

Analysis of Compilation Results

Chapter 1 Overall Result

Consistent with the guideline of UN's System of Environmental and Economic Accounting (SEEA), Taiwan's Green National Income Account presents physical flow accounts, physical asset accounts and environmental activity accounts resulting from the impacts that economic activities have on environmental resources. In addition to providing a synopsis of related accounting statement results, this chapter seeks to establish environmental-economic account indicators from an issue-oriented and multi-faceted perspective. The purpose is to integrate information and observe the systemic interaction between the economy and the environment during economic development.

I . Physical flow accounts

Physical flow accounts are measured in physical units. They employ supply and use tables to present the flows from the environment into and out of the economy, as well as the flows inside the economy. The physical flow account for environmental emissions uses residue emission to show the pollutants recycled, collected and treated by the economy, as well as the flow and direction of their release back into the environment. The energy physical flow account for minerals, earth and rocks presents flows related to the manufacturing, production, supply, consumption and use of different types of energy associated with various the economy and environment.

(I) Physical flow accounts for environmental emissions

In terms of the overall flows of the supply side of environmental emissions, the total supply of air pollution emission in 2016 reached 1,763 thousand metric tons. The top three emitting sectors accounted for more than 78.9% of the total, with emission from households reaching 681 thousand metric tons and 38.6% of the total; the next was the manufacturing with 370 thousand metric tons, accounting for 21.0%. The third was the transportation, which emitted 340 thousand metric tons, accounting for 19.3% of the total. Biochemical oxygen demand, chemical oxygen demand and suspended solids are the most commonly seen water pollutants discharged into the environment. For 2016, households; agriculture, forestry, fishing, and animal husbandry; and the manufacturing (including the electricity and gas

supply) were the top 3 emitters of water pollutants. The three parties aggregated accounted for more than 92% of the whole. A total of 82,920 thousand metric tons of solid wastes were generated in 2016. Among them, the construction came in first by generating 51,802 thousand metric tons, more than 62.5% of the total; the next was the manufacturing with 14,497 thousand metric tons, 17.5% of the total. These two aggregated to account for more than 80% of the total.

Table 1.1.1 Supply and use table for environmental emissions, 2016

Unit: thousand M. T.

	Total supply										Total use
	Total	Agriculture, forestry, fishing and animal husbandry	Mining and quarrying	Manufacturing	Electricity and gas supply	Water supply and remediation activities	Construction	Transportation	Households	Others	Flows into the environment
Air pollution	1,763	100	16	370	118	10	89	340	681	39	1,763
Water pollution	⏟										
BOD	248	27	2	16		3	—	—	190	10	248
COD	638	74	6	53		10	—	—	462	34	638
SS	253	36	3	16		5	—	—	185	10	253
Solid waste	82,920	4,620	44	14,497	3,478	959	51,802	—	⏟ 7,520		82,920

(II) Energy physical flow accounts

In terms of the energy supply and use table for 2016, energy supply totaled 208,647 thousand metric tons of oil equivalent. Within this, energy products that were imported reached 129,224 thousand metric tons of oil equivalent, accounting for 61.9% of the total. The amount of energy goods transformed output from primary and secondary energy reached 76,788 thousand metric tons of oil equivalent, accounting for 36.8% of the total. The amount of energy for natural inputs derived from Taiwan's environment reached 2,635 thousand metric tons of oil equivalent, accounting for only 1.3% of the total.

Within energy for natural inputs, 82% was transformed and invested into

electricity generation, with the main consumers being energy sector (own use), industrial sector, service sector, residential sector, etc. Imports accounted for 62.7% of all energy products. Yields from the transformation of primary and secondary energy accounted for 37.3%. Among these, 60% was primarily invested in coke ovens, petroleum refineries and electricity, while the other 37% was for domestic consumption.

Table 1.1.2 Energy supply and use table of 2016

Unit: thousand M. T. of oil equivalent

	Supply side					Use side					
	From Taiwan environment	From import	Transformation output (1)	Transfers & transformation (2)	Final supply	Domestic consumption	Export	International marine bunkers & civil aviation	Stock changes	Energy residue loss	Statistical discrepancy
Total	2,635	129,224	76,788	129,495	79,152	76,188	17,345	4,043	424	887	5,002
Energy for natural inputs	2,635	—	—	2,164	471	480	—	—	-11	—	2
Energy products	—	129,224	76,788	127,331	78,681	75,707	17,345	4,043	435	887	4,999
Electricity (3)					24,734						

Note: (1) Transformation output: energy amount as transformed from primary energy and secondary energy.

(2) Transfers and transformation refer to the amount of energy committed to processing. Among them, transfers mean intermediate conversion between products, as one petroleum product into another petroleum product; transformation means transforming into other types of energy. However, aside from energy being transferred and transformed into energy products, it may also be directly provided in its final supply application.

(3) The final supply in the table equals to the total supply amount less transfers and transformation. However, hydro power, solar-photovoltaic and wind power, pumped-storage hydroelectricity, thermal power, cogeneration, nuclear power and so forth have all been integrated into the power grid for consumption by various domestic sectors. Therefore, they have been presented in terms of their final supply of electricity here.

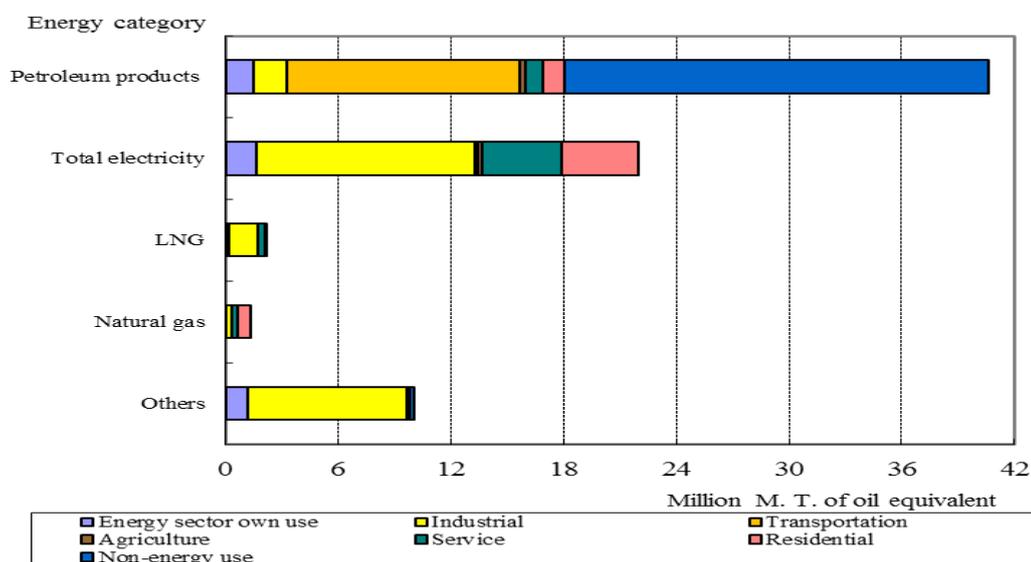
Energy is provided for a multitude of applications. In addition to domestic consumption, it can be exported or used in international marine bunkers and civil aviation. By the kinds of energy for domestic consumption, the petroleum products had the largest share, accounting for 53.3% of the total; the next was the total usage of electricity (including self-use power by power-generating units and power integrated into the power grid), 28.8% of the total. The others were the usage of natural gas, coal products, etc.

With domestic consumption, we can also break it down into energy sector own

use, energy use, and non-energy use (i.e., usage of energy products for non-combustion purposes). Among these, energy use was the staple, accounting for 64.0%; while non-energy use has been given a boost since Formosa Plastics' Sixth Naphtha Cracker started producing ethylene in 2000, accounting for 30.0% of the total in 2016. Energy sector own use accounted for 6.0%.

According to energy use by sectors, the industrial sector was the leader, accounting for 48.8% in 2016. The transport sector accounted for 25.7%, while the residential and service sectors accounted for 12.4% and 11.9%, respectively.

Figure 1.1.1 Status of domestic energy consumption, 2016



Note: Total electricity included hydro power, solar-photovoltaic and wind power, pumped-storage hydroelectricity, thermal power, cogeneration, and nuclear power; they were divided into self-use power and the power integrated into the power grid.

II. Physical asset accounts

Physical asset accounts involve documenting asset reserves and their variation in physical material units during the accounting period. As far as Taiwan's natural resources are concerned, the statistics for non-metallic minerals are for those with high economic values for extraction, such as marble, serpentine, limestone and dolomite. The reserve of non-metallic minerals by the end of 2016 was estimated to be around 10.31 billion metric tons, while the amount of extraction was 0.02 billion metric tons. Energy minerals are the tally of natural gas and condensed oil. As of the end of 2016, the energy mineral reserve was estimated to be 4,081 thousand

kiloliters of oil equivalent, with 309 thousand kiloliters of oil equivalent in annual amount of extraction. Earth and rock resources are the tally of earth and rocks in rivers and lakes; earth and rocks on the land; and earth and rocks in the coastal regions and marines. As of the end of 2016, the estimated reserve was 3.98 billion cubic meters, with 0.03 billion cubic meters of the amount of extraction.

Table 1.1.3 Physical asset accounts for mineral and earth & rock resources, 2016

	Non-metallic mineral resources (Thousand metric tons)	Energy minerals resources (Thousand metric tons of oil equivalent)	Earth & rock resources (Thousand cubic meters)
Opening stocks	10,328,111	4,334	3,978,829
Extraction	16,044	309	26,650
Other changes in volume	—	57	30,493
Closing stocks	10,312,068	4,081	3,982,672

Note: Other changes include re-estimated resource reserves and the discovery of new lodes.

III. Environmental activity accounts

Environmental activity accounts are a documentation of transaction payments made for the purpose of preserving and maintaining the environment. Environmental protection expenditures reached NTD 160.85 billion in 2016, up 3.0% from 2015. The industrial sectors accounted for 55.5% of these expenditures, while the government sectors accounted for 44.5%. Environmental payments to the government in 2016 reached NTD 315.20 billion, down 1.4% from 2015. The transportation category accounted for 63.3% of these, with NTD 199.45 billion; the energy category followed with NTD 93.59 billion, accounting for 29.7%. These two categories aggregated accounted for 93% of the total. In addition, the pollution category totaled NTD 21.53 billion and the resource category reached NTD 0.62 billion, accounting for 6.8% and 0.2% of the total, respectively.

Table 1.1.4 Environmental activity accounts

Unit: million NT\$

	2014	2015	2016	Annual rate of increase (%)
Environmental protection expenditures	154,132	156,233	160,853	3.0
Government agencies	66,810	67,938	71,547	5.3
Industrial sectors	87,322	88,294	89,306	1.1
Environmental payments to the government	299,114	319,542	315,197	-1.4
Energy category	88,719	90,925	93,592	2.9
Transportation category	189,439	207,840	199,453	-4.0
Pollution category	20,187	20,149	21,533	6.9
Resource category	769	628	619	-1.4

IV. Environmental-economic account indicators

Environmental-economic account indicators are diverse indicators built up from related information about the environment and resource statistics, comprehensively compiled in Taiwan's Green National Income Account (see table 1.1.5). They encompass the four facets of environmental emissions, natural resources, environmental activities, and the comprehensive indicators. There are also eight topics: air; water; solid waste; minerals, earth and rocks; water resources; environmental protection expenditures; environmental payments to the government; and degradation & depletion. All told, there are 91 indicators. Through variations in these different indicators figures over the past three years, we may observe environmental loading, environmental quality, the circumstances of natural resource usage, and related actions by society and the government with regard to the environment.

Table 1.1.5 Environmental-economic account indicators (1/4)

Facets	Topics	Indicator items	Unit	2014	2015	2016
Environmental emissions	Air	Annual rate of increase in air pollution emissions	%	-2.72	-2.13	-1.26
		Concentration of air pollution emissions	M.T. / million NT\$	0.12	0.11	0.11
		Annual rate of increase in greenhouse gas emissions	%	-0.02	-0.56	—
		Concentration of greenhouse gas emission	M.T. of CO ₂ equivalent / million NT\$	18.43	18.18	—
		Greenhouse gas emissions per capita	M.T. of CO ₂ equivalent	12.23	12.13	—
		Annual rate of increase in carbon dioxide emissions	%	0.15	-0.33	—
		CO ₂ emissions intensity	M.T. / million NT\$	17.51	17.31	—
		CO ₂ emissions per capita	M.T.	11.62	11.55	—
		Percentage of days of PSI>100	%	1.3	0.6	0.8
		Annual average concentration of air pollutants				
	— Suspended particulates (PM _{2.5})	ug/m ³	23.6	22.0	20.0	
	— Nitrogen dioxide (NO ₂)	ppb	14.4	13.6	13.5	
	— Sulfur dioxide (SO ₂)	ppb	3.4	3.1	3.0	
	— Carbon monoxide (CO)	ppm	0.4	0.4	0.4	
	— Hydrocarbon(Non-methane) (NMHC)	ppmC	0.2	0.2	0.2	
	Water	Annual rate of increase in water pollution emissions				
		— Biochemical oxygen demand (BOD)	%	-1.72	-1.34	-3.62
		— Chemical oxygen demand (COD)	%	-1.45	-1.43	-2.61
		— Suspended solids (SS)	%	-1.82	-1.62	-3.63
		Concentration of water pollution emissions				
		— Biochemical oxygen demand (BOD)	M.T. / million NT\$	0.02	0.02	0.02
		— Chemical oxygen demand (COD)	M.T. / million NT\$	0.04	0.04	0.04
		— Suspended solids (SS)	M.T. / million NT\$	0.02	0.02	0.02
Percentage of lengths of major rivers non-polluted		%	62.8	66.4	66.1	
River quality achievement rate						
— Dissolved oxygen (DO)		%	87.9	87.2	89.8	
— Biochemical oxygen demand (BOD)		%	65.8	68.6	72.4	
— Suspended solids (SS)		%	68.7	71.8	68.4	
— Ammonia nitrogen (NH ₃ —N)	%	57.9	59.1	63.4		

Note: "-" denotes data that is one year behind.

Table 1.1.5 Environmental-economic account indicators (2/4)

Facets	Topics	Indicator items	Unit	2014	2015	2016
Environmental emissions	Water	Reservoir eutrophication index				
		– Number of reservoirs in eutrophic state	Reservoir	5	7	7
		– Number of reservoirs in mesotrophic state	Reservoir	13	12	12
		– Number of reservoirs in oligotrophic state	Reservoir	2	1	1
		Qualified rate of coastal water quality				
		– Dissolved oxygen (DO)	%	99.6	99.0	99.3
		– PH	%	99.5	100.0	99.5
		– Heavy metals	%	100.0	100.0	100.0
		Sewage treatment rate	%	48.9	51.1	53.4
		Qualified rate of drinking water (tap water) quality	%	99.86	99.88	99.92
	Solid waste	Annual rate of increase in solid waste generated	%	4.00	-13.41	-12.10
		– Municipal waste	%	-0.70	-1.59	1.76
		– Agricultural waste	%	6.44	-5.39	-0.33
		– Industrial waste	%	2.71	-1.00	-4.46
		– Construction waste	%	4.67	-18.34	-17.04
		– Medical waste	%	2.94	0.83	1.75
		Treatment rate of solid waste	%	96.94	96.93	96.89
		– Municipal waste	%	100.00	99.98	99.16
		– Agricultural waste	%	98.81	99.47	99.50
		– Industrial waste	%	97.89	97.88	97.77
– Construction waste		%	96.27	96.08	96.00	
– Medical waste		%	99.86	99.85	99.85	
Waste recycling rate		%	55.78	55.56	57.72	
Volume of municipal waste generated per capita		M.T.	0.32	0.31	0.32	
Annual rate of increase in volume of municipal waste recycled by implementing agencies		%	2.09	0.94	7.93	
Reuse rate for proper recycling of industrial waste	%	82.57	84.52	84.11		
Reuse rate for proper recycling of medical waste	%	5.46	6.34	7.00		

Table 1.1.5 Environmental-economic account indicators (3/4)

Facets	Topics	Indicator items	Unit	2014	2015	2016
Natural resources	Minerals, earth and rocks	Annual rate of increase in amount extracted				
		– Non-metallic minerals	%	-6.97	-12.46	-11.81
		– Earth & rock resources	%	1.07	-3.16	-13.69
		– Energy minerals	%	-2.26	-3.54	-29.17
		Annual rate of increase in domestic energy consumption	%	0.80	-0.27	0.26
		Dependence on imported energy	%	97.81	97.72	97.64
		Energy intensity	LOE / thousand NT\$	7.52	7.45	7.36
	Renewable energy supply/ total primary energy supply	%	1.96	2.03	2.15	
	Renewable energy power generation/ total power generation	%	3.78	4.02	4.77	
	Water resources	Annual rate of increase in effective reservoir capacity	%	-0.98	2.21	-0.59
		Ratio of industrial usage of reservoir water to industrial production value	10 thousand cubic meters / million NT\$	0.01	0.01	0.005
		Ratio of agricultural usage of reservoir water to agricultural production value	10 thousand cubic meters / million NT\$	1.60	1.22	1.99
		Annual rate of increase in river runoff	%	-35.05	17.60	–
		Annual rate of increase in the amount of groundwater ultra-pumped	%	-3.60	0.16	-3.39
Environmental activities	Environmental protection expenditures	Environmental protection expenditures by executive agencies (structural ratio)				
		– Government sectors	%	43.35	43.49	44.48
		– Industry sectors	%	56.65	56.51	55.52
		Environmental protection expenditures by purpose of expenditure (structural ratio)				
		– Pollution abatement and control expenditures	%	90.18	91.18	91.50
		– Research & development (R&D)	%	0.67	1.05	1.04
		– Others	%	9.15	7.78	7.46
		Air pollution control expenditures as a proportion of pollution abatement and control expenditures	%	36.06	28.15	27.90
Water pollution control expenditures as a proportion of pollution abatement and control expenditures	%	28.73	31.23	32.23		
Waste treatment expenditures as a proportion of pollution abatement and control expenditures	%	34.14	38.20	37.56		
Environmental protection expenditures as a proportion of GDP	%	0.96	0.93	0.94		

Table 1.1.5 Environmental-economic account indicators (4/4)

Facets	Topics	Indicator items	Unit	2014	2015	2016
	Environmental payments to the government	Structural ratio of environmental payments to the government				
		– Energy category	%	29.66	28.45	29.69
		– Transportation category	%	63.33	65.04	63.28
		– Pollution category	%	6.75	6.31	6.83
		– Resource category	%	0.26	0.20	0.20
		Ratio of energy tax to energy consumption	million NT\$ /10 ³ KLOE	0.76	0.78	0.80
		Ratio of air pollution tax to air pollution emissions	million NT\$ /10 ³ M.T.	4.05	3.94	4.44
		Ratio of general waste pollution tax to generation load	million NT\$ /10 ³ M.T.	0.65	0.66	0.67
		Annual rate of increase in the environmental taxes paid to the government for minerals, earth and rocks exploitation	%	-8.66	-18.32	-1.37
		Environmental payments to the government as a proportion of GDP	%	1.86	1.91	1.84
General indicators	Degradation & depletion	Annual rate of increase in degradation & depletion values	%	-2.99	-3.84	-5.60
		Annual rate of increase in degradation value	%	-4.08	-5.49	-0.46
		– Air	%	-7.16	-5.94	2.30
		– Water	%	-2.49	-4.91	-1.69
		– Solid waste	%	-5.48	-10.92	-0.96
		Annual rate of increase in depletion value	%	-0.23	0.16	-17.35
		– Minerals, earth and rocks resources	%	8.54	0.49	-48.80
		– Groundwater	%	-3.60	0.02	-3.71
		Degradation and depletion as a proportion of GDP	%	0.40	0.37	0.34
		Annual rate of increase in Green GDP	%	5.82	4.12	2.30

Attached table. Environmentally-adjusted Green GDP

Unit: million NT\$

	2014	2015	2016	Annual rate of increase (%)
I . GDP (a)	16,111,867	16,770,671	17,152,093	2.27
II . Depletion	18,669	18,699	15,453	-17.35
(I) Water resource (groundwater)	13,039	13,041	12,557	-3.71
(II) Minerals, earth and rocks resources	5,630	5,658	2,896	-48.80
III . Degradation	45,289	42,801	42,603	-0.46
(I) Air pollution	13,630	12,820	13,115	2.30
(II) Water pollution	29,587	28,136	27,661	-1.69
(III) Solid waste	2,071	1,845	1,827	-0.96
IV . Sum of Depletion and Degradation (b)	63,958	61,500	58,057	-5.60
Proportion to GDP (%)	0.40	0.37	0.34	--
V . Green GDP (a - b)	16,047,909	16,709,171	17,094,036	2.30

Note: 1. About the evaluations of natural resource depletion and environmental pollution degradation, according to SEEA 2003 suggestion, we adopt the Net Price Method and Cost-maintenance, respectively.

2. The contents of the compilation of SEEA 2012 have moved toward economic impacts on the flow accounts and asset accounts for environmental resources. There has been no further mention of the indicator of environmentally-adjusted GDP.

Green GDP environmentally-adjusted is the accounting statements for natural resource usage and environmental pollution emissions, as studied and compiled in accordance with SEEA 2003 guideline. Such statements are used to estimate the monetary value of natural resource depletion and environmental quality degradation. The values of both are then deducted from the GDP to become the Green GDP.

In terms of the overall data from 2014 to 2016, the aggregated value of natural resource depletion and environmental quality degradation totaled NTD 64.0 billion, 61.5 billion and 58.1 billion. Their proportion of GDP dropped from 0.40% in 2014 to 0.34% in 2016. With regard to natural resource depletion, the current items evaluated include water resources (groundwater) and minerals, earth & rock resources (non-metallic minerals; energy minerals; earth and rock resources). The aggregated value of depletion reached NTD 15.5 billion in 2016, down 17.35% from 2015. Within this, depletion of water resources was valued at NTD 12.6 billion in 2016, down 3.71% from 2015. In addition, the amount extracted-of minerals, earth & rock resources declined, their depletion was valued at NTD 2.9 billion, down 48.8% from 2015.

About environmental quality degradation, we refer to the suggestions of SEEA 2003. Currently, we mainly compile and calculate the three categories for environmental pollutants: air pollution, water pollution and solid waste, and the Cost-maintenance approach is also adopted to estimate their degradation value. The aggregated degradation value of the three categories in 2016 totaled NTD 42.6 billion, down 0.46% from 2015. Within these, water pollution degradation value was the highest, at NTD 27.7 billion in 2016; it was followed by air pollution degradation value at NTD 13.1 billion while solid waste degradation was valued at NTD 1.8 billion.

If the estimated results of the aforementioned natural resource depletion and environmental quality degradation are deducted from the GDP, the Green GDP in 2016 reached NTD 17.09 trillion, up 2.30% from 2015.