Introduction to the 2017 Energy Balances

I. Foreword

To conform to the international energy statistics such as those of the OECD/IEA and for the ease of international comparison, the Bureau of Energy released the new format Energy Balances in 2007. Based on the feedbacks from the readers, revision of new format has been employed again in 2012 and 2018 to integrate the statistics for biomass and waste and to adapt to the latest revision of OECD/IEA energy balance.

Though the new format Energy Balances has been compiled with data retroactive to 1982, they were printed with the coverage of 2008 through 2017 only due to the huge volume resulted from the expansions of rows and columns. In addition, electronic files of new format Balances since 1982 have been posted on the website of this Bureau: http://web3.moeaboe.gov.tw/ECW/english/web_book/WebReports.aspx?book=B_EN&menu_id=1541

Due to the change in the coverage of energy product, heat value, data source, and statistical classification, users should pay attention to the data content when applying the energy supply and consumption data in Energy Balance for international comparison.

II. Clarification of Revised Items in 2018

To improve international comparability and data quality, four revisions have been implemented:

1.Electricity:

(1)Adjustment of calorific value of electricity: following the International Recommendations for Energy Statistics of United Nations, the physical energy content method was adopted for the calorific value of electricity (860 kcal/kWh) instead of partial substitution method.

(2)Rearrangement of electricity related columns: referring to OECD/IEA energy balance, primary electricity, including nuclear, hydro, geothermal, solar PV and wind, are presented independently. The column of electricity only records transformation output of electricity generation and its consumption.

2.Natural Gas: modify the industrial classification of the sales data of natural gas and LNG gas industries since February 2003 to be in line with the 10th edition of Standard Industrial Classification of the R.O.C..

3.CHP Plants:

(1)Adjustment of allocation method for fuel input to heat production and power generation activities in CHP plants: adopt the Ecabert method. The useful heat produced is converted to its input equivalent by dividing it by the boiler efficiency. Then the heat assigned to the electricity production is the remaining heat after the input equivalent of the useful heat has been subtracted.

(2)Addition of missing fuel inputs to the energy balance to reflect actual usage of manufacturers.

(3)Harmonization of industrial classification between energy providers and CHP plants.

4.Sewerage, Waste Management and Remediation Activities: in line with the 10th edition of Standard Industrial Classification of the R.O.C., integrate the "sewerage, waste management and remediation activities" industry into the "Water supply; sewerage, waste management and remediation activities" industry.

III. Functions of the Energy Balances

The purpose of this serial publication, with energy products in columns and energy flows in rows to form a matrix format, is to provide the annual aggregate information on energy products at national level with flows from supply, through transformation, down to final consumption by sector and major industries of Taiwan.

The annual energy statistics are the accumulation of 12 monthly statistics, which have been compiled from the reports in original unit submitted each month to this Bureau by energy supply firms, large energy users, and relevant government administrations, and then converted to statistics and Balances in KLOE and 10^7 kilocalories. Since some monthly data are preliminary and subject to revisions, energy statistics annually released by this Bureau might vary from those released later in other publications.

Though the formats of Energy Statistics and Energy Balances of OECD/IEA differ slightly, the Energy Balances in original, 10^7 kilocalories, and KLOE unit, respectively, published by this Bureau have been compiled in the same format with same methodology.

The unit in this serial edition of Energy Balances is 10^7 kilocalories, i.e. the tone of oil equivalent (toe) in the OECD/IEA balances. For other energy statistical publications by this Bureau, however, the unit is KLOE, i.e. $0.9*10^7$ kilocalories.

Regarding the reliability of this serial Balances, since the supply data have been provided by energy industry and large energy users mandated by laws and regulations, data quality is

assured in terms of completeness, accuracy, and timeliness.

As for consumption data, just like the IEA energy statistics, final consumption represents for the most part energy deliveries to consumers. For gas and electricity, though the consumption data are in essence the sales data of the energy industry, acquired through meter-reading, they are essentially the actual consumption of consumers since there is no stockpile at users' end.

Concerning the coal data, figures are the actual volume consumed (for power generation and industrial process alike) and reported by large users. For petroleum products, those for transportation vehicles are sales data which varies slightly from the actual consumption since there are little stocks in car tanks. Factories might have more stocks for diesel oil and fuel oil, but that won't cause significant deviation between the actual consumption and the sales volume as end users are not obliged to hold oil stockpiles by law.

IV. Limitations to the Energy Balances

Since the data in these Balances is aggregated to national level, data of individual area or single firm could not be derived or inferred from the figures of these Balances. In addition, due to the frequent revisions of standard industrial classification, the product shift of a certain company, and the data of cross-industry conglomerate submitted by a representative company, the categorization of a certain firm into a specific industry may deviate from the actual production of that firm and may even differ between energy suppliers and this Bureau.

Owing to the limitations on data sources, some historic or detailed figures are estimates or not yet available. Moreover, since fuels for auto producer cogeneration plants are estimated by applying the Ecabert method, and subtracted from final consumption from pertinent industry and then displayed in transformation input, figures of final consumption by industry in these Balances might not be consistent with data collected through survey questionnaires or other sources.

Last but not least, the Energy Balances are meant to provide energy data at national level within a matrix format to demonstrate the energy flow from production, through transformation, and to the final consumption. Accordingly, they don't contain the data on useful energy output and wasted energy output as the Sankey Diagram.

V. Major Data Sources of Energy Balances

Energy Product	Energy Flow	Data Source	Remark
Bituminous Coal-Coking Coal	Production	Bureau of Mine	Domestic production split between coking coal and steam coal.
	Import, Consumption, Stock	Bureau of Mine, Steel Industry	
Bituminous Coal-Steam Coal	Production	Bureau of Mine	Domestic production split between coking coal and steam coal.
	Import, Consumption, Stock	Bureau of Mine, Power Supply Industry, Steel Industry, Other Large Users	
Anthracite	Import	Customs, Steel Industry	
	Consumption, Stock	Steel Industry	
Sub-Bituminous Coal	Import, Consumption, Stock	Power Supply Industry, Steel Industry	
Coke Oven Coke	Import	Customs, Steel Industry	
	Consumption, Stocks	Steel Industry	
Coke Oven Gas, Blast Furnace Gas, Oxygen Steel Furnace Gas	Production, Consumption, Loss	Steel Industry	
Crude Oil, LPG, Naphtha, Motor Gasoline, Jet Fuel, Kerosene, Diesel Oil, Fuel Oil	Production, Import, Export, International Marine Bunkers, Sales, Stock	Refineries, Petroleum Importers	These products are regulated by the Petroleum Management Law.
Other Petroleum Products	Production	Refineries, Lubricant Producers	
	Import, Export	Customs, Refineries	
	Sales	Refineries	
(Indigenous) Natural Gas, and (Imported) LNG	Production, Import	Refineries	
	Sales, Stock	Refineries, Gas Supply Industry	
Electricity, Heat	Generation, Sales, Loss	Power Supply Industry, including Cogeneration Plants	

Remark: Production refers to the indigenous production of primary energy or the transformation output of secondary energy.

VI. The Layout of the Energy Balances

1.The rows of the Energy Balances are composed of three major parts, i.e. energy supply, energy transformation and energy sector own use, and total final consumption.

Energy Supply		
Row 1	Indigenous Production	(1)This only refers to the domestic production of the primary energy. (2)The primary energy refers to the energy that has not been put to any conversion or transformation process, e.g. crude oil, natural gas, biomass and waste, hydro, geothermal, solar and wind power. (3)Overseas production of primary energy such as crude oil by domestic energy enterprises should not be included in "Indigenous Production."
Row 2	Imports	(1)This indicates the primary and secondary energy imported from abroad. (2)Though the OECD/IEA considers nuclear power quasi indigenous and therefore classifies it into indigenous production, nuclear power is deemed imports in this Balances. (3)While the summation of indigenous production and imports is titled Total Energy Supply in other publications of this Bureau, it is dubbed Total Primary Energy Supply (TPES) in Japanese energy statistics. The OECD/IEA has not named the summation of indigenous production and imports.
Row 3	Exports	This indicates the primary and secondary energy shipped to abroad.
Row 4	International Marine Bunkers	This reflects quantities of fuel supplied to sea-going ships at the domestic harbors for destination port in foreign countries whatever their flags and category. The international marine bunkers are different from exports.
Row 5	International Civil Aviation	This reflects quantities of fuel supplied for international civil aviation.
Row 6	Change in Stocks	(1)This by definition indicates the fluctuation in stocks of the primary and secondary energy between ends of two consecutive years. (2)The stock changes for bituminous coal-coking coal, bituminous coal-steam coal, anthracite, sub-bituminous coal, coke, crude oil, refinery feedstocks, liquefied petroleum gas (LPG), naphtha, motor gasoline, jet fuel, kerosene, diesel oil, and fuel oil, and liquefied natural gas (LNG) are basically the actual changes in stocks in recent years. For other energy products, the change in stocks is in fact the residual to balance supply and demand of that energy, as was in previous format. (3)Since the bituminous coal and sub-bituminous coal

		could not be split at the stages of storage and combustion for power industry before June 2016, they are estimates according to the ratio of imports, but are reported number thereafter. Thus, uncertainty exists in change in stocks and statistical differences for these two coals. However, the statistical difference shrinks when these two coals combined.
Row 7	Total Primary Energy Supply (TPES, known as Total Energy Requirement in old format)	Total Primary Energy Supply (TPES), as in OECD/IEA energy statistics and equivalent to Domestic Primary Energy Supply (DPES) in Japanese energy statistics, is derived by the formula: Row 7＝Row 1＋Row 2－Row 3－Row 4－Row 5－Row 6.
Transformation and Own Use		
Row 8	Transfers(Input)	(1)This refers to the inter product transfer among the petroleum products. The figures reflect quantities transferred to other oil products. As for LNG, the figure reflects the quantity of LNG re-gasified to produce NG (2), and the re-gasified LNG used to produce NG (1). (2)Due to the complexity of the refining and petrochemical processes, and the lack of complete and accurate data as a result, some figures in this row are estimates.
Row 9	Statistical Differences	This row is derived by the formula: R9=R7-R8-R10+R19-R22-R32-R33 for those columns with actual stock changes; it is zero for columns if the stock change is the residual to keep that column balanced.
Row 10	Transformation Input	(1)This row represents the primary and secondary energy transformed into other types of the secondary energy, such as coals transformed into cokes, coal and fuel oil into thermal power etc. (2)The row “Coke and Gas” in the previous format is divided into “Coke Ovens” and “Blast Furnaces”. (3)Power generation and cogeneration are detailed into public and auto producers. While public producers refer to the electricity plants and cogeneration plants generating for sale as main business, the auto producers are plants generating basically for own use. (4)The PCI coal used in the blast furnaces, which was considered as fuel and categorized into Energy Sector Own Use in 2006 to 2008 editions, is reclassified into Transformation Input starting 2009

		edition. (5)Fuels for auto cogeneration producers are derived by subtracting the input equivalent of the useful heat from total fuel input. (6)Electricity to pump up is classified into the "Energy Sector Own Use."
Row 19	Transformation Output	(1)This indicates the domestic production of the secondary energy, such as the coke transformed from coking coal in coke ovens. (2)The efficiency of refinery is roughly obtained as the ratio of Transformation Output plus the Transfer of the Column "Crude Oil and Petroleum Products Total" to the Transformation Input of "Crude Oil". Theoretically, the closer to 100% the ratio, the higher the refinery efficiency. (3)The transformation output of the (domestic) natural gas is the re-gasified imported Liquefied Natural Gas (LNG) with the same heating value as the domestic natural gas. (4)The transformation output of the hydro power is the gross pumped storage power generation. (5)The "Electricity-Electricity Plants Subtotal/ Transformation Output"
Row 21	Transfers(Output)	This refers to the inter product transfer among the petroleum products. The figures reflect quantities transferred into this oil product from other oil products. As for (domestic) natural gas, the figure reflects the quantity of NG (1) transferred from re-gasified LNG. As for imported LNG, the figure reflects the quantity NG (2) transferred from re-gasified LNG.
Row 22	Energy Sector Own Use	(1)This indicates the quantity of own-use in each energy transformation unit or energy industry, for example, the own use or station service of coal mining, coke ovens, blast furnaces, oil & gas mining, oil refineries, electricity plants, electricity to pump up, and gas supply industry. (2)Since refining companies in Taiwan also operate naphtha cracking plants, energy data of petroleum refineries contains data which should have been classified into petrochemical materials in the industrial sector.
Row 32	Loss	(1)This represents the actual emission as waste of coke oven gas, blast furnace gas, and oxygen steel furnace gas in steel mill, and the line loss of the power transmission and distribution system.

		(2)Figures starting 2001 of line losses are actual losses and were estimated from line loss rate before 2001.
Total Final Consumption		
Row 33	Total Final Consumption (TFC)	(1)This row is the sum of energy consumption and non-energy use, that is Row 33 = Row 34 + Row 95. The energy consumption is the summation of five final consuming sectors, namely industrial, transportation, agricultural, service, and residential sectors. (2)The non-energy use is the quantity for use other than energy purpose. (3)The estimated naphtha and LPG for petrochemical feed stocks are included in industrial sector. However, the petrochemical feed stocks are classified as non-energy use starting with 2007 edition of the OECD/IEA energy statistics.
Row 34	Energy Consumption	Energy Consumption is classified by Industrial Sector, Transportation Sector, Agricultural Sector, Service Sector, and Residential Sector. Row 34＝Row 35＋Row 73＋Row 80＋Row 83＋Row 94.
Row 35	Industrial Sector	(1)This includes mining (excluding coal mining, oil and gas mining), manufacturing industries (except for coal products, oil refineries), water supply, sewerage, waste management and remediation activities, and construction. (2)Due to industrial transformation, business diversification and collective purchasing, the industrial classification of major energy users exists uncertainty. The industry level energy consumption data should be used with caution. (3)Due to the lack of detailed petroleum product data, the data for the sub-industry under Chemical Materials is incomplete.
Row 73	Transportation Sector	(1)This includes basically the energy consumption for transport in domestic air, road, railroad, pipeline, and internal navigation (excluding international marine bunkers and international civil aviation). (2)Therefore the electricity for tracks, for example, is shown in railroad while that for platform lighting and office use is included in “Services Sector\Transport Services”. (3)The international civil aviation which appears between “International Marine Bunkers” and “Stocks Changes” starting with 2009 edition of OECD/IEA Energy Balances remains in Transportation Sector in these Balances.

Row 80	Agricultural Sector	This includes agriculture, animal husbandry and forestry, fishing and aquaculture, as was in the old format.
Row 83	Service Sector	This sector includes the energy consumption of the wholesale and retail, hotels and restaurants, transport services, storage and warehousing, communication, finance, insurance, and real estate, business services, social and personal services, and public administration, etc.
Row 94	Residential Sector	This indicates the energy consumption of households (of non-commercials).
Row 95	Non-Energy Use	(1)This includes the energy products for non-energy purpose such as lubricants, asphalts, and solvents, etc. Anthracites for industrial catalyst and filtering, cokes for enforcement of carbon content, are the examples of non-energy use of energy products. (2)Due to lack of detailed data, feedstock of Chemical Materials is for reference only.
Row 100	Electricity Generated	This shows the gross electricity generation split into Electricity Plants and Cogeneration Plants, as well as generation of hydro (including pumped storage production), coal, oil, natural gas, nuclear, geothermal, solar photovoltaic, and wind.
Row 103	Heat Generated	This shows the heat generated by public cogeneration plants.
Row 100 to 104 serve only as supplement to the Energy Balances and are not indispensable to a complete energy balance table.		

2.The columns of Energy Balances indicate the primary and secondary energy of various energy commodities, including 7 main categories, i.e. coal, petroleum, natural gas, biomass and waste, electricity, solar thermal, and heat.

Coal	Column.1 (Coal & Coal Products) ＝Col.2 (Bituminous Coal-Coking Coal)＋Col.3 (Bituminous Coal-Steam Coal)+ Col.4 (Anthracite)＋Col.5 (Sub-bituminous Coal)＋Col.6 (Lignite)＋Col.7 (Peat)＋Col.8 (Coke Oven Coke)＋Col.9 (Patent Fuel)＋Col.10 (Coke Oven Gas)＋Col.11 (Blast Furnace Gas)＋Col.12 (Oxygen Steel Furnace Gas)
	(1)In previous format, coal was divided into indigenous coal, imported coking coal, and imported steam coal. The new format displays 6 categories of coal as illustrated, though some data are not available yet. Oxygen steel furnace gas is a new energy in new format. (2)The production of indigenous coal in previous Energy Balances is split

	into production of bituminous coal-coking coal and bituminous coal-steam coal, respectively, according to the ratio of coking and fuel use. (3)The coal imports of steel industry, which was classified into imported coking coal and imported steam coal in previous format, is re-categorized into coking coal, steam coal, anthracite, and sub-bituminous coal according to the quality of coal. (4)Volumes of coke oven gas, blast furnace gas, and oxygen steel furnace gas for cogeneration in the steel industry are estimates for early years due to lack of reliable data.
Petroleum	Col.13 (Crude Oil & Petroleum Products) = Col.14 (Crude Oil) + Col.15 (Refinery Feed Stocks) + Col.16 (Additives/Oxygenates) + Col.17 (Refinery Gas) + Col.18 (LPG) + Col.20 (Natural Gasoline) + Col.21 (Naphtha) + Col.22 (Motor Gasoline) + Col.24 (Aviation Gasoline) + Col.25 (Jet Fuel-Gasoline Type) + Col.26 (Jet Fuel-Kerosene Type) + Col.27 (Kerosene) + Col.28 (Diesel Oil) + Col.29 (Fuel Oil) + Col.30 (White Spirits) + Col.31 (Lubricants) + Col.32 (Asphalts) + Col.33 (Solvents) + Col.34 (Paraffin Waxes) + Col.35 (Petroleum Coke) + Col.36 (Other Petroleum Products)
	(1)Col.19 (Propane Air, PA): Consumption of PA is included in Col.18 (LPG). This column is for reference only. (2)Col.23 (Unleaded Gasoline): Consumption of unleaded gasoline is included in Col.22 (Motor Gasoline) and is intended for reference only. (3)Columns of refinery feed stocks, additives/oxygenates, white spirits, and paraffin waxes, are new columns in new format and need to be improved in terms of completeness and accuracy. (4)The definition of naphtha varied in previous years. It might mean intermediate products or final products. It indicates final products in recent years. (5)The jet fuel is split into gasoline type and kerosene type; columns of olefins and aromatics, which are the basic petrochemical materials rather than energy products, are removed and are not shown in the new format any more. (6)Some of the figures of the lubricants and other petroleum products are estimates due to different definitions by different companies. (7)Interproduct transfer of oil products is the quantity for reprocessing or transfer. Hence, that of naphtha is the amount for reformate gasoline: that of diesel oil is the amount transferred to LPG, and other gas oil (FCC); that of fuel oil is for LPG, gasoline, diesel oil, and others (ROC, RFCC).
Natural Gas	Col. 37 (Natural Gas Total)= Col. 38 (Indigenous Natural Gas) + Col. 39 (Imported LNG)
	(1)Natural gas has two origins: Indigenous natural gas and imported LNG with heating values 8,000 Kcal/cubic meter and 9,000 kcal/cubic meters (net heating value), respectively; they are dubbed NG (1) and NG (2) at

	retail side. A significant portion of NG (1) is the re-gasified part of the LNG with the heating value reduced to 8,000 kcal/cubic meter as the indigenous natural gas, and is shown as the transfers (output) of (indigenous) natural gas. (2)Since LNG outnumbers the indigenous natural gas year by year, the summation of indigenous natural gas and imported LNG is measured in metric ton with indigenous natural gas converted from volume to weight by its heat content equivalent to the imported LNG.
Biomass and Waste	(1)Col.40 (Biomass and Waste Total)＝Col.41 (Biomass Total)＋Col.45 (Waste and other Non-specified) (2)Col.41 (Biomass Total) ＝ Col.42 (Solid Biomass) ＋ Col.43 (Liquid Biomass)＋Col.44 (Biogas)
	(1)Solid biomass includes bagasse, black liquor, and rice husks, which are used as fuel in CHP plants. (2)Liquid biomass includes biodiesel, bioethanol, and bio-fuel oil. (3)Biogas is formed by the digestion of landfilled and sewage waste, and used as fuel in CHP plants. (4)Waste includes municipal solid waste and industrial waste, which are used as fuel in CHP plants.
Electricity	(1)In the latest revision, the calorific value of electricity adopted the physical energy content method (860 kcal/kWh) instead of partial substitution method. (2)The primary electricity, including nuclear, hydro, geothermal, solar PV and wind, are presented independently. The column of electricity only records transformation output of electricity generation and its consumption.
Solar Thermal	Col.52 (Solar Thermal) is the estimated energy from the installed capacity of solar heat collectors for domestic hot water or swimming pools.
Heat	Col.53 (Heat) shows the flow of heat produced by public cogeneration plants and that produced and sold by auto producer cogeneration plants.

VII. Measurement Units in Energy Balances and Other Publications

MT=Metric Ton=1,000 kg (kilograms)
L=Liter=1,000 c.c. (cubic centimeters)
KL=Kilo Liters,
KWh=Kilo Watt hour
MWh=Mega Watt hour
LOE=Liter Oil Equivalent=9,000 Kcal (kilo calories)
KLOE=Kilo Liter of Oil Equivalent=1,000 LOE=$0.9*10^7$ Kcal
TOE=Tonne of Oil Equivalent=10^7 Kcal