The Energy Balance Table of Japan

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Singapore

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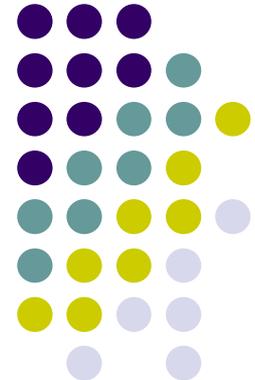
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Energy Balance Table

- An Energy Balance Table (EBT) is an accounting table presenting a coherent picture of flows of all types of energy from their origin, through transformation processes to final use

- A comprehensive model that represents information on physical flow of energy

- As an energy balance table contains all the types of energy sources consumed in the energy system; a single unit for all types of energy is used.

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Objectives of EBT in Japan

CO_2

CO_2

Final consumption

Production /Import

transformation
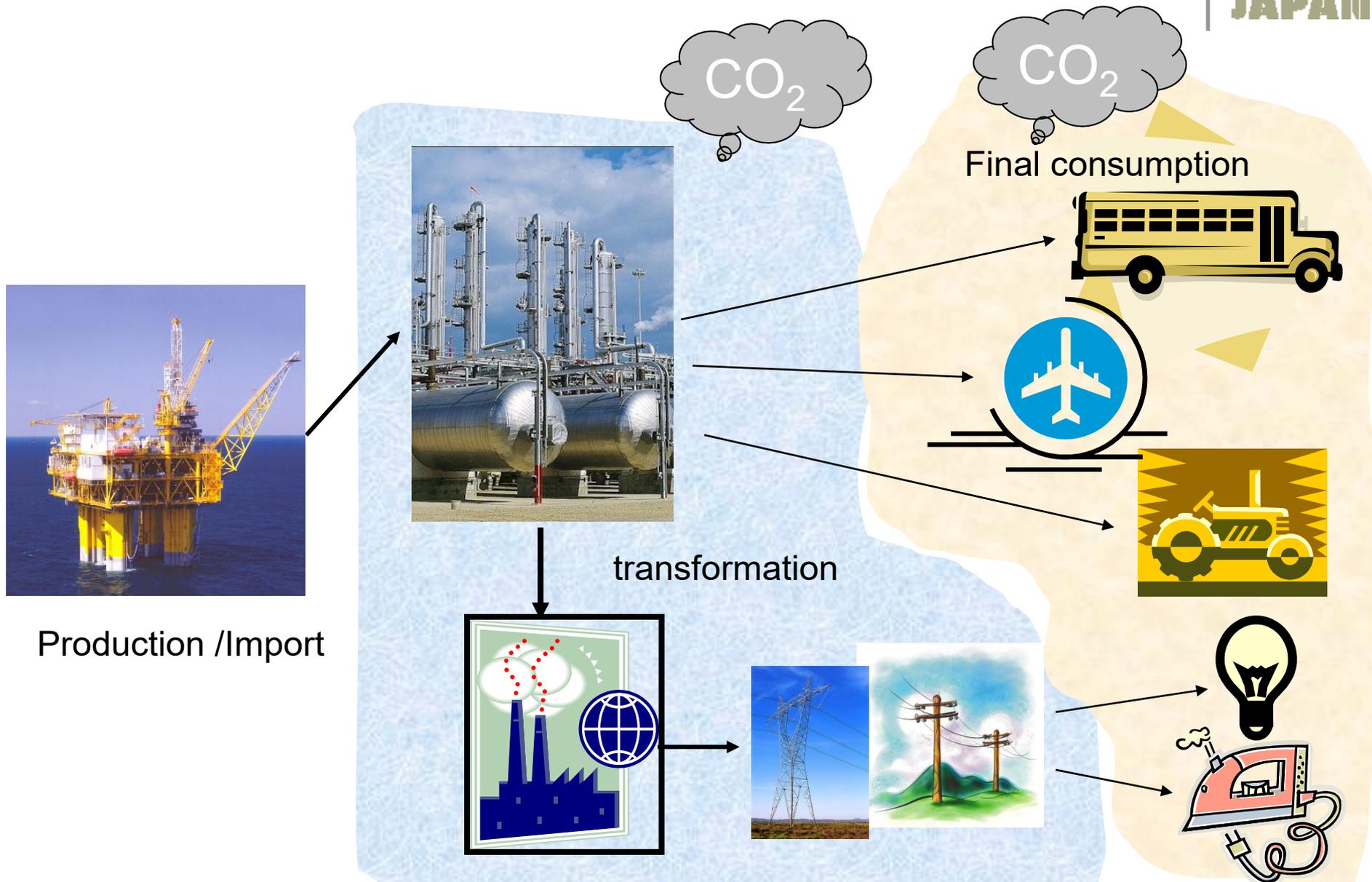
Uses of EBT in Japan

- Monitoring the energy market

- Energy security analysis

- Planning for sustainable development

- Mitigation of environmental impact of energy

- Analysis of economic opportunities from new technologies i.e.: energy efficiency

- Energy planning and policy formulation

- Reporting Japan's energy supply and demand to IEA Reporting Japan's energy-related CO_2 emissions to UN

- Contributing transparency framework in the Paris Agreement

Users of EBT in Japan

- Energy Policy Makers
  - Formulation and monitoring the impact of energy policies on the economy
  - Monitoring the country's energy security
  - Planning energy industries' development and promotion of energy conserving technological processes
  - Environmental policy, especially greenhouse gas emission inventories, and environmental statistics
- Business community
  - Evaluation of various business options
  - Energy demand forecasting for supply planning

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Users of EBT in Japan

- Compilers and users of national accounts
  - Energy statistics together with basic economic statistics, are needed to provide basis for the analysis of economic trends, business cycles, etc
- International Organizations
  - Monitoring of various aspects of global energy and environmental status, including climate change, energy statistics are needed to carry out such activities
- General Public
  - Availability of timely energy statistics is important in evaluation of energy and environmental situation in order to make more informed decisions such as information on energy costs, prices, and their trends, contribute to the decision making about efficiency, sustainability and the economy

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Parts of an EBT of Japan

Products

Flows

Primary Supply

Transformation

Final Demand

	Coal	Coal Products	Crude Oil	Oil Products	Natural Gas	City Gas	Renewable	Hydraulic Power Generation (excl. pumped)	Pumped Storage	Effective Recovery Use of Wasted Energy	Nuclear Power Generation	Electricity	Heat	Total
	10^3 t	10^3 t	10^3 kl	10^3 kl	10^3 t	10^6 m3	TJ	10^6 kWh	10^6 kWh	TJ	10^6 kWh	10^6 kWh	TJ	TJ
Primary Energy Supply	193170.1	1062.6	192363.7	13355.8	91552.9	-17.8	860086.5	78901.9	0.0	604694.4	18060.0	0.0	0.0	20170405.0
Indigenously Produced	1254.2	0.0	519.4	0.0	2092.1	0.0	838953.1	78901.9	0.0	604694.4	18060.0	0.0	0.0	2421077.4
Imported	191918.1	2301.7	190719.2	46349.8	84748.5	0.0	21165.4	0.0	0.0	0.0	0.0	0.0	0.0	18744242.7
Total Primary Energy Supply	193172.3	2301.7	191238.5	46349.8	86840.6			0.0	0.0	604694.4	18060.0	0.0	0.0	21165320.1
Export	-2.2	-1158.2	0.0	-33516.2	0.0	0.0	-52.0	0.0	0.0	0.0	0.0	0.0	0.0	-1311686.6
Stockpile Change / Supply	0.0	-80.9	1125.2	522.1	4712.3	-17.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	316771.5
Domestic Primary Energy Supply	193170.1	1062.6	192363.7	13355.8	91552.9	-17.8	860086.5	78901.9	0.0	604694.4	18060.0	0.0	0.0	20170405.0
														20375077.3
Energy Transformation & Own Use	-177570.6	37830.7	-192713.1	155200.6	-92121.9	28414.0	-843213.8	-78901.9	0.0	-577185.5	-18060.0	965593.7	880263.4	-6753052.4
Manufacture of Coal Products	-59813.7	56422.0	0.0	-548.7	0.0	0.0	0.0	0.0	0.0	-4967.4	0.0	0.0	0.0	-114014.0
Oil Products	0.0	0.0	-190213.6	189260.7	62.5	0.0	-12494.2	0.0	0.0	0.0	0.0	0.0	-117634.3	-163157.3
Gas Conversion and Production	0.0	0.0	0.0	-1828.4	-31984.8	42840.8	-130.2	0.0	0.0	0.0	0.0	0.0	0.0	48.1
Power Generation	-98972.6	-4014.8	-3191.3	-11495.2	-56935.7				0.0	-114061.5	-18060.0	882737.5	0.0	-4461289.3
Auto Power Generation	-8794.9	-6905.5	-1.3	-5762.4	-630.2				0.0	-225152.4	0.0	178883.6	0.0	-851060.5
Auto Steam Generation	-9158.8	-2729.5	-2.3	-8466.8	-454.1	-4916.8	-160664.7	0.0	0.0	-226191.8	0.0	0.0	982168.0	-269893.5
District Heat Supply	0.0	0.0	0.0	-5.8	0.0	-342.0	0.0	0.0	0.0	-3509.9	0.0	-1002.4	21749.6	-57.9
Own Use and Loss	-487.3	-4740.7	-67.8	-6804.0	-2749.8	-1514.4	-4539.7	0.0	0.0	-100.5	0.0	-95025.0	-6019.9	-965062.4
Transformation and Consumption Stockpile Change	-343.3	-200.8	763.1	218.9	570.2	-0.4	-3470.9	0.0	0.0	-3201.9	0.0	0.0	0.0	47785.4
Statistical Discrepancy	-727.1	1513.6	-349.4	4605.5	-1719.8	4313.4	7018.3	0.0	0.0	110.4	0.0	-12634.4	-72377.9	161207.7
Final Energy Consumption	16326.5	37379.7	0.0	168564.8	1150.8	28396.2	16872.7	0.0	0.0	27398.5	0.0	978228.1	952641.3	13622025.0
Industry	16325.0	37379.7	0.0	74694.2	1150.8	18667.6	7332.8	0.0	0.0	27398.5	0.0	691346.0	951538.9	8577835.3
Agriculture, Fishery, Mining and Construction,	1.1	11.2	0.0	8875.5	91.7	75.1	0.0	0.0	0.0	0.0	0.0	10905.0	1094.9	388206.8
Manufacturing	16310.5	37254.6	0.0	51574.7	1059.0	5962.1	314.5	0.0	0.0	27398.5	0.0	347822.2	886864.5	5839432.4
Commercial Industry	13.4	113.9	0.0	14,244.1	0.0			0.0	0.0	0.0	0.0	332,618.8	63,579.4	2350196.2
Residential	0.0	0.0	0.0	13825.5	0.0	9660.3	9539.9	0.0	0.0	0.0	0.0	269278.5	1102.4	1917279.8
Transportation	1.5	0.0	0.0	80045.1	0.0	68.3	0.0	0.0	0.0	0.0	0.0	17603.6	0.0	3126909.9
Passenger Transportation	1.5	0.0	0.0	46872.6	0.0	6.6	0.0	0.0	0.0	0.0	0.0	16758.4	0.0	1852872.3
Freight	0.0	0.0	0.0	33172.5	0.0	61.7	0.0	0.0	0.0	0.0	0.0	845.2	0.0	1274037.6
Non-energy and Feedstock Use	0.9	717.9	0.0	41435.7	207.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1614301.6

Building the EBT of Japan

- Data Collection

- Processing
  - Energy Statistics Table (Table 1)
  - Conversion Factor Table (Table 2)
  - Energy Balance Table = Table 1 * Table 2

- Review
  - Supply vs. Demand
  - TPES vs. TFEC
  - Efficiency of Energy Transformation Processes
  - Time-series change
  - Comparison with previous year balance

- Revise and improve when required
  - Constant change of domestic and international circumstance
  - Revised primary data
  - Adjustment with a questionnaire of international organization

Source of EBT in Japan

Primary Supply

Parts of energy balance table	Source
Import, Export	Trade Statistics
Import, Export of oil products	Current Survey of Petroleum Products Supply and Demand

Transformation

Parts of energy balance table	Source
Oil Products	Current Survey of Petroleum Products Supply and Demand
Gas Conversion and Production	Report of Gas Company
Power Generation	Electric Power Statistics
Auto Power Generation, Auto Steam Generation	Current Survey of Energy Consumption Energy Consumption Statistics
District Heat Supply	Report of District Heating Company

Sources of Primary Information on Supply

- Customs under the provision of the Customs Law and the relevant international conventions.
- Energy importers and exporters
- Companies involved in the transformation sector such as oil refineries, power plants, etc.

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Source of EBT in Japan

Final Consumption

Parts of EBT	Source
Agriculture, Forestry, Fishery	Statistics from Ministry of Agriculture, Forestry and Fisheries(MAFF)
Major 9 sectors in manufacturing	Current Survey of Energy Consumption
Other manufacturing, Non manufacturing	Energy Consumption Statistics
Commercial	Energy Consumption Statistics Report of District Heating Company
Residential	Report on the Family Income and Expenditure Survey Report of Gas Company Report of District Heating Company
Transportation	Monthly Statistical Report on Fuel Consumption by **Motor Vehicle** Transport Monthly Report on **Air Transport** Monthly Report on **Coastwise Vessel Transport** Monthly Report on **Railway Transport**

Sources of Information on Demand

- Consumers of energy
- Sales data collected from energy companies

Source of EBT in Japan

	Coal 10^3 t	Coal Prod 10^3 t	Crude Oil 10^3 kl	Oil Produc 10^3 kl	Natural Ga 10^3 t	City Gas 10^6 m3	Renewable TJ	Hydraulic 10^6 kWh	Pumped S 10^6 kWh	Effective TJ	Nuclear P 10^6 kWh	Electricity 10^6 kWh	Heat TJ	Total TJ
Primary Energy Supply	193170.1	1062.6	192363.7	13355.8	91552.9	−17.8	860086.5	78901.9	0.0	604694.4	18060.0	0.0	0.0	20170405.0
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Total Primary Energy Suppl			301.7			0.		78901.9	0.0	604694.4	18060.0	0.0	0.0	21165320.1
Export			58.2			0.0	−32.0	0.0	0.0	0.0	0.0	0.0	0.0	−1311686.6
Stockpile Change / Supply	0.0	−80.9				−17.8		0.0	0.0	0.0	0.0	0.0	0.0	316771.5
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Oil Products					62.5									−163157.3
Gas Conversion and Produc														48.1
Power Generation														−4461289.3
Auto Power Generation														−851060.5
Auto Steam Generation														−269893.5
District Heat Supply														−57.9
Own Use and Loss	−487.3	−4740.7	−67.8	−6804.0	−2749.8	−1514.4	−4539.7	0.0	0.0	−100.5	0.0	−95025.0		−965062.4
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Final Energy Consumption	16326.5	37379.7	0.0	168564.8	1150.8		16872.7	0.0	0.0	27398.5	0.0	978228.1		13622025.0
Industry	16325.0	37379.7	0.0	74694.2	1150.8		7332.8	0.0	0.0	27398.5	0.0	691346.0		8577835.3
Agriculture, Fishery, Mining							0.0	0.0	0.0	0.0	0.0	10,905.0		388206.8
Manufacturing	16310.5	37254.6	0.0	51574.7	1059.0		314.5	0.0	0.0	27398.5	0.0	347822.2		5839432.4
Manufacture of Food, Beverag	9.4	3.1	0.0	883.9	0.0		0.0	0.0	0.0	0.0	0.0	26,931.4		247019.7
Manufacture of Textile Mill Pro	4.3	0.0	0.0	173.2	1.1		0.0	0.0	0.0	0.0	0.0	9421.8		95625.2
Manufacture of Pulp, Paper an							259.7	0.0	0.0	778.2	0.0	31128.4		341327.7
Manufacture of Chemical and							0.0	0.0	0.0	1922.1	0.0	52993.7		2345047.2
Manufacture of Ceramic, Stone							54.8	0.0	0.0	21784.7	0.0	18110.7		365579.7
Manufacture of Iron and Steel							0.0	0.0	0.0	1456.2	0.0	69745.8		1670597.8
Manufacture of Non-Ferrous							0.0	0.0	0.0	1457.3	0.0	13065.4		98371.3
Manufacture of Machinery	3.0	116.6	0.0	1078.5	31.6		0.0	0.0	0.0	0.0	0.0	94917.1		504751.5
Miscellaneous Manufacturing Ir	14.0	2.2	0.0	320.2	0.0		0.0	0.0	0.0	0.0	0.0	31,508.0		171112.3
Commercial Industry	13.4	113.9						0.0	0.0	0.0	0.0	332,618.8		2350196.2
Residential	0					9660.3	9539.9	0.0	0.0	0.0	0.0	269278.5		1917279.8
Transportation	1.5											17603.6	0.0	3126909.9
Passenger Transportation	1.5											16758.4	0.0	1852872.3
Freight	0.0											845.2	0.0	1274037.6
Non-energy and Feedstock	0.9	717.9	0.0	41435.7	207.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1614301.6

Annotations:
- Trade Statistics
- Trade Statistics / Current Survey of Petroleum Products Supply and Demand
- Trade Statistics
- ○Current Survey of Petroleum Products Supply and Demand ○Electric Power Statistics ○Report of Gas Company ○Current Survey of Energy Consumption ○Energy Consumption Statistics ○Report of District Heating Company
- Gas Report of Gas Company
- Report of District Heating Company
- Statistics from MAFF
- Current Survey of Energy Consumption
- Energy Consumption Statistics
- Report on the Family Income and Expenditure Survey
- ○Monthly Statistical Report on Fuel Consumption by Motor Vehicle Transport ○Monthly Report on Air Transport ○Monthly Report on Coastwise Vessel Transport ○Monthly Report on Railway Transport

Units Conversion

- To be comparable, all energy sources should be expressed in a uniform unit
  - How would you get the sum of tons of coal, barrel of oil, cubic feet of gas, GWh of hydro?

- Units are expressed in joules in Japan's EBT using conversion factors but could be
  - Volume – barrels, liters, cubic feet, cubic meters, etc
  - Thermal – kcal,, BTU, TOE

- CO_2 emissions can be calculated from the above data using emission factors

Conversion factors and emissions factors are reviewed and surveyed once per five years in Japan.

CO_2 emissions = energy consumption (original unit) ×conversion factors × emission factors × oxidization factors

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Example of Energy Flows in the EBT

Note: In the EBT unit must be absolute heat value (ex. TJ)

	Crude	LPG	Mogas	Diesel	Others	Electricity
Primary Energy Supply	205421	16146	1544	-4076	19053	
Statistical Differences	0	-498	-210	-743	1611	
Petroleum Refinery	-205421	5294	45206	55668	96710	
Own-use and Losses		-62		-47	-9220	-725
Electricity/Heat Generation		-832		-780	-15265	7248
Other Transformation		-3253			-5325	
Total Final Consumption		17791	46960	51508	84342	6523
Industry sector		2575		10716	21108	
Transportation sector		1489	46960	27814	13231	
Comm/Resid sector		7924		9528	18328	
Others		18		3265	629	
Non-energy		5785		185	31047	

Review of Energy Balance Table

- Supply vs. Demand
  - TPES cannot be less than TFEC even if there is no transformation sector
  - Statistical difference cannot be larger than acceptable amount.
- Transformation Efficiency
  - Efficiency cannot exceed 100%
  - Efficiency of electricity generation should not exceed the technically acceptable values, otherwise there are data errors
- Time series check and comparison with previous year's balance
  - Normally, reasonable change rate is expected because population and economic growth change as well as increased penetration of energy consuming devices do not occur dramatically.
  - However, huge change is not impossible but underlying reasons should be determined.

Data processing for developing countries

- Sales Data
  - In many cases, sales data collected from energy companies are used as proxy for final energy consumption in the absence of more detailed data
  - There is a need to process the sales data to convert into final consumption data
  - A sectoral energy consumption survey is usually carried out to have bases for conversion of sales data to consumption

Data processing for developing countries cont.

- Example 1:
  - 1000 tons of diesel oil is reported as sold to Industry
  - Survey says that of the total diesel supply:
    - 50% is used in the boilers
    - 10% for conveyors, tractors, etc
    - 20% for transporting products
    - 20% for electricity generator
  - Final consumption would be:
    - 600 tons consumed in industry
    - 200 tons in transport
    - 200 tons for auto-producer electricity generation
  - There is a significant change in energy accounting!
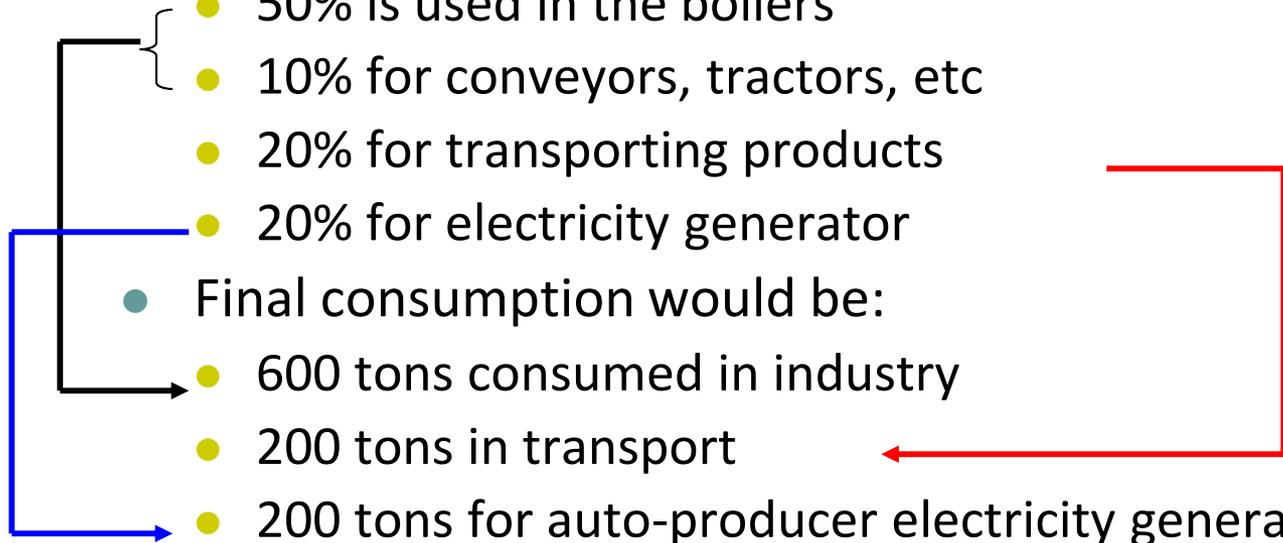
Data processing for developing countries cont.

- Example 2:
    - 5000 tons of diesel sold by oil company to electric power plant
    - The same electric power plant reported 10 GWh of electricity output
    - Estimate thermal efficiency
        - Output/input
        - 10 GWh / 5000 tons diesel
        - 1 GWh = 3,600 GJ; 1 ton of diesel = 45.66 GJ
        - 36,000 GJ / 228,300 GJ = 15.8% (very low??)
    - Check with the electric power plant the amount of diesel consumed
        - Not all 5000 tons may have been consumed for electricity generation
        - Some part may have been stored or used for other purposes