

Supplementary Materials S1. The data collection results of the product.

Table S1. Detailed information of production machine and outputs in each process.

Process	Machine information					Outputs			
	Name of machine	Type	Number of machines	Rated power (kW)	Total rated power (kW)	Working hours (h/d)	T-shirts outputs (pieces/h)	Polo shirts outputs (pieces/h)	Mass loss rate (%)
Clothing inspection	Inspecting machine	/	2	0.75	1.5	6	1450	1175	0%
Loosing fabric	Loosing fabric machine	/	2	0.75	1.5	8	1460	1570	0%
Drawing	Plotter	ACC 320	1	1.3	1.3	4	43200	25200	0%
	Computer	Dell	1	0.25	0.25	4			
Spreading	Spreading machine	2070814	4	0.16	0.64	1.5	3600	3600	0%
Cutting	Cutting machine	629X	4	0.75	3	2	3600	3600	15%
Checking pairs	Manual	/	/	/	/	8	1875	1875	2%
Matching	Manual	/	/	/	/	8	1625	1625	0%
Sewing	Sewing machine	/	32	0.475	15.2	8	2500	2500	Less than 1%
Shearing head	Cutting line machine	T22-A2	18	0.4	7.2	8	1820	1250	Less than 1%
Button attaching	Buttoning machine	KE-430	2	0.4	0.8	8	/	500	0%
Buttonhole	Buttonhole machine	/	6	0.4	2.4	8	/	500	0%
Ironing	Steam iron	/	/	/	/	8	1400	1200	0%
	Iron board	YST7142	30	0.75	22.5	8			0%
Inspection	Manual	/	/	/	/	8	1875	1875	0%
Measurements	Manual	/	/	/	/	8	1200	1200	0%
Hanging tags	Manual	/	/	/	/	8	1800	1800	0%
Packing	Manual	/	/	/	/	8	2700	2700	0%
Needle Inspection	Checking needle machine	HN 730G	1	0.14	0.14	8	1800	1800	0%
Baling	Packing machine	FPS-502	1	0.18	0.18	8	9600	7680	0%

Table S2. Detailed information of auxiliary production machine in each process.

Process	Name of machine	Type	Number of the machines	Rated power (kW)	Total rated power (kW)	Working hours (h/d)
Clothing inspection	Lighting Fan Exhaust fan Computer Printer	MXb-Y40 / YTA3-50 Dell 1600KIIH	560 78 10 4 1	0.04 0.075 0.35 0.25 0.042	32.792 (From May to Sep.) 26.942	10 10 (From May to Sep.) 10 10 10
Loosing fabric						
Spreading						
Cutting						
Checking pairs						
Matching						
Drawing	Lighting	MXOS-3	7	0.02	1.94 (From May to Sep.) 0.34	10
	Split air conditioning	KF-41G	1	1.5		10 (From May to Sep.)
	Exhaust fan	/	1	0.3		10
Sewing	Lighting	MXb-Y40	1120	0.04	303.072 (From May to Sep.) 49.092	10
	Fan	YTA3-50	7	0.35		10
	Central air conditioning	MW-40	6	42.33		10 (From May to Sep.)
	Computer	Dell	6	0.25		10
	Printer	1600KIIH	1	0.042		10
	Fan	/	4	0.075		10
Shearing head	Lighting Exhaust fan Compressor A Compressor B Computer Printer	/	560 15 1 1 3 1	0.04 0.35 7.5 4 0.25 0.042	39.942	10 10 10 10 10 10
Button attaching						
Button holding						
Ironing						
Inspection						
Measurements						
Hanging tags						
Packing						
Needle Inspection						
Baling						

Table S3. Detailed information of and energy consumption and machine in operation section (offices, restrooms).

Name of machine	Type	Number of machines	Rated power (kW)	Working hours (h/d)
Lighting	MX0S-3	136	0.02	10
Split air conditioning	KF-41G	1	1.5	10 (From May to Sep.)
Exhaust fan	/	18	0.3	10
Water heater	/	3	6	10
Computer	DELL	13	0.25	10
Printer	XEROX 5655	1	0.042	10
Air conditioning	KF	1	6.62	10 (From May to Sep.)
Lighting	MXb-Y40	106	0.04	10
Fan	/	6	0.055	10 (From May to Sep.)
Exhaust fan	/	8	0.35	10

Table S4. Outputs of the whole year.

Month	T-shirts (piece)	Polo (piece)
Jan.	289227	112121
Feb.	86645	28179
Mar.	301962	143597
Apr.	330009	106683
May	359582	137782
Jun.	357558	154009
Jul.	237648	52988
Aug.	224080	74167
Sep.	259159	120797
Oct.	209805	79973
Nov.	258115	152642
Dec.	291674	111057
Total outputs (piece)	3205464	1273995
Average outputs per month (piece)	267122	106166
Average outputs per day (piece)	11916	4754

Supplementary Materials S2. The calculation results of the product carbon footprint.

Table S5. S1 Carbon footprint of T-shirts of each CFU from Jan. to Dec. (g CO₂ eq/kg).

Month	Clothing inspection	Loosing fabric	Drawing	Spreading	Cutting	Checking pairs	Matching	Sewing	Shearing head
Jan.	4.00	5.79	2.45	0.45	1.06	0.00	0.00	40.20	29.03
Feb.	5.08	7.29	3.15	0.57	1.34	0.00	0.00	53.45	37.14
Mar.	3.74	5.48	2.25	0.43	1.00	0.00	0.00	35.64	26.92
Apr.	3.80	5.45	2.36	0.43	1.00	0.00	0.00	40.04	27.79
May	2.13	3.09	1.31	0.24	0.57	0.00	0.00	21.50	15.48
Jun.	2.18	3.18	1.32	0.25	0.58	0.00	0.00	21.31	15.75
Jul.	4.37	6.16	2.78	0.49	1.14	0.00	0.00	50.33	32.33
Aug.	3.30	4.73	2.04	0.37	0.87	0.00	0.00	34.51	24.07
Sep.	3.12	4.57	1.88	0.36	0.84	0.00	0.00	29.93	22.50
Oct.	5.67	8.20	3.47	0.64	1.51	0.00	0.00	57.25	41.18
Nov.	2.58	3.84	1.53	0.30	0.70	0.00	0.00	23.25	18.42
Dec.	4.77	6.90	2.92	0.54	1.27	0.00	0.00	48.18	34.65
Average	3.73	5.39	2.29	0.42	0.99	0.00	0.00	37.97	27.10
Month	Ironing	Inspection	Measurements	Hanging tags	Packing	Needle inspection	Baling	Total CF	
Jan.	97.71	0.00	0.00	0.00	0.00	0.49	0.59	181.77	
Feb.	123.98	0.00	0.00	0.00	0.00	0.83	1.00	233.84	
Mar.	91.56	0.00	0.00	0.00	0.00	0.55	0.65	168.21	
Apr.	92.74	0.00	0.00	0.00	0.00	0.47	0.57	174.65	
May	52.10	0.00	0.00	0.00	0.00	0.25	0.31	96.97	
Jun.	53.29	0.00	0.00	0.00	0.00	0.31	0.37	98.53	
Jul.	106.21	0.00	0.00	0.00	0.00	0.60	0.74	205.15	
Aug.	80.42	0.00	0.00	0.00	0.00	0.59	0.72	151.63	
Sep.	76.47	0.00	0.00	0.00	0.00	0.41	0.49	140.57	
Oct.	138.52	0.00	0.00	0.00	0.00	0.72	0.86	258.04	
Nov.	63.38	0.00	0.00	0.00	0.00	0.52	0.61	115.12	
Dec.	116.53	0.00	0.00	0.00	0.00	0.46	0.55	216.77	
Average	91.08	0.00	0.00	0.00	0.00	0.52	0.62	170.11	

Table S6. S2 Carbon footprint of T-shirts of each CFU from Jan. to Dec. (g CO₂ eq/kg).

Month	Clothing inspection	Loosing fabric	Drawing	Spreading	Cutting	Checking pairs	Matching	Sewing	Shearing head
Jan.	26.81	26.62	1.34	10.8	10.8	24.39	28.14	162.31	21.8
Feb.	34.08	33.85	1.73	13.73	13.73	31.01	35.78	215.79	28.48
Mar.	25.05	24.88	1.23	10.09	10.09	22.79	26.3	143.88	19.71
Apr.	25.5	25.32	1.29	10.27	10.27	23.2	26.77	161.67	21.32
May	17.4	17.28	4.08	7.01	7.01	15.83	18.26	535.9	11.64
Jun.	17.77	17.65	4.14	7.16	7.16	16.17	18.66	531.16	11.67
Jul.	35.68	35.43	8.69	14.37	14.37	32.46	37.45	1254.52	25.85
Aug.	26.9	26.72	6.39	10.84	10.84	24.48	28.24	860.14	18.42
Sep.	25.47	25.3	5.89	10.26	10.26	23.18	26.74	745.93	16.52
Oct.	46.26	45.95	1.9	18.63	18.63	42.09	48.57	231.14	30.99
Nov.	17.29	17.18	0.84	6.97	6.97	15.73	18.15	93.87	13.13
Dec.	31.98	31.76	1.6	12.88	12.88	29.09	33.57	194.5	26.07
Average	27.52	27.33	3.26	11.08	11.08	25.04	28.89	427.57	20.47
Month	Ironing	Inspection	Measurements	Hanging tags	Packing	Needle inspection	Baling	Total CF	
Jan.	377.24	21.16	33.06	22.04	14.69	22.04	0	803.24	
Feb.	1259.1	27.64	43.19	28.8	19.2	28.8	0	1814.91	
Mar.	336.74	19.13	29.9	19.93	13.29	19.93	0	722.95	
Apr.	337.27	20.7	32.34	21.56	14.37	21.56	0	753.41	
May	291.62	11.3	17.66	11.77	7.85	11.77	0	986.39	
Jun.	283.41	11.33	17.71	11.8	7.87	11.8	0	975.47	
Jul.	522.99	25.09	39.21	26.14	17.43	26.14	0	2115.82	
Aug.	475.29	17.88	27.94	18.63	12.42	18.63	0	1583.74	
Sep.	355.98	16.04	25.06	16.71	11.14	16.71	0	1331.18	
Oct.	515.72	30.08	47	31.33	20.89	31.33	0	1160.52	
Nov.	344.63	12.74	19.91	13.27	8.85	13.27	0	602.8	
Dec.	356.83	25.31	39.55	26.36	17.58	26.36	0	866.33	
Average	454.74	19.87	31.04	20.7	13.8	20.7	0	1143.06	

Table S7. S3 Carbon footprint of T-shirts of each CFU from Jan. to Dec. (g CO₂ eq/kg).

Month	Clothing inspection	Loosing fabric	Drawing	Spreading	Cutting	Checking pairs	Matching	Sewing	Shearing head
Jan.	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49
Feb.	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Mar.	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33
Apr.	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44
May	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
Jun.	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Jul.	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21
Aug.	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74
Sep.	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44
Oct.	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Nov.	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
Dec.	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68
Average	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65
Month	Ironing	Inspection	Measurements	Hanging tags	Packing	Needle inspection	Baling	Total CF	
Jan.	1.49	1.49	1.49	1.49	1.49	1.49	1.49	23.89	
Feb.	3.2	3.2	3.2	3.2	3.2	3.2	3.2	51.23	
Mar.	1.33	1.33	1.33	1.33	1.33	1.33	1.33	21.29	
Apr.	1.44	1.44	1.44	1.44	1.44	1.44	1.44	23.1	
May	1.06	1.06	1.06	1.06	1.06	1.06	1.06	17.03	
Jun.	1.04	1.04	1.04	1.04	1.04	1.04	1.04	16.72	
Jul.	2.21	2.21	2.21	2.21	2.21	2.21	2.21	35.3	
Aug.	1.74	1.74	1.74	1.74	1.74	1.74	1.74	27.84	
Sep.	1.44	1.44	1.44	1.44	1.44	1.44	1.44	23.07	
Oct.	2.1	2.1	2.1	2.1	2.1	2.1	2.1	33.68	
Nov.	1.06	1.06	1.06	1.06	1.06	1.06	1.06	17	
Dec.	1.68	1.68	1.68	1.68	1.68	1.68	1.68	26.87	
Average	1.65	1.65	1.65	1.65	1.65	1.65	1.65	26.42	

Table S8. Total carbon footprint of T-shirts of each CFU from Jan. to Dec. (kgCO₂ eq/kg).

Month	Clothing inspection	Loosing fabric	Drawing	Spreading	Cutting	Checking pairs	Matching	Sewing	Shearing head
Jan.	0.032	0.034	0.005	0.013	0.013	0.026	0.030	0.204	0.052
Feb.	0.042	0.044	0.008	0.018	0.018	0.034	0.039	0.272	0.069
Mar.	0.030	0.032	0.005	0.012	0.012	0.024	0.028	0.181	0.048
Apr.	0.031	0.032	0.005	0.012	0.013	0.025	0.028	0.203	0.051
May	0.021	0.021	0.006	0.008	0.009	0.017	0.019	0.558	0.028
Jun.	0.021	0.022	0.007	0.008	0.009	0.017	0.020	0.554	0.028
Jul.	0.042	0.044	0.014	0.017	0.018	0.035	0.040	1.307	0.060
Aug.	0.032	0.033	0.010	0.013	0.013	0.026	0.030	0.896	0.044
Sep.	0.030	0.031	0.009	0.012	0.013	0.025	0.028	0.777	0.040
Oct.	0.054	0.056	0.007	0.021	0.022	0.044	0.051	0.291	0.074
Nov.	0.021	0.022	0.003	0.008	0.009	0.017	0.019	0.118	0.033
Dec.	0.038	0.040	0.006	0.015	0.016	0.031	0.035	0.244	0.062
Average	0.033	0.034	0.007	0.013	0.014	0.027	0.031	0.467	0.049
Month	Ironing	Inspection	Measurements	Hanging tags	Packing	Needle inspection	Baling	Total CF	
Jan.	0.476	0.023	0.035	0.024	0.016	0.024	0.002	1.009	
Feb.	1.386	0.031	0.046	0.032	0.022	0.033	0.004	2.100	
Mar.	0.430	0.020	0.031	0.021	0.015	0.022	0.002	0.912	
Apr.	0.431	0.022	0.034	0.023	0.016	0.023	0.002	0.951	
May	0.345	0.012	0.019	0.013	0.009	0.013	0.001	1.100	
Jun.	0.338	0.012	0.019	0.013	0.009	0.013	0.001	1.091	
Jul.	0.631	0.027	0.041	0.028	0.020	0.029	0.003	2.356	
Aug.	0.557	0.020	0.030	0.020	0.014	0.021	0.002	1.763	
Sep.	0.434	0.017	0.027	0.018	0.013	0.019	0.002	1.495	
Oct.	0.656	0.032	0.049	0.033	0.023	0.034	0.003	1.452	
Nov.	0.409	0.014	0.021	0.014	0.010	0.015	0.002	0.735	
Dec.	0.475	0.027	0.041	0.028	0.019	0.029	0.002	1.110	
Average	0.547	0.022	0.033	0.022	0.015	0.023	0.002	1.340	