

Supplementary Material File S1. Parameter settings

(1) Total energy consumption

Though there is a lack of constraints on the total energy consumption in relevant policy documents, it can be determined based on the product of energy consumption per unit of GDP and GDP, which are given constraints in relevant policy documents. To predict the future total energy consumption, GDP and energy consumption per unit of GDP can firstly be predicted. In terms of GDP, the "The 14th Five-Year Plan" mentions that the average annual growth rate of regional GDP is about 6%, and the per capita GDP of the city will double on the basis of 2020. According to the statement, the real level of GDP per capita in China will double by 2050 compared to 2020[1]. Based on the prediction of the permanent population, the average annual GDP growth rate under the baseline scenario is estimated to be 6% from 2021 to 2025, 7.78% from 2026 to 2030, 6.66% from 2031 to 2035, 4.87% from 2036 to 2045, 3.48% from 2046 to 2050, 3.01% from 2051 to 2055, and 3.01% from 2056 to 2060. The GDP growth rate under the low-carbon scenario is slower compared to the baseline scenario, and the demonstration scenario is a bit slower compared to the low-carbon scenario. The GDP growth rate forecast for each scenario is shown in Table S1. The determination of energy consumption per unit of GDP is detailed below and will not be elaborated here.

(2) Carbon emission intensity

By 2025, Suzhou City will achieve the national goals ("The 14th Five-Year Plan" of the People's Republic of China) that the carbon emission intensity in 2025 will decrease by 18% compared to 2020. Scholars [2] have proposed that the carbon emission intensity in China by 2060 will be about 2% of that in 2020. Based on this, the average annual decrease rate of carbon emissions under the baseline scenario is estimated to be 3.89% from 2021 to 2025, 4.6% from 2026 to 2030, 8.8% from 2031 to 2035, 10.0% from 2036 to 2045, 11.5% from 2046 to 2050, 13% from 2051 to 2055, and 12% from 2056 to 2060. The carbon emission intensity under the low-carbon scenario decreases faster, and the demonstration scenario is even more severe. The prediction of carbon emission intensity reduction in each scenario is shown in Table S1.

(3) Total social electricity consumption

At present, there are few policy documents regarding the overall electricity consumption in society, lacking direct constraints. The overall electricity consumption in Suzhou City (Shown in Appendix B) is predicted with a Logistic model by taking into account medium-and long-term macro policy factors. The growth rate of electricity consumption in the benchmark scenario is relatively fast, while in the low-carbon scenario, the growth rate has decreased. The demonstration scenario has the lowest growth rate. The changes in social electricity consumption under three scenarios are shown in Table S2.

(4) Total population

According to the "Suzhou Municipal Government's Overall Plan for Land and Space (2021-2035) ", the permanent population in the city will be between 17-18 million by 2035, and is expected to peak around 2035. With the comprehensive implementation of the "three-child" policy and the acceleration of urbanization, a large number of people are entering, and the

permanent population of Suzhou may grow rapidly in the near future. After comprehensive consideration, the average annual growth rate of the population in the benchmark scenario is determined to be 3.7% from 2021 to 2025, 1.2% from 2026 to 2030, 1.00% from 2031 to 2035, -0.6% from 2036 to 2045, -0.5% from 2046 to 2050, and -0.4% from 2051 to 2060. The low-carbon scenario assumes a lower population growth rate than the baseline scenario, while the demonstration scenario assumes a lower population growth rate. The predicted growth rate of permanent residents under each scenario is shown in Table S1.

(5) Energy structure

The energy consumption structure in this work refers to the proportion of industrial coal consumption to the total energy consumption. The "Comprehensive Work Plan for Energy Conservation and Emission Reduction" during the 14th Five Year Plan period mentions that coal consumption in the Yangtze River Delta region will decrease by about 5%. For a long period of time, China's energy will still be dominated by coal, and the proportion of coal in 2030 cannot be less than 44% [2]. The proportion of non-fossil energy consumption will reach over 80% by 2060[3]. Taking into account the proportion of natural gas and other fossil energy sources, and the need for coal as a backup, the proportion of coal consumption will be approximate 13% by 2060. Therefore, it is estimated that the decline rate in energy structure for benchmark scenario will be 3.9% in 2021-2025, 4.2% in 2026-2030, 5% in 2031-2035, 5.2% in 2036-2045, 3% in 2046 - 2055, and 1.6% from 2056 to 2060. The energy structure decline rate in the low-carbon scenario is faster than that in the baseline scenario, and the demonstration scenario is more aggressive compared to the low-carbon scenario. The predicted energy structure decline rate in each scenario is shown in Table S1.

(6) Energy consumption per unit of GDP

According to "The 14th Five-Year Plan" in Jiangsu Province, by 2025, the energy consumption per unit of GDP in Jiangsu Province will decrease by 13.5% compared to 2020, and the case for Suzhou City will be the same with Jiangsu Province. In addition, the energy intensity per unit of GDP will decrease by more than 80% in 2050 compared to 2005[3]. Therefore, the average annual decrease rate of energy consumption per unit of GDP in Suzhou City under the benchmark scenario is 3% from 2021 to 2025, 4.2% from 2026 to 2030, 5.6% from 2031 to 2035, 4.6% from 2036 to 2045, 3.2% from 2046 to 2055, and 2.2% from 2056 to 2060. The decrease rate in energy consumption per unit of GDP in the low-carbon scenario is faster than the baseline scenario, and the demonstration scenario is more aggressive compared to the low-carbon scenario. The predicted growth rate of energy consumption per unit of GDP in each scenario is shown in Table S1.

Table S1. Changes in various influencing factors under three scenarios

Scenarios	Influence factors	2021- 2025	2026- 2030	2031- 2035	2036- 2045	2046- 2050	2051- 2055	2056- 2060
Benchmark scenario	Permanent population	3.70%	1.20 %	1.00 %	- 0.60 %	- 0.50 %	- 0.40 %	- 0.40 %
	Energy consumption p er unit of GDP	3.00%	4.20 %	5.60 %	4.60 %	3.20 %	3.20 %	2.20 %
	Carbon emission intensity	-3.89%	- 4.60 %	- 8.80 %	- 10.00 %	- 11.50 %	- 13.00 %	- 12.00 %
	Energy structure	-5.50%	- 4.50 %	- 5.60 %	- 5.20 %	- 3.00 %	- 3.00 %	- 1.60 %
	GDP	6.00%	7.80 %	6.60 %	4.60 %	3.20 %	3.20 %	2.20 %
Low- carbon scenario	Permanent population	3.30%	1.00 %	0.80 %	- 0.70 %	- 0.70 %	- 0.50 %	- 0.50 %
	Energy consumption p er unit of GDP	-3.10%	- 4.30 %	- 5.70 %	- 4.70 %	- 3.70 %	- 3.30 %	- 2.30 %
	Carbon emission intensity	-4.10%	- 4.90 %	- 9.20 %	- 10.40 %	- 12.10 %	- 13.90 %	- 12.30 %
	Energy structure	-5.70%	- 4.70 %	- 5.90 %	- 5.70 %	- 3.80 %	- 3.60 %	- 2.00 %
	GDP	5.70%	7.40 %	6.30 %	4.50 %	3.10 %	3.00 %	2.00 %
Demonstrat ion scenario	Permanent population	3.00%	0.80 %	0.60 %	- 0.75 %	- 0.90 %	- 0.70 %	- 0.70 %
	Energy consumption p er unit of GDP	-3.50%	- 4.70 %	- 6.00 %	- 5.20 %	- 4.20 %	- 3.80 %	- 2.80 %
	Carbon emission intensity	-4.50%	- 5.30 %	- 9.60 %	- 10.90 %	- 13.70 %	- 14.70 %	- 13.00 %
	Energy structure	-5.90%	- 5.00 %	- 6.40 %	- 6.30 %	- 4.20 %	- 4.00 %	- 2.40 %

GDP	5.40%	7.00 %	6.00 %	4.20 %	2.80 %	2.50 %	1.70 %
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Table S2. Changes in Electricity consumption in the whole society under three scenarios

Year	Benchmark scenario		Low-carbon scenario		Demonstration scenario	
	Total energy consumption	Total social electricity consumption	Total energy consumption	Total social electricity consumption	Total energy consumption	Total social electricity consumption
2021	90075550.07	21282460.62	89728020.69	21011387.41	89104009.66	20655197
2022	92615680.59	23001937.34	91902399.82	22629301.17	90628579.27	22143909
2023	95227442.78	24832374.57	94129470.67	24334667.95	92179234.26	23692669
2024	97912856.66	26776413.5	96410510.14	26126598.91	93756420.96	25297369
2025	100673999.2	28836019.49	98746826.03	28003307.84	95360593.32	26953048
2026	103947237.1	31012369.92	101493765.2	29962050.17	97240150.61	28653928
2027	107326898.6	33305743.35	104317118.8	31999079.07	99156753.98	30393469
2028	110816443.8	35715413.69	107219012.4	34109622.61	101111133.6	32164455
2029	114419445.4	38239553.73	110201630.9	36287885.2	103104034	33959105
2030	118139592.3	40875152.37	113267219.9	38527076.03	105136214.6	35769200
2031	118901742	43617950.49	113540080.6	40819466.04	104757724.2	37586232
2032	119668808.6	46462399.98	113813598.7	43156473.75	104380596.4	39401560
2033	120440823.6	49401650.18	114087775.6	45528778.99	104004826.2	41206579
2034	121217819.2	52427565.25	114362613.1	47926461.76	103630408.9	42992874
2035	121999827.3	55530775.09	114638112.6	50339162.41	103257339.4	44752383
2036	121740069.5	58700760.86	114166376.8	52756257.82	101999252	46477532
2037	121480864.8	61925975.04	113696582.1	55167047.29	100756493.1	48161360
2038	121222212	65193993.83	113228720.7	57560941.37	99528875.96	49797618
2039	120964109.9	68491698.48	112762784.5	59927646.49	98316216.14	51380844
2040	120706557.3	71805480.13	112298765.6	62257338.73	97118331.36	52906411
2041	120449553.1	75121461.73	111836656.2	64540820.52	95935041.61	54370550
2042	120193096.1	78425729.36	111376448.4	66769655.27	94766169.07	55770350
2043	119937185.1	81704564.92	110918134.3	68936276.27	93611538.06	57103734
2044	119681819.1	84944671.84	110461706.2	71034067.35	92470975.08	58369420
2045	119426996.7	88133386.11	110007156.3	73057414.73	91344308.72	59566863
2046	119317824.7	91258865.63	109220935.1	75001730.47	89958067.49	60696189
2047	119208752.4	94310252.24	108440333.1	76863449.33	88592863.86	61758122
2048	119099779.9	97277802.27	107665310	78640001.92	87248378.56	62753907
2049	118990907	100152983.1	106895826.1	80329767.45	85924297.17	63685225
2050	118882133.6	102928534.8	106131841.6	81932010.06	84620310.03	64554126
2051	118766750.6	105598498.3	105708375.5	83446802.78	83439856.71	65362946
2052	118651479.6	108158210.5	105286599.1	84874942.94	82275870.71	66114242
2053	118536320.4	110604272.3	104866505.6	86217862.88	81128122.31	66810732
2054	118421273	112934490.9	104448088.2	87477539.08	79996385	67455233
2055	118306337.3	115147802.5	104031340.4	88656402.55	78880435.43	68050618
2056	118237043.9	117244179.4	103671391.9	89757252.8	77975203.56	68599772

2057	118167791	119224527.1	103418433.7	90783176.95	77080360.12	69105554
2058	118098578.7	121090574.3	103166092.7	91737475.41	76195785.91	69570771
2059	118029407	122844760.9	102914367.5	92623594.76	75321363.07	69998155
2060	117960275.7	124490126.8	102663256.4	93445068.26	74456975.11	70390342

* The unit of total energy consumption is 10,000 tons of standard coal; The unit of electricity consumption of the whole society is 10,000 kWh.

Reference

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