Supplementary Materials

Evaluation of Urban Sustainability based on Development Structures and Economic Aggregates: A Case Study of Jiaxing, China

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Table S1. Raw data of the urban ecosystem from 2005 to 2018 in Jiaxing.

Item	Unit	2005	2006	2007	2008	2009	2010	2011
Renewable resources (*R*)								
Solar energy	J	1.42×10^{19}	1.42×10^{19}	1.42×10^{19}	1.42×10^{19}	1.42×10^{19}	1.42×10^{19}	1.42×10^{19}
Wind, kinetic energy	J	1.79×10^{16}	1.61×10^{16}	1.45×10^{16}	1.29×10^{16}	1.29×10^{16}	1.29×10^{16}	8.95×10^{15}
Rainfall, geopotential energy	J	6.67×10^{13}	7.09×10^{13}	7.85×10^{13}	9.38×10^{13}	9.03×10^{13}	1.01×10^{13}	7.36×10^{13}
Rainfall, chemical potential energy	J	9.46×10^{15}	1×10^{16}	1.11×10^{16}	1.33×10^{16}	1.28×10^{16}	1.43×10^{16}	1.04×10^{16}
Geothermal heat	J	4.31×10^{15}	4.31×10^{15}	4.31×10^{15}	4.31×10^{15}	4.31×10^{15}	4.31×10^{15}	4.31×10^{15}
Nonrenewable resources and products (*N*)								
Loss of organic matter in topsoil	J	3.43×10^{15}	3.46×10^{15}	3.46×10^{15}	3.46×10^{15}	3.38×10^{15}	3.38×10^{15}	3.38×10^{15}
Nonrenewable water resources	g	2.37×10^{15}	2.01×10^{15}	1.77×10^{15}	1.32×10^{15}	1.34×10^{15}	1.24×10^{15}	1.59×10^{15}
Electricity	J	1.5×10^{17}	1.67×10^{17}	1.62×10^{17}	1.62×10^{17}	1.66×10^{17}	1.7×10^{17}	1.99×10^{17}
Nitrogen fertilizer	g	7.76×10^{10}	7.89×10^{10}	7.69×10^{10}	7.81×10^{10}	7.84×10^{10}	7.84×10^{10}	7.83×10^{10}
Phosphate fertilizer	g	1.44×10^{10}	1.47×10^{10}	1.35×10^{10}	1.35×10^{10}	1.33×10^{10}	1.26×10^{10}	1.23×10^{10}
Potash fertilizer	g	5.6×10^{9}	5.6×10^{9}	5.49×10^{9}	5.48×10^{9}	5.57×10^{9}	5.51×10^{9}	5.46×10^{9}
Compound fertilizer	g	8.7×10^{9}	8.7×10^{9}	8.56×10^{9}	8.62×10^{9}	8.69×10^{9}	8.59×10^{9}	8.61×10^{9}
Plastic film	g	4.64×10^{9}	5.06×10^{9}	5.06×10^{9}	5.56×10^{9}	5.68×10^{9}	5.77×10^{9}	5.83×10^{9}
Pesticide	g	6.79×10^{9}	6.66×10^{9}	6.57×10^{9}	6.71×10^{9}	6.71×10^{9}	6.64×10^{9}	6.61×10^{9}
Cement	g	1.56×10^{13}	1.61×10^{13}	1.69×10^{13}	1.62×10^{13}	1.7×10^{13}	1.69×10^{13}	1.81×10^{13}
Imports (*I*)								
Imported products and services	$	2.88×10^{9}	3.48×10^{9}	4.44×10^{9}	5.73×10^{9}	4.86×10^{9}	6.78×10^{9}	9.21×10^{9}
Exports (*E*)								
Tourism	$	1.32×10^{9}	1.78×10^{9}	2.22×10^{9}	2.78×10^{9}	3.35×10^{9}	4.34×10^{9}	5.35×10^{9}
Exported products and services	$	7.04×10^{9}	9.18×10^{9}	1.17×10^{10}	1.41×10^{10}	1.23×10^{10}	1.6×10^{10}	1.93×10^{10}
Waste (*W*)								
Waste water	g	2.49×10^{14}	2.65×10^{14}	3.11×10^{14}	2.93×10^{14}	2.92×10^{14}	3.3×10^{14}	3.32×10^{14}
Sulfur dioxide	g	9.1×10^{10}	1.1×10^{11}	1.17×10^{11}	1.15×10^{11}	1.06×10^{11}	7.02×10^{10}	8.04×10^{10}
Nitrogen oxides	g	-	-	3.4×10^{10}	3.35×10^{10}	4.04×10^{10}	4.66×10^{10}	5.96×10^{10}

Table S1 (continued). Raw data of the urban ecosystem from 2005 to 2018 in Jiaxing.

Item	Unit	2012	2013	2014	2015	2016	2017	2018
Renewable resources (*R*)								
Solar energy	J	1.42×10^{19}	1.42×10^{19}	1.42×10^{19}	1.42×10^{19}	1.42×10^{19}	1.42×10^{19}	1.42×10^{19}
Wind, kinetic energy	J	8.95×10^{15}	1.02×10^{16}	2.64×10^{16}	1.99×10^{16}	2.05×10^{16}	1.99×10^{16}	1.95×10^{16}
Rainfall, geopotential energy	J	1.1×10^{14}	8.75×10^{13}	8.68×10^{13}	1.1×10^{14}	1.14×10^{14}	9.24×10^{13}	1.17×10^{14}
Rainfall, chemical potential energy	J	1.56×10^{16}	1.24×10^{16}	1.23×10^{16}	1.56×10^{16}	1.62×10^{16}	1.31×10^{16}	1.65×10^{16}
Geothermal heat	J	4.31×10^{15}	4.31×10^{15}	4.31×10^{15}	4.31×10^{15}	4.31×10^{15}	4.31×10^{15}	4.31×10^{15}
Nonrenewable resources and products (*N*)								
Loss of organic matter in topsoil	J	3.39×10^{15}	3.38×10^{15}	3.37×10^{15}	3.37×10^{15}	3.36×10^{15}	3.34×10^{15}	3.33×10^{15}
Nonrenewable water resources	g	9.78×10^{14}	1.48×10^{15}	1.35×10^{15}	9.27×10^{14}	9.71×10^{14}	1.21×10^{15}	9.64×10^{14}
Electricity	J	2.45×10^{17}	2.42×10^{17}	2.23×10^{17}	2.75×10^{17}	2.88×10^{17}	3.01×10^{17}	3.07×10^{17}
Nitrogen fertilizer	g	7.85×10^{10}	7.83×10^{10}	7.81×10^{10}	7.63×10^{10}	7.5×10^{10}	7.45×10^{10}	7.28×10^{10}
Phosphate fertilizer	g	1.22×10^{10}	1.2×10^{10}	1.19×10^{10}	1.17×10^{10}	1.14×10^{10}	1.1×10^{10}	1.04×10^{10}
Potash fertilizer	g	5.48×10^{9}	5.44×10^{9}	5.31×10^{9}	5.24×10^{9}	5.28×10^{9}	5.32×10^{9}	5.33×10^{9}
Compound fertilizer	g	8.72×10^{9}	$8.89\times10^{9}9$	8.75×10^{9}	8.6×10^{9}	8.77×10^{9}	8.88×10^{9}	9.53×10^{9}
Plastic film	g	5.93×10^{9}	6×10^{9}	6.06×10^{9}	6.09×10^{9}	6.04×10^{9}	6.11×10^{9}	6.21×10^{9}
Pesticide	g	6.67×10^{9}	6.74×10^{9}	6.52×10^{9}	6.28×10^{9}	6.12×10^{9}	5.98×10^{9}	5.89×10^{9}
Cement	g	1.67×10^{13}	1.65×10^{13}	1.63×10^{13}	1.47×10^{13}	1.51×10^{13}	1.6×10^{13}	1.8×10^{13}
Imports (*I*)								
Imported products and services	$	9.14×10^{9}	1.03×10^{10}	1.01×10^{10}	8.16×10^{9}	7.8×10^{9}	1.03×10^{10}	1.21×10^{10}
Exports (*E*)								
Tourism	$	6.65×10^{9}	7.72×10^{9}	9.2×10^{9}	1.09×10^{10}	1.28×10^{10}	1.52×10^{10}	1.86×10^{10}
Exported products and services	$	1.96×10^{10}	2.15×10^{10}	2.37×10^{10}	2.29×10^{10}	2.33×10^{10}	2.64×10^{10}	3.04×10^{10}
Waste (*W*)								
Waste water	g	3.44×10^{14}	3.76×10^{14}	3.85×10^{14}	3.93×10^{14}	3.98×10^{14}	3.91×10^{14}	4.29×10^{14}
Sulfur dioxide	g	7.7×10^{10}	7.33×10^{10}	7.77×10^{10}	6.83×10^{10}	2.78×10^{10}	2.28×10^{10}	1.89×10^{10}
Nitrogen oxides	g	6.23×10^{10}	5.81×10^{10}	5.78×10^{10}	5.29×10^{10}	3.49×10^{10}	3.99×10^{10}	3.59×10^{10}

Table S2. The emergy accounting of the urban ecosystem from 2005 to 2018 in Jiaxing (sej).

	Year	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Renewable resources (*R*)															
1	Solar energy	1.42E+19	1.42E+19	1.42E+19	1.42E+19	1.42E+19	1.42E+19	1.42E+19	1.42E+19	1.42E+19	1.42E+19	1.42E+19	1.42E+19	1.42E+19	1.42E+19
2	Wind, kinetic energy	3.43E+19	3.08E+19	2.77E+19	2.47E+19	2.47E+19	2.47E+19	1.71E+19	1.71E+19	1.94E+19	5.05E+19	3.79E+19	3.91E+19	3.79E+19	3.72E+19
3	Rainfall, geopotential energy	8.54E+17	9.07E+17	1.00E+18	1.20E+18	1.16E+18	1.29E+18	9.43E+17	1.40E+18	1.12E+18	1.11E+18	1.40E+18	1.46E+18	1.18E+18	1.49E+18
4	Rainfall, chemical potential energy	2.19E+20	2.32E+20	2.58E+20	3.08E+20	2.96E+20	3.30E+20	2.42E+20	3.60E+20	2.87E+20	2.85E+20	3.60E+20	3.74E+20	3.03E+20	3.83E+20
5	Geothermal heat	2.11E+19	2.11E+19	2.11E+19	2.11E+19	2.11E+19	2.11E+19	2.11E+19	2.11E+19	2.11E+19	2.11E+19	2.11E+19	2.11E+19	2.11E+19	2.11E+19
Nonrenewable resources and products (*N*)															
6	Loss of organic matter in topsoil	8.14E+17	8.16E+17	8.24E+17	8.31E+17	8.33E+17	8.08E+17	8.52E+17	8.41E+17	8.30E+17	7.98E+17	7.83E+17	7.58E+17	7.49E+17	7.15E+17
7	Nonrenewable water resources	5.38E+21	4.57E+21	4.01E+21	3.00E+21	3.05E+21	2.80E+21	3.60E+21	2.22E+21	3.36E+21	3.06E+21	2.11E+21	2.20E+21	2.74E+21	2.19E+21
8	Electricity	1.98E+22	2.20E+22	2.14E+22	2.14E+22	2.19E+22	2.25E+22	2.63E+22	3.23E+22	3.20E+22	2.95E+22	3.63E+22	3.80E+22	3.98E+22	4.06E+22
9	Nitrogen fertilizer	2.23E+20	2.27E+20	2.22E+20	2.25E+20	2.26E+20	2.26E+20	2.26E+20	2.26E+20	2.25E+20	2.25E+20	2.20E+20	2.16E+20	2.15E+20	2.10E+20
10	Phosphate fertilizer	4.26E+19	4.35E+19	3.99E+19	4.01E+19	3.94E+19	3.74E+19	3.64E+19	3.60E+19	3.54E+19	3.51E+19	3.46E+19	3.38E+19	3.24E+19	3.07E+19
11	Potash fertilizer	4.67E+18	4.67E+18	4.58E+18	4.57E+18	4.64E+18	4.60E+18	4.56E+18	4.57E+18	4.54E+18	4.43E+18	4.37E+18	4.40E+18	4.43E+18	4.45E+18
12	Compound fertilizer	1.84E+19	1.84E+19	1.81E+19	1.83E+19	1.84E+19	1.82E+19	1.83E+19	1.85E+19	1.88E+19	1.86E+19	1.82E+19	1.86E+19	1.88E+19	2.02E+19
13	Plastic film	1.34E+18	1.46E+18	1.46E+18	1.60E+18	1.64E+18	1.66E+18	1.68E+18	1.71E+18	1.73E+18	1.75E+18	1.75E+18	1.74E+18	1.76E+18	1.79E+18
14	Pesticide	8.21E+	8.05E+	7.95E+	8.12E+	8.11E+	8.04E+	8.00E+	8.07E+	8.16E+	7.89E+	7.60E+	7.41E+	7.23E+	7.13E+

	Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
		18	18	18	18	18	18	18	18	18	18	18	18	18	18
15	Cement	1.98E+22	2.05E+22	2.15E+22	2.05E+22	2.16E+22	2.14E+22	2.29E+22	2.12E+22	2.09E+22	2.07E+22	1.87E+22	1.92E+22	2.03E+22	2.28E+22
Imports (*I*)															
16	Imported products and services	7.33E+21	1.11E+22	1.37E+22	1.59E+22	1.23E+22	1.68E+22	2.45E+22	2.33E+22	2.84E+22	2.68E+22	2.16E+22	2.03E+22	2.83E+22	3.23E+22
Exports (*E*)															
17	Tourism	6.63E+21	7.99E+21	8.67E+21	1.03E+22	1.27E+22	1.63E+22	2.02E+22	2.40E+22	2.75E+22	3.21E+22	3.89E+22	4.62E+22	5.61E+22	7.02E+22
18	Exported products and services	3.49E+22	4.55E+22	4.86E+22	5.44E+22	4.86E+22	6.26E+22	7.52E+22	7.27E+22	7.85E+22	8.40E+22	8.30E+22	8.52E+22	9.81E+22	1.16E+23
Waste (*W*)															
19	Waste water	6.29E+20	6.68E+20	7.86E+20	7.39E+20	7.36E+20	8.32E+20	8.37E+20	8.68E+20	9.50E+20	9.72E+20	9.92E+20	1.00E+21	9.85E+20	1.08E+21
20	Sulfur dioxide	6.44E+18	7.77E+18	8.30E+18	8.12E+18	7.50E+18	4.97E+18	5.69E+18	5.45E+18	5.19E+18	5.50E+18	4.84E+18	1.97E+18	1.62E+18	1.34E+18
21	Nitrogen oxides	n.a.[a]	n.a.	9.66E+17	9.50E+17	1.15E+18	1.32E+18	1.69E+18	1.77E+18	1.65E+18	1.64E+18	1.50E+18	9.90E+17	1.13E+18	1.02E+18
22	Green GDP ($)	5.02E+09	7.48E+09	1.01E+10	1.41E+10	1.59E+10	2.16E+10	2.69E+10	3.08E+10	3.45E+10	3.92E+10	4.03E+10	4.14E+10	4.77E+10	5.59E+10

[a] n.a. indicates that the relevant data is missing.

Table S3. The emergy needed to dilute water pollutants by environmental self-purification (sej).

Year	COD	NH_4^+-N	Total phosphorus	petroleum	Volatile phenol	Cyanide	Lead	Mercury	Cadmium	Chromium	Arsenic	$R_{d\text{-}water}$
2011	6.16E+20	9.90E+21	9.51E+21	8.96E+19	1.14E+20	n.a.[a]	1.26E+18	1.14E+17	1.52E+18	n.a.	1.36E+16	9.90E+21
2012	5.83E+20	9.58E+21	8.40E+21	2.17E+19	1.24E+19	n.a.	1.31E+18	9.14E+16	1.55E+18	6.70E+16	1.64E+16	9.58E+21
2013	5.60E+20	9.20E+21	7.62E+21	1.42E+19	3.64E+19	n.a.	1.15E+18	5.94E+17	1.65E+18	6.42E+17	1.40E+16	9.20E+21
2014	5.43E+20	8.77E+21	7.77E+21	1.47E+19	1.81E+19	4.63E+18	1.07E+18	6.17E+17	1.35E+18	7.69E+17	1.32E+16	8.77E+21
2015	5.17E+20	8.52E+21	8.36E+21	2.81E+19	1.59E+18	6.39E+17	1.11E+18	6.86E+16	1.35E+18	1.14E+18	1.28E+16	8.52E+21
2016	2.03E+20	5.04E+21	1.49E+21	2.00E+19	1.37E+18	3.62E+17	8.40E+16	4.57E+16	1.83E+16	1.14E+17	1.78E+15	5.04E+21
2017	1.93E+20	4.64E+21	1.45E+21	3.41E+19	n.a.	3.50E+17	4.58E+17	4.57E+16	2.20E+18	2.95E+17	1.08E+16	4.64E+21
2018	1.81E+20	4.30E+21	4.67E+20	3.46E+19	8.00E+15	3.95E+17	7.68E+17	1.14E+17	3.14E+18	5.70E+17	1.61E+16	4.30E+21

[a] n.a. indicates that the relevant data is missing.

Table S4. The emergy needed to dilute air pollutants by environmental self-purification (sej).

Year	**Sulfur dioxide**	**Nitrogen oxides**	**Dust**	$R_{d\text{-}air}$
2011	2.63E+22	7.79E+21	9.30E+21	2.63E+22
2012	2.51E+22	8.14E+21	8.60E+21	2.51E+22
2013	2.61E+22	8.27E+21	9.23E+21	2.61E+22
2014	5.22E+22	1.55E+22	2.10E+22	5.22E+22
2015	3.80E+22	1.18E+22	1.22E+22	3.80E+22
2016	1.58E+22	7.90E+21	6.89E+21	1.58E+22
2017	1.27E+22	8.87E+21	6.82E+21	1.27E+22
2018	1.04E+22	7.87E+21	4.88E+21	1.04E+22

Table S5. The emergy of human resources losses caused by pollutants in the urban ecosystem of Jiaxing (sej).

Year	Water pollutants						Air pollutants			Total
	petroleum	Volatile phenol	Cyanide	Cadmium	Chromium	Arsenic	Sulfur dioxide	Nitrogen oxides	Dust	E_{PH}
2011	2.83E+16	3.65E+14	n.a.[a]	1.65E+16	n.a.	6.77E+15	7.63E+19	9.20E+19	1.86E+20	3.54E+20
2012	6.86E+15	3.95E+13	n.a.	1.68E+16	3.49E+16	8.18E+15	7.30E+19	9.61E+19	1.72E+20	3.41E+20
2013	4.50E+15	1.16E+14	n.a.	1.78E+16	3.35E+17	6.99E+15	6.96E+19	8.96E+19	1.69E+20	3.29E+20
2014	4.63E+15	5.78E+13	1.47E+14	1.46E+16	4.01E+17	6.59E+15	7.37E+19	8.90E+19	2.03E+20	3.67E+20
2015	8.89E+15	5.08E+12	2.02E+13	1.46E+16	5.94E+17	6.38E+15	6.48E+19	8.15E+19	1.43E+20	2.90E+20
2016	6.33E+15	4.39E+12	1.14E+13	1.98E+14	5.94E+16	8.91E+14	2.64E+19	5.37E+19	7.92E+19	1.59E+20
2017	1.08E+16	n.a.	1.11E+13	2.39E+16	1.54E+17	5.41E+15	2.17E+19	6.15E+19	8.00E+19	1.63E+20
2018	1.09E+16	2.55E+10	1.25E+13	3.40E+16	2.97E+17	8.06E+15	1.79E+19	5.53E+19	5.80E+19	1.32E+20

[a] n.a. indicates that the relevant data is missing.

Table S6. The emergy of natural capital losses caused by pollutants in the urban ecosystem of Jiaxing (sej).

Year	**Water pollutants**				**Air pollutants**		**Total**
	Lead	**Mercury**	**Cadmium**	**Arsenic**	**Sulfur dioxide**	**Nitrogen oxides**	E_{EQ}
2011	2.80E+15	3.39E+13	2.20E+16	2.32E+14	2.87E+20	1.17E+21	1.46E+21
2012	2.91E+15	2.71E+13	2.24E+16	2.81E+14	2.75E+20	1.22E+21	1.50E+21
2013	2.56E+15	1.76E+14	2.38E+16	2.40E+14	2.62E+20	1.14E+21	1.40E+21
2014	2.38E+15	1.83E+14	1.95E+16	2.26E+14	2.78E+20	1.13E+21	1.41E+21
2015	2.46E+15	2.03E+13	1.95E+16	2.19E+14	2.44E+20	1.04E+21	1.28E+21
2016	1.87E+14	1.35E+13	2.64E+14	3.06E+13	9.95E+19	6.84E+20	7.84E+20
2017	1.02E+15	1.35E+13	3.18E+16	1.86E+14	8.16E+19	7.83E+20	8.65E+20
2018	1.71E+15	3.39E+13	4.53E+16	2.77E+14	6.75E+19	7.04E+20	7.72E+20

Table S7. The emergy accounting and evaluation indicators of urban ecosystem in Jiaxing from 2005 to 2011.

System	Indicator	Unit	Symbol	Formula	2005	2006	2007	2008	2009	2010	2011
Basic data of urban ecosystem	Population	person	P	-	3343300	3355500	3368100	3380700	3396000	3416000	3430500
	Area	m^2	A	-	3.91E+09	3.91E+09	3.91E+09	3.91E+09	3.91E+09	3.91E+09	3.91E+09
Emergy data of urban ecosystem	Renewable resources	sej	R	MAX (1~5)	2.19E+20	2.32E+20	2.58E+20	3.08E+20	2.96E+20	3.30E+20	2.42E+20
	Nonrenewable resources	sej	N_0	SUM (6~7)	5.38E+21	4.57E+21	4.01E+21	3.00E+21	3.05E+21	2.81E+21	3.60E+21
	Nonrenewable products	sej	N_1	SUM (8~15)	3.99E+22	4.28E+22	4.31E+22	4.23E+22	4.38E+22	4.42E+22	4.95E+22
	Nonrenewable resources and products	sej	N	SUM (6~15)	4.53E+22	4.74E+22	4.71E+22	4.52E+22	4.68E+22	4.70E+22	5.31E+22
	Imports	sej	I	16	7.33E+21	1.11E+22	1.37E+22	1.59E+22	1.23E+22	1.68E+22	2.45E+22
	Total emergy used	sej	U	$R+N+I$	5.28E+22	5.87E+22	6.11E+22	6.14E+22	5.94E+22	6.41E+22	7.78E+22
	Exports	sej	E	SUM (17~18)	4.15E+22	5.35E+22	5.72E+22	6.47E+22	6.13E+22	7.89E+22	9.54E+22
	Waste	sej	W	SUM (19~21)	6.35E+20	6.76E+20	7.95E+20	7.48E+20	7.45E+20	8.38E+20	8.45E+20
	Environmental self-purification emergy of water pollutants	sej	$R_{d\text{-}water}$	-	-	-	-	-	-	-	9.90E+21
	Environmental self-purification emergy of air pollutants	sej	$R_{d\text{-}air}$	-	-	-	-	-	-	-	2.63E+22
	Emergy of human resources losses	sej	E_{PH}	-	-	-	-	-	-	-	3.54E+20
	Emergy of natural capital losses	sej	E_{EQ}	-	-	-	-	-	-	-	1.46E+21

System	Indicator	Unit	Symbol	Formula	2005	2006	2007	2008	2009	2010	2011
Natural subsystem	Environmental loading ratio	-	ELR	$(I+N) / R$	240.44	251.70	236.12	198.72	199.50	193.08	321.17
	Waste loading ratio	-	WLR	W / R	2.90	2.91	3.09	2.43	2.51	2.54	3.50
Social subsystem	Emergy density	sej/m^2	ED	U / A	1.35E+13	1.5E+13	1.56E+13	1.57E+13	1.52E+13	1.64E+13	1.99E+13
	Emergy per person	sej/person	EPP	U / P	1.58E+16	1.75E+16	1.81E+16	1.82E+16	1.75E+16	1.88E+16	2.27E+16
Economic subsystem	Emergy yield ratio	-	EYR	U / I	7.21	5.27	4.47	3.87	4.84	3.81	3.18
	Emergy investment ratio	-	EIR	$I / (R+N)$	0.16	0.23	0.29	0.35	0.26	0.36	0.46
	Emergy exchange ratio	-	EER	I / E	0.18	0.21	0.24	0.25	0.20	0.21	0.26
Comprehensive indicators of sustainability	Emergy sustainability index	-	ESI	EYR / ELR	3.00E-02	2.09E-02	1.89E-02	1.95E-02	2.42E-02	1.98E-02	9.90E-03
	Environmental load rate based on eco-environmental costs	-	ELR_{EC}	$(I+N+R_{d\text{-}air}+E_{PH}+E_{EQ}) / R$	-	-	-	-	-	-	437.40
	Emergy yield ratio based on eco-environmental costs	-	EYR_{EC}	$(U+R_{d\text{-}air}+E_{PH}+E_{EQ}) / (I+R_{d\text{-}air}+E_{PH}+E_{EQ})$	-	-	-	-	-	-	2.01
	Emergy sustainability index based on eco-environmental costs	-	ESI_{EC}	EYR_{EC} / ELR_{EC}	-	-	-	-	-	-	4.61E-03

Table S7 (continued). The emergy accounting and evaluation indicators of urban ecosystem in Jiaxing from 2012 to 2018.

System	Indicator	Unit	Symbol	Formula	2012	2013	2014	2015	2016	2017	2018
Basic data of urban ecosystem	Population	person	P	-	3445200	3459300	3481400	3494800	3521200	3563700	3604400
	Area	m^2	A	-	3.91E+09	3.91E+09	3.91E+09	3.91E+09	3.91E+09	3.91E+09	3.91E+09
Emergy data of urban ecosystem	Renewable resources	sej	R	MAX (1~5)	3.60E+20	2.87E+20	2.85E+20	3.60E+20	3.74E+20	3.03E+20	3.83E+20
	Nonrenewable resources	sej	N_0	SUM (6~7)	2.22E+21	3.36E+21	3.06E+21	2.11E+21	2.20E+21	2.74E+21	2.19E+21
	Nonrenewable products	sej	N_1	SUM (8~15)	5.38E+22	5.32E+22	5.04E+22	5.53E+22	5.75E+22	6.03E+22	6.36E+22
	Nonrenewable resources and products	sej	N	SUM (6~15)	5.61E+22	5.65E+22	5.35E+22	5.74E+22	5.97E+22	6.31E+22	6.58E+22
	Imports	sej	I	16	2.33E+22	2.84E+22	2.68E+22	2.16E+22	2.03E+22	2.83E+22	3.23E+22
	Total emergy used	sej	U	$R+N+I$	7.97E+22	8.53E+22	8.06E+22	7.93E+22	8.03E+22	9.17E+22	9.85E+22
	Exports	sej	E	SUM (17~18)	9.68E+22	1.06E+23	1.16E+23	1.22E+23	1.31E+23	1.54E+23	1.86E+23
	Waste	sej	W	SUM (19~21)	8.75E+20	9.56E+20	9.80E+20	9.98E+20	1.01E+21	9.88E+20	1.08E+21
	Environmental self-purification emergy of water pollutants	sej	$R_{d\text{-}water}$	-	9.58E+21	9.20E+21	8.77E+21	8.52E+21	5.04E+21	4.64E+21	4.30E+21
	Environmental self-purification emergy of air pollutants	sej	$R_{d\text{-}air}$	-	2.51E+22	2.61E+22	5.22E+22	3.80E+22	1.58E+22	1.27E+22	1.04E+22
	Emergy of human resources losses	sej	E_{PH}	-	3.41E+20	3.29E+20	3.67E+20	2.90E+20	1.59E+20	1.63E+20	1.32E+20
	Emergy of natural capital losses	sej	E_{EQ}	-	1.50E+21	1.40E+21	1.41E+21	1.28E+21	7.84E+20	8.65E+20	7.72E+20

System	Indicator	Unit	Symbol	Formula	2012	2013	2014	2015	2016	2017	2018
Natural subsystem	Environmental loading ratio	-	ELR	$(I+N) / R$	220.39	295.90	282.07	219.35	213.93	301.53	256.36
	Waste loading ratio	-	WLR	W / R	2.43	3.33	3.44	2.77	2.69	3.26	2.83
Social subsystem	Emergy density	sej/m^2	ED	U / A	2.04E+13	2.18E+13	2.06E+13	2.03E+13	2.05E+13	2.35E+13	2.52E+13
	Emergy per person	sej/person	EPP	U / P	2.31E+16	2.46E+16	2.32E+16	2.27E+16	2.28E+16	2.57E+16	2.73E+16
Economic subsystem	Emergy yield ratio	-	EYR	U / I	3.42	3.00	3.00	3.68	3.97	3.24	3.05
	Emergy investment ratio	-	EIR	$I / (R+N)$	0.41	0.50	0.50	0.37	0.34	0.45	0.49
	Emergy exchange ratio	-	EER	I / E	0.24	0.27	0.23	0.18	0.15	0.18	0.17
Comprehensive indicators of sustainability	Emergy sustainability index	-	ESI	EYR / ELR	1.55E-02	1.01E-02	1.06E-02	1.68E-02	1.85E-02	1.07E-02	1.19E-02
	Environmental load rate based on eco-environmental costs	-	ELR_{EC}	$(I+N+R_{d\text{-}air}+E_{PH}+E_{EQ}) / R$	295.31	392.76	471.64	329.14	258.65	346.80	285.76
	Emergy yield ratio based on eco-environmental costs	-	EYR_{EC}	$(U+R_{d\text{-}air}+E_{PH}+E_{EQ}) / (I+R_{d\text{-}air}+E_{PH}+E_{EQ})$	2.12	2.01	1.67	1.95	2.62	2.51	2.52
	Emergy sustainability index based on eco-environmental costs	-	ESI_{EC}	EYR_{EC} / ELR_{EC}	7.19E-03	5.12E-03	3.53E-03	5.91E-03	1.01E-02	7.23E-03	8.82E-03

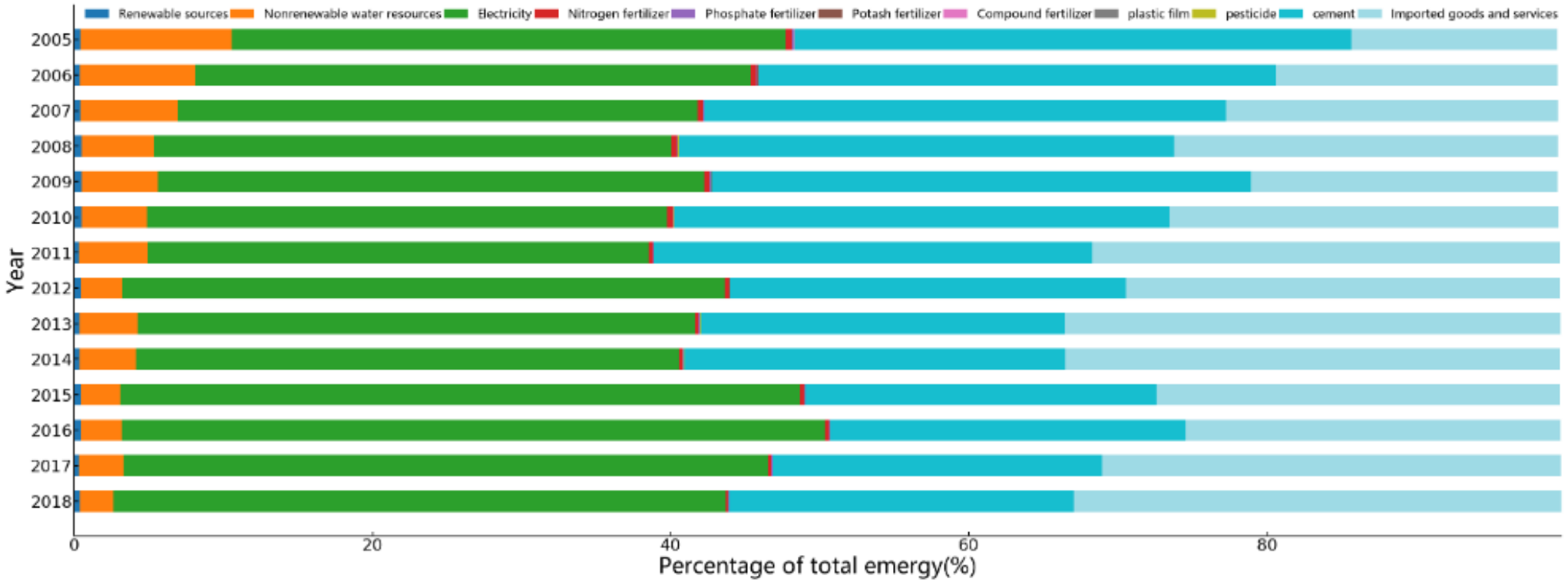


Figure S1. The structure and changes of the total emergy used in Jiaxing.

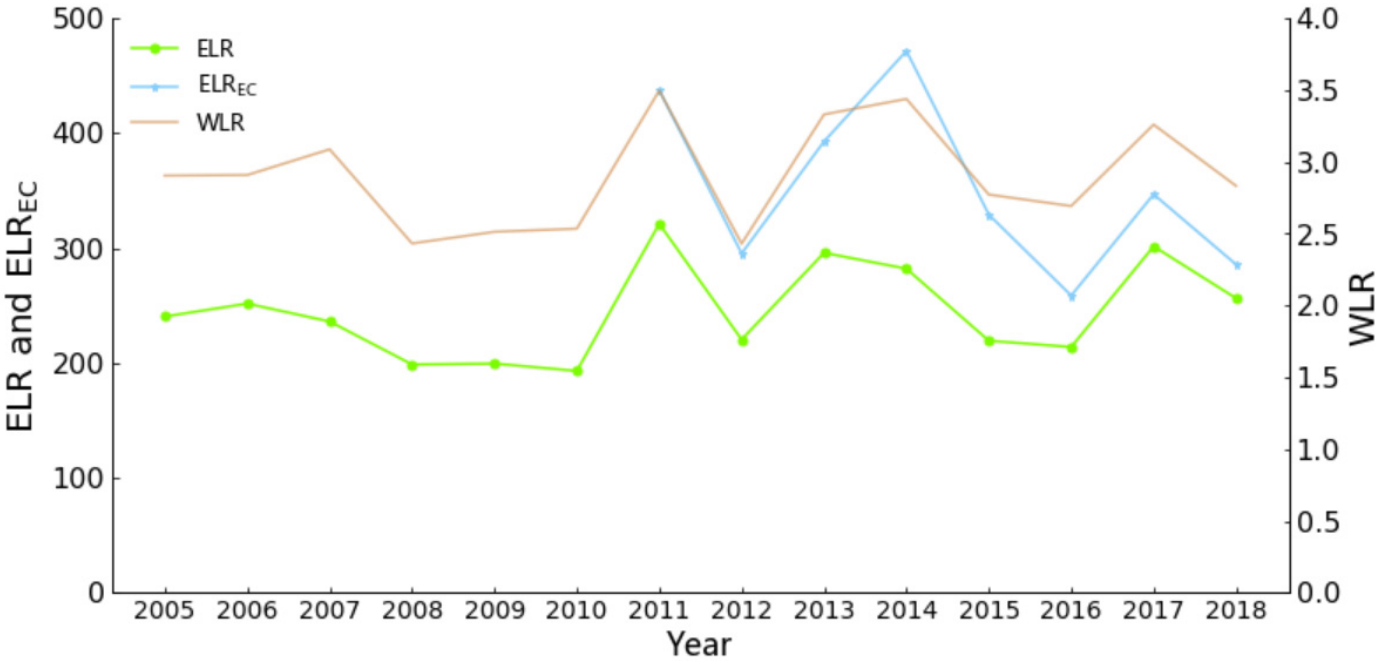


Figure S2. Dynamic changes of the environmental load rate (ELR), the environmental load rate based on the eco-environmental costs (ELR_{EC}) and the waste load rate (WLR) in the natural subsystem of Jiaxing.

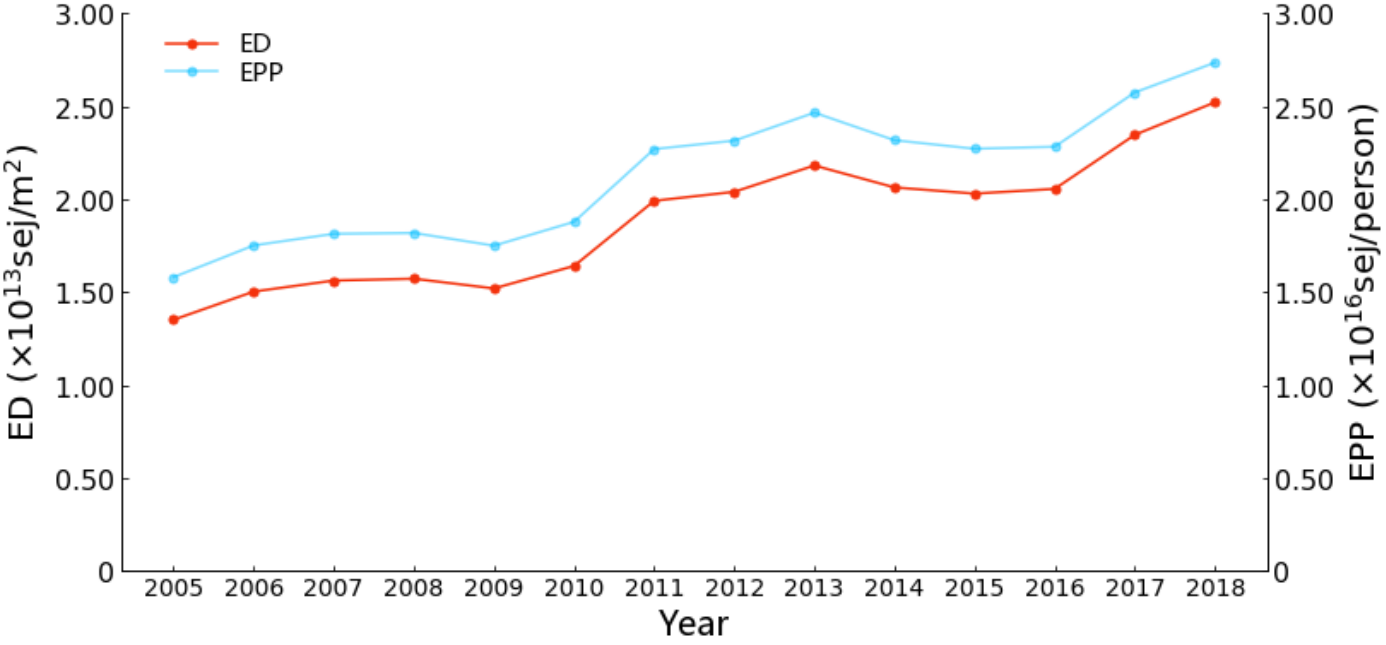


Figure S3. Dynamic changes of the emergy density (ED) and the emergy per person (EPP) in the social subsystem from 2005 to 2018.



Figure S4. Dynamic changes of the emergy yield rate (EYR) and emergy yield rate based on the eco-environmental costs (EYR_{EC}) in the economic subsystem of Jiaxing.



Figure S5. Dynamic changes of the emergy sustainability index (ESI) and the emergy sustainability index based on the eco-environmental costs (ESI_{EC}) of the urban ecosystem in Jiaxing.