0	3.1	3.9	4.2	5.2
	ICE	TWh_{el}	3.4	7.7	0.7	0.6	0.7	0.6	0.5
	Oil CHP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal PP hard coal	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal CHP	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Nuclear PP	TWh_{el}	0.0	0.0	35.7	35.7	35.7	35.7	35.7
	Total power generation	$\mathbf{TWh_{el}}$	**186.4**	**213.8**	**321.2**	**641.7**	**809.2**	**960.7**	**1102.2**
	CSP SF for power	TWh_{th}	0.0	7.9	19.7	61.8	102.1	132.2	163.3
Heat generation	CSP SF for heat	TWh_{th}	0.0	26.9	49.0	55.0	80.8	91.4	95.4
	Solar thermal heat	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Geothermal heat DH	TWh_{th}	0.1	0.2	0.2	0.3	0.3	0.2	0.3
	Biomass CHP	TWh_{th}	0.0	0.0	0.0	0.0	0.2	0.3	0.1
	Biomass DH	TWh_{th}	0.0	0.2	0.2	0.0	0.5	0.2	0.0
	Biomass IH	TWh_{th}	0.0	0.2	0.4	0.5	0.5	0.5	2.2
	Waste-to-energy CHP	TWh_{th}	0.0	3.6	8.3	13.3	11.9	12.0	12.5
	Biogas CHP	TWh_{th}	0.0	0.2	0.0	1.9	3.2	4.4	4.9
	Biogas IH	TWh_{th}	0.0	0.7	0.7	0.7	0.7	0.7	0.9
	Electric heating DH	TWh_{th}	0.0	0.5	0.6	3.8	6.5	9.9	13.9
	Electric heating IH	TWh_{th}	28.2	21.6	21.0	19.1	12.6	6.7	1.6
	Heat pump DH	TWh_{th}	0.0	0.0	0.1	0.0	0.5	0.6	0.3
	Heat pump IH	TWh_{th}	0.0	8.8	12.8	17.0	24.7	30.4	33.2
	Methane CHP	TWh_{th}	0.0	0.7	2.5	2.4	2.0	2.4	3.3
	Methane DH	TWh_{th}	18.6	12.7	7.7	3.6	0.6	0.2	0.0
	Methane IH	TWh_{th}	92.9	98.8	100.6	94.3	57.0	50.1	39.7
	Oil CHP	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Oil DH	TWh_{th}	13.1	9.3	5.9	3.3	0.3	0.1	0.0
	Oil IH	TWh_{th}	117.3	113.4	105.8	101.6	124.4	112.1	96.4
	Coal CHP	TWh_{th}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coal DH	TWh_{th}	21.3	15.9	14.5	12.0	9.9	7.8	4.8
	Total heat generation	$\mathbf{TWh_{th}}$	**291.5**	**313.7**	**330.3**	**328.8**	**336.6**	**330.0**	**309.5**
Storage throughput	Battery	TWh_{el}	0.0	10.5	40.9	47.3	46.2	17.5	17.9
	Battery prosumers	TWh_{el}	0.0	0.0	0.7	3.1	5.8	10.3	16.0
	PHES	TWh_{el}	0.0	1.6	9.5	10.1	9.1	8.9	8.8
	A-CAES	TWh_{el}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TES HT	TWh_{th}	0.0	15.2	20.4	28.5	39.0	40.5	47.5
	TES DH	TWh_{th}	0.0	9.5	7.7	5.8	25.5	32.4	28.7
	Gas (CH_4) storage	$TWh_{th,CH4}$	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Gas (H_2) storage	$TWh_{th,H2}$	0.0	0.0	6.0	5.4	9.5	9.1	9.2

Table 2.13 Power-to-X capacities and output for Egypt from 2020 to 2050 for the BPS-HT. Values are subject to rounding errors.

	Technology	Unit	2020	2025	2030	2035	2040	2045	2050
Capacity	Water electrolysis	$GW_{th,H2}$	0.0	0.0	0.0	11.8	201.4	285.7	310.3
	CO_2 direct air capture	$MtCO_2/a$	0.0	0.0	10.3	34.2	115.1	163.3	167.1
	Methanation	$GW_{th,CH4}$	0.0	0.0	0.0	0.0	0.0	2.9	6.8
	Steam reforming	$GW_{th,H2}$	0.0	0.3	6.6	22.0	22.0	22.0	22.0
	Fischer-Tropsch unit	$GW_{th,liq}$	0.0	0.0	3.8	12.8	43.1	59.3	59.3
	Methane liquefaction	$GW_{th,LNG}$	0.0	0.1	0.2	0.5	1.0	2.5	5.9
	Hydrogen liquefaction	$GW_{th,LH2}$	0.0	0.0	0.1	0.5	2.2	6.8	14.7
	Seawater desalination	mil m^3/day	2.2	6.3	15.4	26.9	34.3	37.3	38.6
Output	Water electrolysis	$TWh_{th,H2}$	0.0	0.0	0.0	24.9	611.9	953.8	941.4
	CO_2 direct air capture	$MtCO_2$	0.0	0.0	9.7	32.5	109.4	153.9	120.8
	Methanation	$TWh_{th,CH4}$	0.0	0.0	0.0	0.0	0.0	16.3	44.8
	Steam reforming	$TWh_{th,H2}$	0.0	2.1	54.7	167.9	54.5	0.0	0.0
	Fischer-Tropsch unit	$TWh_{th,liq}$	0.0	0.0	31.9	106.6	358.5	493.9	367.0
	Methane liquefaction	$TWh_{th,LNG}$	0.2	0.6	1.8	3.8	8.3	20.6	49.4
	Hydrogen liquefaction	$TWh_{th,LH2}$	0.0	0.0	0.8	4.1	18.6	56.7	122.2
	Seawater desalination	b m^3	0.8	2.3	5.6	9.8	12.5	13.6	14.1

Table 2.14 Power-to-X capacities and output for Egypt from 2020 to 2050 for the BPS-4-HT. Values are subject to rounding errors.

	Technology	Unit	2020	2025	2030	2035	2040	2045	2050
Capacity	Water electrolysis	$GW_{th,H2}$	0.0	0.0	4.8	59.6	229.5	287.5	304.1
	CO_2 direct air capture	$MtCO_2/a$	0.0	0.0	10.3	34.2	115.8	163.2	164.8
	Methanation	$GW_{th,CH4}$	0.0	0.0	0.0	0.0	0.4	3.1	7.6
	Steam reforming	$GW_{th,H2}$	0.0	0.3	6.2	7.1	7.1	7.1	7.1
	Fischer-Tropsch unit	$GW_{th,liq}$	0.0	0.0	3.8	12.8	43.1	59.3	59.3
	Methane liquefaction	$GW_{th,LNG}$	0.0	0.1	0.2	0.5	1.0	2.5	5.9
	Hydrogen liquefaction	$GW_{th,LH2}$	0.0	0.0	0.1	0.5	2.2	6.8	14.7
	Seawater desalination	mil m^3/day	2.2	6.3	15.4	26.9	34.3	37.3	38.7
Output	Water electrolysis	$TWh_{th,H2}$	0.0	0.0	6.7	169.9	733.9	955.9	932.6
	CO_2 direct air capture	$MtCO_2$	0.0	0.0	9.7	32.5	109.8	154.1	121.1
	Methanation	$TWh_{th,CH4}$	0.0	0.0	0.0	0.0	2.4	17.4	46.1
	Steam reforming	$TWh_{th,H2}$	0.0	2.1	47.9	23.0	0.0	0.0	0.0
	Fischer-Tropsch unit	$TWh_{th,liq}$	0.0	0.0	31.9	106.6	358.5	493.9	367.0
	Methane liquefaction	$TWh_{th,LNG}$	0.2	0.6	1.8	3.8	8.3	20.6	49.4
	Hydrogen liquefaction	$TWh_{th,LH2}$	0.0	0.0	0.8	4.1	18.6	56.7	122.2
	Seawater desalination	b m^3	0.8	2.3	5.6	9.8	12.5	13.6	14.1

Table 2.15 Power-to-X capacities and output for Egypt from 2020 to 2050 for the BPS-LT. Values are subject to rounding errors.

	Technology	Unit	2020	2025	2030	2035	2040	2045	2050
Capacity	Water electrolysis	$GW_{th,H2}$	0.0	0.0	2.4	15.7	185.9	283.0	317.7
	CO_2 direct air capture	$MtCO_2/a$	0.0	0.0	10.3	34.2	115.1	162.6	167.8
	Methanation	$GW_{th,CH4}$	0.0	0.0	0.0	0.0	0.0	2.6	7.9
	Steam reforming	$GW_{th,H2}$	0.0	0.3	5.7	19.5	22.0	22.0	22.0
	Fischer-Tropsch unit	$GW_{th,liq}$	0.0	0.0	3.8	12.8	43.1	59.3	59.3
	Methane liquefaction	$GW_{th,LNG}$	0.0	0.1	0.2	0.5	1.0	2.5	5.9
	Hydrogen liquefaction	$GW_{th,LH2}$	0.0	0.0	0.1	0.5	2.2	6.8	14.7
	Seawater desalination	mil m^3/day	2.2	6.3	15.4	26.9	34.3	37.3	38.6
Output	Water electrolysis	$TWh_{th,H2}$	0.0	0.0	7.2	40.4	551.2	922.3	978.8
	CO_2 direct air capture	$MtCO_2$	0.0	0.0	9.7	32.5	109.4	153.3	120.9
	Methanation	$TWh_{th,CH4}$	0.0	0.0	0.0	0.0	0.0	13.4	45.0
	Steam reforming	$TWh_{th,H2}$	0.0	2.1	47.5	152.5	78.8	13.7	0.0
	Fischer-Tropsch unit	$TWh_{th,liq}$	0.0	0.0	31.9	106.6	358.5	493.9	367.0
	Methane liquefaction	$TWh_{th,LNG}$	0.2	0.6	1.8	3.8	8.3	20.6	49.4
	Hydrogen liquefaction	$TWh_{th,LH2}$	0.0	0.0	0.8	4.1	18.6	56.7	122.2
	Seawater desalination	b m^3	0.8	2.3	5.6	9.8	12.5	13.6	14.1

Table 2.16 Power-to-X capacities and output for Egypt from 2020 to 2050 for the BPSnoF. Values are subject to rounding errors.

	Technology	Unit	2020	2025	2030	2035	2040	2045	2050
Capacity	Water electrolysis	$GW_{th,H2}$	0.0	0.0	0.0	1.9	30.3	48.2	85.6
	CO_2 direct air capture	$MtCO_2/a$	0.0	0.0	0.0	0.0	0.0	0.0	7.0
	Methanation	$GW_{th,CH4}$	0.0	0.0	0.0	0.0	0.0	0.0	4.1
	Steam reforming	$GW_{th,H2}$	0.0	0.3	1.0	4.4	5.2	5.2	5.2
	Fischer-Tropsch unit	$GW_{th,liq}$	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Methane liquefaction	$GW_{th,LNG}$	0.0	0.1	0.2	0.5	1.0	2.5	5.9
	Hydrogen liquefaction	$GW_{th,LH2}$	0.0	0.0	0.1	0.5	2.2	6.8	14.7
	Seawater desalination	mil m^3/day	2.2	6.3	15.4	26.9	34.3	37.3	38.6
Output	Water electrolysis	$TWh_{th,H2}$	0.0	0.0	0.0	2.4	83.1	160.0	284.3
	CO_2 direct air capture	$MtCO_2$	0.0	0.0	0.0	0.0	0.0	0.0	4.8
	Methanation	$TWh_{th,CH4}$	0.0	0.0	0.0	0.0	0.0	0.0	24.3
	Steam reforming	$TWh_{th,H2}$	0.0	2.1	8.5	36.4	18.2	11.5	6.1
	Fischer-Tropsch unit	$TWh_{th,liq}$	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Methane liquefaction	$TWh_{th,LNG}$	0.2	0.6	1.8	3.8	8.3	20.6	49.4
	Hydrogen liquefaction	$TWh_{th,LH2}$	0.0	0.0	0.8	4.1	18.6	56.7	122.2
	Seawater desalination	b m^3	0.8	2.3	5.6	9.8	12.5	13.6	14.1

Table 2.17 Power-to-X capacities and output for Egypt from 2020 to 2050 for the DPS. Values are subject to rounding errors.

	Technology	Unit	2020	2025	2030	2035	2040	2045	2050
Capacity	Water electrolysis	$GW_{th,H2}$	0.0	0.0	6.6	37.7	79.6	126.1	330.9
	CO_2 direct air capture	$MtCO_2/a$	0.0	0.0	0.0	13.8	31.0	76.9	226.2
	Methanation	$GW_{th,CH4}$	0.0	0.0	0.0	8.0	8.2	8.2	8.2
	Steam reforming	$GW_{th,H2}$	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Fischer-Tropsch unit	$GW_{th,liq}$	0.0	0.0	0.0	0.0	8.1	28.6	84.3
	Methane liquefaction	$GW_{th,LNG}$	0.0	0.0	0.1	0.2	0.4	0.7	1.5
	Hydrogen liquefaction	$GW_{th,LH2}$	0.0	0.0	0.0	0.0	0.2	0.8	3.3
	Seawater desalination	mil m^3/day	2.2	5.1	8.0	10.9	13.8	16.7	19.7
Output	Water electrolysis	$TWh_{th,H2}$	0.0	0.0	53.8	162.8	286.2	424.3	1169.1
	CO_2 direct air capture	$MtCO_2$	0.0	0.0	0.0	13.1	29.5	73.0	214.9
	Methanation	$TWh_{th,CH4}$	0.0	0.0	0.0	66.2	44.9	1.7	4.8
	Steam reforming	$TWh_{th,H2}$	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Fischer-Tropsch unit	$TWh_{th,liq}$	0.0	0.0	0.0	0.0	67.5	238.4	701.6
	Methane liquefaction	$TWh_{th,LNG}$	0.2	0.3	0.5	1.3	3.3	6.2	12.3
	Hydrogen liquefaction	$TWh_{th,LH2}$	0.0	0.0	0.0	0.0	1.3	6.6	27.7
	Seawater desalination	b m^3	0.8	1.8	2.9	4.0	5.0	6.1	7.2

Table 2.18 Power-to-X capacities and output for Egypt from 2020 to 2050 for the CPS. Values are subject to rounding errors.

	Technology	Unit	2020	2025	2030	2035	2040	2045	2050
Capacity	Water electrolysis	$GW_{th,H2}$	0.0	0.0	6.3	40.8	57.6	77.7	94.1
	CO_2 direct air capture	$MtCO_2/a$	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Methanation	$GW_{th,CH4}$	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Steam reforming	$GW_{th,H2}$	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Fischer-Tropsch unit	$GW_{th,liq}$	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Methane liquefaction	$GW_{th,LNG}$	0.0	0.0	0.1	0.1	0.1	0.1	0.2
	Hydrogen liquefaction	$GW_{th,LH2}$	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Seawater desalination	mil m^3/day	2.2	5.0	5.6	6.4	7.0	7.8	8.5
Output	Water electrolysis	$TWh_{th,H2}$	0.0	0.0	50.7	247.9	340.4	411.9	466.0
	CO_2 direct air capture	$MtCO_2$	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Methanation	$TWh_{th,CH4}$	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Steam reforming	$TWh_{th,H2}$	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Fischer-Tropsch unit	$TWh_{th,liq}$	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Methane liquefaction	$TWh_{th,LNG}$	0.2	0.3	0.5	0.6	0.8	1.1	1.3
	Hydrogen liquefaction	$TWh_{th,LH2}$	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Seawater desalination	b m^3	0.8	1.8	2.0	2.3	2.6	2.8	3.1

2.2. General trends

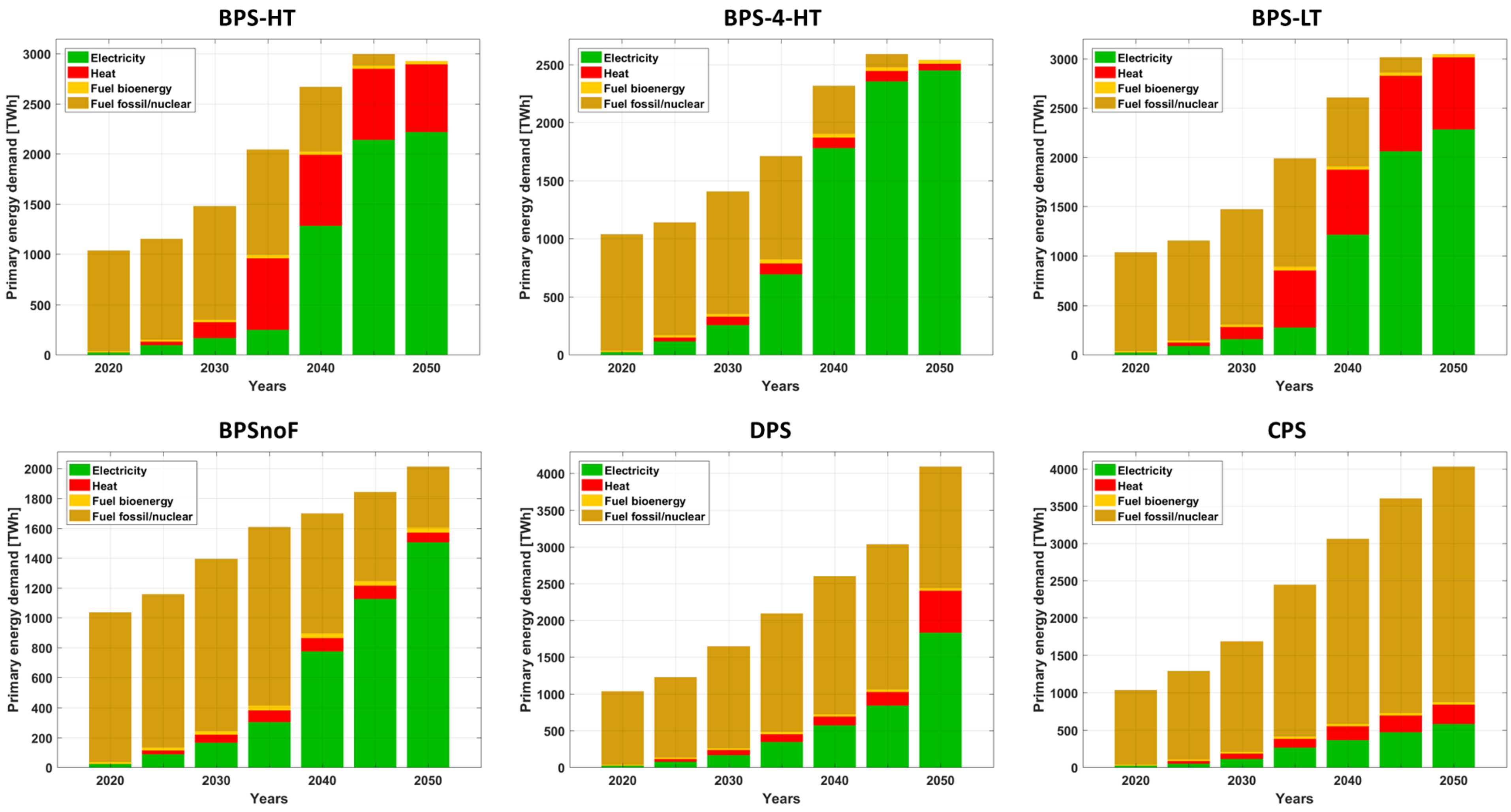

Figure 2.1 Development of the TPED by energy source across all scenarios. Note that the y-axis range differs among scenarios.

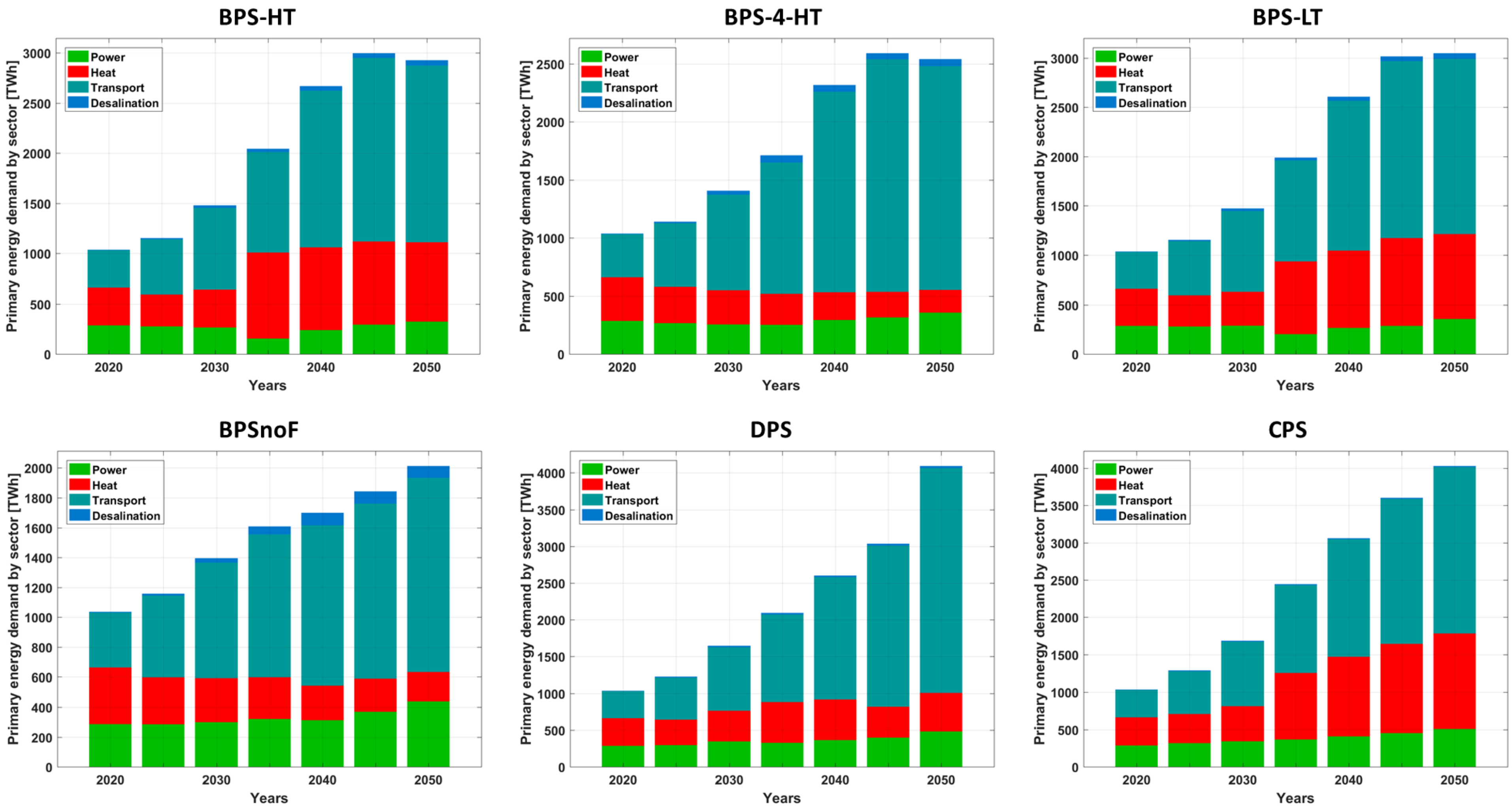

Figure 2.2 Development of the TPED by energy sector across all scenarios. Note that the y-axis range differs among scenarios.

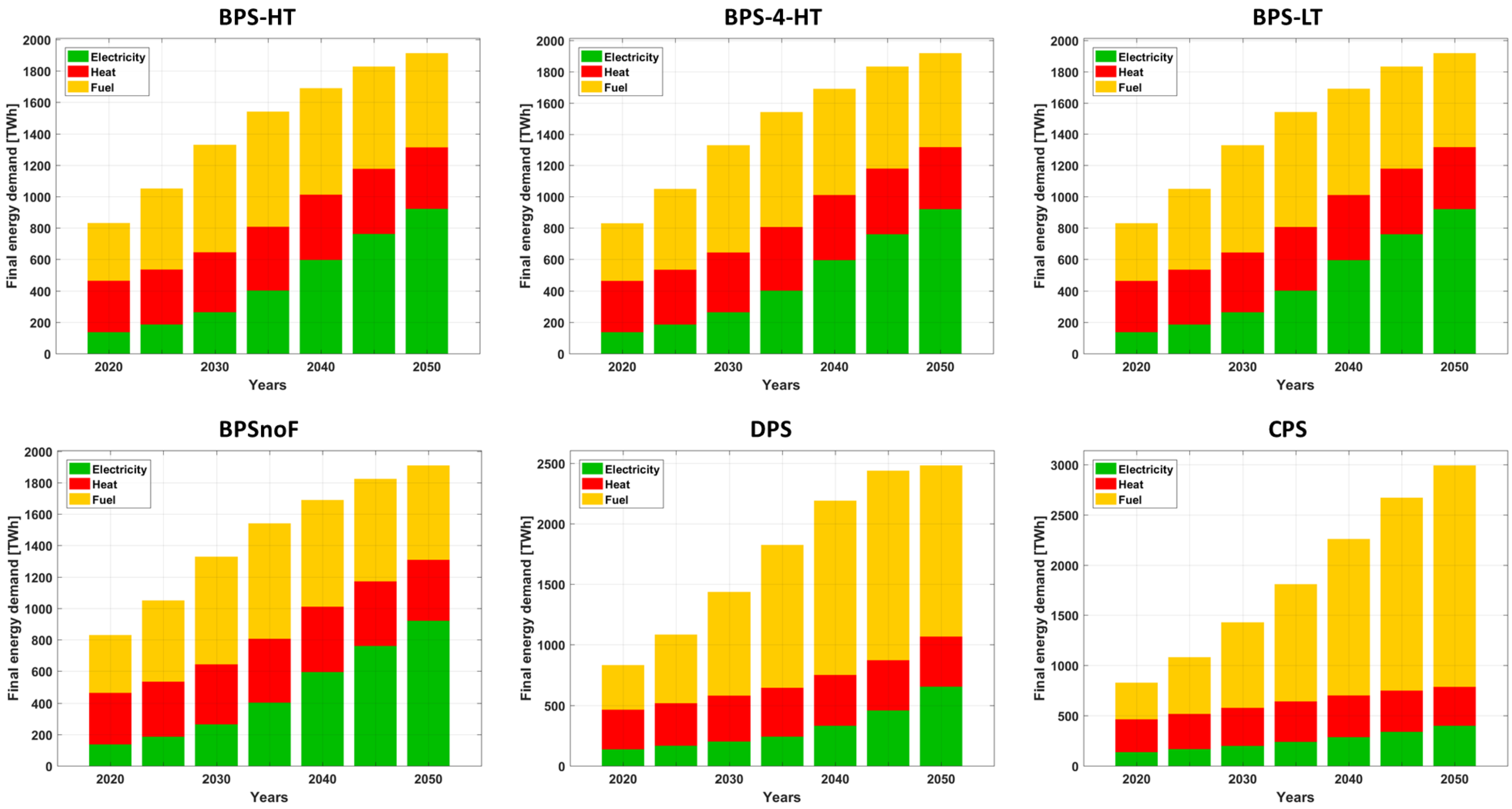

Figure 2.3 Development of the TFED by energy source across all scenarios. Note that the y-axis range differs among scenarios.

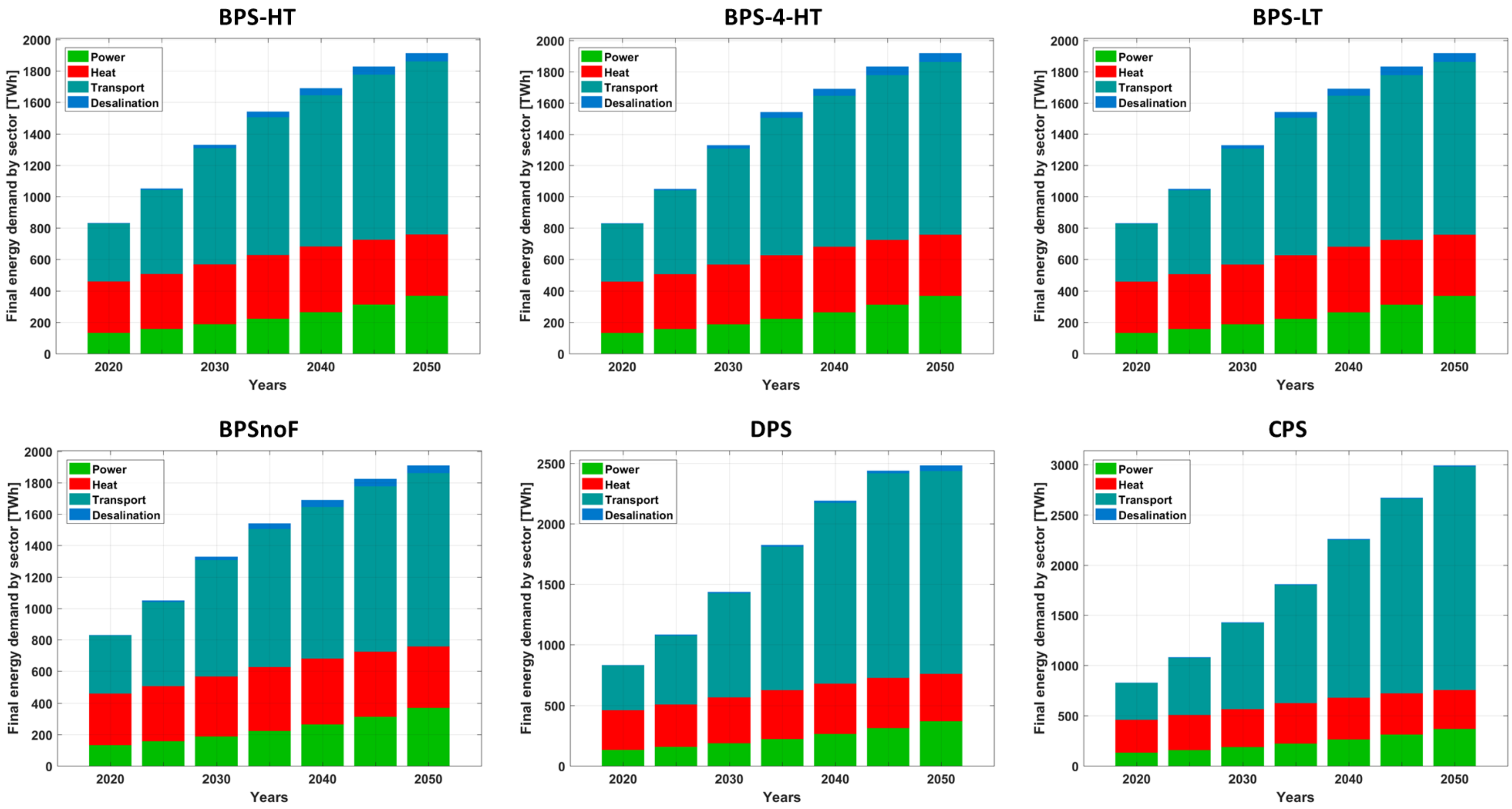

Figure 2.4 Development of the TFED by energy sector across all scenarios. Note that the y-axis range differs among scenarios.

2.3. Power sector

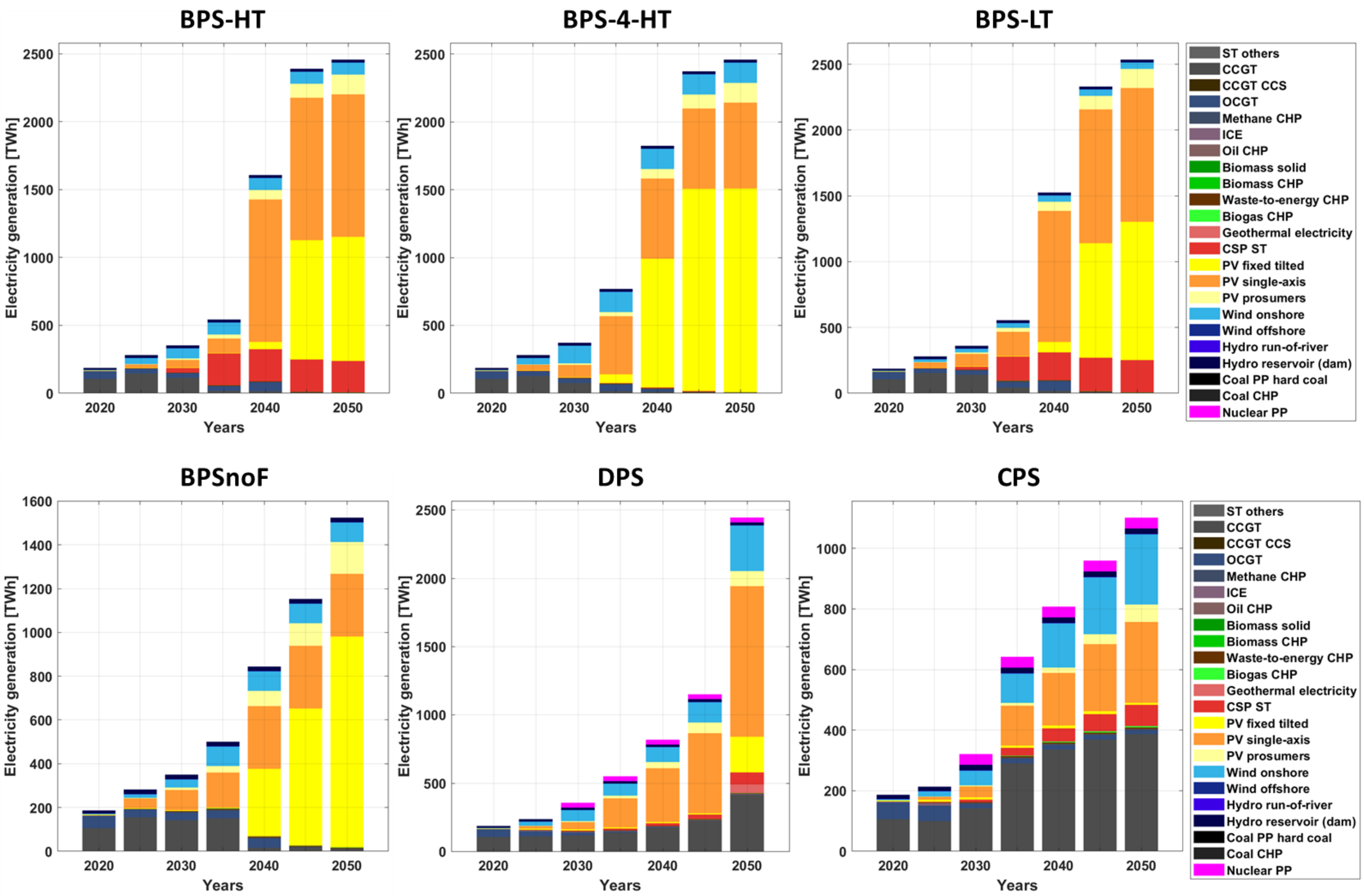

Figure 2.5 Development of electricity generation by technology across all scenarios. Note that the y-axis range differs among scenarios.

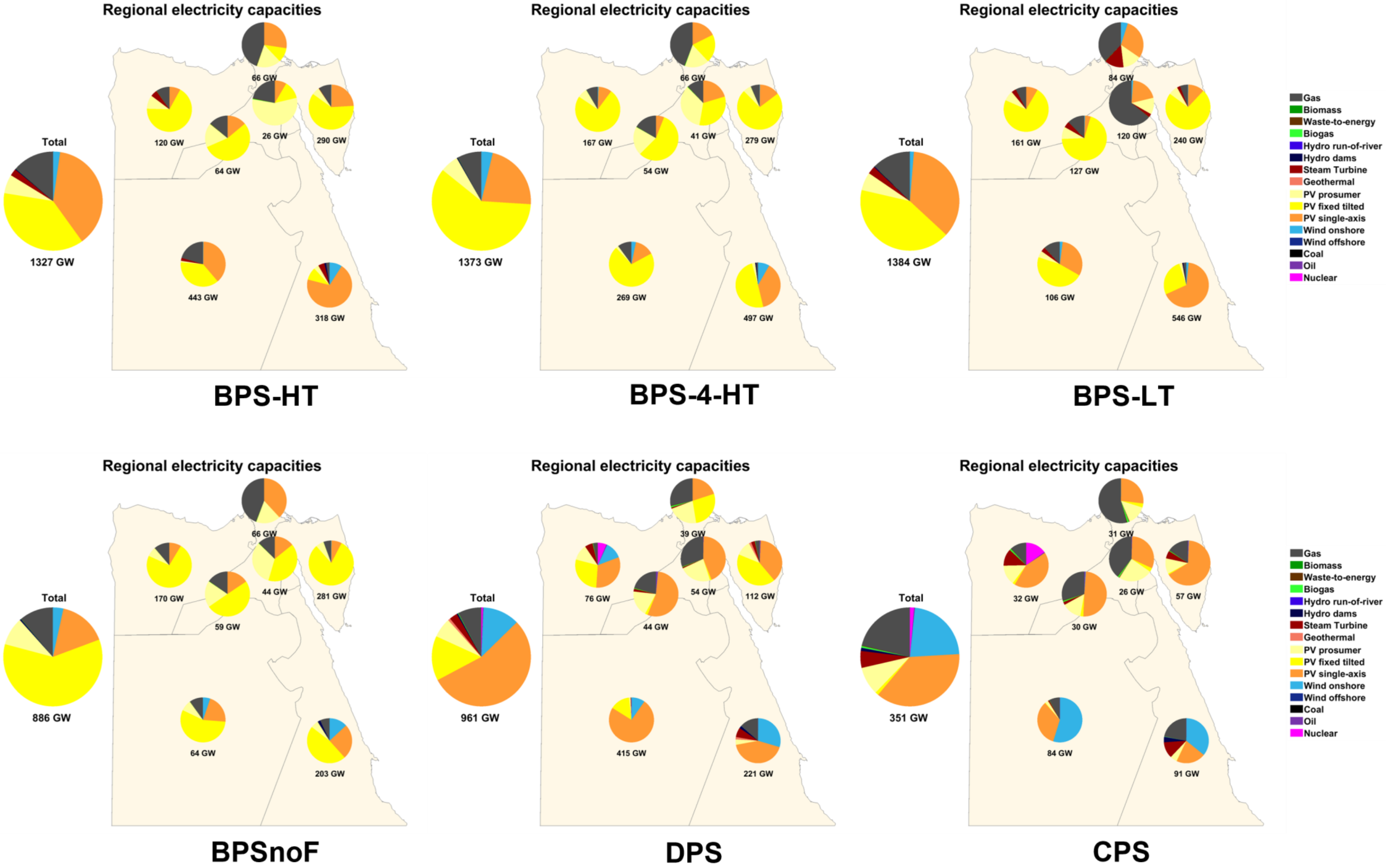

Figure 2.6 Installed regional electrical capacities by technology in 2050 across all scenarios.

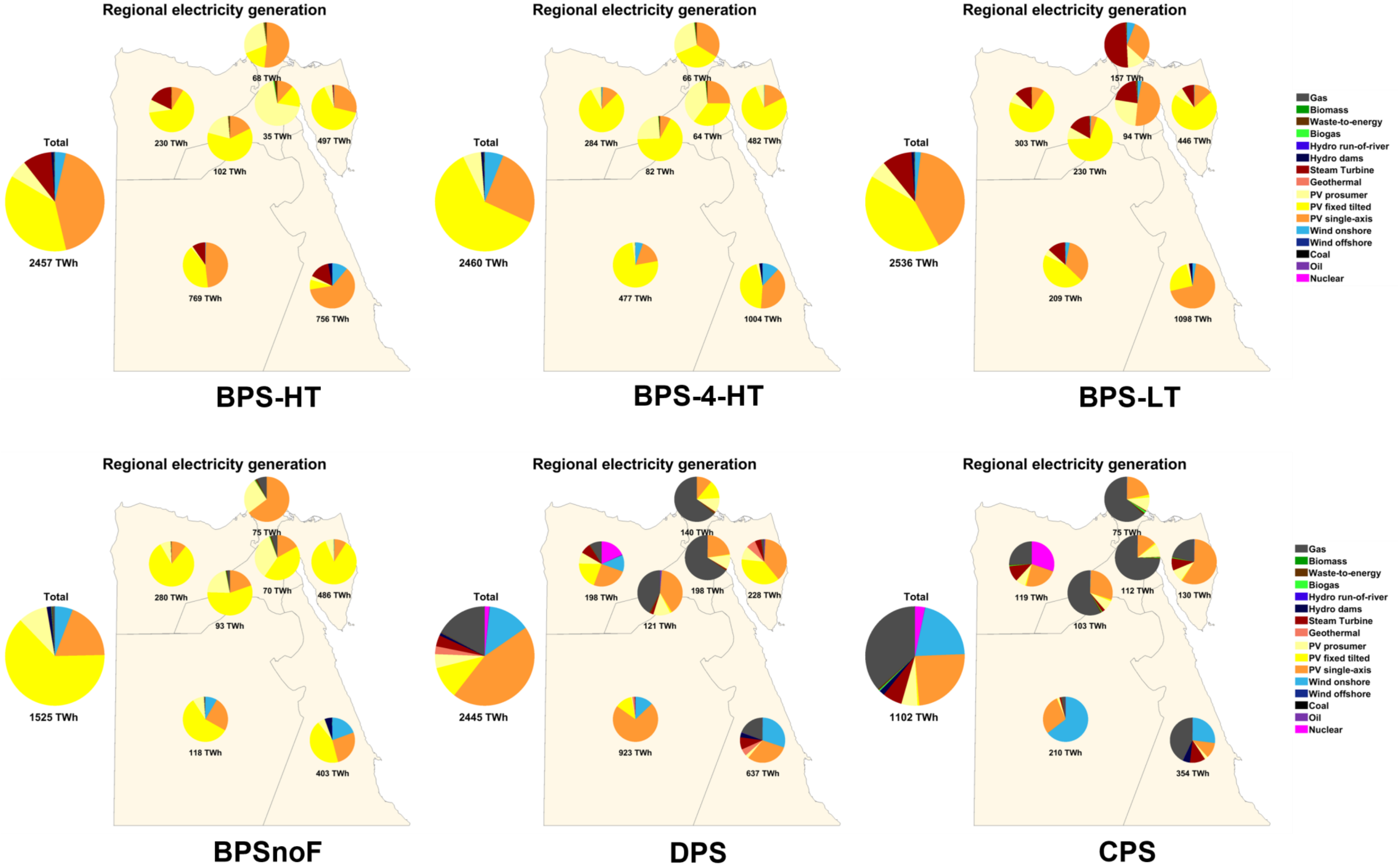

Figure 2.7 Regional electricity generation by technology in 2050 across all scenarios.

2.4. Heat sector

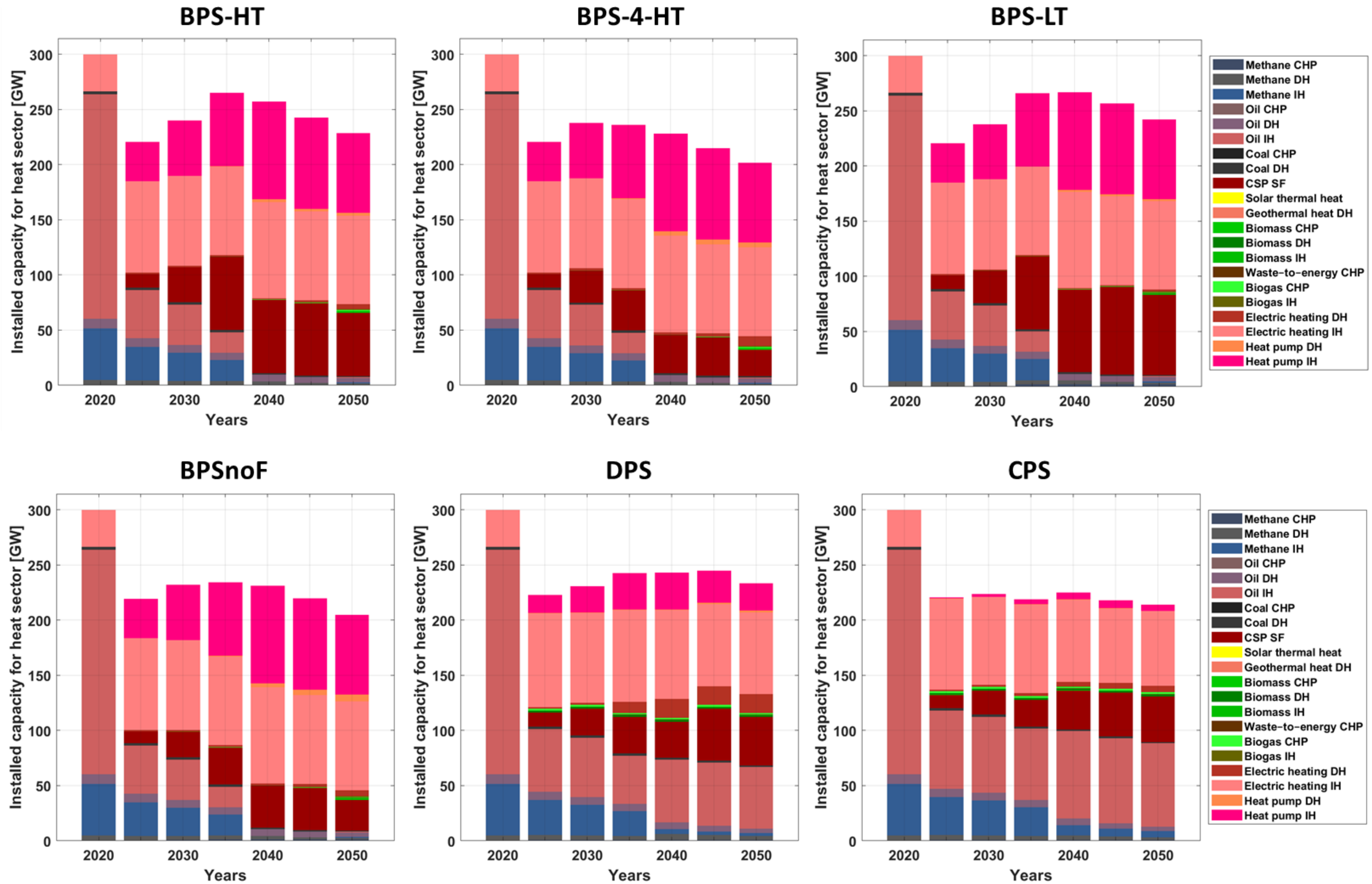

Figure 2.8 Development of installed heat capacities by technology across all scenarios.

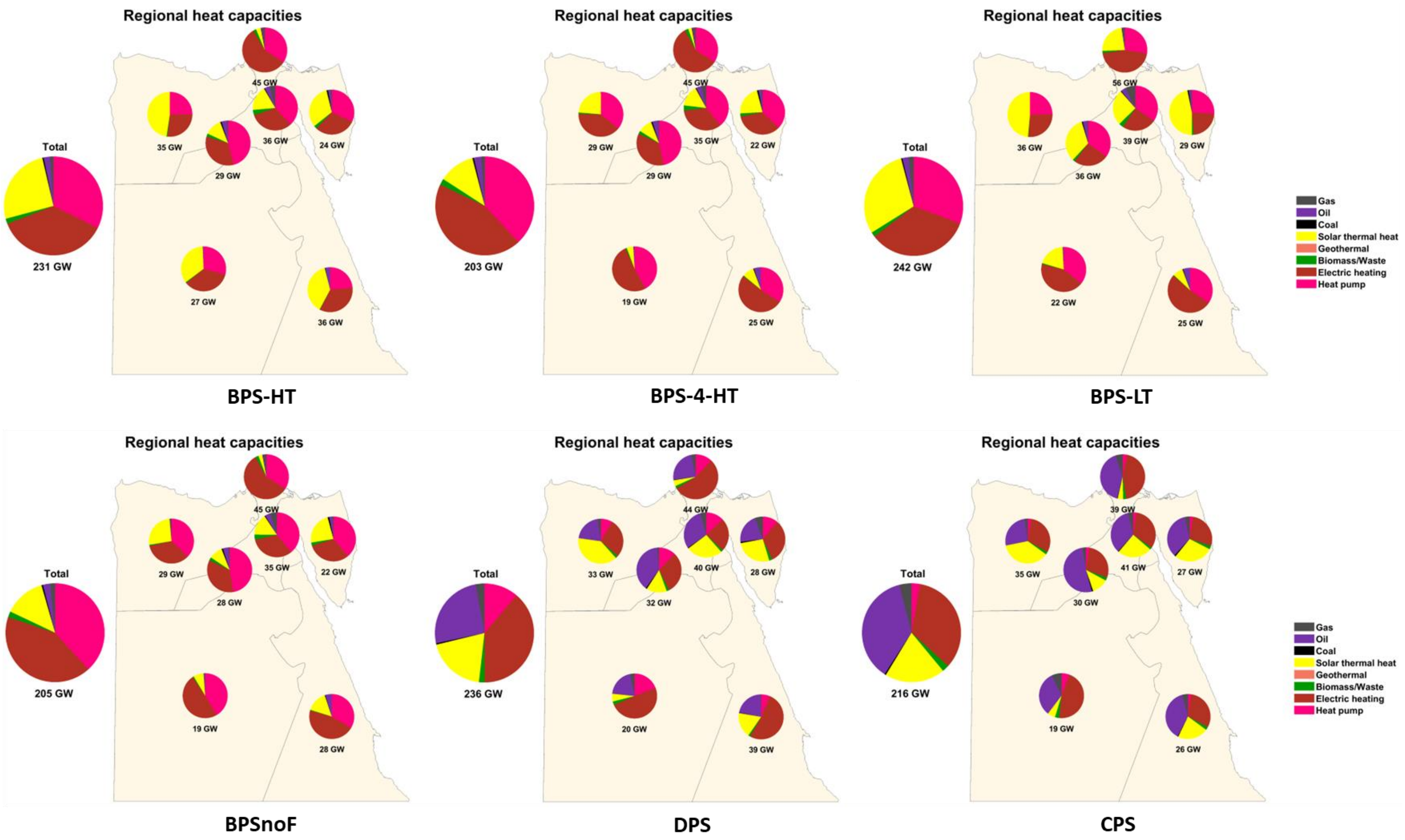

Figure 2.9 Installed regional heat capacities in 2050 across all scenarios.

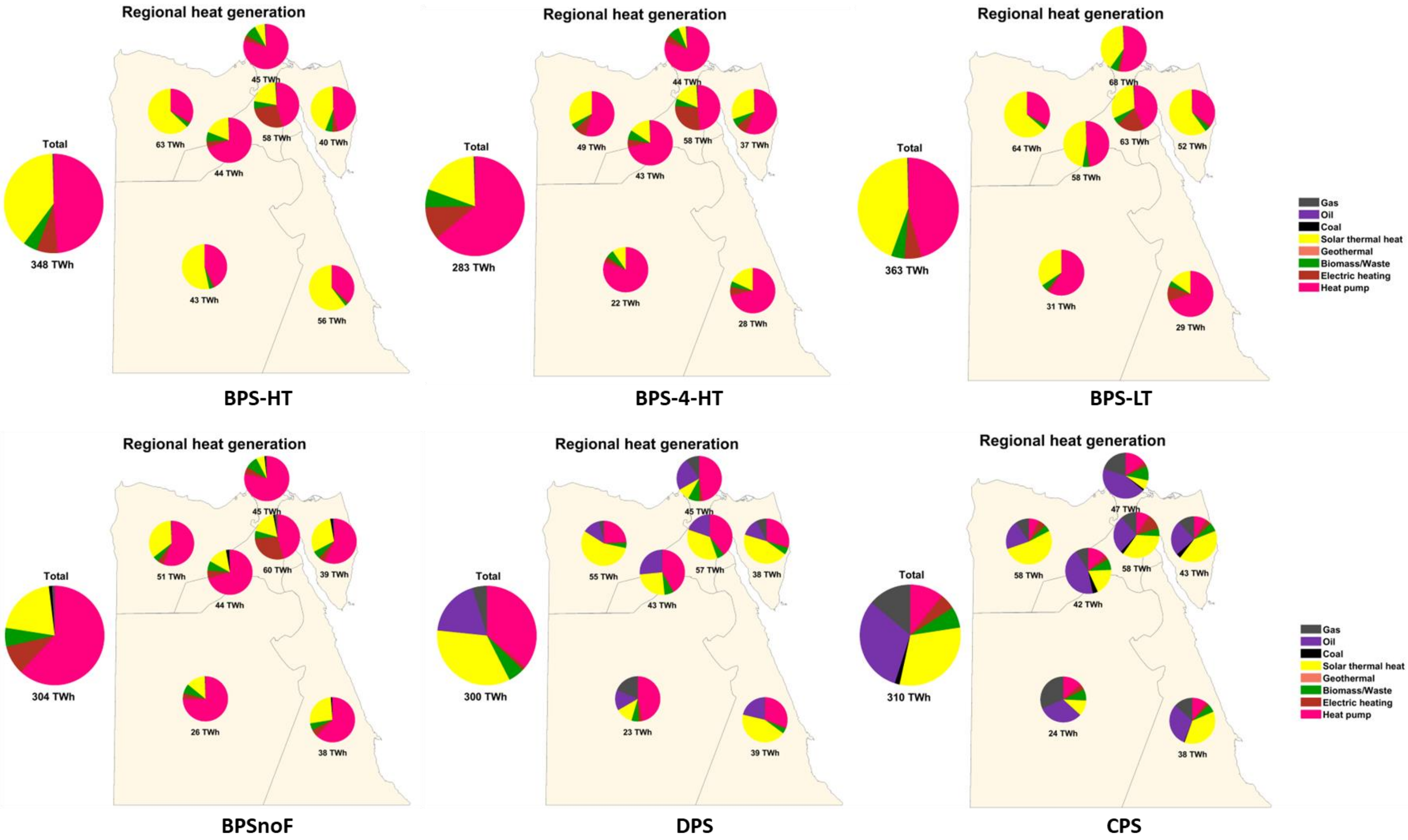

Figure 2.10 Regional heat generation in 2050 across all scenarios.

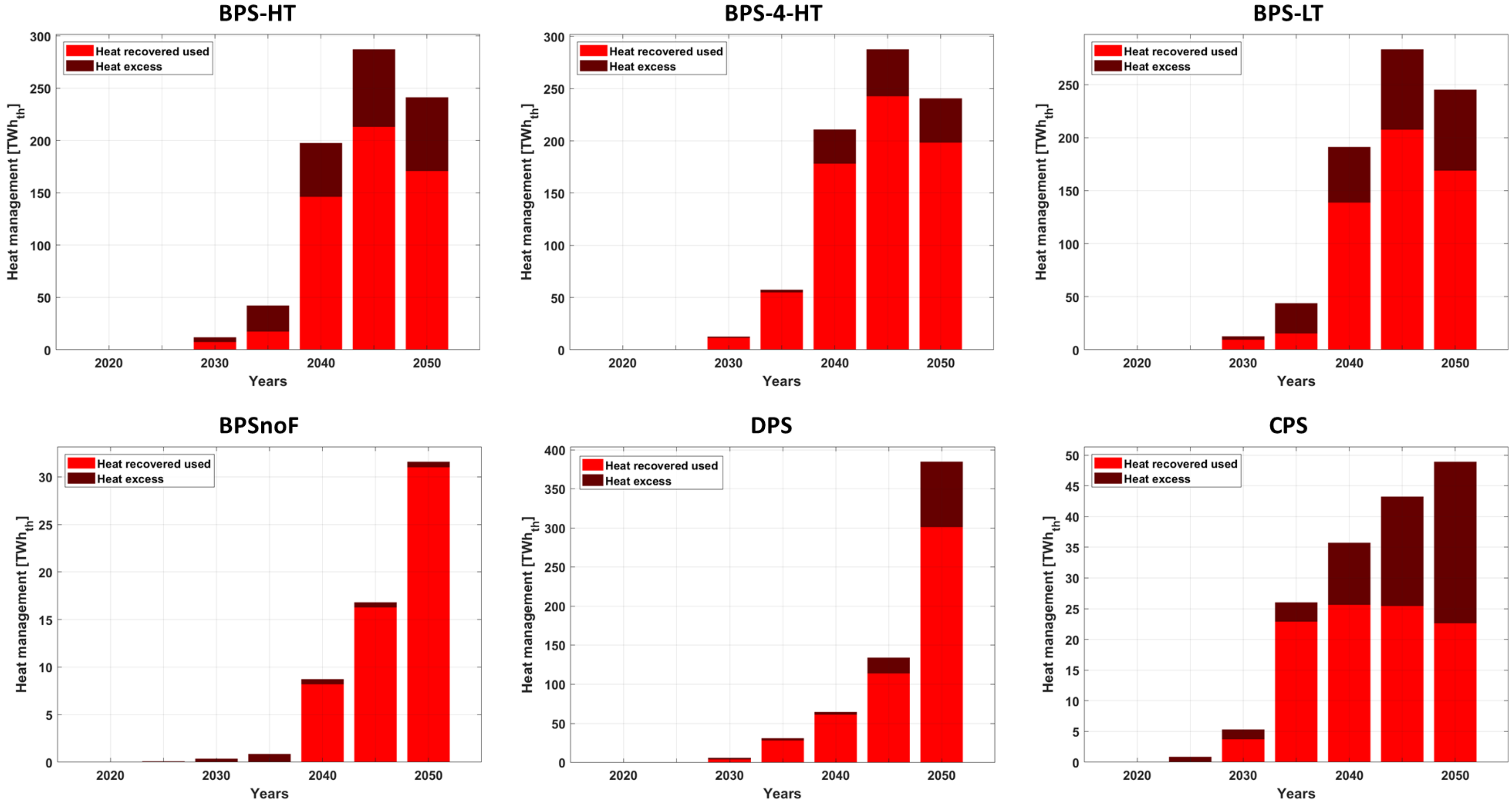

Figure 2.11 Development of heat loss management across all scenarios. Note that the y-axis range differs among scenarios.

2.5. Transport sector

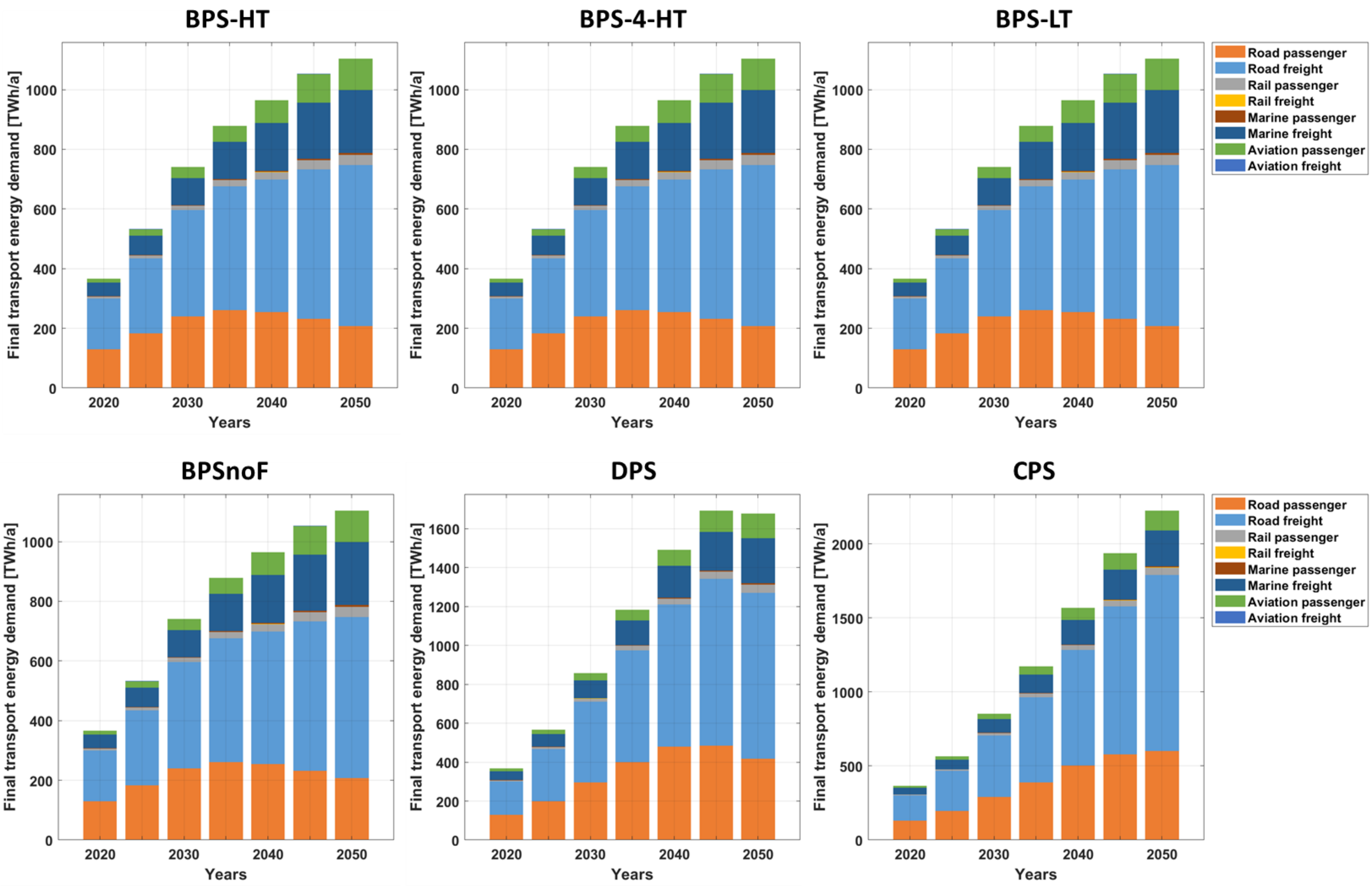

Figure 2.12 Development of the final transport energy demand by transport mode across all scenarios. Note that the y-axis range differs among scenarios.

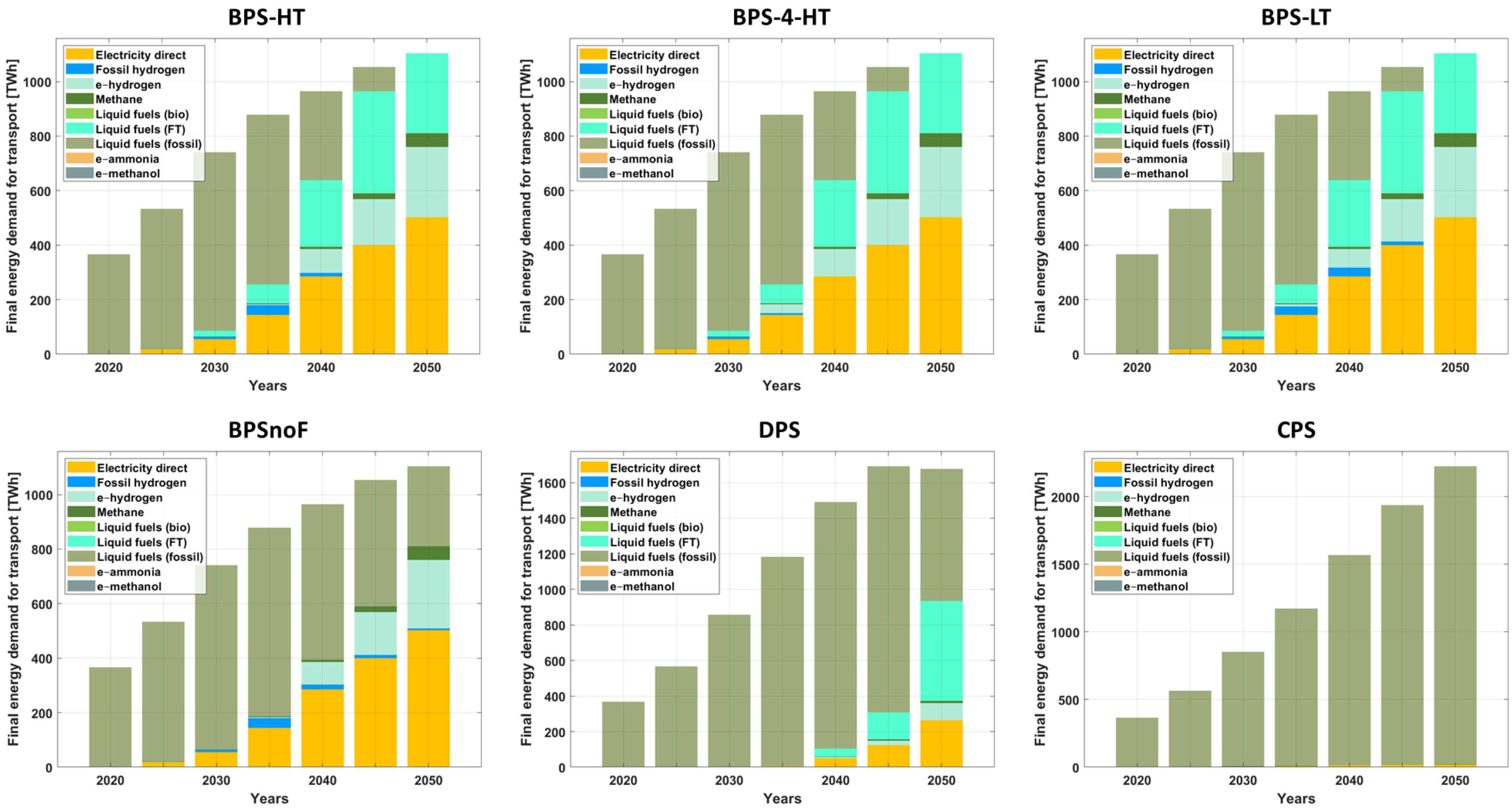

Figure 2.13 Development of the final transport energy demand by energy source across all scenarios. Note that the y-axis range differs among scenarios.

2.6. Desalination sector

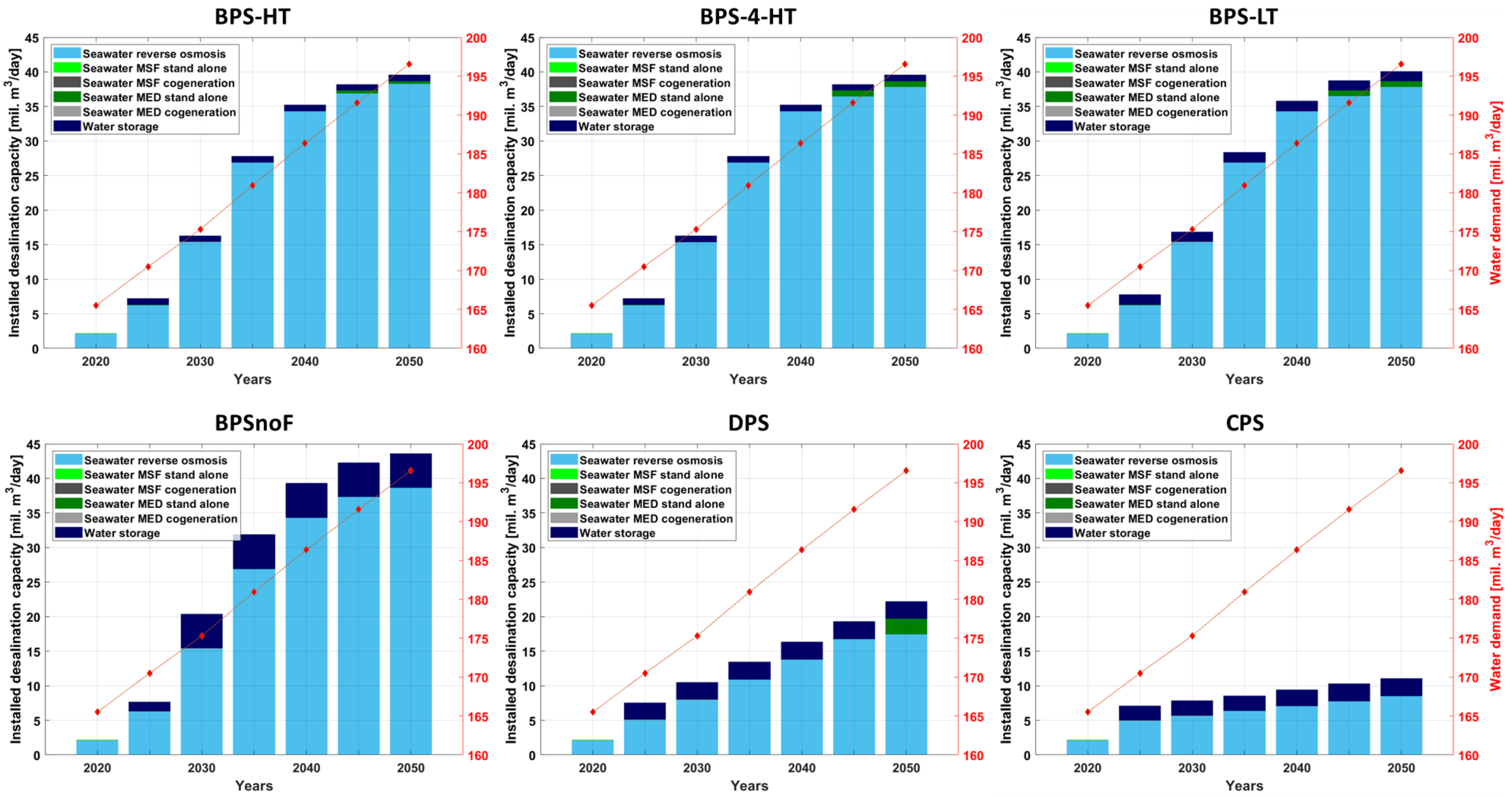

Figure 2.14 Development of installed desalination capacity, water storage, and total water demand across all scenarios.

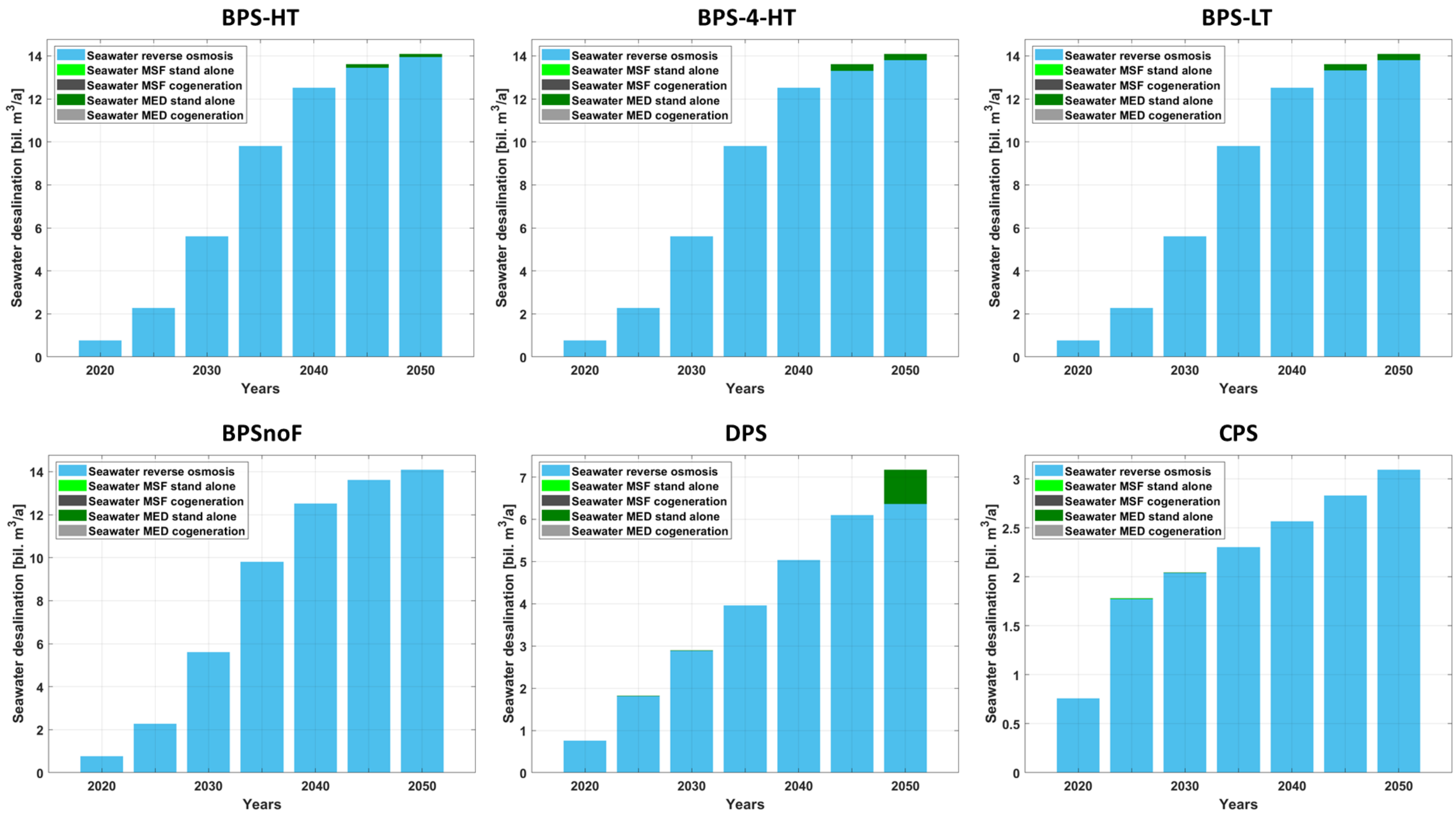

Figure 2.15 Development of annual desalinated water by technology across all scenarios. Note that the y-axis range differs among scenarios.

2.7. Electricity storage

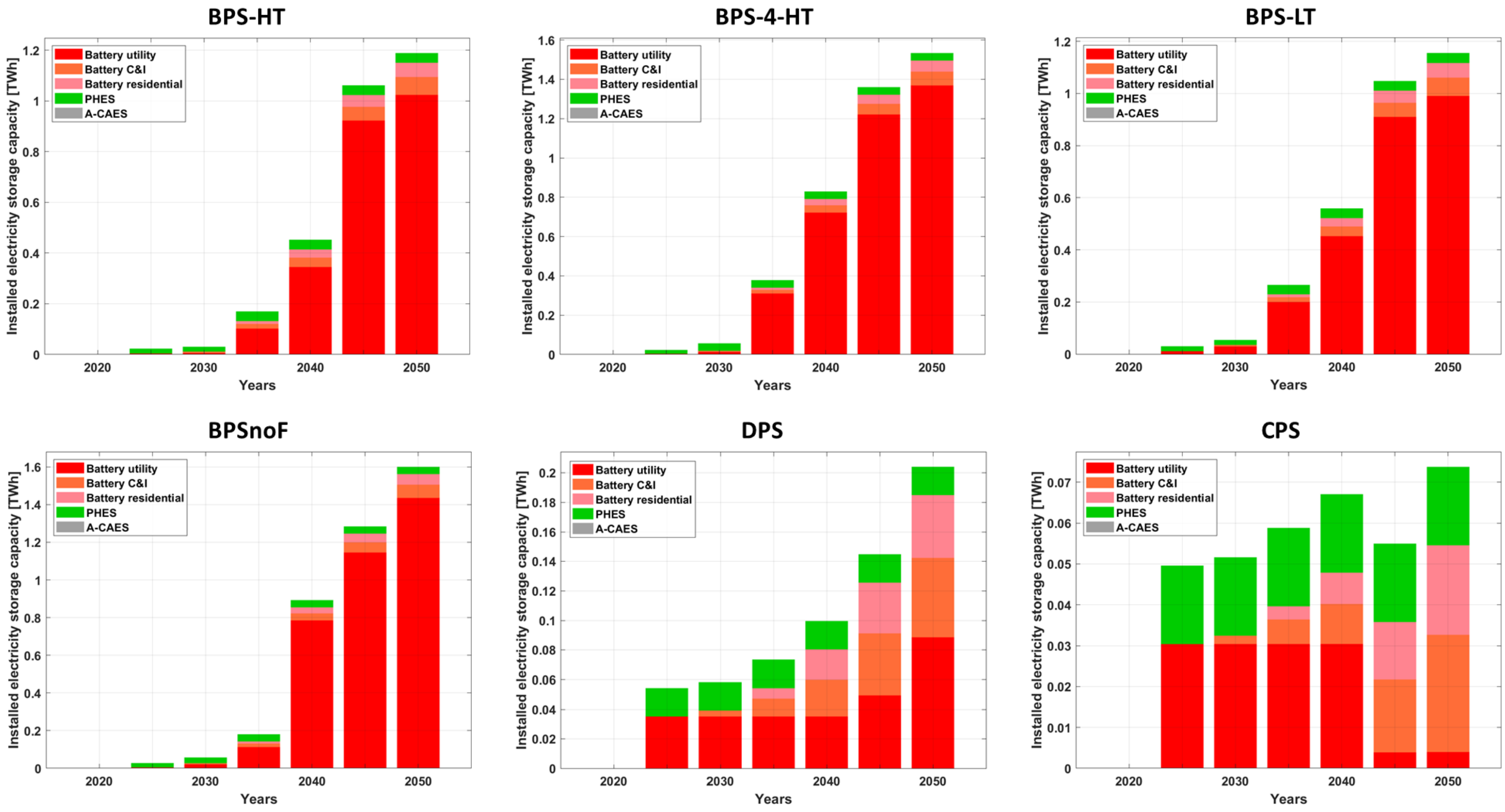

Figure 2.16 Development of the installed electricity storage capacities across all scenarios. Note that the y-axis range differs among scenarios.

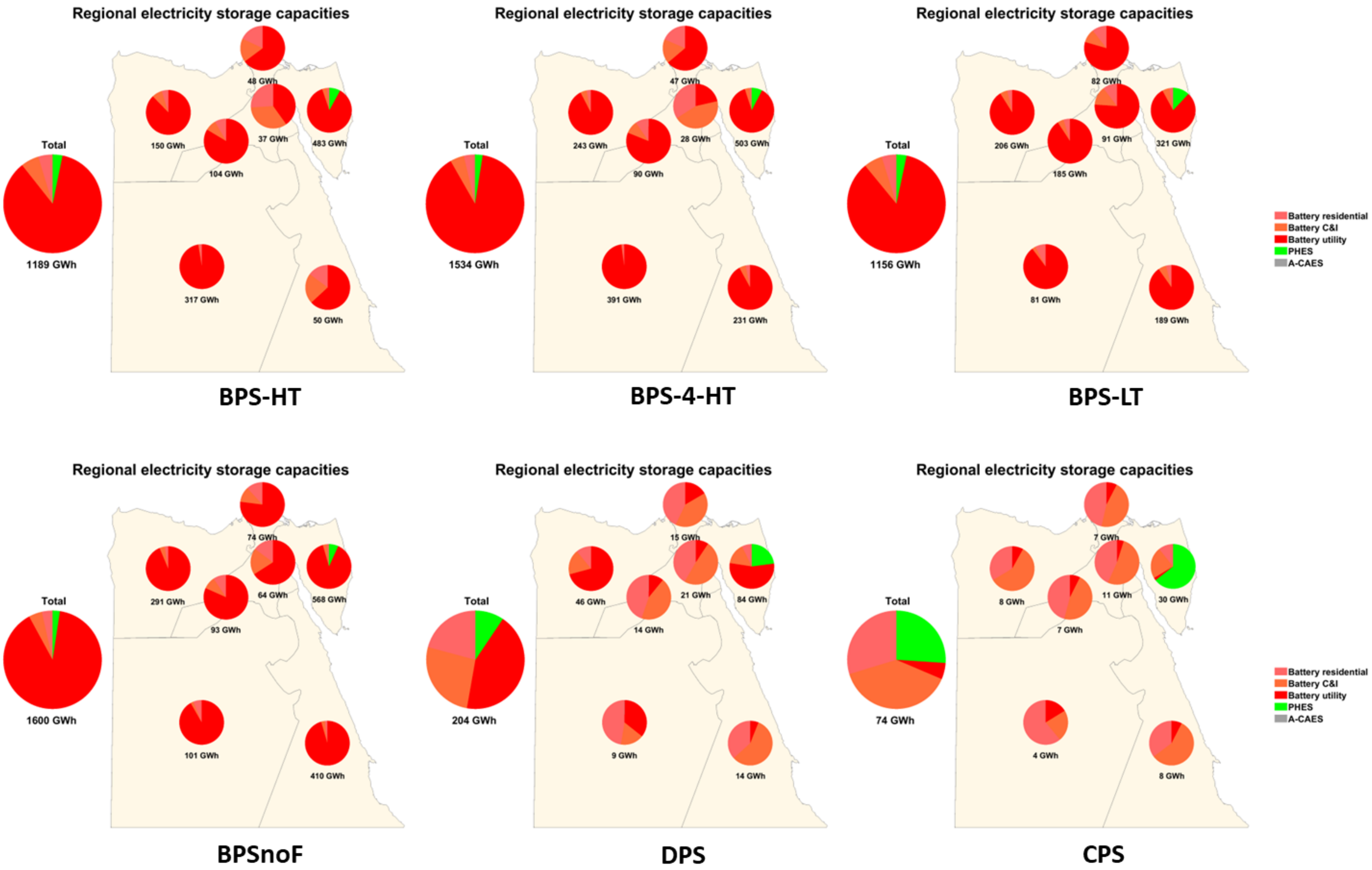

Figure 2.17 Installed regional electricity storage capacities by technology in 2050 across all scenarios.

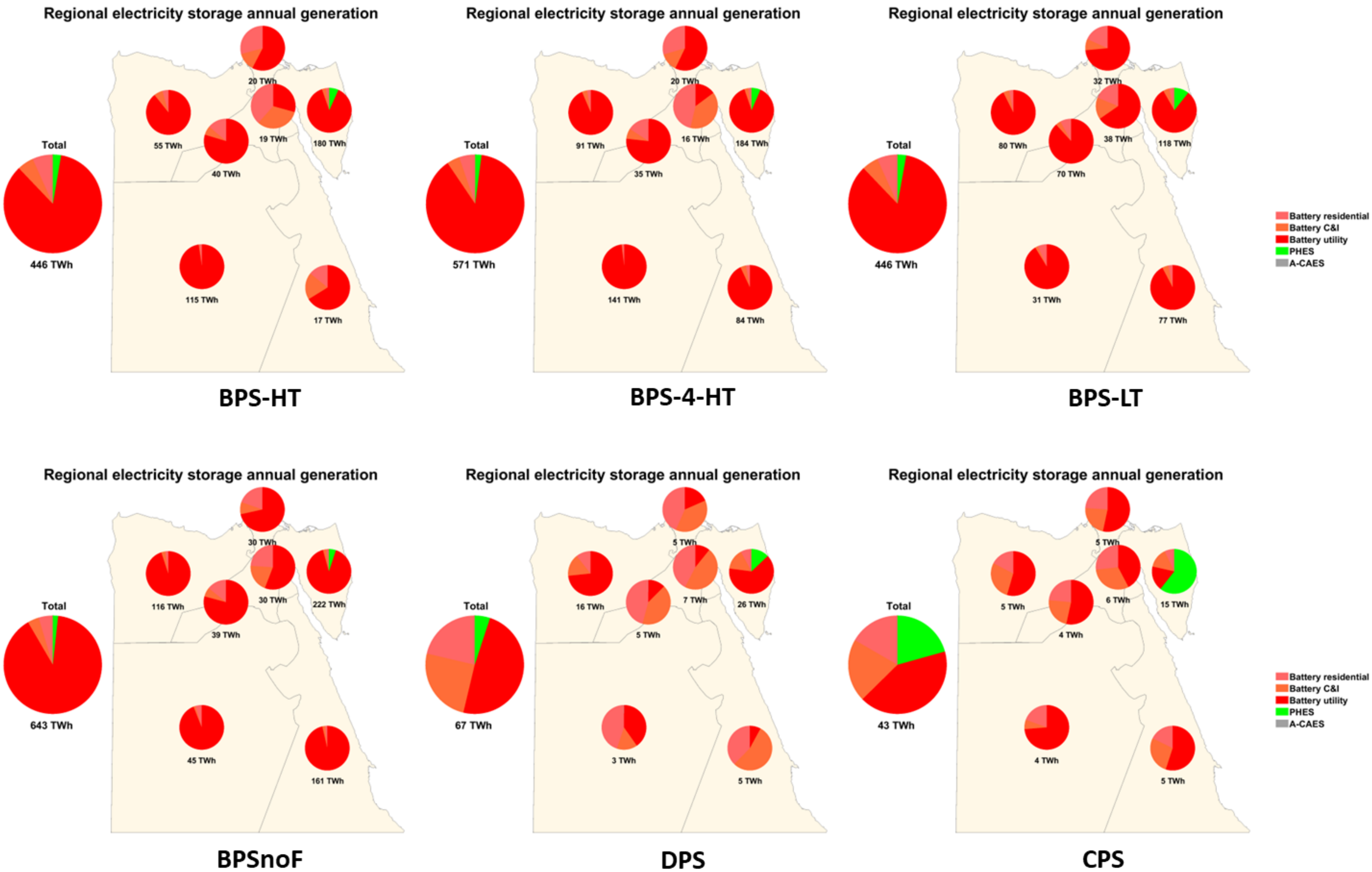

Figure 2.18 Regional electricity storage annual throughput by technology in 2050 across all scenarios.

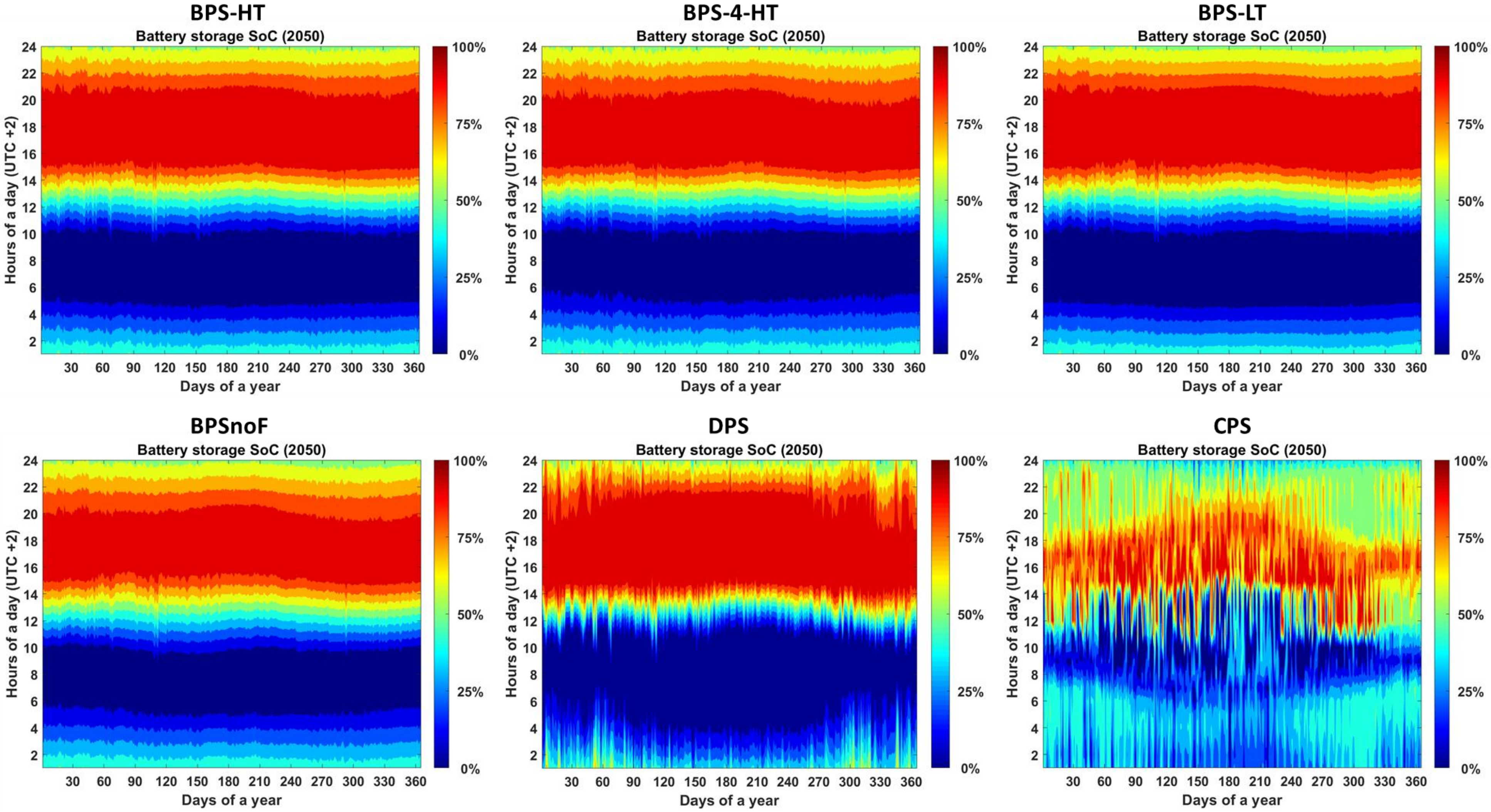

Figure 2.19 Battery storage state-of-charge in 2050 across all scenarios.

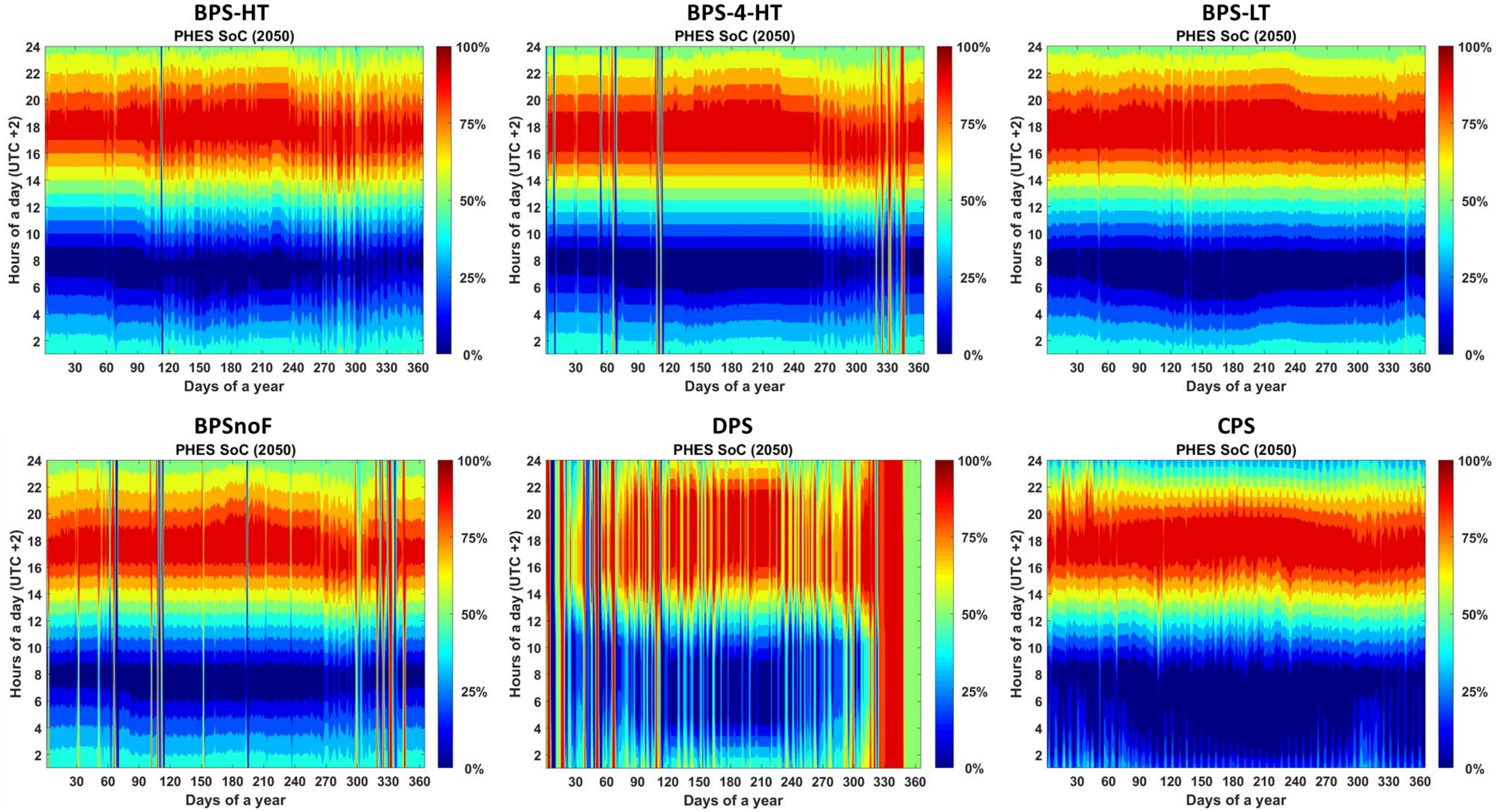

Figure 2.20 Pumped hydro energy storage state-of-charge in 2050 across all scenarios.

2.8. Heat storage

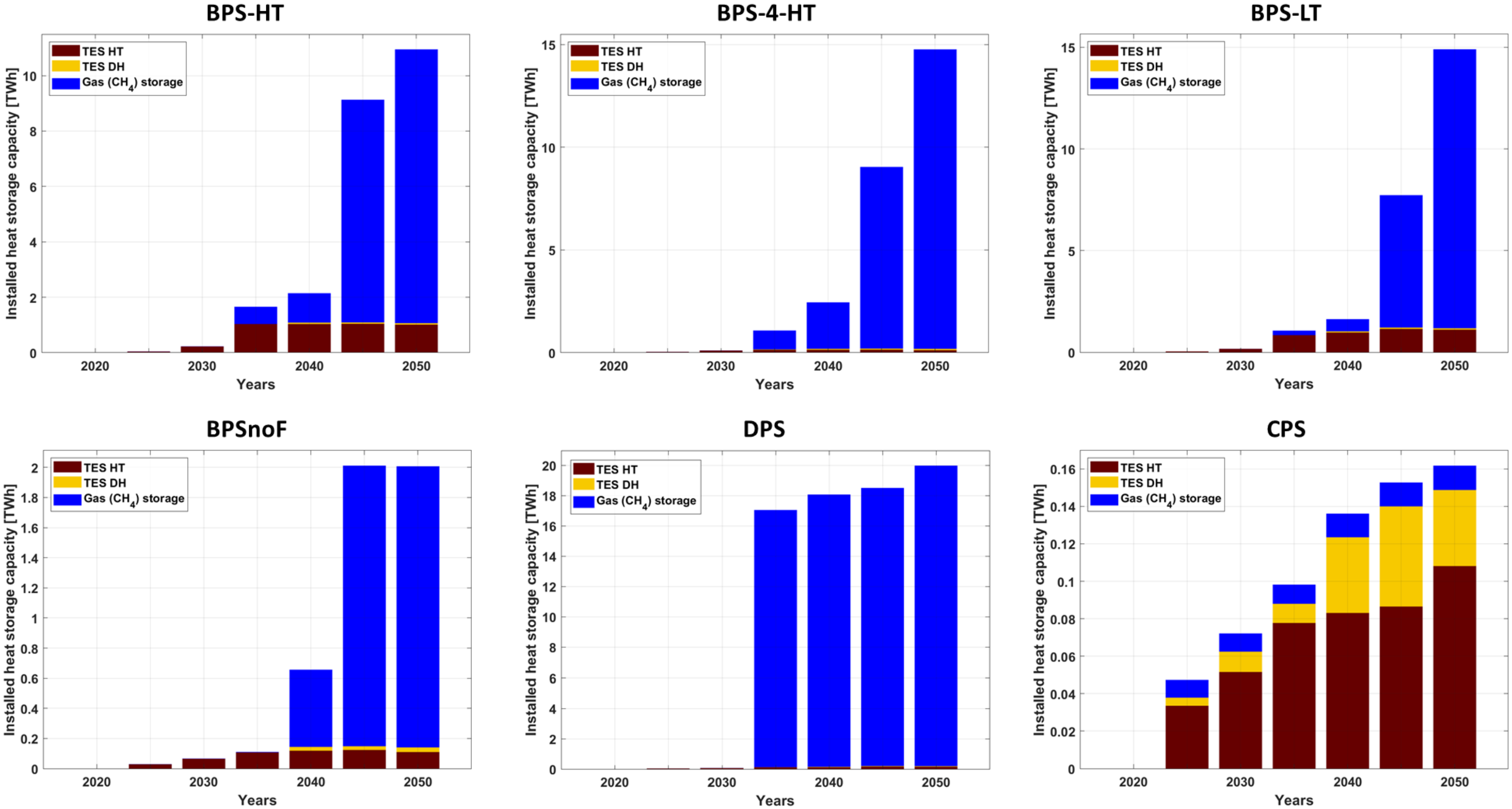

Figure 2.21 Development of the installed heat storage capacities across all scenarios. Note that the y-axis range differs among scenarios.

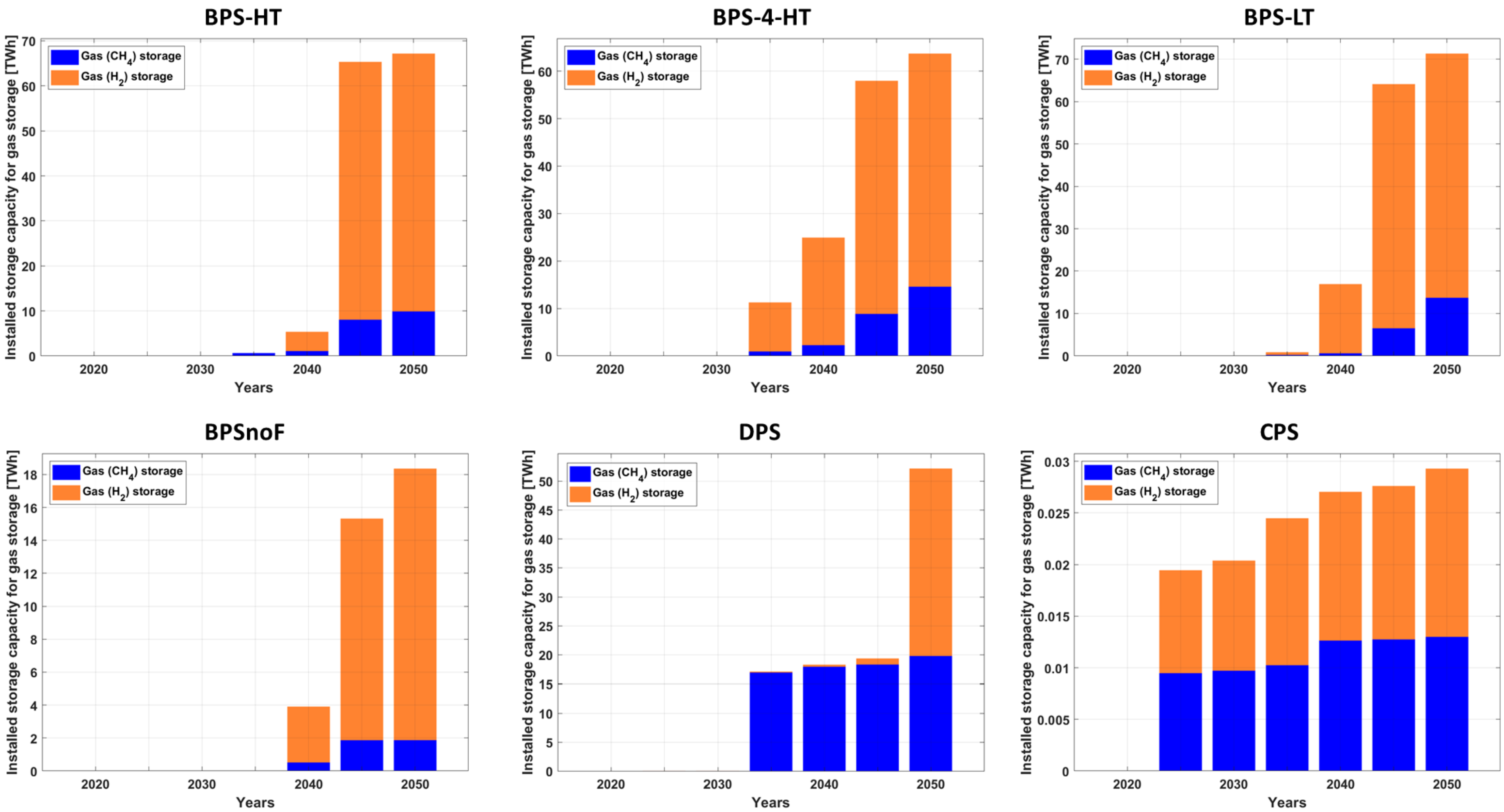

Figure 2.22 Development of the installed gas storage capacities across all scenarios; gas (CH4) storage is in common with the previous figure. Note that the y-axis range differs among scenarios.

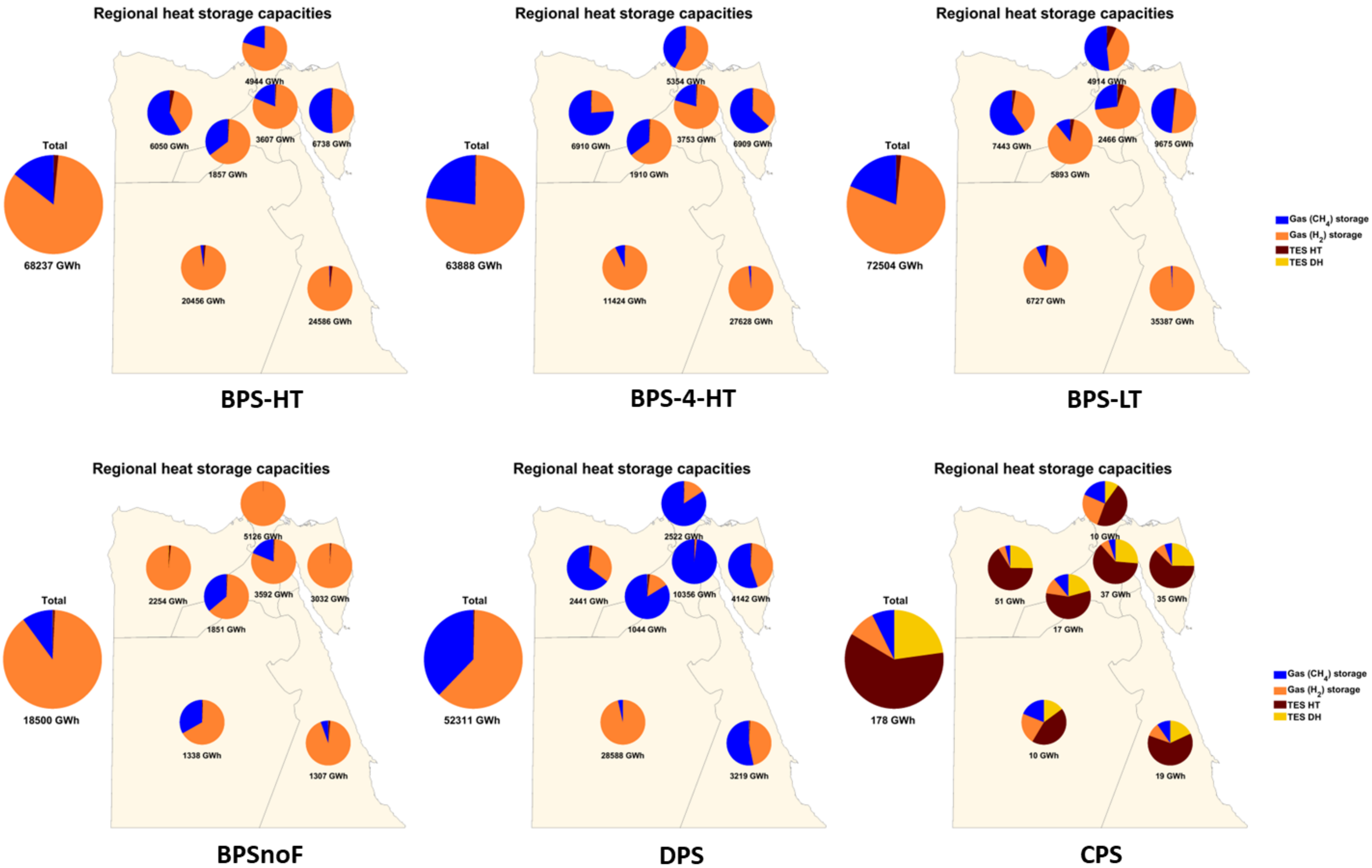

Figure 2.23 Installed regional heat storage capacities in 2050 across all scenarios.

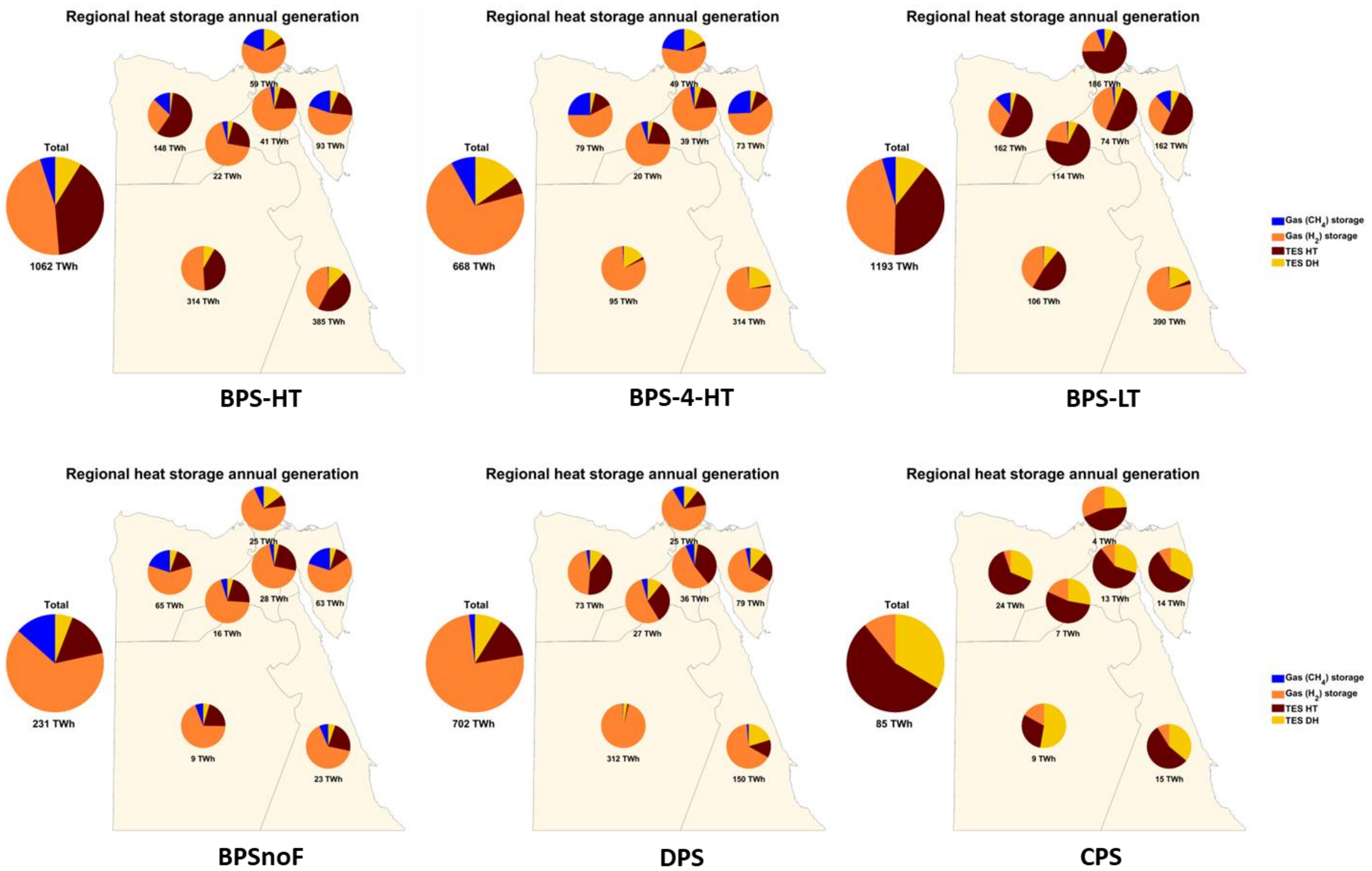

Figure 2.24 Regional heat storage annual throughput in 2050 across all scenarios.

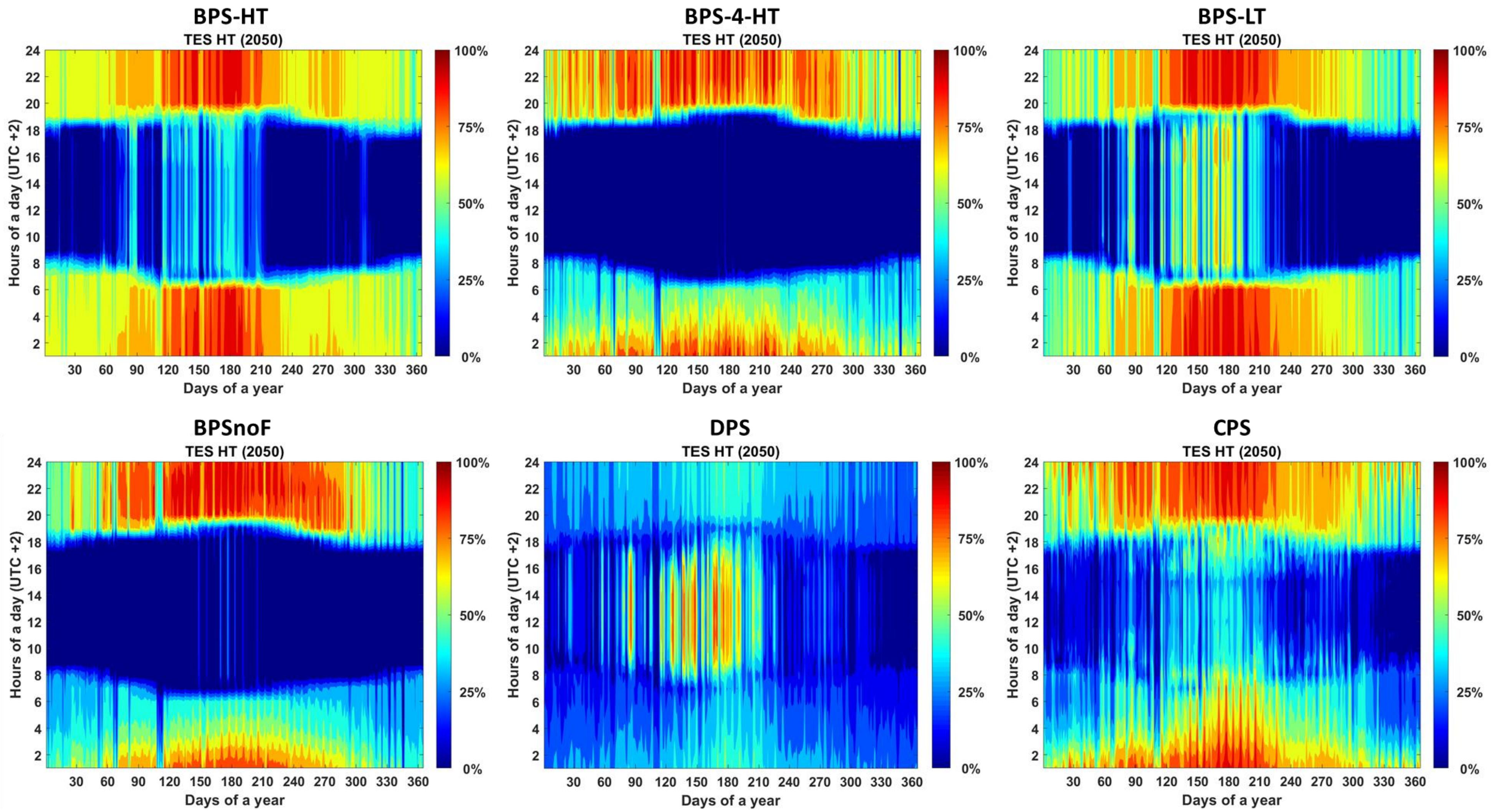

Figure 2.25 High temperature thermal energy storage state-of-charge in 2050 across all scenarios.

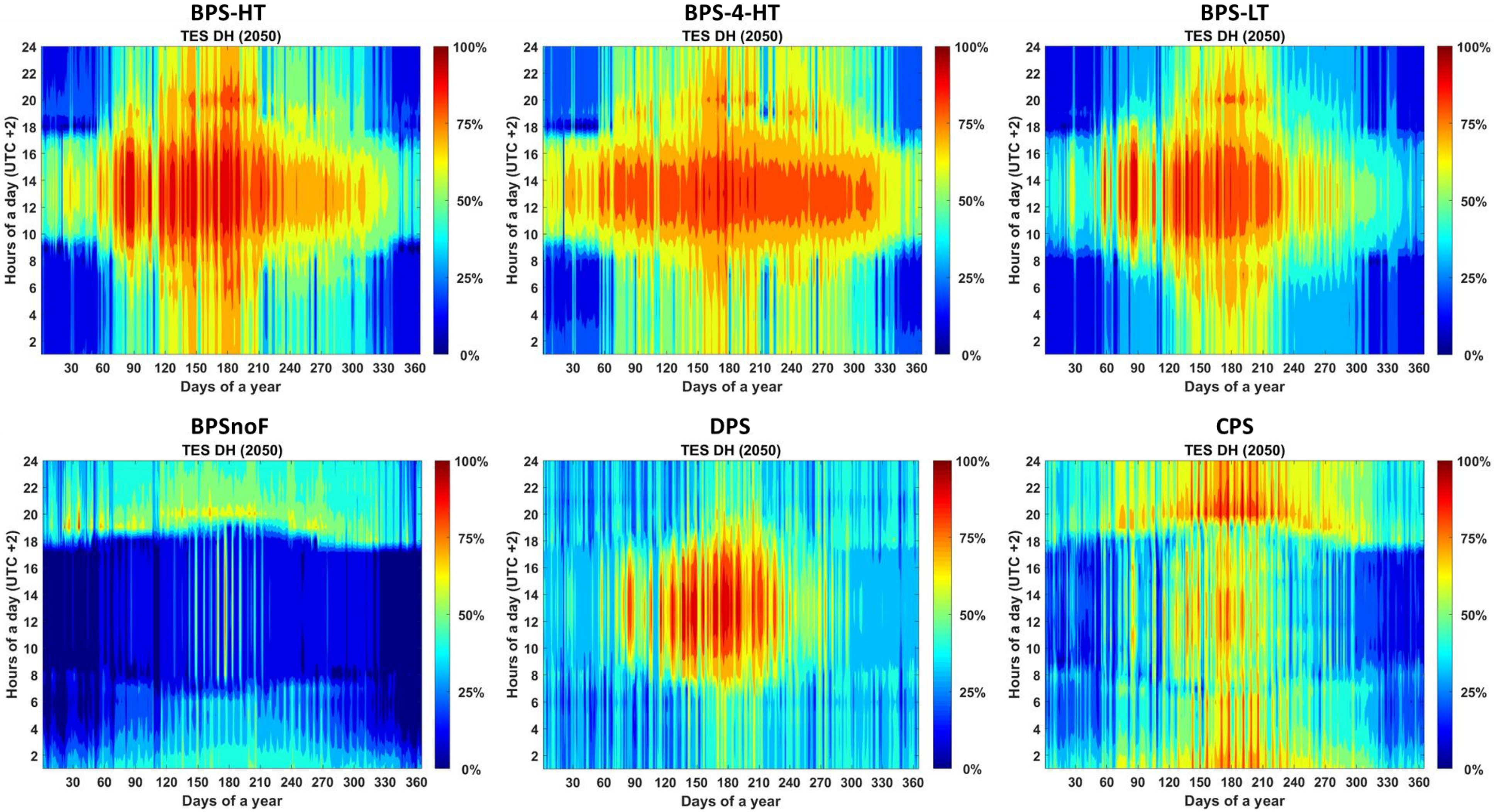

Figure 2.26 District heating thermal energy storage state-of-charge in 2050 across all scenarios.

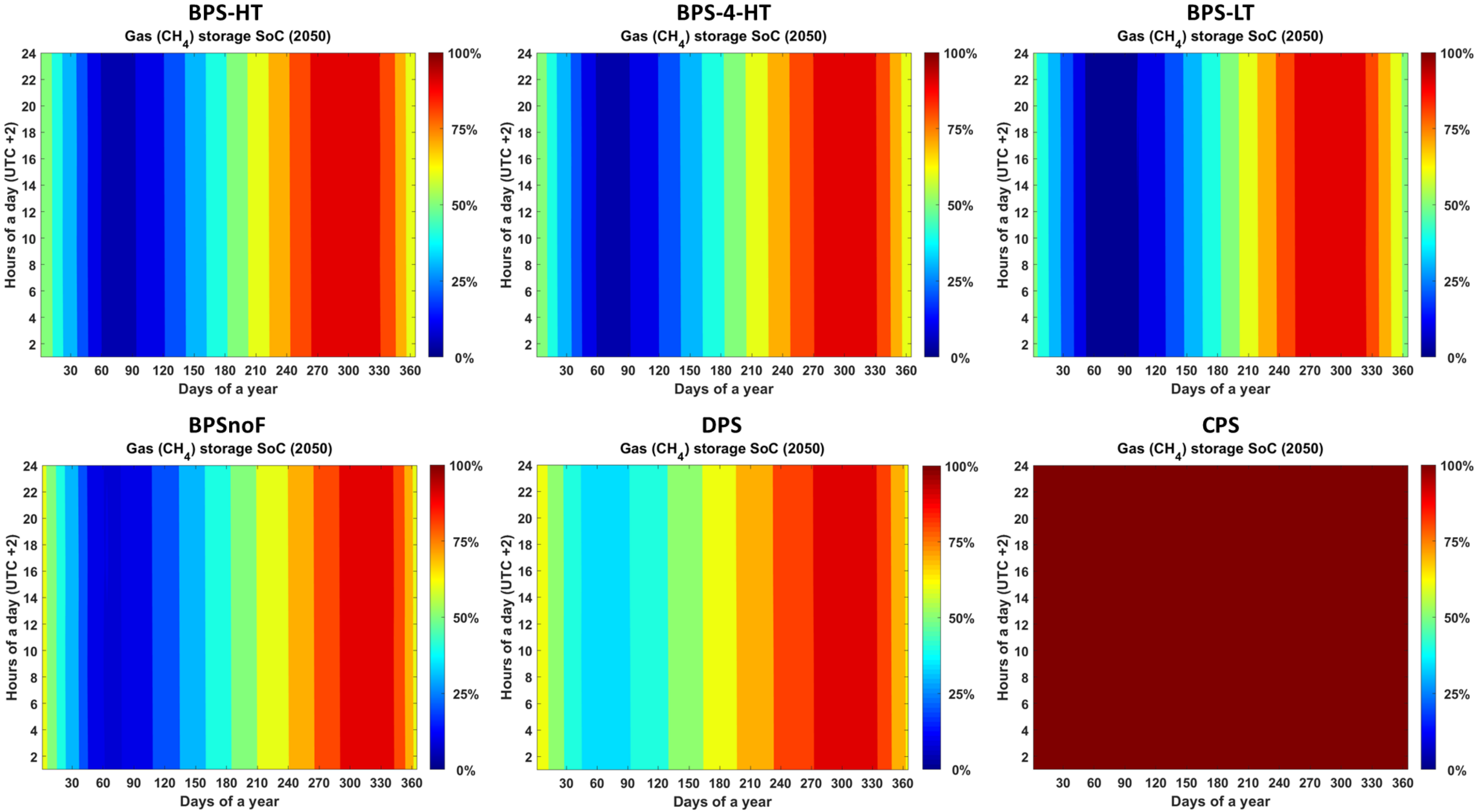

Figure 2.27 Methane gas storage state-of-charge in 2050 across all scenarios.

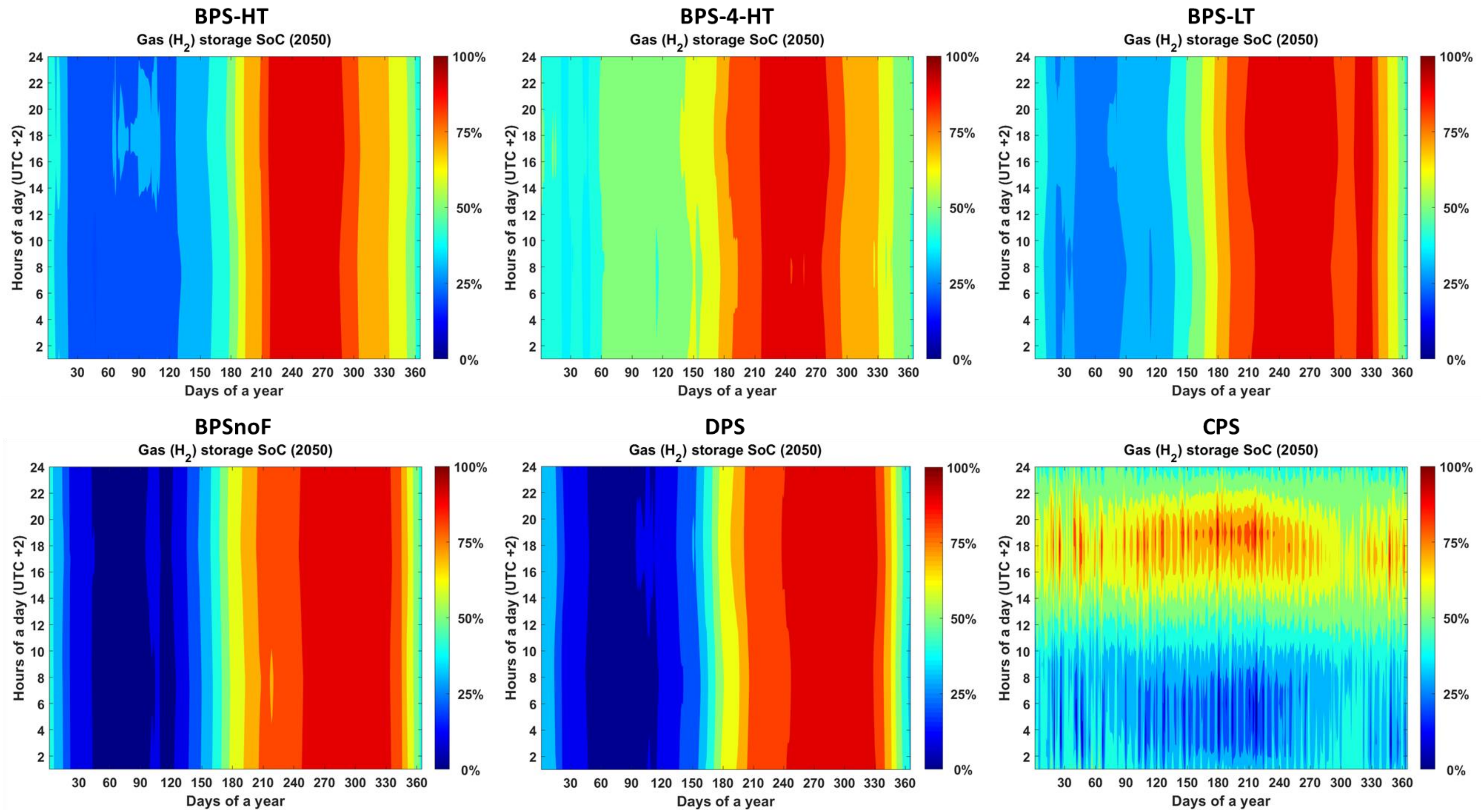

Figure 2.28 Hydrogen gas storage state-of-charge in 2050 across all scenarios.

2.9. Grid transmission

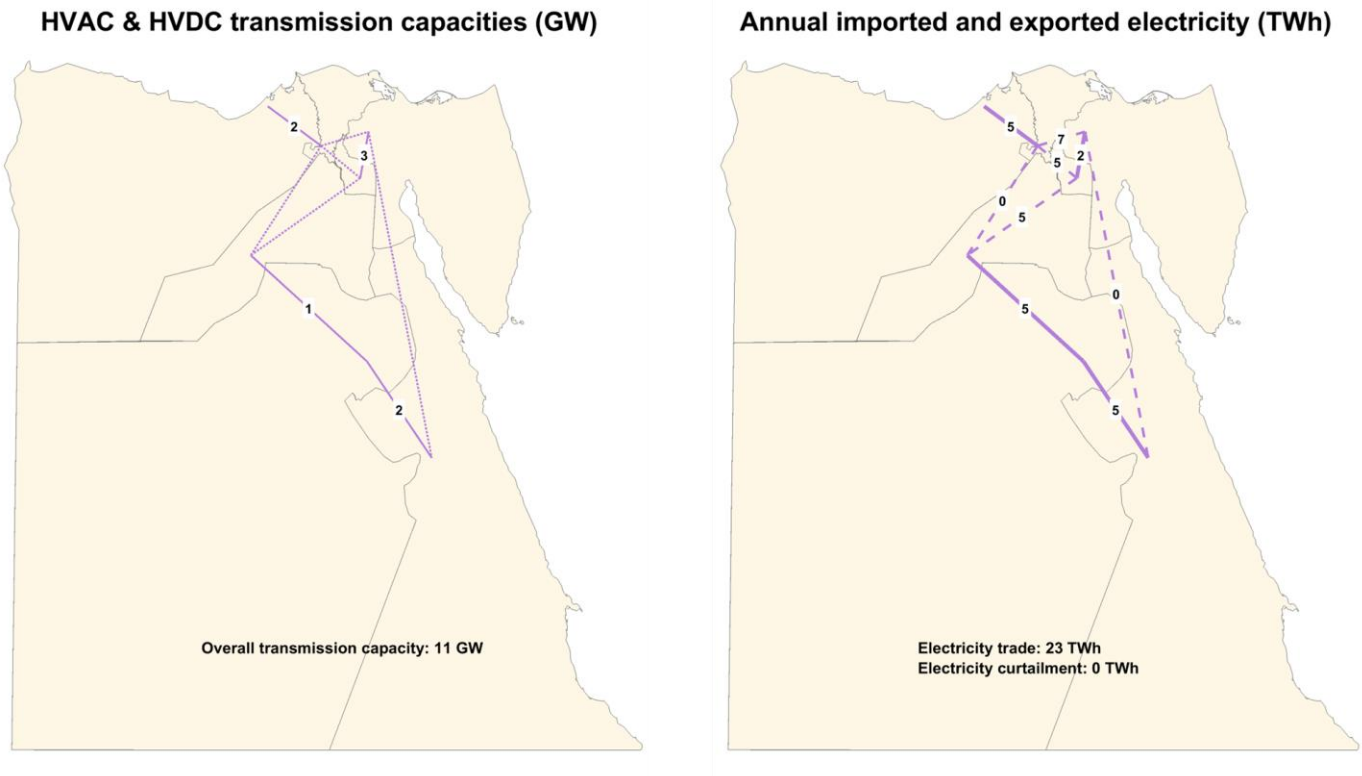

Figure 2.29 The situation in 2020 in terms of the total installed grid capacity (left) and the electricity trade between regions in TWh (right).

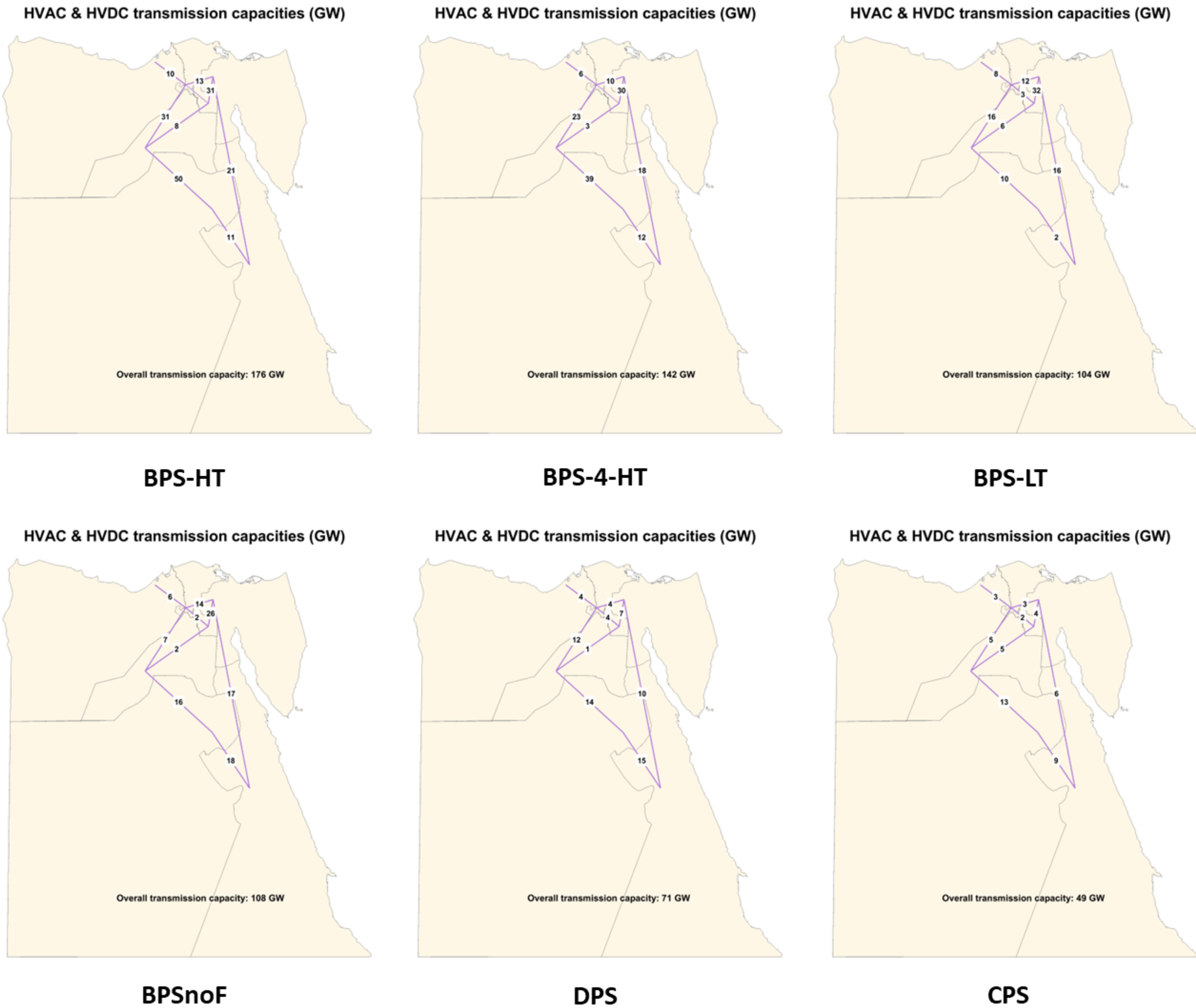

Figure 2.30 Total installed grid transmission capacities in 2050 across all scenarios.

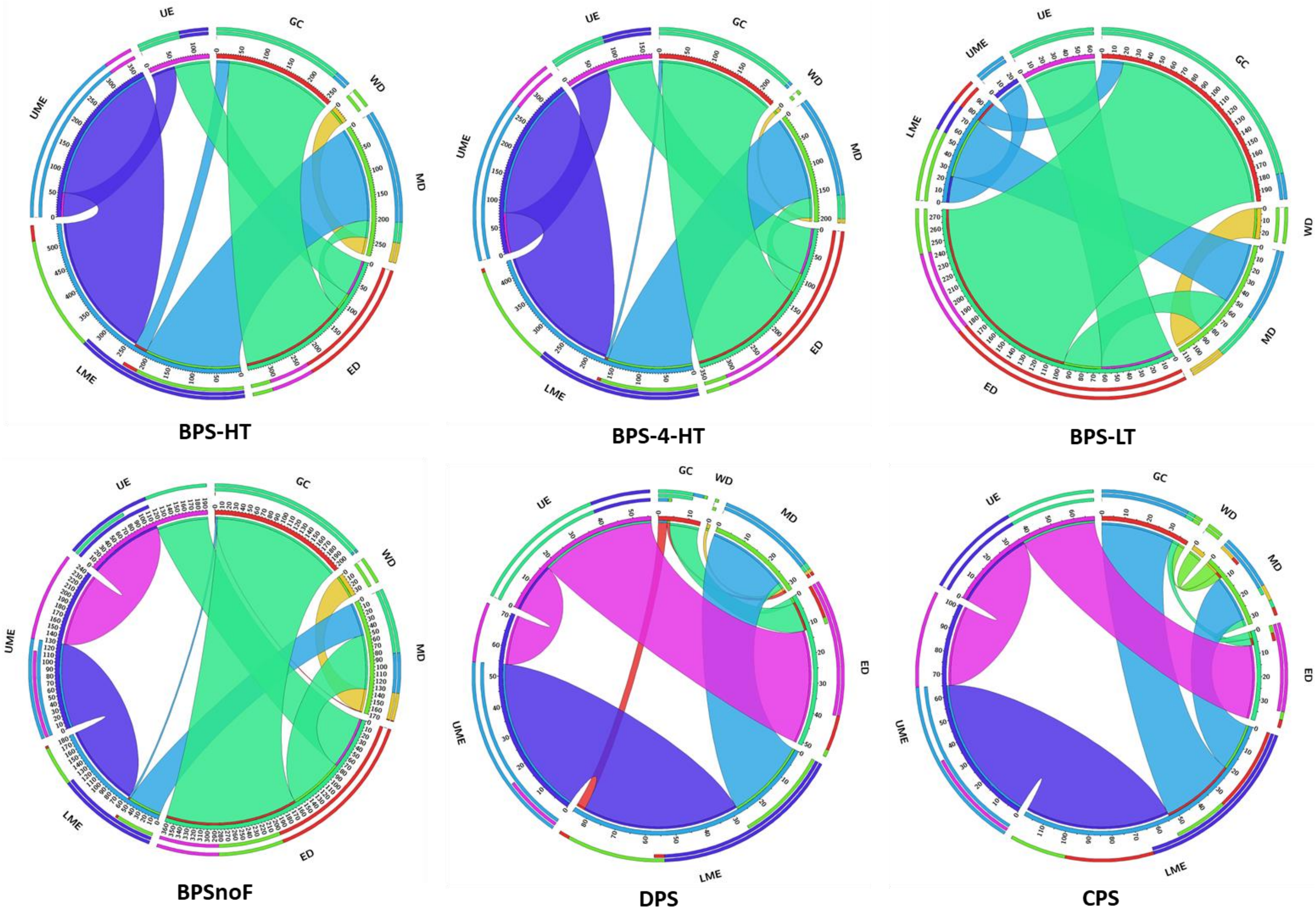

Figure 2.31 Regional electricity trade in 2050 across all scenarios; all values are in TWh.

2.10. e-Fuels

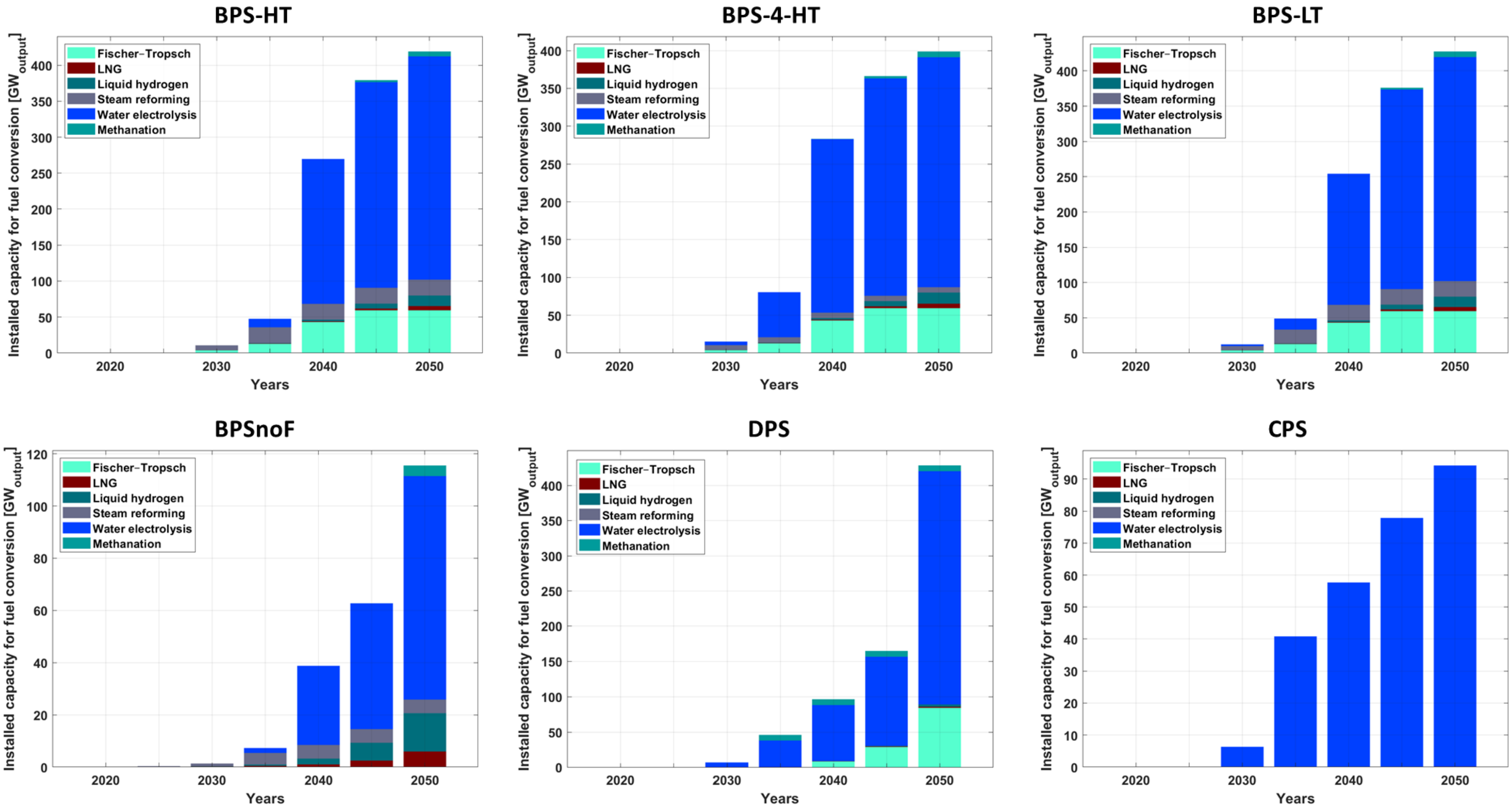

Figure 2.32 Development of installed fuel conversion capacities by technology across all scenarios. Note that the y-axis range differs among scenarios.

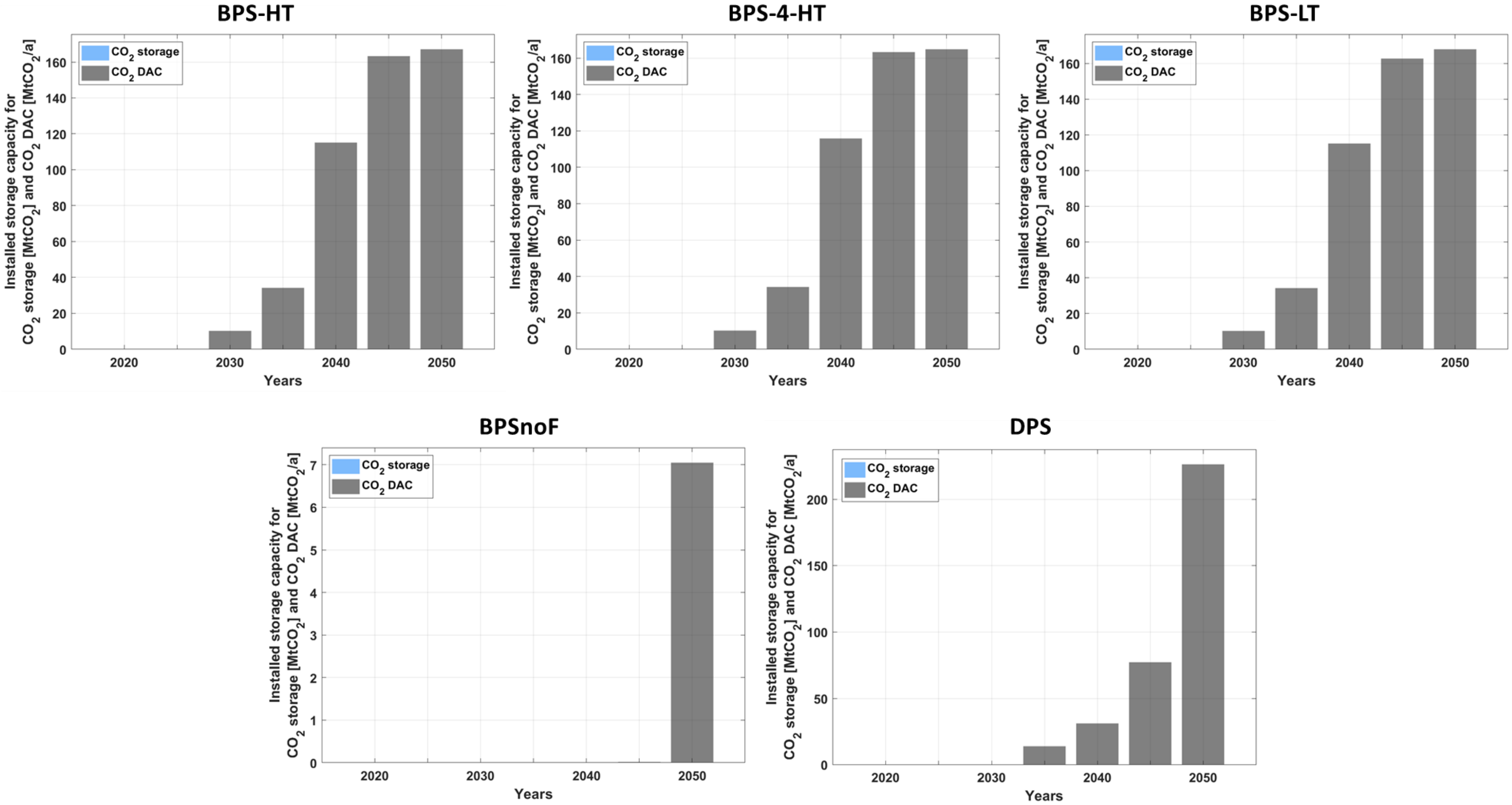

Figure 2.33 Development of CO_2 direct air capture capacity and storage capacity across the scenarios with installed capacities. Note that the y-axis range differs among scenarios.

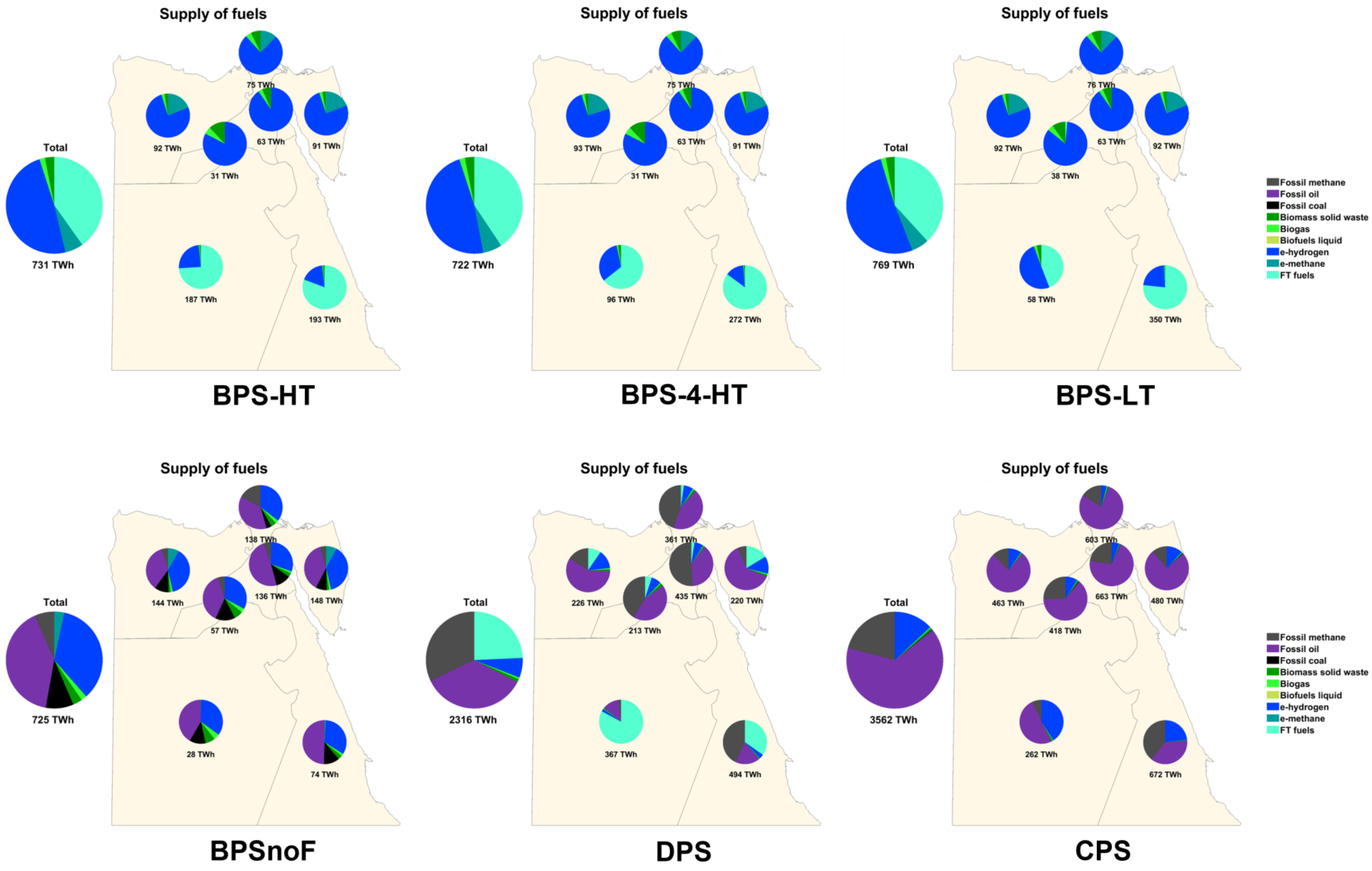

Figure 2.34 Regional supply of fuels in 2050 across all scenarios.

2.11. Energy flows also visualising sector coupling

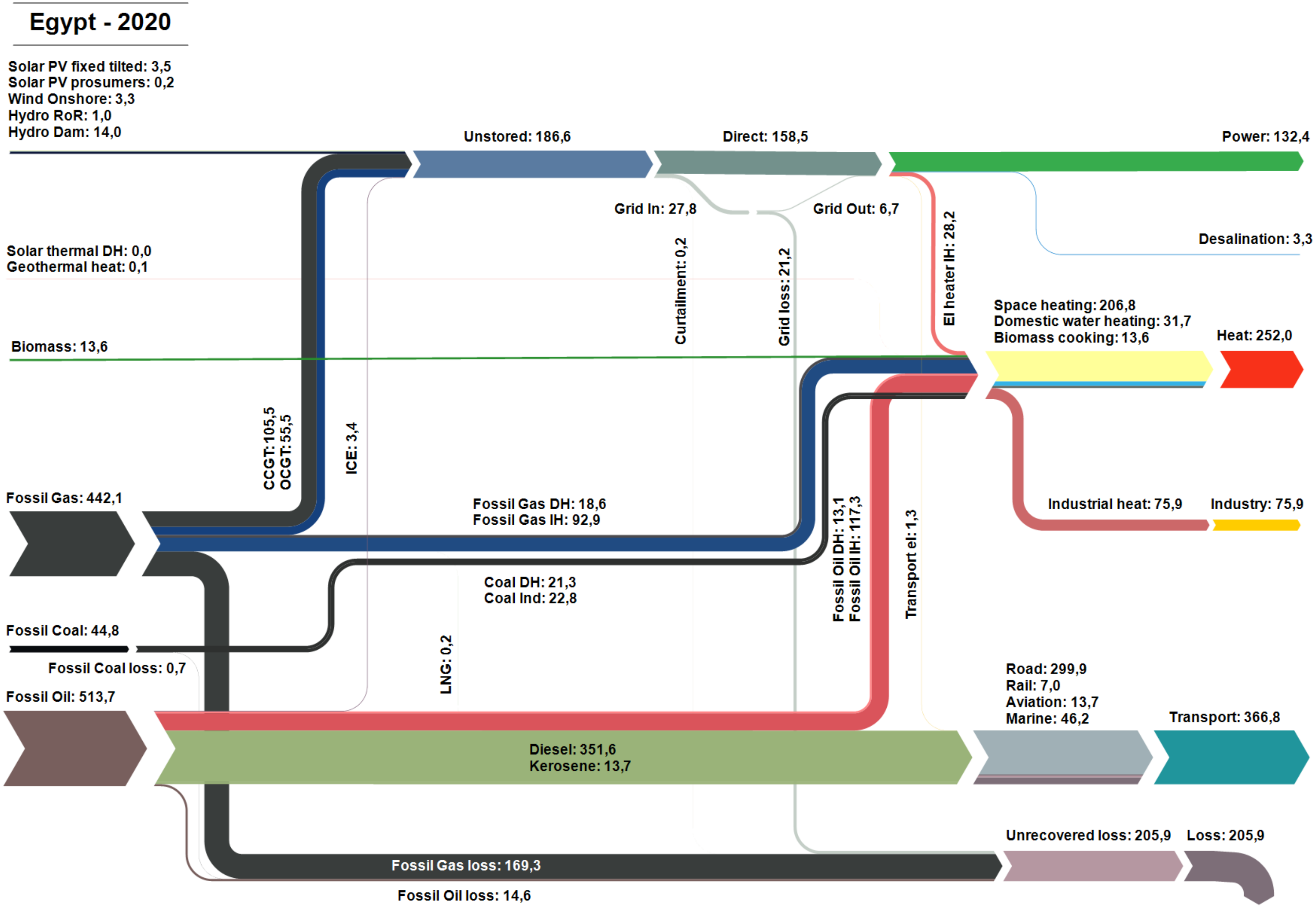

Figure 2.35 Energy flow in 2020 for Egypt; all values are in TWh.

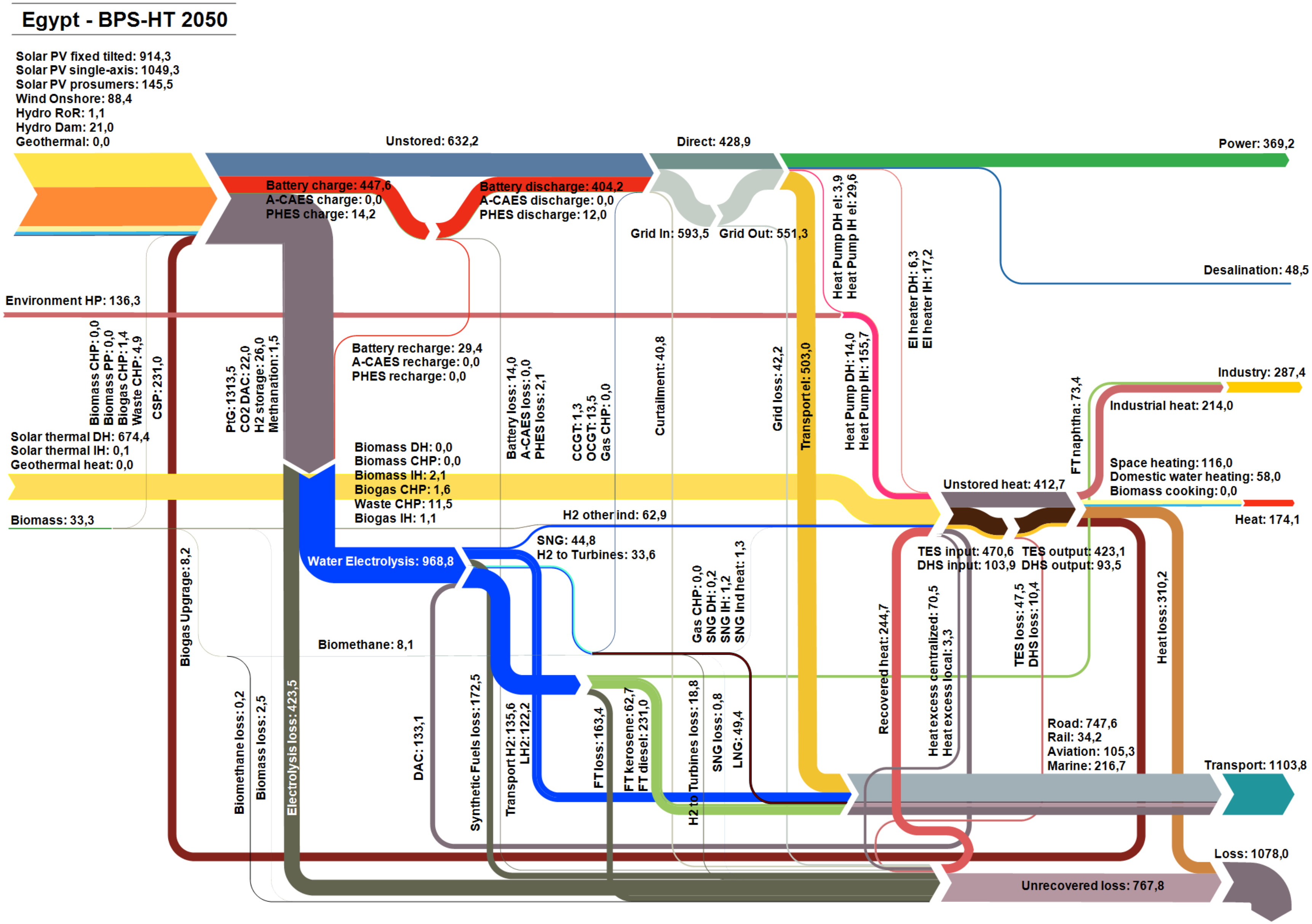

Figure 2.36 Energy flow for the BPS-HT in 2050 for Egypt; all values are in TWh.

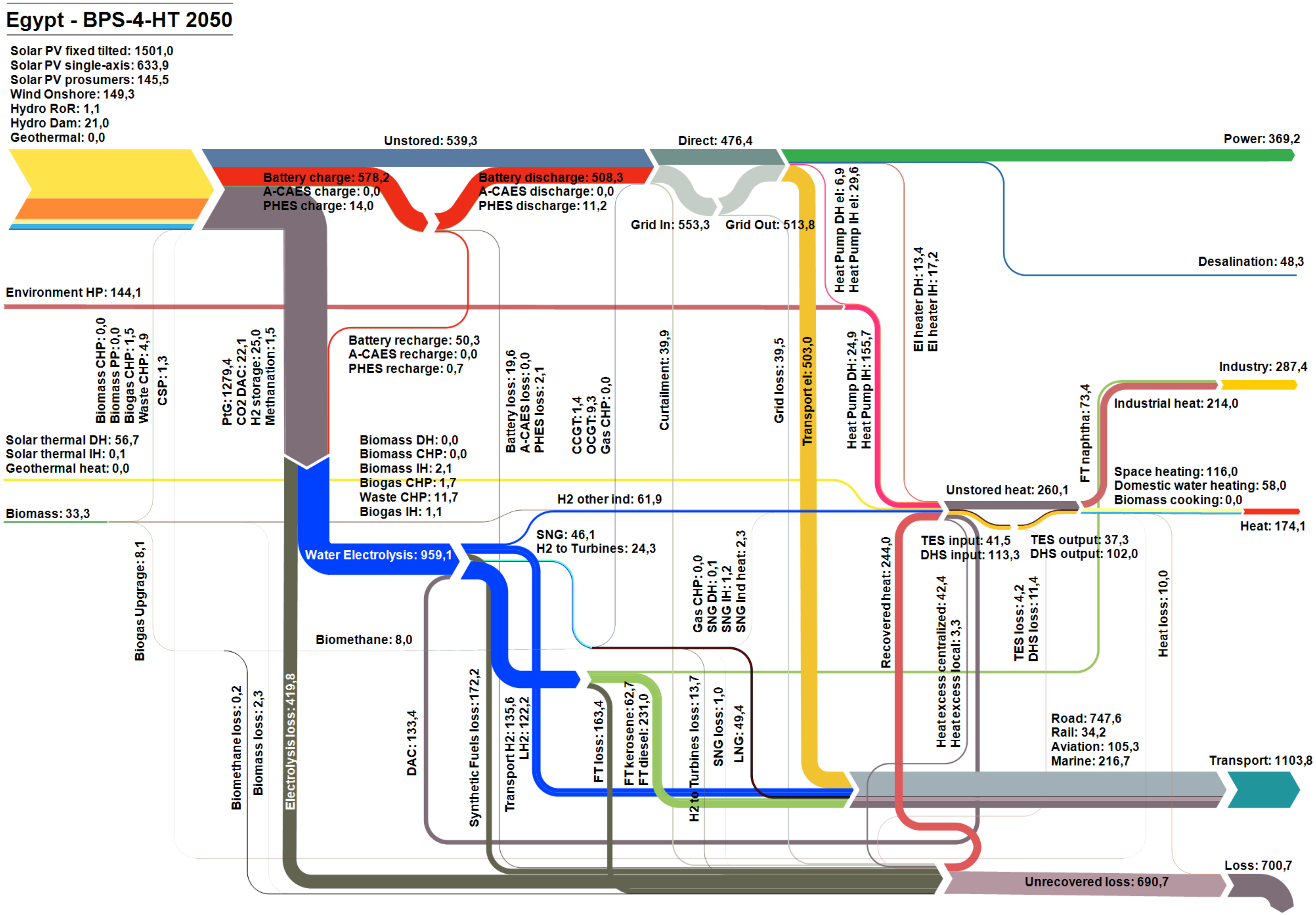

Figure 2.37 Energy flow for the BPS-4-HT in 2050 for Egypt; all values are in TWh.

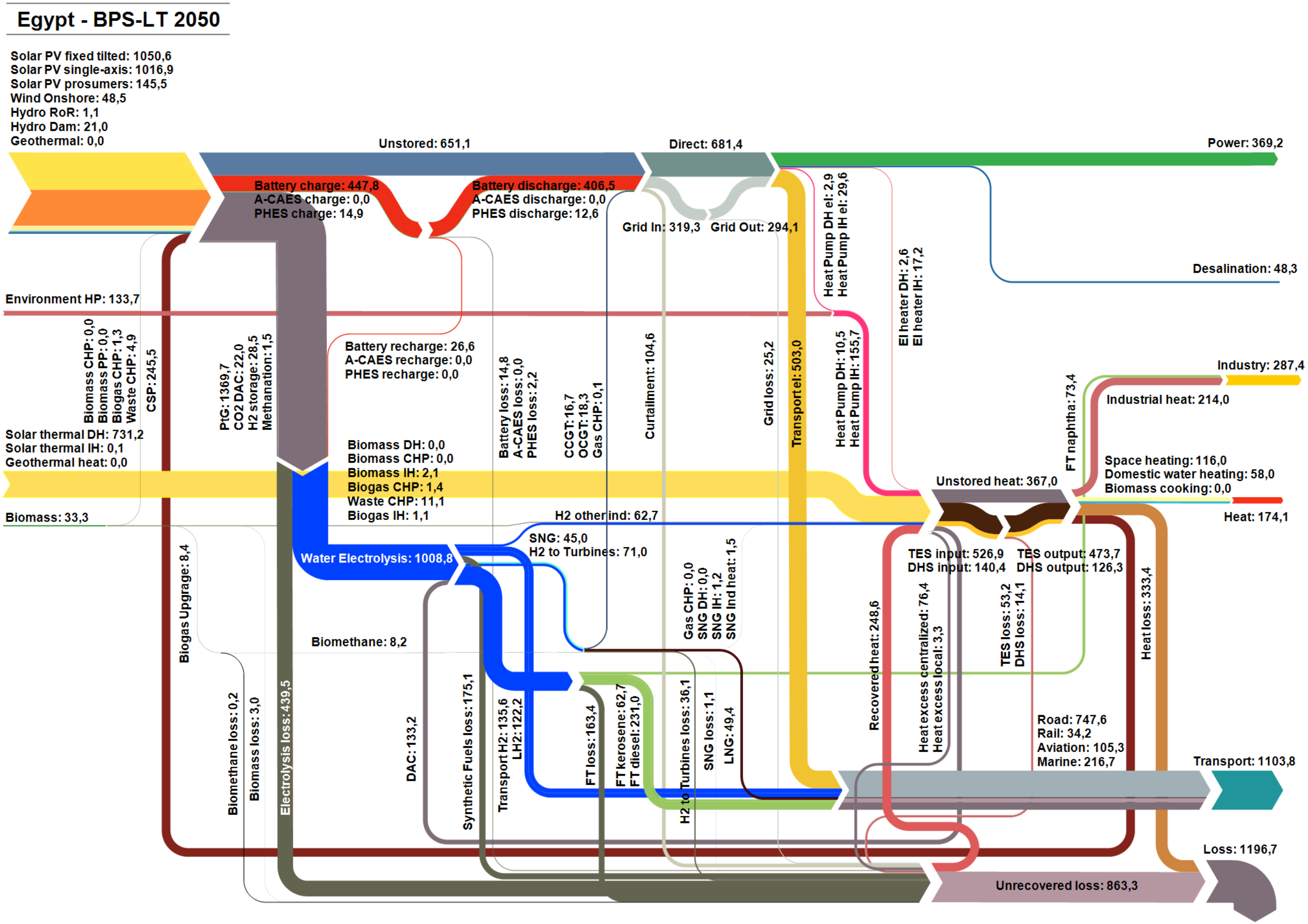

Figure 2.38 Energy flow for the BPS-LT in 2050 for Egypt; all values are in TWh.

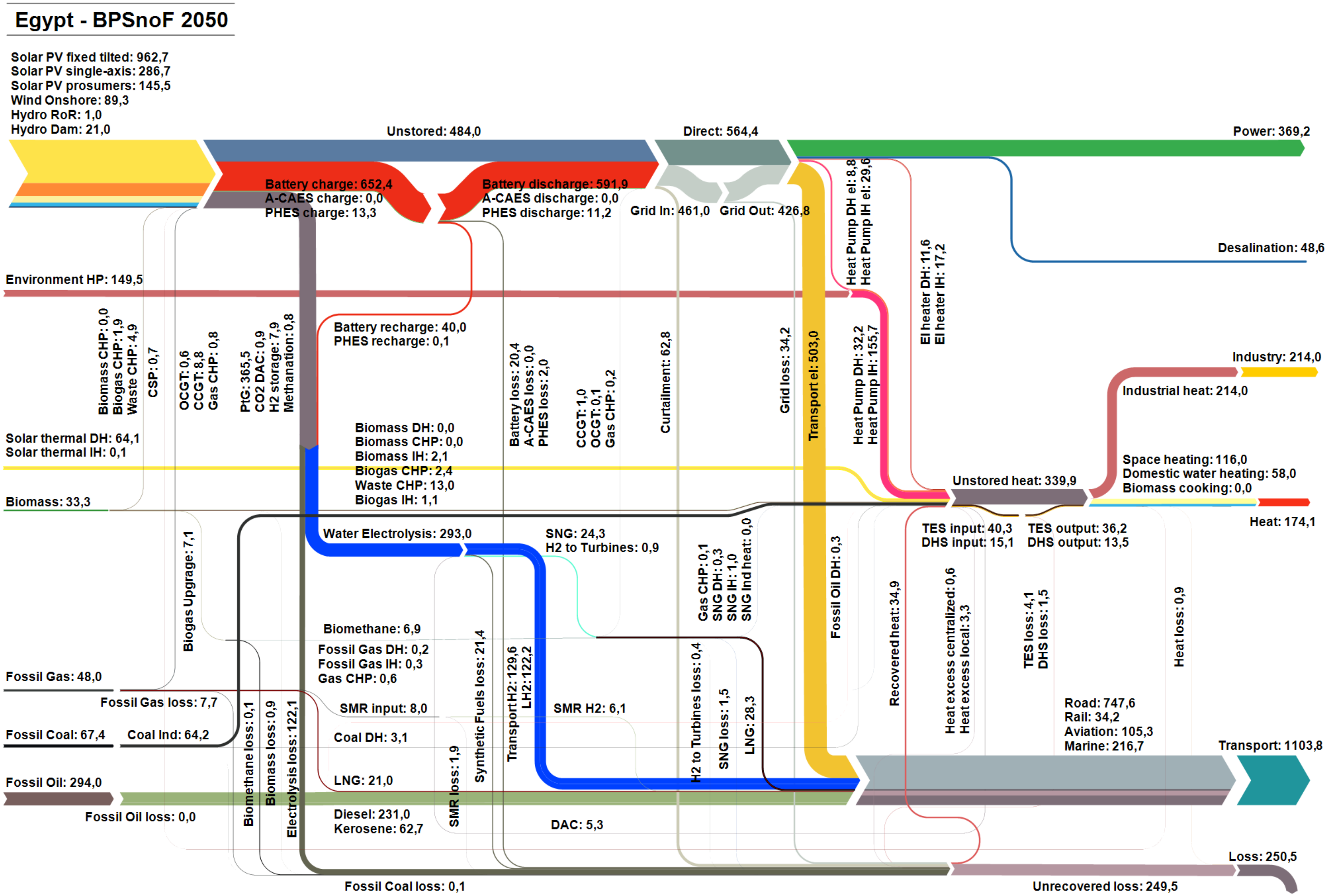

Figure 2.39 Energy flow for the BPSnoF in 2050 for Egypt; all values are in TWh.

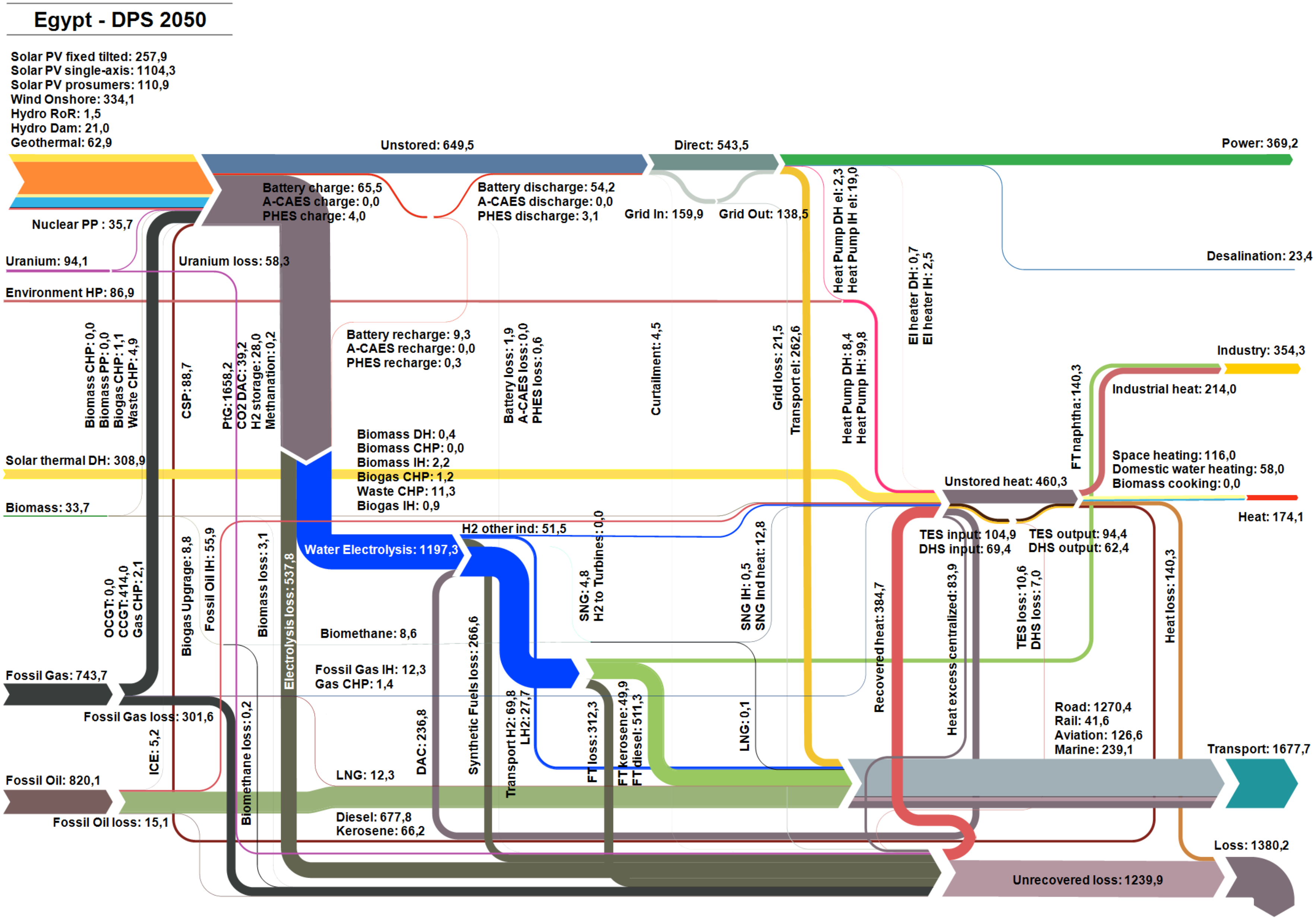

Figure 2.40 Energy flow for the DPS in 2050 for Egypt; all values are in TWh.

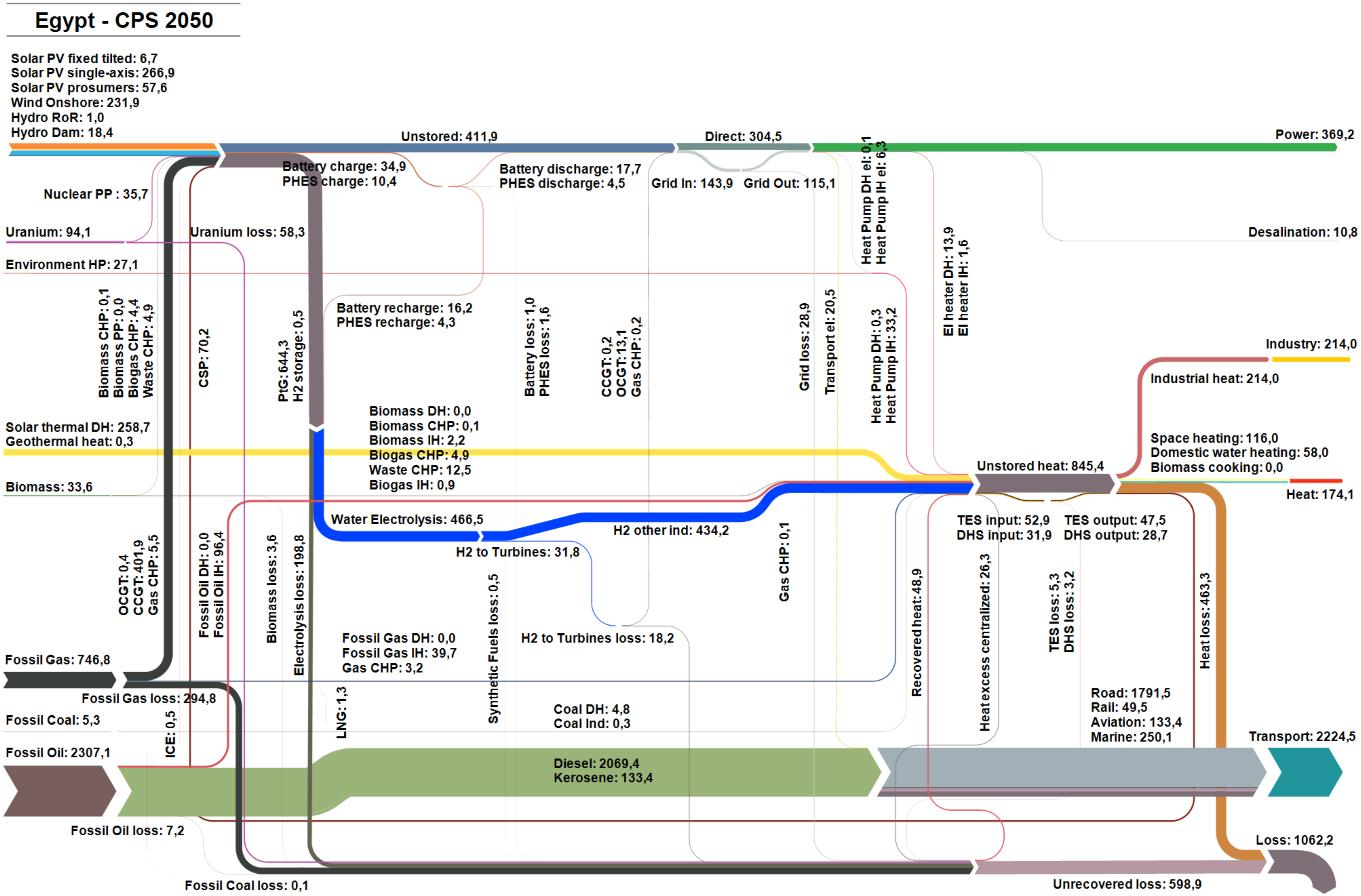

Figure 2.41 Energy flow for the CPS in 2050 for Egypt; all values are in TWh.

2.12. System costs

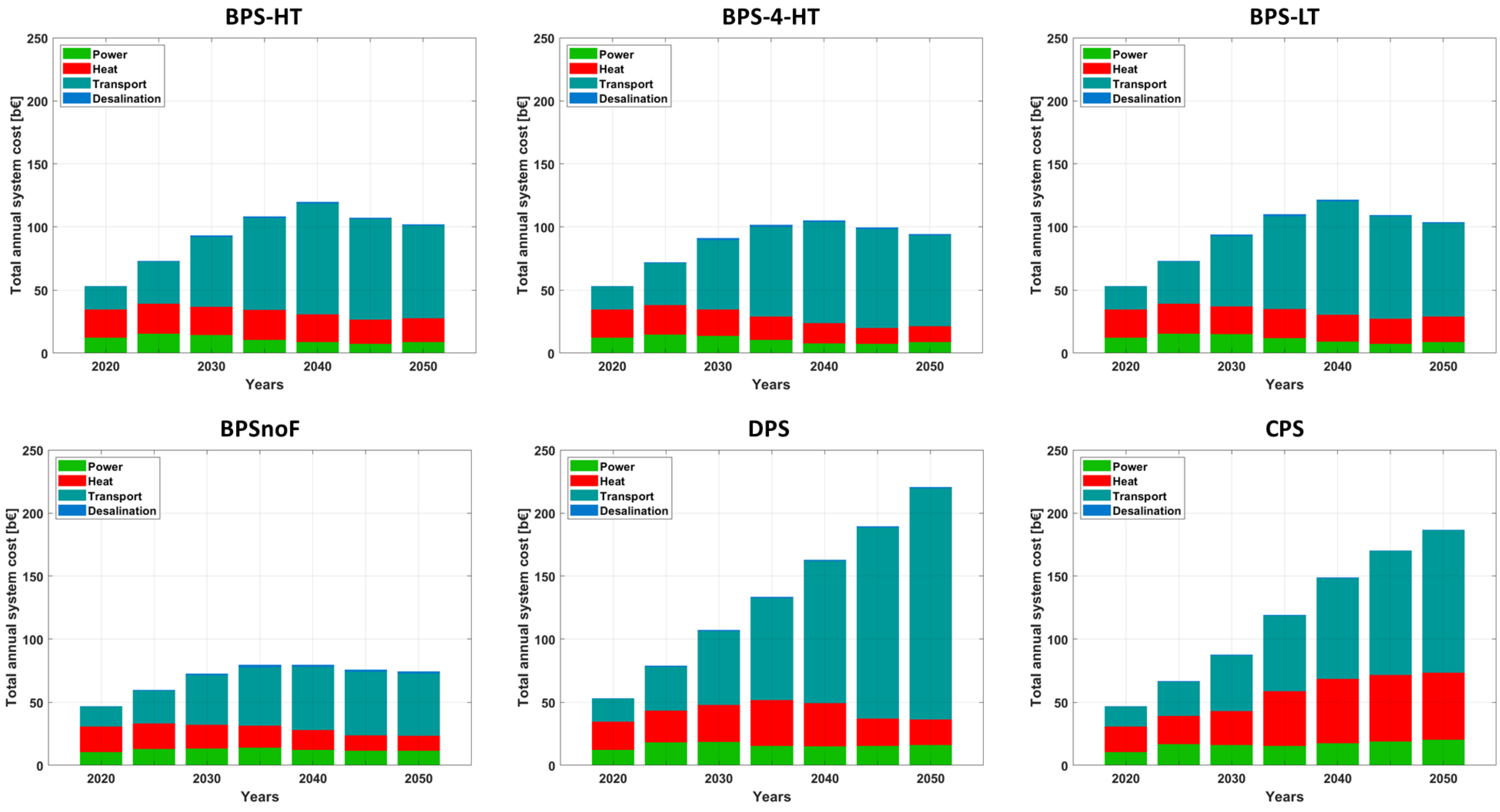

Figure 2.42 Development of total annual system cost by energy sector across all scenarios.

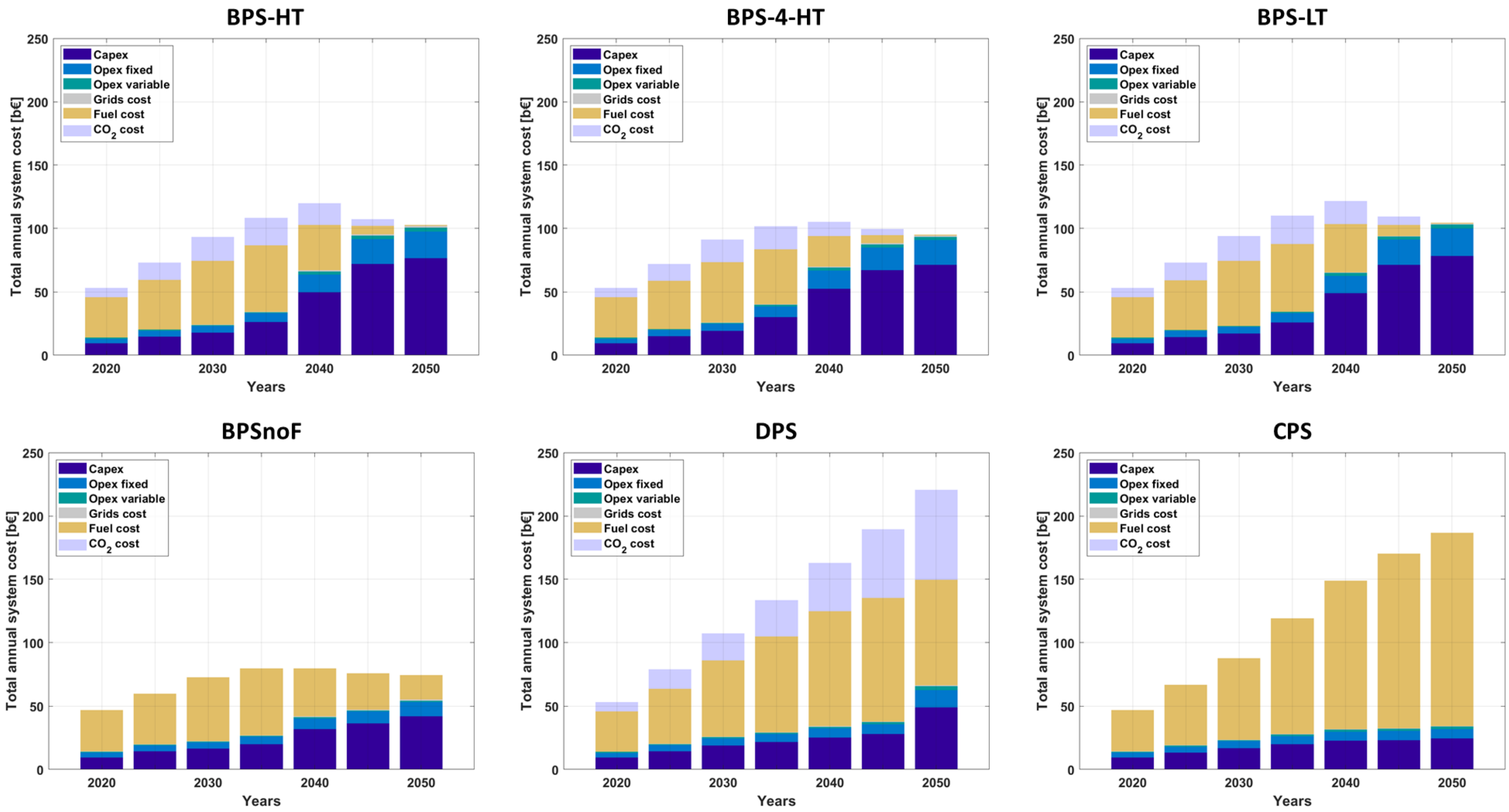

Figure 2.43 Development of total annual system cost by cost category across all scenarios.

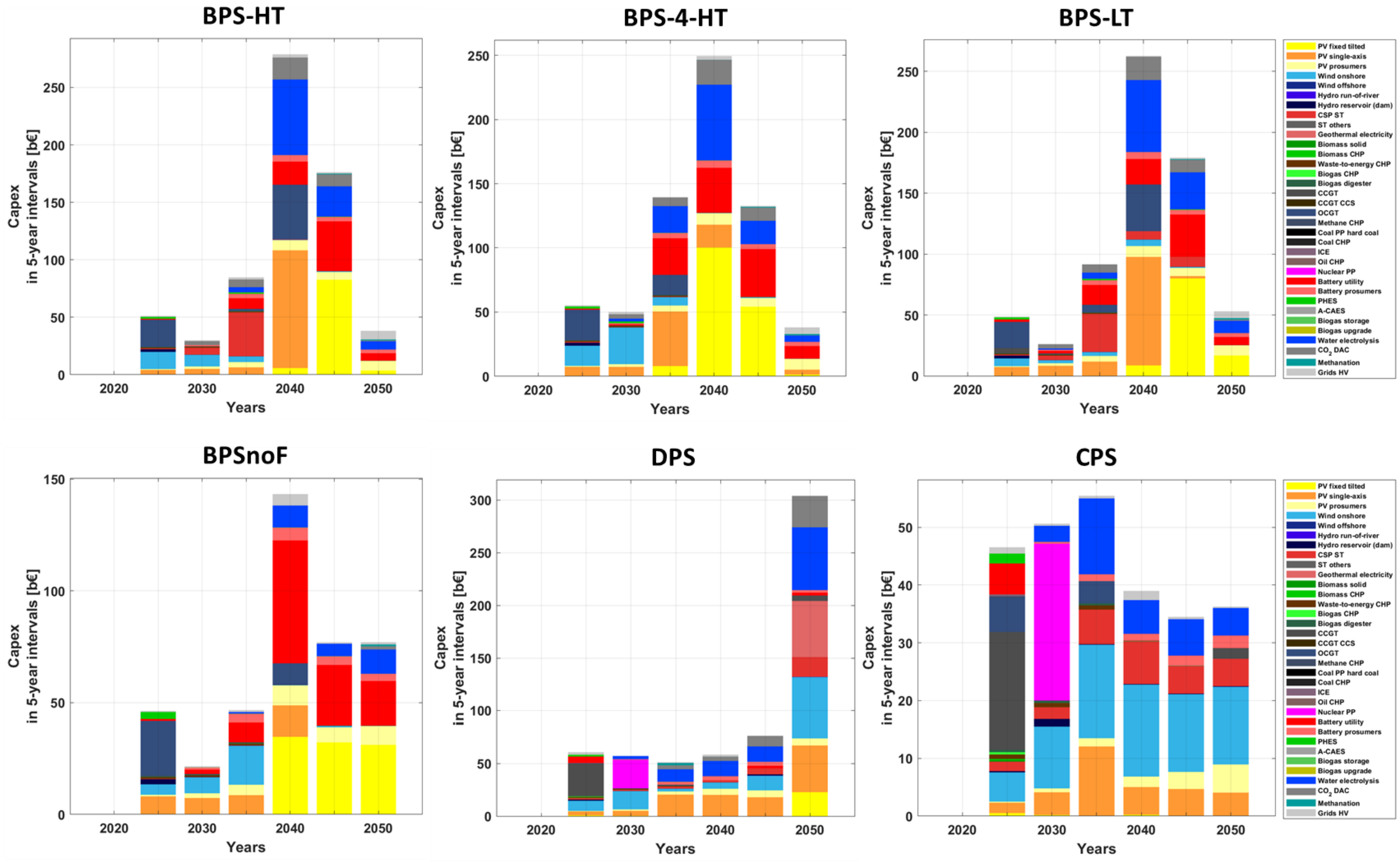

Figure 2.44 Capital expenditure by technology in 5-year intervals across all scenarios. Note that the y-axis range differs among scenarios.

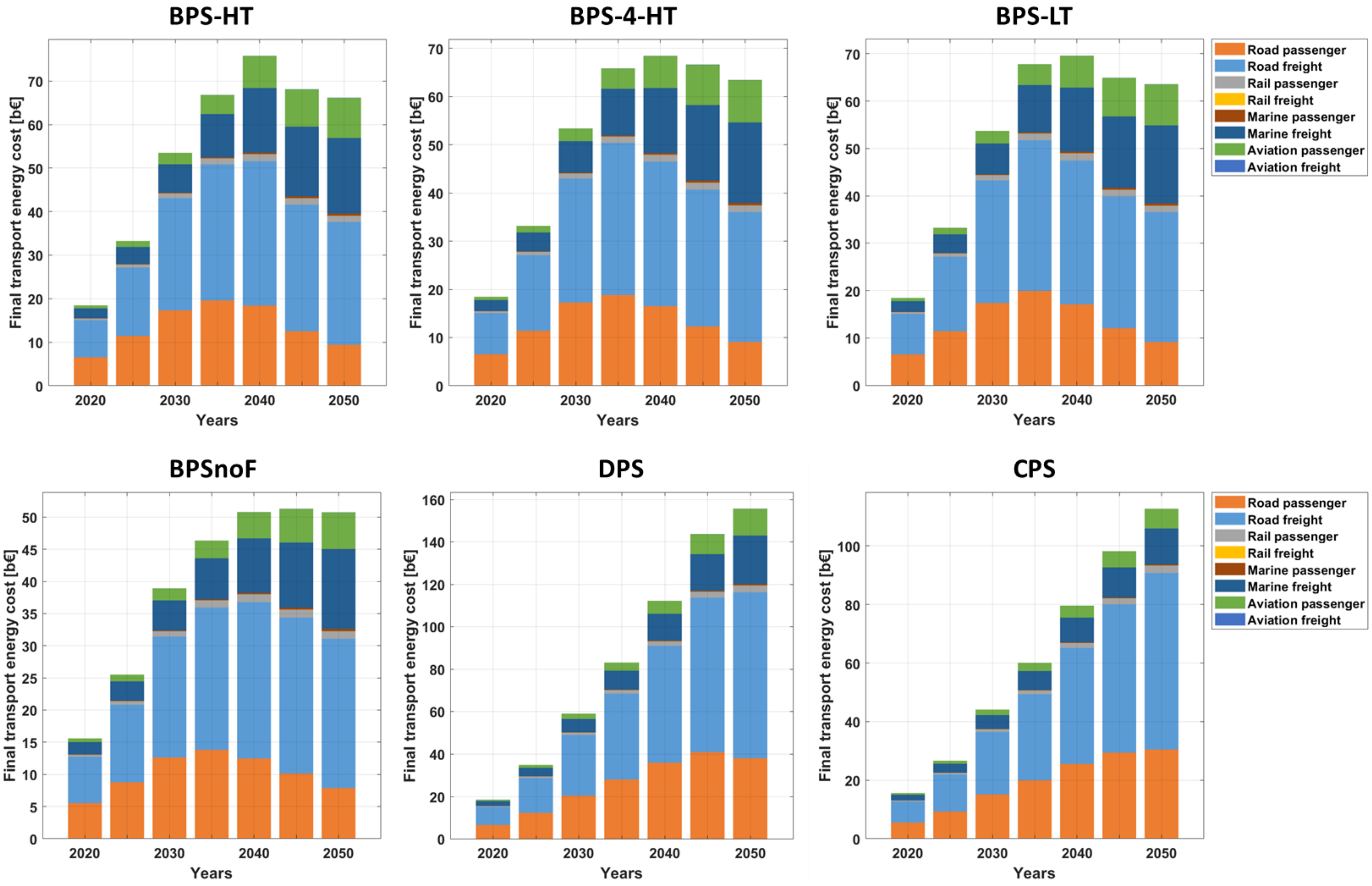

Figure 2.45 Development of total energy cost for transport across all scenarios. Note that the y-axis range differs among scenarios.

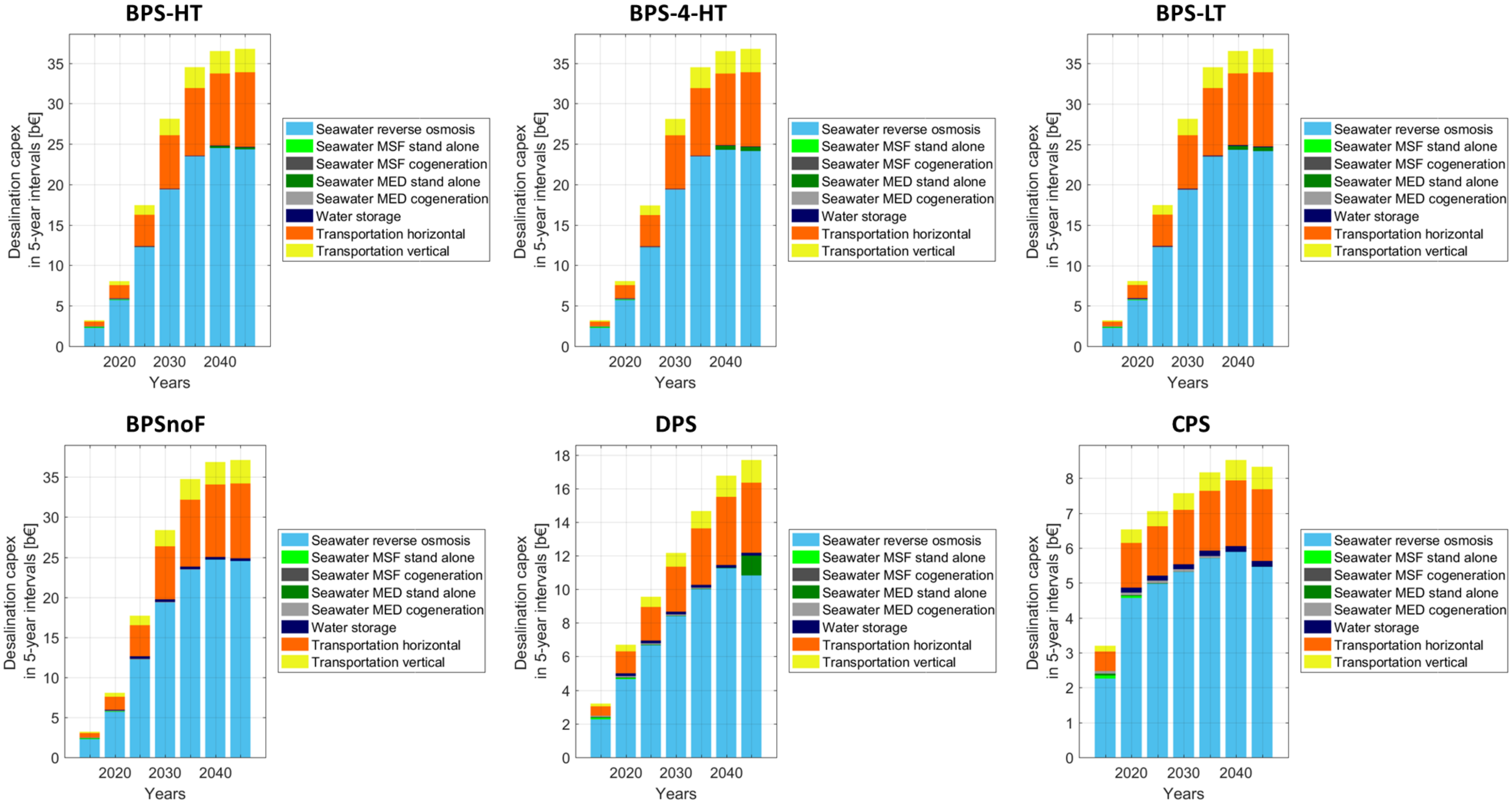

Figure 2.46 Desalination capital expenditure by technology in 5-year intervals across all scenarios. Note that the y-axis range differs among scenarios.

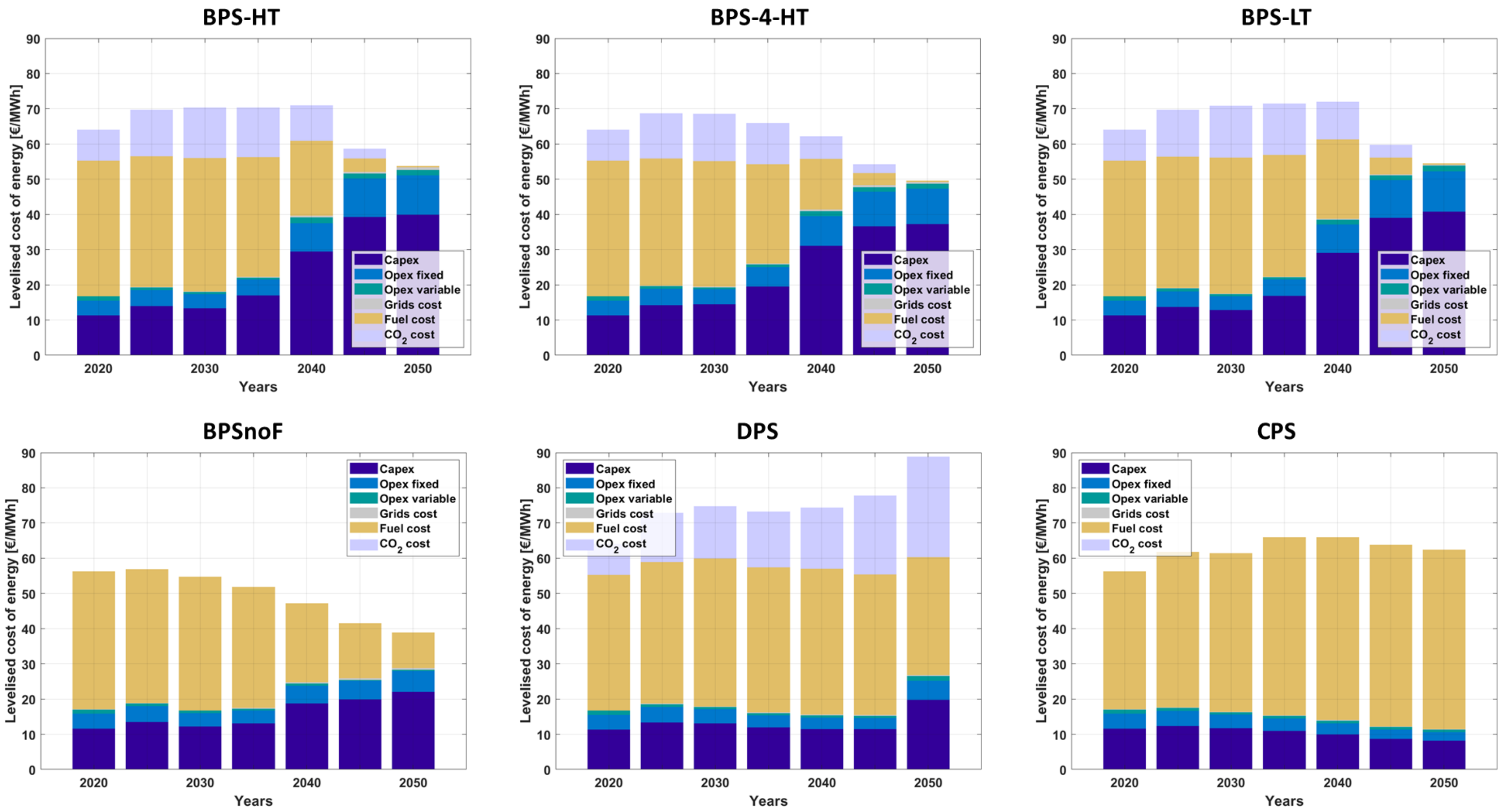

Figure 2.47 Development of the levelised cost of energy by cost category across all scenarios.

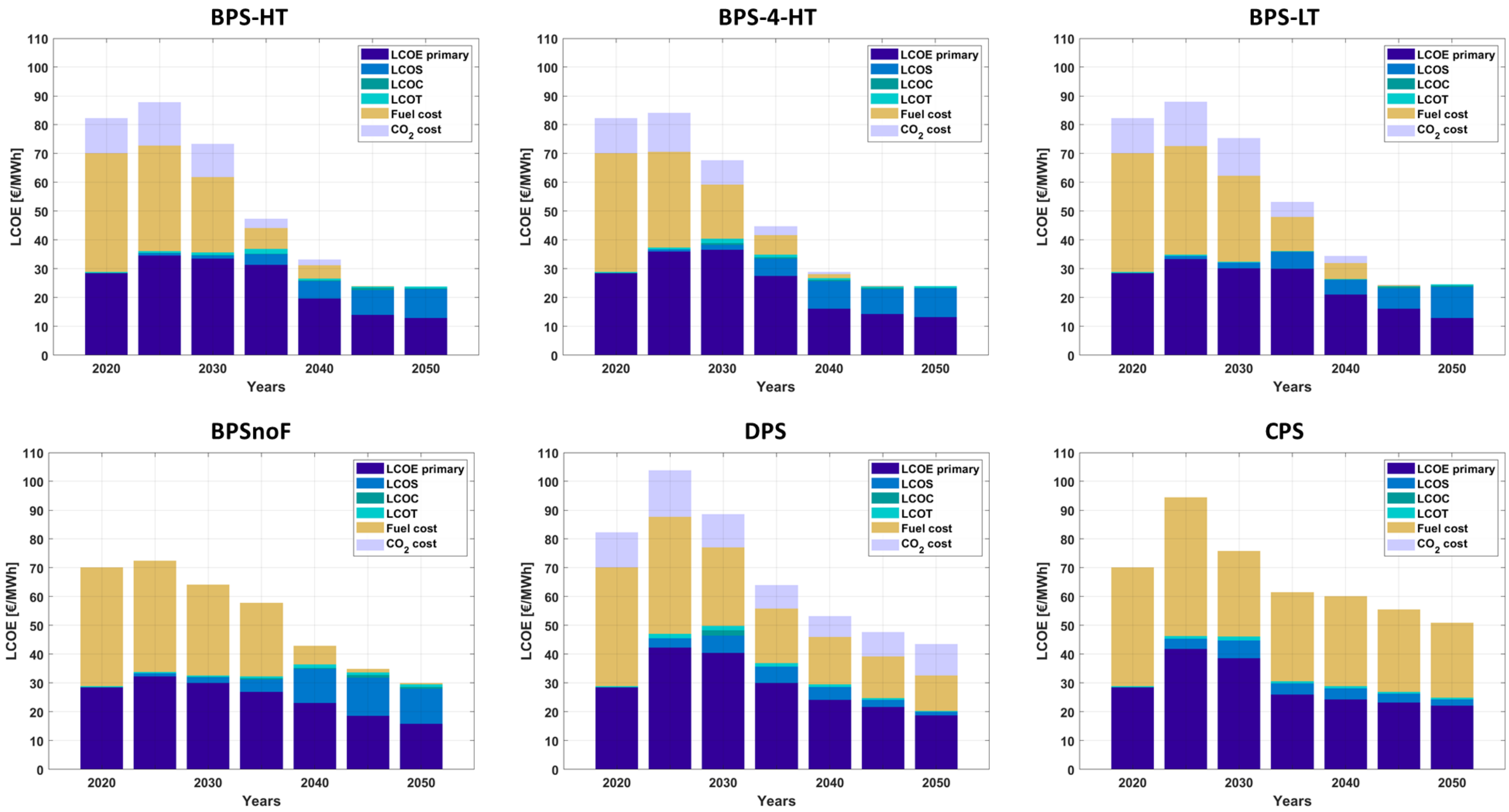

Figure 2.48 Development of the levelised cost of electricity by cost category across all scenarios.

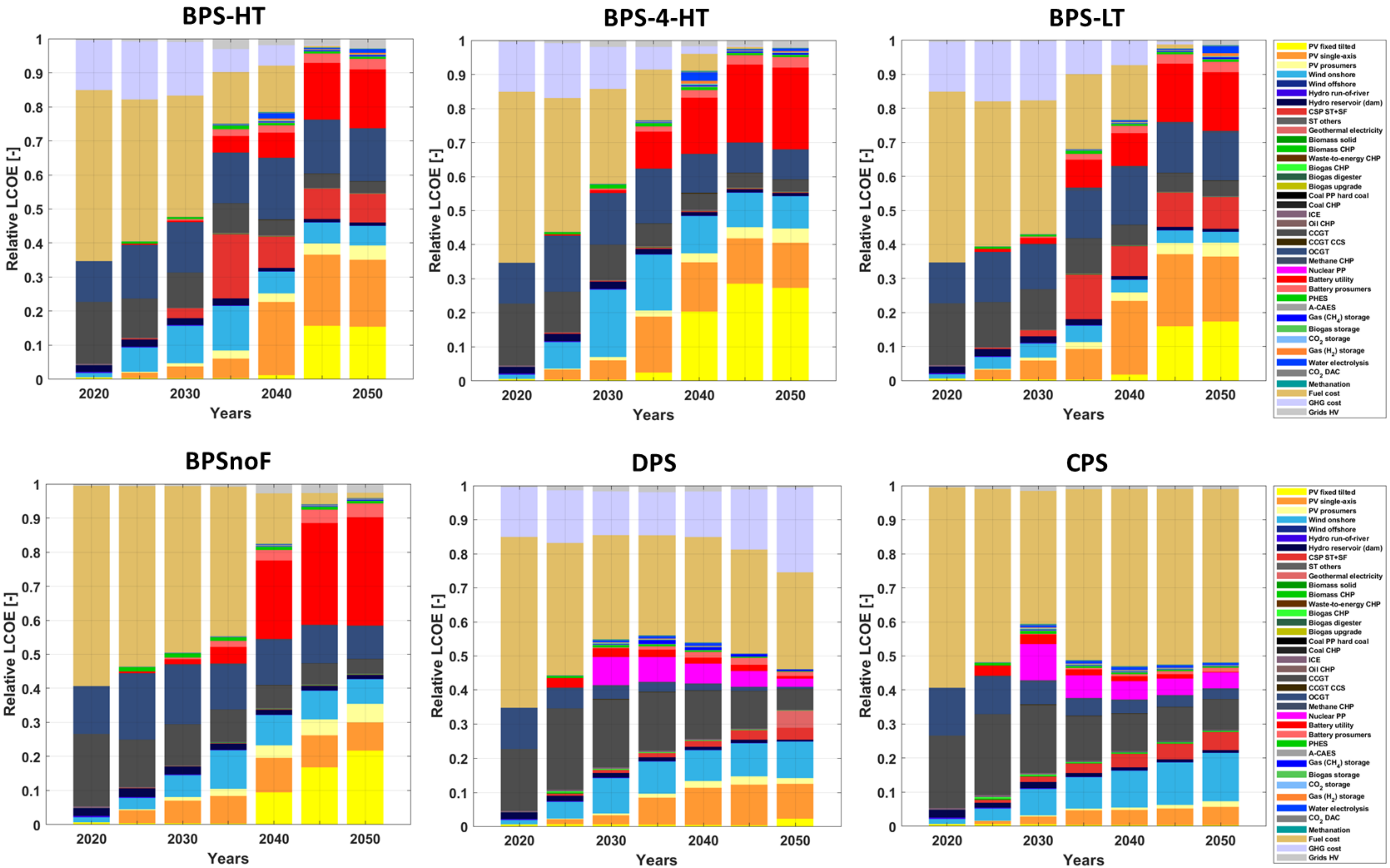

Figure 2.49 Development of technology-wise shares from the levelised cost of electricity across all scenarios.

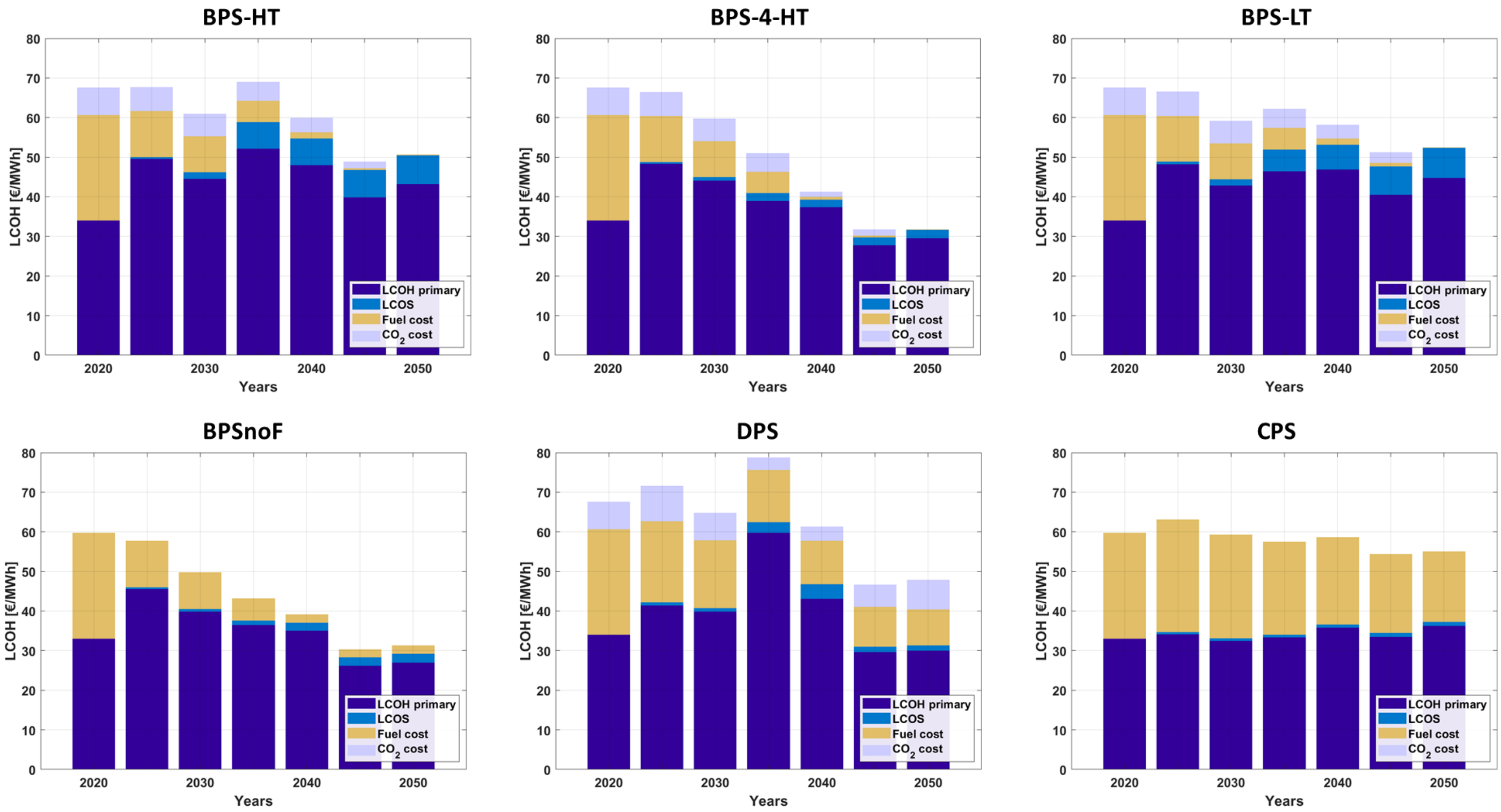

Figure 2.50 Development of the levelised cost of heat by cost category across all scenarios.

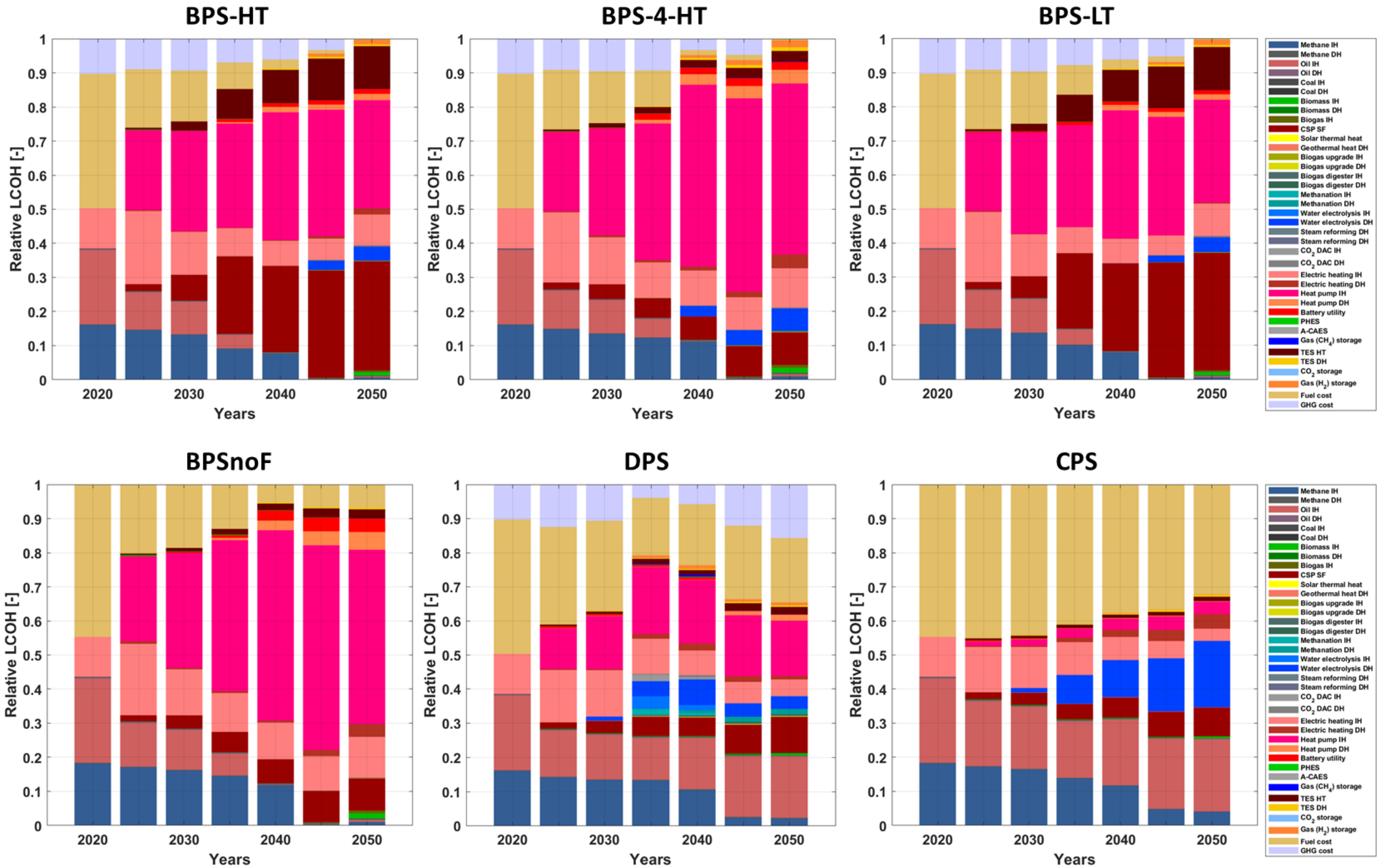

Figure 2.51 Development of technology-wise shares from the levelised cost of heat across all scenarios.

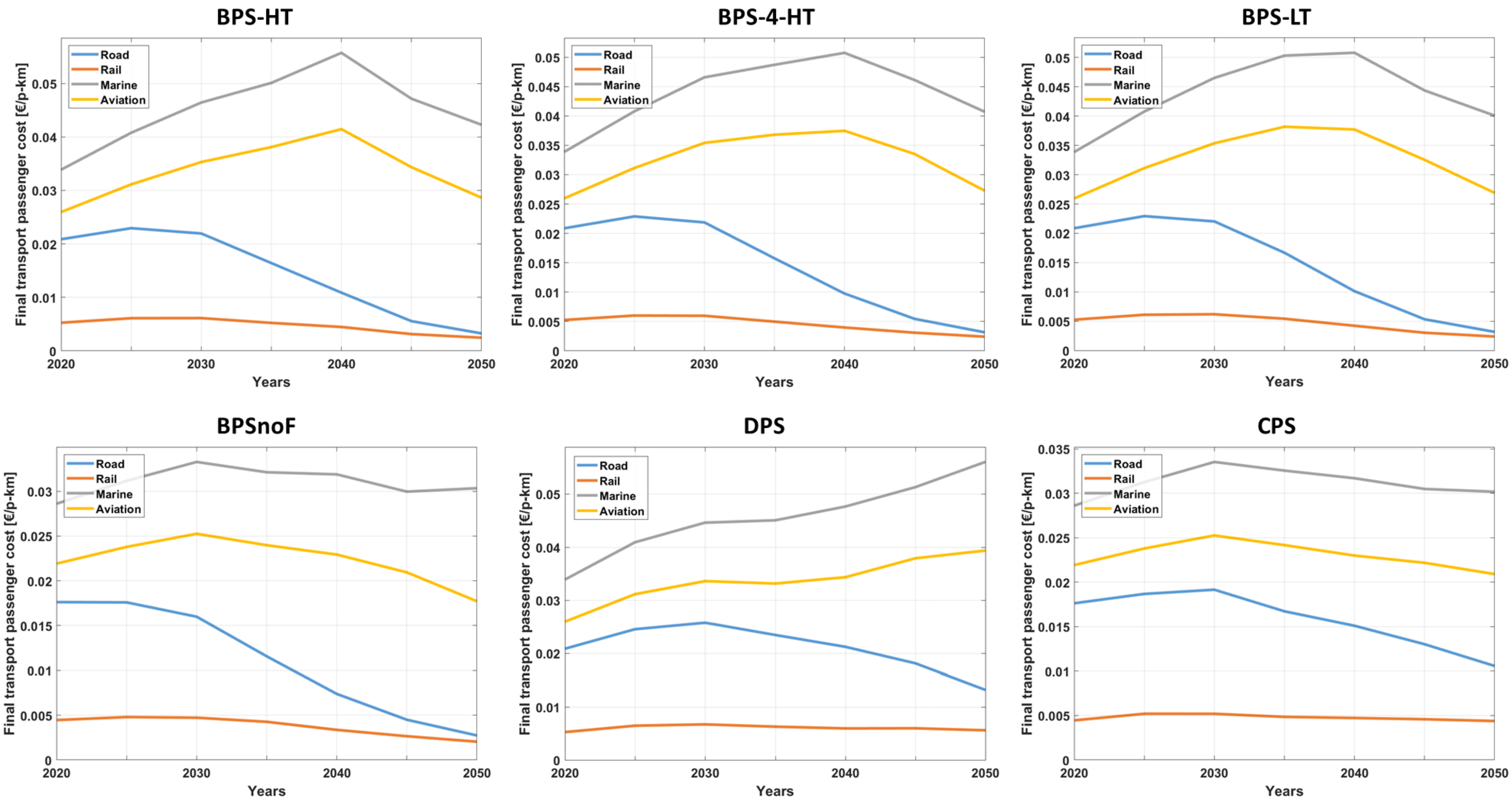

Figure 2.52 Development of the final transport passenger cost across all scenarios. Note that the y-axis range differs among scenarios.

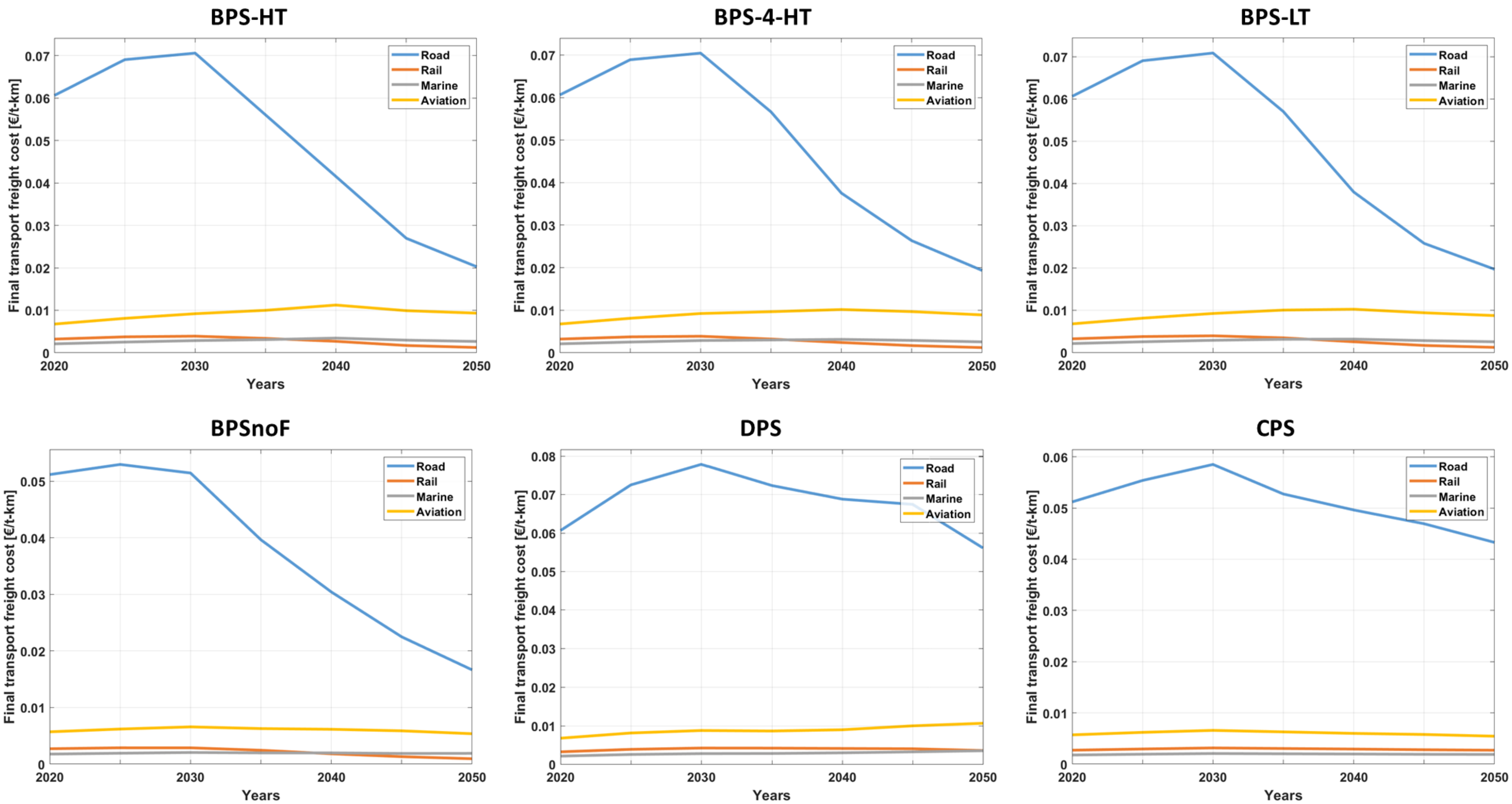

Figure 2.53 Development of the final transport freight cost across all scenarios. Note that the y-axis range differs among scenarios.

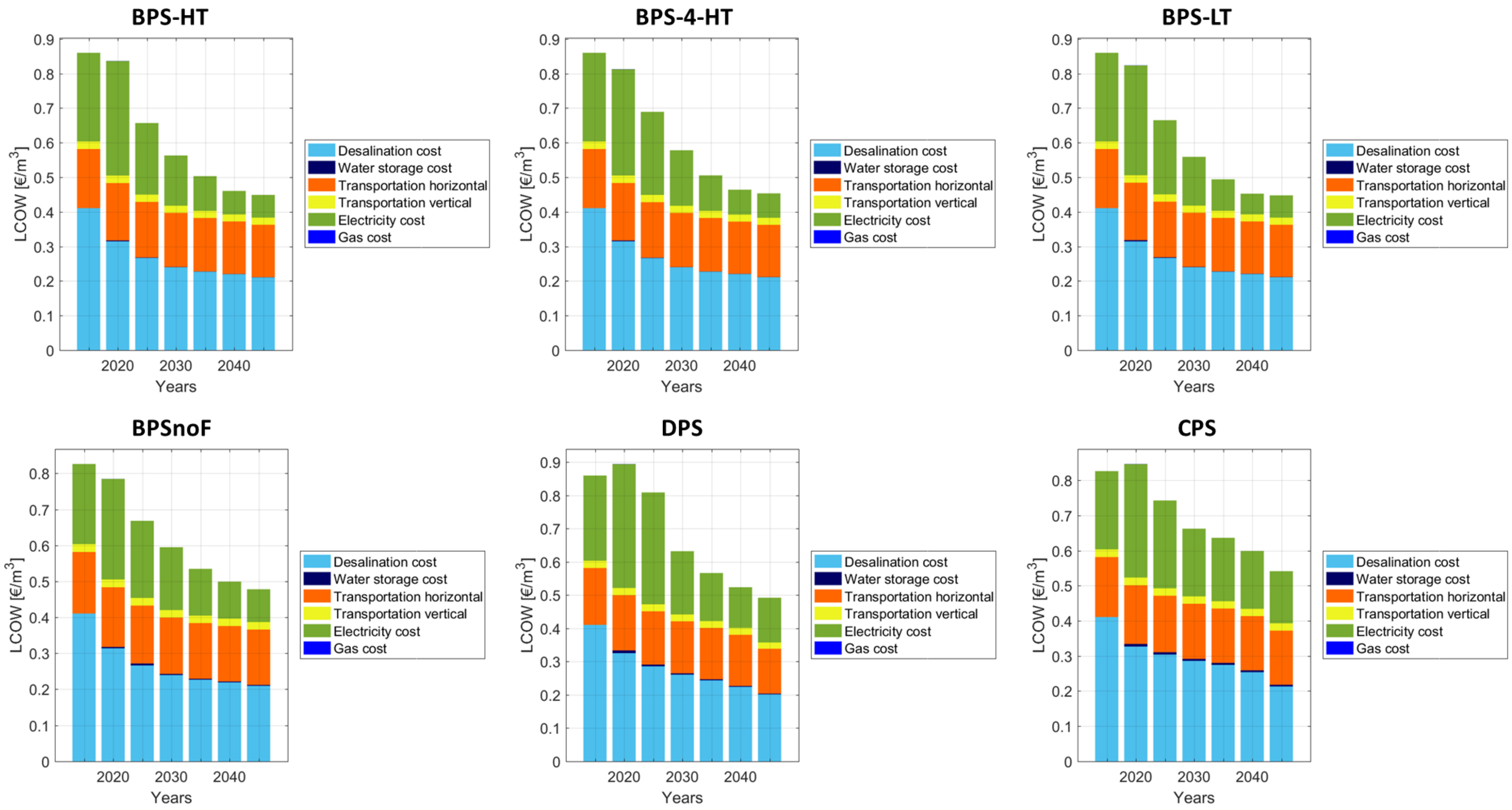

Figure 2.54 Development of the levelised cost of desalinated water by cost category across all scenarios. Note that the y-axis range differs among scenarios.

2.13. System CO_2 emissions

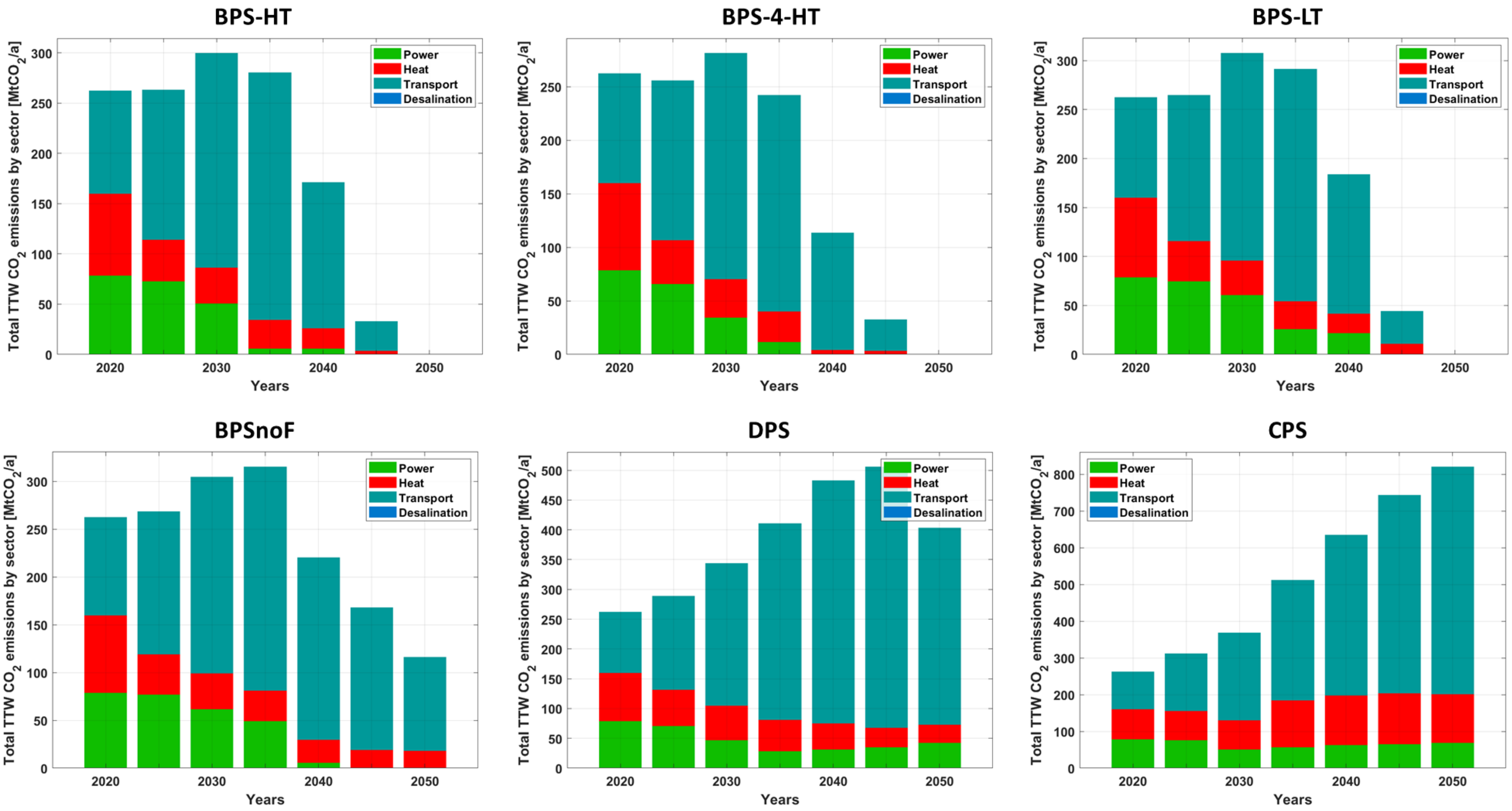

Figure 2.55 Development of total tank-to-wheel CO_2 emissions by sector across all scenarios. Note that the y-axis range differs among scenarios.

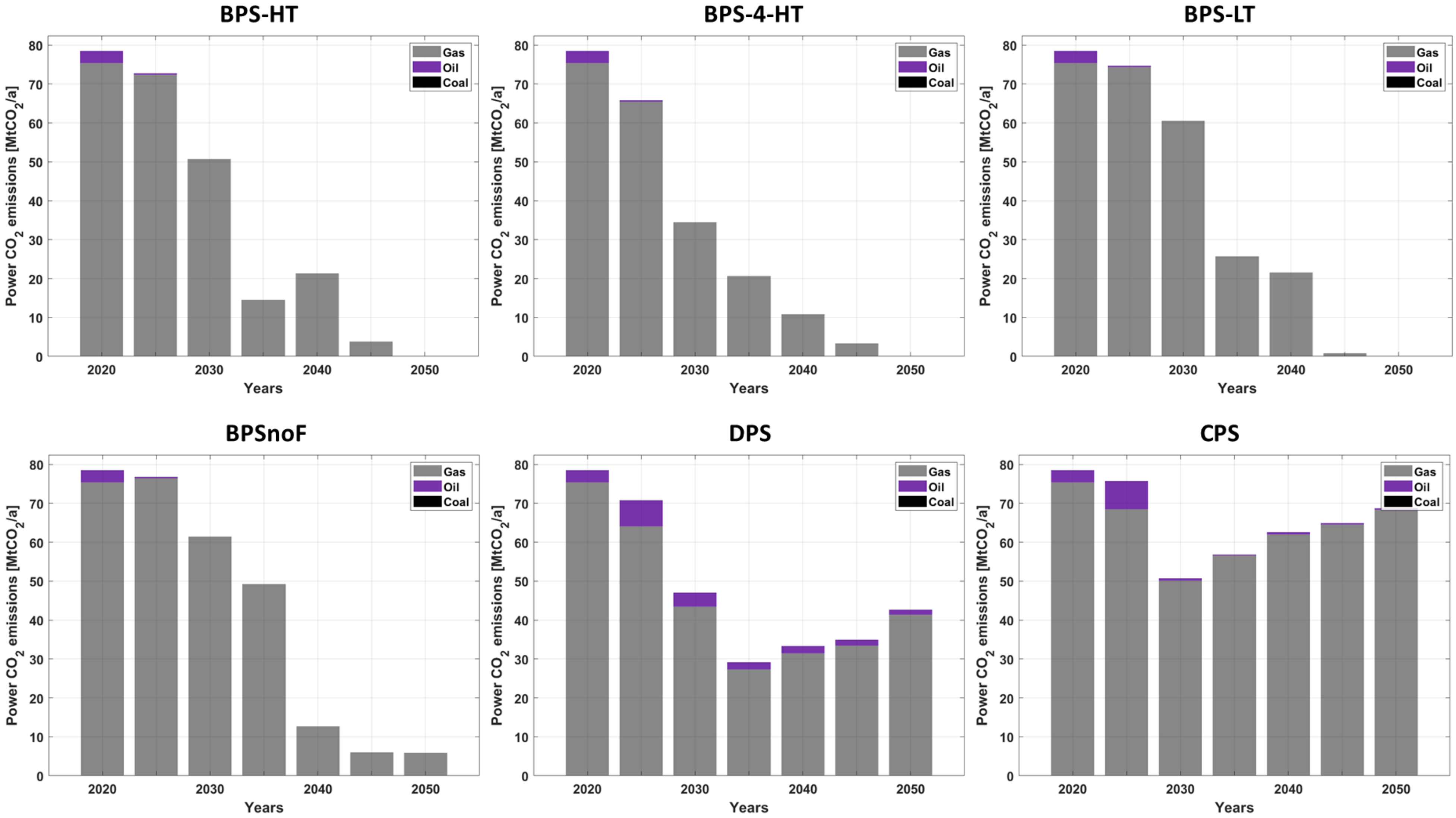

Figure 2.56 Development of the power sector CO_2 emissions and emission intensity across all scenarios (TTW).

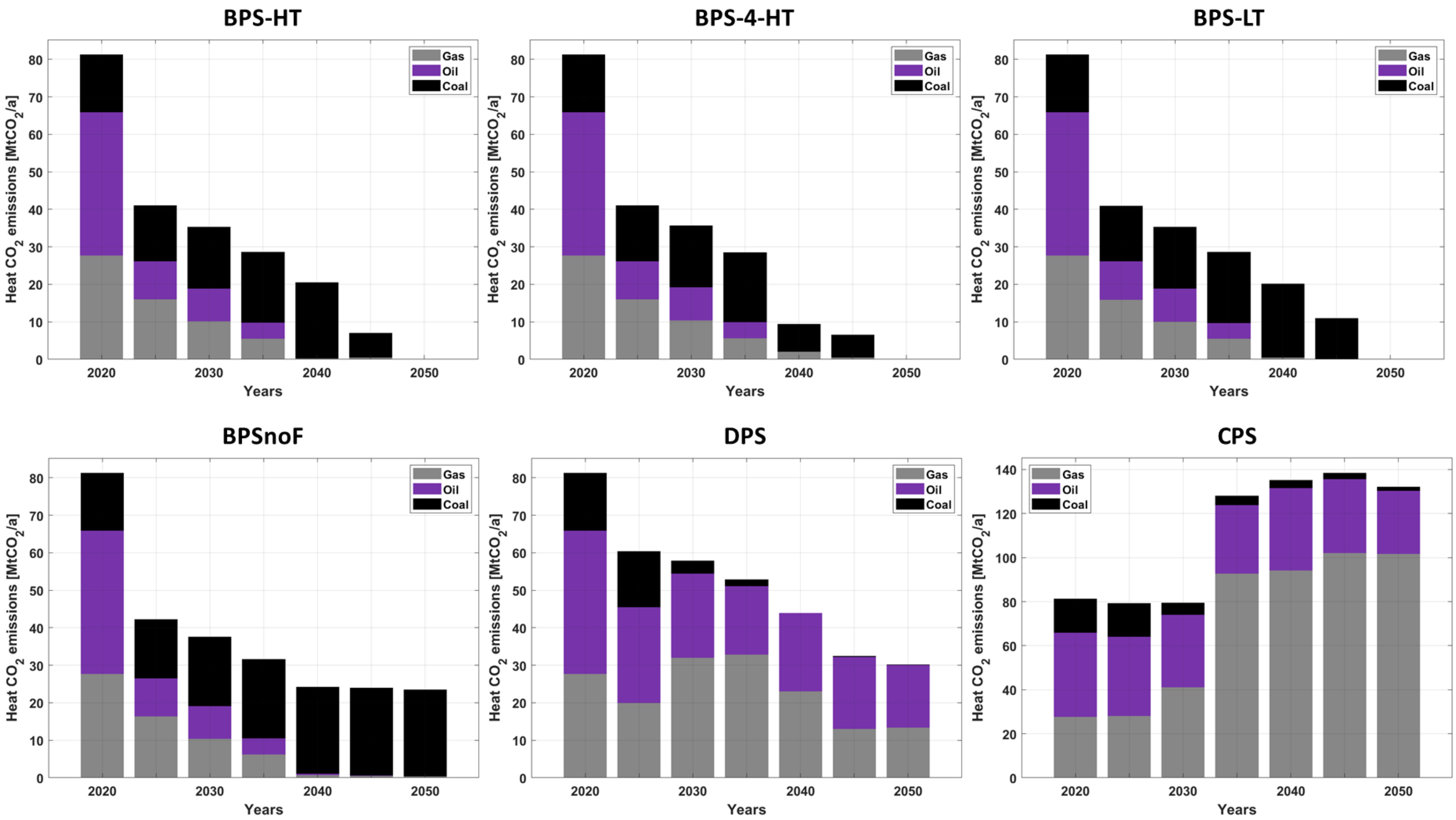

Figure 2.57 Development of the heat sector CO_2 emissions and emission intensity across all scenarios (TTW). Note that the y-axis range differs among scenarios.

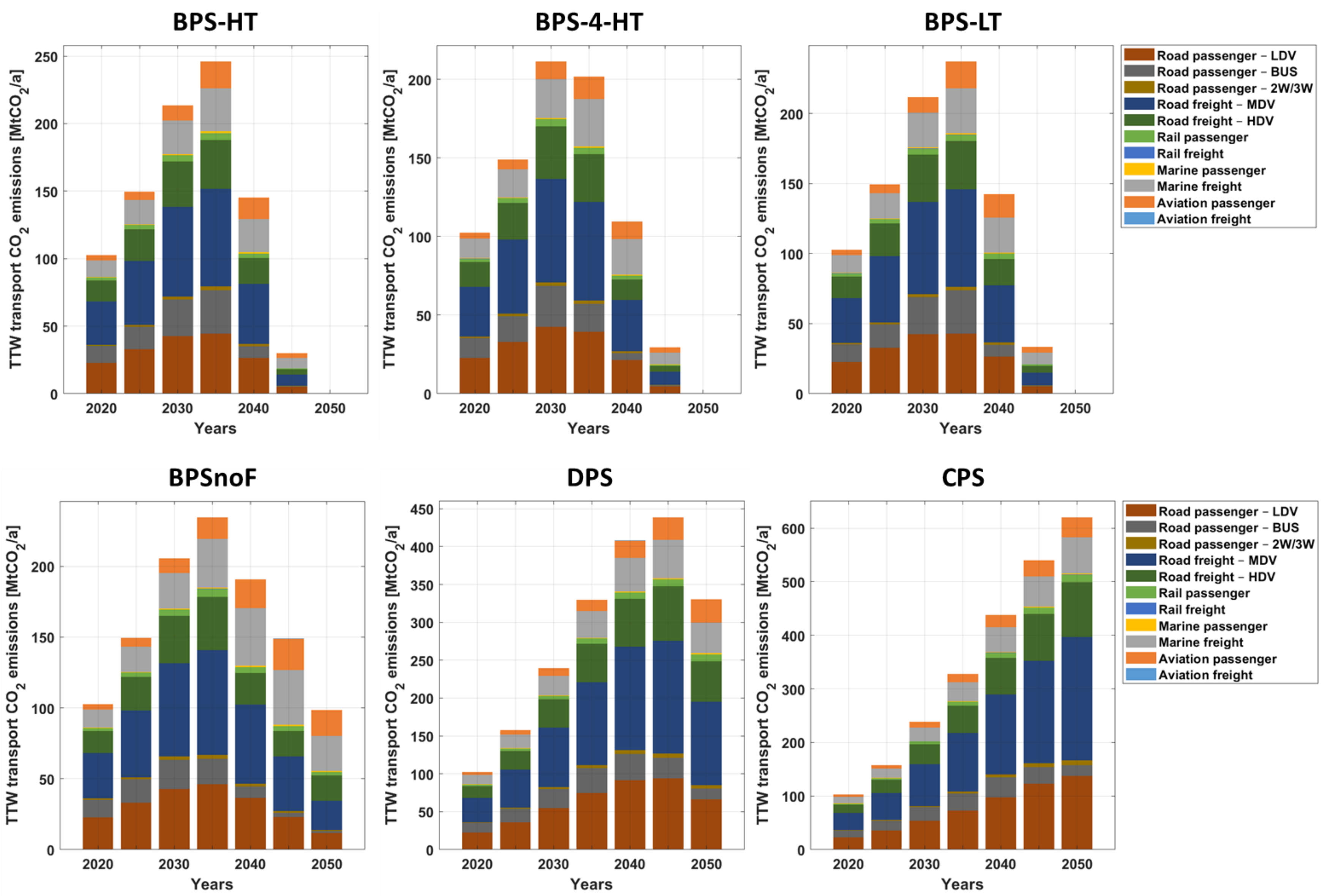

Figure 2.58 Development of the transport sector CO_2 emissions by transport mode across all scenarios (TTW). Note that the y-axis range differs among scenarios.

Symbols and abbreviations

Prefixes

b	Billion
G	Giga
k	Kilo
M	Mega
mil	Million
T	Tera

Units

€	Euro
a	Annum
h	Hour
kg	Kilogram
km	Kilometer
m^3	Cubic meter
p-km	Passenger-Kilometer
t(on)	Metric tonne
t-km	Tonne-Kilometer
W	Watt
Wh	Watt-hour

Subscripts

el	Electrical
eq	Equivalent
FTliq	Fischer-Tropsch liquid fuel
H2	Hydrogen
LHV	Lower Heating Value
Liq	Liquid
LNG	Liquified Natural Gas
SNG	Synthetic Natural Gas
th	Thermal

Abbreviations

2-3W	2-3 Wheeler
A-CAES	Adiabatic Compressed Air Energy Storage
BCH	Biomass for Cooking and Heating
BEV	Battery Electric Vehicle
BPS	Best Policy Scenario
BPS-4-HT	Best Policy Scenario 4% High Transmission
BPS-HT	Best Policy Scenario High Transmission
BPS-LT	Best Policy Scenario Low Transmission
BPSnoF	Best Policy Scenario no Forcing
C&I	Commercial & Industrial
CAPEX	Capital Expenditures
CAPMAS	Central Agency for Public Mobilization & Statistics

CCGT	Combined-Cycle Gas Turbine
CCGT CCS	Combined-Cycle Gas Turbine with Carbon Capture and Storage
CH_4	Methane
CHP	Combined Heat and Power
CO_2	Carbon Dioxide
COP	Coefficient of Performance
COP26	26th Conference of the Parties
CPS	Current Policy Scenario
CSP	Concentrated Solar Thermal Power
DAC	CO_2 Direct Air Capture
DH	District Heating
DHW	Domestic Hot Water
DNI	Direct Normal Irradiation
DPS	Delayed Policy Scenario
ED	East Delta
EEHC	Egyptian Electricity Holding Company
EV	Electric Vehicle
FCEV	Fuel Cell Electric Vehicle
FLH	Full-Load Hours
FT	Fischer-Tropsch
GC	Greater Cairo
GHG	Greenhouse Gas
GT	Gas Turbine
H_2	Hydrogen
HDV	Heavy Duty Vehicle
HP	Heat Pump
HT	High Temperature
HV	High Voltage
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
ICE	Internal Combustion Engine
IH	Individual Heating
IHD	Industrial Process Heat Demand
LCOC	Levelised Cost of Curtailment
LCOE	Levelised Cost of Electricity
LCOH	Levelised Cost of Heat

LCOS	Levelised Cost of Storage
LCOT	Levelised Cost of Transmission
LCOW	Levelised Cost of Water
LDV	Light Duty Vehicle
LH_2	Liquified Hydrogen
LME	Lower Middle Egypt
LNG	Liquefied Natural Gas
LUT	Lappeenranta-Lahti University of Technology LUT
LUT-ESTM	LUT Energy System Transition Model
MD	Middle Delta
MDV	Medium Duty Vehicle
MED	Multiple Effect Distillation
MED-9	Mediterranean 9; Morocco, Algeria, Tunisia, Libya, Egypt, Israel, Jordan, Lebanon, and Syria
MENA	Middle East & North Africa
MENA-EDS	Middle East and North Africa Energy Demand and Supply model
MSF	Multi-Stage Flash distillation
NA	North Africa
OCGT	Open Cycle Gas Turbine
OPEX fix	Fixed Operational Expenditures
OPEX var	Variable Operational Expenditures
OSeMOSYS	Open-Source energy MOdelling SYStem
PHES	Pumped Hydro Energy Storage
PHEV	Plug-in Hybrid Electric Vehicle
PP	Power Plant
PtG	Power-to-Gas
PV	Photovoltaic
RE	Renewable Energy
RoR	Run-of-River
SF	Solar Field
SHD	Space Heating Demand
SMR	Steam Methane Reforming
SNG	Synthetic Natural Gas
SoC	State-of-Charge
ST	Steam Turbine
TES	Thermal Energy Storage
TFED	Total Final Energy Demand

TIMES	The Integrated MARKAL-EFOM System
TPED	Total Primary Energy Demand
TTW	Tank-to-Wheel
UE	Upper Egypt
UME	Upper Middle Egypt
WD	West Delta

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