

Introduction to the 2010 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, a slightly revised new format has been employed to produce the Energy Balances afterwards.

Energy Balance Sheets published before 2007 were designed basically with the then OECD/IEA format as a reference framework. The layout of columns and rows had remained relatively stable when compared to the constant adjustments of the OECD/IEA format, which is more responsive to the appeal of a better configuration for the complete energy flows and facilitation to calculate the Green House Gases (GHG) emission. Consequently, the differences between the columns and rows in Energy Balances of the previous format and the concurrent OECD/IEA format had become increasingly significant.

The new format Energy Balances has thus been prepared with the OECD format as a reference, while taking into account the consistency of historical data, the characteristics of Taiwan energy situation, and the changes in heat content of energy products, thereby leading to the subsequent updates in formats and figures of relevant statistical tables in other publications of this Bureau.

Though the new format Energy Balances has been compiled with data retroactive to 1982, they were printed with the coverage of 2001 through 2010 only to save the huge volume resulted from the expansions of rows and columns. In addition, electronic files of new format Balances ranging from 1982 through 2010 have been posted on the website of this Bureau:

http://www.moeaboe.gov.tw/opengovinfo/Plan/all/energy_balance/main/en/default.htm

II. 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.

While electricity consumption figures in unit of 10^7 kilocalories have been converted by a constant 860 kcal/KWh to facilitate international comparison, figures in unit of KLOE have been calculated by average plant efficiency of thermal power plants, for the purpose of domestic performance evaluation of energy efficiency (EE) policy and action plans, fuel switch assessment, energy consumption projections, and planning of energy supply.

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.

III. 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 average plant efficiency of thermal power plants, 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.

IV. Major Data Sources of Energy Balances

Energy Product	Energy Flow	Data Source	Remark
Bituminous Coal-Coking Coal	Production Import、 Consumption、Stock	Bureau of Mine Steel Industry	Domestic production split between coking coal and steam coal.
Bituminous Coal-Steam Coal	Production Import、 Consumption、Stock	Bureau of Mine Power Supply Industry、Steel Industry、Other Large Users	
Anthracite	Import Consumption、Stock	Customs、Steel Industry Steel Industry	

Sub-Bituminous Coal	Import、Consumption、Stock	Power Supply Industry、Steel Industry	
Coke Oven Coke	Import、Consumption、Stocks	Customs、Steel Industry 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 Import、Export Sales	Refineries Customs、Refineries Refineries	
(Indigenous) Natural Gas、(Imported) LNG	Production、Import Sales、Stock	Gas Producer /Importer 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.

V. 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

		<p>primary energy.</p> <p>(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, hydro power, geothermal, solar and wind power.</p> <p>(3) Overseas production of primary energy such as crude oil by domestic energy enterprises should not be included in “Indigenous Production”.</p> <p>(4) While the indigenous production of hydro power in the previous format was composed of both the gross conventional hydro power generation and the gross pumped storage power generation, it represents only the gross conventional hydro power generation in new format.</p> <p>(5) The gross pumped storage hydro power generation is displayed in “Hydro Power\ Transformation Output” for the purpose of full disclosure.</p> <p>(6) The electricity to pump up is shown in the Energy Sector Own Use in the column “Electricity-Electricity Plans Subtotal”.</p>
Row 2	Imports	<p>(1) This indicates the primary and secondary energy imported from abroad.</p> <p>(2) Though the OECD/IEA considers it quasi indigenous and therefore classifies it into indigenous production, nuclear power is deemed imports in this Balances as was in the previous format.</p> <p>(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.</p>
Row 3	Exports	<p>This indicates the primary and secondary energy shipped to abroad.</p>
Row 4	International Marine Bunkers	<p>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.</p>
Row 5	Change in Stocks	<p>(1) This by definition indicates the fluctuation in stocks of the primary and secondary energy between ends of two consecutive years.</p> <p>(2) The stock changes for bituminous coal-coking coal, bituminous coal-steam coal, anthracite, sub-bituminous coal, coke, crude oil, liquefied petroleum gas (LPG), naphtha, motor gasoline, jet</p>

		<p>fuel, kerosene, diesel oil, and fuel oil, are basically the actual changes in stocks in recent years.</p> <p>(3) 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.</p> <p>(4) Since the bituminous coal and sub-bituminous coal could not be split at the stages of storage and combustion for power industry, they are estimates according to the ratio of imports. Thus, uncertainty exists in change in stocks and statistical differences for these two coals. However, the statistical difference shrinks when these two coals combined.</p>
Row 6	Total Primary Energy Supply (TPES, known as Total Energy Requirement in old format)	<p>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: $Row\ 6 = Row\ 1 + Row\ 2 - Row\ 3 - Row\ 4 - Row\ 5.$</p>
Transformation and Own Use		
Row 7	Transfer	<p>(1) This refers to the inter product transfer among the petroleum products. While positive figures indicate volumes transferred from other oil products, negative figures reflect quantities transferred to other oil products.</p> <p>(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.</p> <p>(3) Figures since 2009 edition are those provided by refineries, whereas figures in previous 2006 to 2008 editions were estimated by this Bureau using constant ratios which might not represent the actual annual changes.</p>
Row 8	Statistical Differences	<p>This row is derived by the formula: $Row\ 8 = Row\ 6 - Row\ 9 + Row\ 18 - Row\ 19 - Row\ 29 - Row\ 30$ for those columns with actual stock changes; it is zero for columns if the stock change is the residual to keep that column balanced.</p>
Row 9	Transformation Input	<p>(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.</p> <p>(2) The row “Coke and Gas” in the previous format is divided into “Coke Ovens” and “Blast Furnaces”.</p> <p>(3) Power generation and cogeneration are detailed into public and auto producers. While public</p>

		<p>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.</p> <p>(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.</p> <p>(5) LNG in “Transformation Input \ Petroleum Refineries” indicates the input volume of LNG to convert from liquid state back to gaseous state.</p> <p>(6) Fuels for auto cogeneration producers are derived by assumption that the thermal efficiency of electricity generation is the same as that of the average thermal power plants.</p> <p>(7) Electricity to pump up in the previous format is reclassified into the “Energy Sector Own Use” in the new format.</p>
Row 18	Transformation Output	<p>(1) This indicates the domestic production of the secondary energy, such as the coke transformed from coking coal in coke ovens.</p> <p>(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.</p> <p>(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.</p> <p>(4) The transformation output of the hydro power is the gross pumped storage power generation.</p>
Row 19	Energy Sector Own Use	<p>(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.</p> <p>(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.</p> <p>(3) The own use of energy sector was included in final consumption in the previous format, and is relocated</p>

		between the transformation and loss, and therefore no longer a part of final consumption in new format. (4) Thus, the summation of energy sector own use and total final consumption in new format, entitled “Total Domestic Consumption” in other publications, is equivalent to the “Final Energy Consumption” in previous format of Balances.
Row 29	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 30	Total Final Consumption (TFC)	(1) This row is the sum of energy consumption and non-energy use, that is Row 30 = Row 31 + Row 94. (2) The energy consumption is the summation of five final consuming sectors, namely industrial, transportation, agricultural, services, and residential sectors. (3) The non-energy use is the quantity for use other than energy purpose. (4) 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 31	Energy Consumption	(1) Commercial sector and Other sectors in old format are grouped into Services Sector, except for the Water Supply and Construction which are put into Industrial Sector in new format. (2) The classification of energy statistics by sector and subsector might not be identical to that for industrial production statistics and national income statistics.
Row 32	Industrial Sector	(1) This includes mining (excluding coal mining, oil and gas mining), manufacturing industries (except for coal products, oil refineries), water supply, and construction. (2) Water Supply and Construction appearing in “Other Sectors” in the previous format are categorized into industrial sector in the new format. (3) Due to lack of detailed data, figures of sub-industries in Chemical Materials are for reference only.
Row	Transportation Sector	(1) This includes basically the energy consumption

71		<p>for transport in international civil aviation, domestic air, road, railroad, pipeline, and internal navigation (excluding international marine bunkers).</p> <p>(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”.</p> <p>(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.</p>
Row 79	Agricultural Sector	This includes agriculture, animal husbandry and forestry, fishing and aquaculture, as was in the old format.
Row 82	Services Sector	<p>(1) This 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.</p> <p>(2) Since commerce which consisted of the wholesale and retail, hotels and restaurants, and international trade is no longer an single industry in the latest Standard Industrial Classification (SIC), the Commercial Sector in old format was merged with the Other Sectors, exclusive of water supply and construction, to form the “Services Sector” in new format.</p>
Row 93	Residential Sector	This indicates the energy consumption of households (of non-commercials).
Row 94	Non-Energy Use	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.
Row 98	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 101	Heat Generated	This shows the heat generated by public cogeneration plants.
Row 98 to 102 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 five main categories, i.e. coal, petroleum, natural gas, electricity, and solar thermal and heat.

Coal	<p>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)</p> <p>(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.</p> <p>(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.</p> <p>(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.</p> <p>(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.</p>
Petroleum	<p>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)</p>

	<p>(1) Col.19 (Propane Air, PA): Consumption of PA is included in Col.18 (LPG). This column is for reference only.</p> <p>(2) Col.23 (Unleaded Gasoline): Consumption of unleaded gasoline is included in Col.22 (Motor Gasoline) and is intended for reference only.</p> <p>(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.</p> <p>(4) The definition of naphtha varied in previous years. It might mean intermediate products or final products. It indicates final products in recent years.</p> <p>(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.</p> <p>(6) Some of the figures of the lubricants and other petroleum products are estimates due to different definitions by different companies.</p> <p>(7) Interproduct transfer of oil products is the quantity for reprocessing or transfer. Hence, that of naphtha is the amount for reformat 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).</p> <p>(8) LPG consumption of commercial sector in previous format is categorized into “Services Sectors\ Hotels and Restaurants” for convenience.</p>
Natural Gas	<p>Col. 37 (Natural Gas Total)= Col. 38 (Indigenous Natural Gas) + Col. 39 (Imported LNG)</p> <p>(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 transformation output of (indigenous) natural gas.</p> <p>(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.</p>
Electricity	<p>(1) Col.40 (Electricity Total)= Col.41 (Electricity-Electricity Plants Subtotal) + Col.46 (Electricity-Cogeneration Plants)</p> <p>(2) Col.41 (Electricity-Electricity Plants Subtotal)= Col.42 (Hydro Power) + Col.43 (Nuclear Power) + Col.44 (Thermal Power) + Col.45 (Geothermal Electricity, Solar Photovoltaic and Wind Power)</p>

	<p>(1) The electricity sold to the transmission and distribution system by the cogeneration plants is included in “Electricity-Electricity Plants Subtotal\Transformation Output”.</p> <p>(2) Hydro power production consisted of both conventional generation and production from pumped storage plants in previous format. In this new format, however, it consists of gross conventional hydro power only. Gross production from pumped storage plants is shown as “Hydro Power \Transformation Output”.</p> <p>(3) The “Electricity-Electricity Plants Subtotal\Transformation Input _ Public Electricity Plants” is the net power generation transmitted to the electricity grid from various types of fuel, while the station use of power plants of all types is shown in electricity plants of energy sector own use.</p> <p>(4) Nuclear power deemed quasi-indigenous energy and classified into Indigenous Production by OECD/IEA, is categorized as imports in this new format as was in the previous format.</p> <p>(5) Geothermal, solar, and wind power are included in “Electricity-Electricity Plants Subtotal” for ease of processing.</p> <p>(6) Col.46 (Electricity –Cogeneration Plants): transformation output of this column is the total gross electricity generation of all public and auto producer cogeneration plants; the row “Transformation Input\ Public Electricity Plants” in this column is the electricity sold to the transmission and distribution system by all the cogeneration plants; station use of the public cogeneration plants is shown in “Cogeneration Plants” of energy sector own use and that of auto producers is shown in the pertinent industries.</p> <p>(7) Figures of Col.47 (Biomass Power) which exhibits the electricity generated from black liquor in paper factory and biogas electricity generation and so forth, and Col.48 (Waste to Generation) such as electricity generated by incinerators of municipal waste, are included in Col.46 (Electricity-Cogeneration Plants) and are for reference only.</p>
Solar Thermal and Heat	<p>(1) Col.49 (Solar Thermal) is the estimated energy from the installed capacity of solar heat collectors for domestic hot water or swimming pools.</p> <p>(2) Col.50 (Heat) shows the flow of heat produced by public cogeneration plants and that produced and sold by auto producer cogeneration plants.</p>
New and Renewable Energy	<p>(1) The production of ethanol gasoline (E100), bio diesel oil, and renewable fuel oil is included in the transformation output of motor gasoline, diesel oil, and fuel oil, respectively, and unveiled in the footnote at the bottom of the balance tables.</p> <p>(2) Geothermal, solar, and wind power is shown in a separate column.</p> <p>(3) Waste to generation, and biomass cogeneration are included in “Electricity-Cogeneration Plants”, since the relevant plants are governed by regulations on promotion of cogeneration.</p> <p>(4) Separate column for new and renewable energy will be shown to depict the complete energy flow from supply, through transformation, and to final consumption in the future if reliable data is available.</p>

VI. 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

VII. What's New

1. Due to reclassification, consumption data of domestic natural gas and imported LNG are updated for industrial, residential, and services sectors while the total consumption remains unchanged.
2. Solar photovoltaic data revised for 2008 and 2009.