Chapter 6

Biomass Supply and Demand Data

Ministry of Energy and Mines, Lao PDR

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Chapter 6
Biomass Supply and Demand Data

1. Introduction

Biomass energy has played an important role in the Lao PDR, especially as cooking fuel in the residential sector. The industry and the commercial sectors also consume biomass but at a lesser amount. The share of biomass in the total final energy consumption was 60.8 % in 2010. The share decreased to 46.1% by 2018 as households consumed more LPG and more efficient biomass stove became available in the rural areas (MEM, 2020).

Biomass consumed were mainly fuelwood and charcoal; bagasse was also used to generate electricity besides the final sectors – residential, commercial, and industry. Biomass data are usually estimated since most of the biomass consumed are non-commercial biomass (fuelwood). The commercial biomass in the Lao PDR is charcoal, and production data are available from large charcoal factories. The amount of fuelwood used to produce the charcoal has not been reported to the MEM. In this regard, it will be necessary to develop a questionnaire for the charcoal companies to enable the MEM to collect commercial biomass energy data.

This chapter aims to inform the biomass supply and demand data of the Lao PDR, assess the missing data, and design a questionnaire for the commercial biomass supply companies to improve these commercial biomass data.

2. Primary Data on Biomass

Based on the *Lao PDR Energy Statistics 2018* (MEM, 2018), primary biomass data cover fuelwood and charcoal production and their consumption in the final sector in 2000–2015. Final sector consumption was estimated, and fuelwood production was assumed to be the same as final sector consumption. Charcoal production was based on the production data available from some charcoal factories. The MEM continues to update the energy data, including biomass, and the latest was up to 2018.

2.1 Fuelwood

Fuelwood is non-commercial biomass since it is mostly obtained from cutting trees in the forest or backyards, and is thus free. No specific company cuts trees only for fuelwood

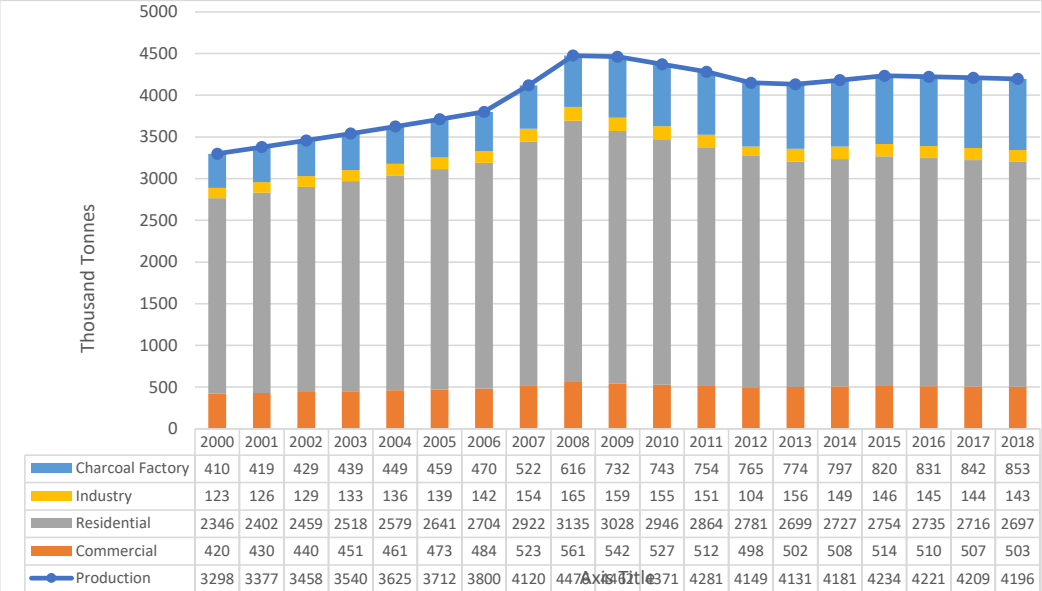
purposes and sells them commercially to households. Data on fuelwood production is therefore not available.

Fuelwood production is estimated based on the consumption in the final and transformation sectors. Final sector consumption is the consumption of the residential, commercial, and industry sectors. The transformation sector's fuelwood consumption is the amount used to produce the charcoal.

The MEM fuelwood consumption data excludes the consumption to produce the charcoal. The fuelwood requirement was estimated using the international efficiency standard of a fuelwood burner in a charcoal factory. Figure 6.1 shows the production and consumption of fuelwood from 2000 to 2018.

The Lao PDR energy statistics covers only up to 2015. From 2016 to 2018, fuelwood production data was estimated based on the rural population growth rate. Final sector fuelwood consumption was calculated based on the share of the 2015 consumption.

Figure 6.1 Production and Consumption of Fuelwood, 2000–2018



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Charcoal Factory	410	419	429	439	449	459	470	522	616	732	743	754	765	774	797	820	831	842	853
Industry	123	126	129	133	136	139	142	154	165	159	155	151	104	156	149	146	145	144	143
Residential	2346	2402	2459	2518	2579	2641	2704	2922	3135	3028	2946	2864	2781	2699	2727	2754	2735	2716	2697
Commercial	420	430	440	451	461	473	484	523	561	542	527	512	498	502	508	514	510	507	503
Production	3298	3377	3458	3540	3625	3712	3800	4120	4477	4321	4371	4281	4149	4131	4181	4234	4221	4209	4196

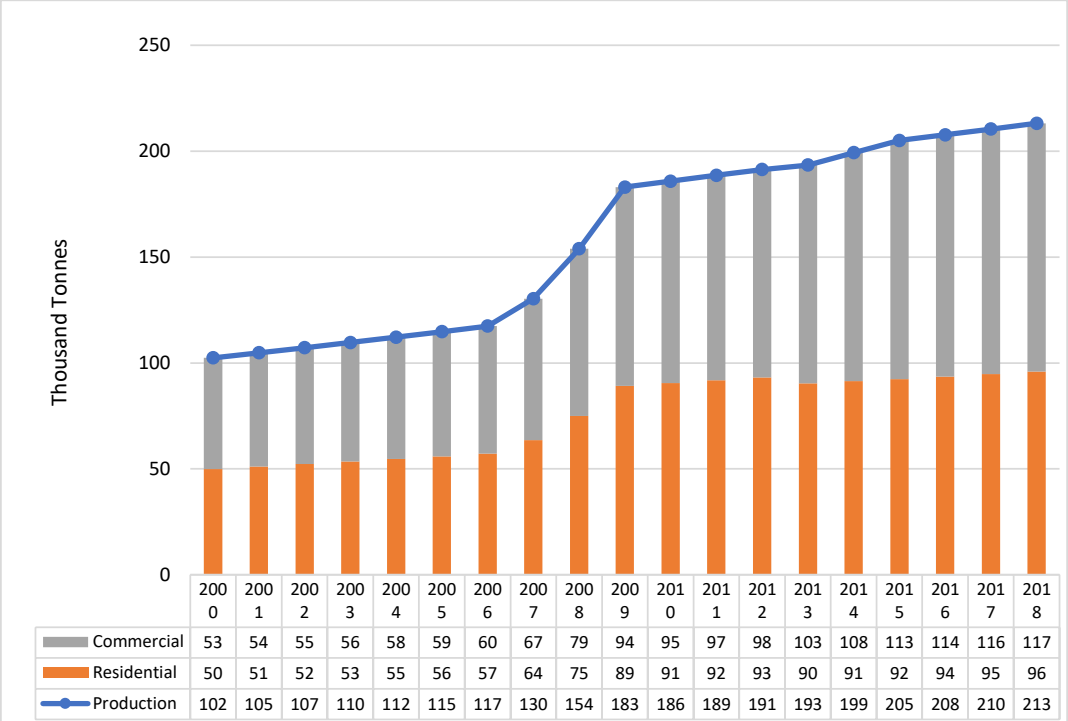
Source : MEM, Lao PDR.

2.2.Charcoal

Charcoal is consumed by the commercial and residential sectors of the Lao PDR. MEM Lao PDR has collected and estimated data on charcoal production and consumption. Charcoal is usually produced commercially and consumed for cooking, including barbecue. Some households produce their charcoal requirement, but this is small. The majority of households purchase their charcoal needs. Figure 6.2 shows the production and consumption of fuelwood from 2000 to 2018.

As in fuelwood, charcoal production data was also estimated based on the total population's growth rate. This is in line with the charcoal production data that has been increasing at almost the same rate as population growth. The charcoal consumption of the final sector was also estimated based on 2015 consumption.

Figure 6.2 Production and Consumption of Charcoal, 2000–2018



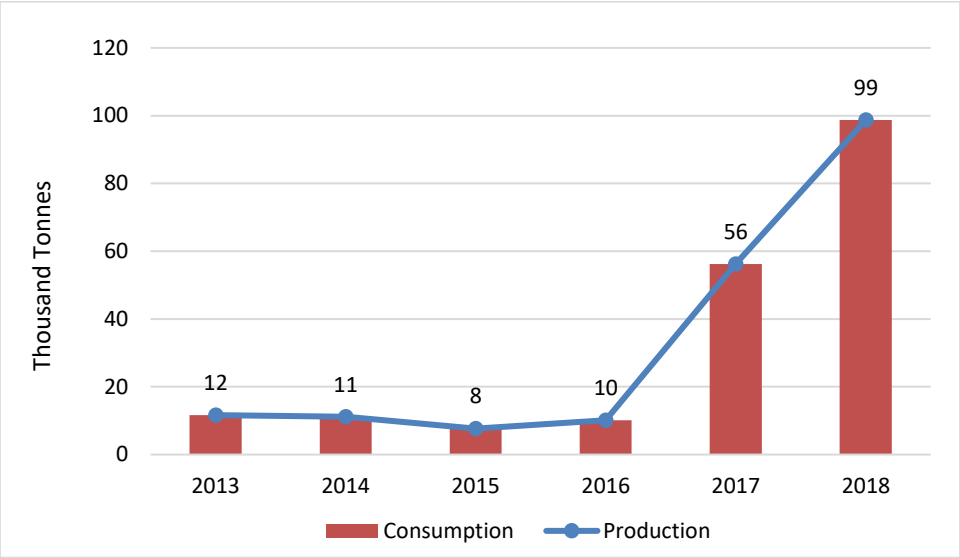
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Commercial	53	54	55	56	58	59	60	67	79	94	95	97	98	103	108	113	114	116	117
Residential	50	51	52	53	55	56	57	64	75	89	91	92	93	90	91	92	94	95	96
Production	102	105	107	110	112	115	117	130	154	183	186	189	191	193	199	205	208	210	213

Source: MEM, Lao PDR.

2.3 Others

Other biomass includes bagasse, straw, rice husks, nut shells, etc. Currently, the data on supply and demand of other biomass types are not available. The data of the Department of Energy, Policy and Planning, MEM showed that bagasse was used to produce electricity. The quantity of bagasse used by the biomass power plant was unavailable. In this regard, the missing data was estimated. The efficiency assumption of the biomass power production is based on the international efficiency standard for biomass power production.

Figure 6.3 Bagasse Production and Consumption, 2013–2018



Source: MEM, Lao PDR.

Data on the amount of electricity generated from biomass power plants are available in the Department of Energy, Policy and Planning statistic since its first operation in 2013. Biomass power plant efficiency is assumed to be 20%, and the heating value of bagasse is assumed to be 2,000 kcal/kg. These assumptions were used to estimate the amount of bagasse consumed by the power plant, as shown in Figure 6.3. Bagasse production is the amount of bagasse consumed by the power plant.

3. Format of Biomass Energy Data Collection

The biomass energy discussed in section 2 will be entered in the reporting format for biomass (fuelwood, charcoal, bagasse). The joint questionnaire format of APEC–ASEAN, developed to build the main statistics on renewable energy, was used. This joint questionnaire format checks the data's completeness because the questionnaire balances the supply and use of the respective products.

The APEC–ASEAN joint questionnaire consists of five questionnaires for coal, oil, gas, oil, electricity, and renewable energy products. Biomass energy is part of the renewable energy questionnaire. The questionnaire consisted of the supply data, transformation, and energy industry own use and final consumption (including non-energy use).

3.1. Commercial biomass questionnaire

The renewable energy joint APEC–ASEAN questionnaire includes biomass and other renewable energy, such as hydro, solar, wind, and biofuel. Table 6.1 shows the renewable energy in the joint questionnaire for the supply data table. As noted, renewable energy covers

biomass, biogas, industrial waste, municipal solid waste, liquid biofuels, hydro, geothermal, solar, wind, tide, wave, and ocean. Based on the primary data, the Lao PDR has only biomass, hydro, and solar. Biofuel and wind data are not yet available. Biomass includes fuelwood and wood waste, charcoal, and other biomass (bagasse, paddy husk, etc.).

Fuelwood and other biomass are mostly non-commercial fuel. Charcoal, on the other hand, is commercial biomass. Considering that hydro and solar are consumed to produce electricity, the data on the install capacity, fuel input, electricity production, losses, etc. will be covered by the electricity questionnaire. The questionnaire will only cover only commercial biomass, which is only for charcoal since biofuel companies are not yet available.

As discussed in Section 6.2.2, charcoal is produced from fuelwood in a charcoal factory. The MEM has been able to provide the charcoal production data. These data should be collected from the charcoal companies. Since charcoal is produced from fuelwood, the charcoal companies should also be able to provide the amount of fuelwood consumed to produce the charcoal. In this regard, the MEM should design the questionnaire for the charcoal companies to submit these data (fuelwood consumed and charcoal produced).

Table 6.1 Supply Data Table for Renewable Energy Joint APEC–ASEAN Questionnaire

		FuelWood & Woodwaste	Bagasse	Charcoal[2]	Other Biomass[3]	Biogas	Industrial Waste	Municipal Solid Waste	Liquid Biofuels	of which Biogasoline	of which Bioethanol	of which Bio-jet	of which biodiesels	Hydro	Geothermal		Solar			Tide, Wave & Ocean	Wind
															Electricity	Heat	Photovoltaic	Thermal			
																		Electricity	Heat		
		1000t	1000t	1000t	1000t	10^{10}kcal (gross)	1000t	1000t	1000t	1000t	1000t	1000t	1000t	GWh	GWh	10^{10}kcal (gross)	GWh	GWh	10^{10}kcal (gross)	GWh	GWh
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Production[1]	(+) 1	4.196	99	213,17										22.999			60				
Imports	(+) 2																				
Exports	(-) 3																				
Stock Changes (+ or -)	(+) 4	-	-	-	-	-	-	-	-	-	-	-	-								
Gross Inland Deliveries (calculated)	**(=) 5**	**4.196**	**99**	**213**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**22.999**	**-**	**-**	**60**	**-**	**-**	**-**	**-**
Statistical Differences	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gross Inland Deliveries (observed)	**7**	4.196	99	213	-	-	-	-	-	-	-	-	-	22.999	-	-	60	-	-	-	-
TOTAL STOCKS on NATIONAL TERRITORY																					
Total stocks on national territory - Opening	8																				
Total stocks on national territory - closing	9																				

Notes:

1. This includes production of both primary and secondary energy. However, only quantities used for energy purposes should be reported. For example, only the amount of bagasse that are used as fuel should be reported and not all the amount of bagasse pr
2. Charcoal covers solid residue of the destructive distillation and pyrolysis of wood and other vegetal material.
3. Other Biomass includes agricultural wastes such as straw, rice husks, nut shells, poultry litter, crushed grape dregs, etc. and other wastes that are not classified as woodwaste, industrial and municipal solid wastes.

The basis for designing this questionnaire is the APEC–ASEAN Questionnaire. This includes data on charcoal production, the amount of fuelwood consumed to produce charcoal, the sales of charcoal domestically (by sector), and export of charcoal.

The charcoal company's questionnaire comprises charcoal production and export and sales to the final sector (industry, residential, and commercial). In case of export, specify the volume and country of destination. In addition, the questionnaire also contains the amount of fuelwood and other biomass consumed by the charcoal factory and own use (if any). Table 6.2 shows the commercial biomass questionnaire for the charcoal factories. For each questionnaire, state the charcoal company's name and the date of completion.

Table 6.2 Commercial Biomass Questionnaire for Charcoal Company

Company name:
Date:

	Unit	2019	2020
Charcoal Production	**ton**		
Charcoal Export (specify by country destination)			
Country:	**ton**		
Country:	**ton**		
Country:	**ton**		
Country:	**ton**		
Country: Others	**ton**		
Total Charcoal Export	**ton**		
Charcoal Factory input			
Wood	**ton**		
Others (please specify)			
--Specify 1	**ton**		
--Specify 2	**ton**		
Own Use	**ton**		
Charcoal Sales (Domestic)			
Industry	**ton**		
Residential	**ton**		
Commercial	**ton**		
Total Charcoal Sales	**ton**		

3.2 Unit and conversion

The unit for charcoal supply and sales is tonnes. Biomass (wood and/or others) consumption used in a charcoal factory is also in tonnes. The questionnaire also includes a conversion section, which the charcoal company needs to fill in. This is the biomass average heating value (net) by type in kilocalorie per kilogram (kcal/kg).

The values of Lao PDR's renewable energy in the joint questionnaire are as follows:

- Fuelwood and wood waste: 3,820 kcal/kg
- Bagasse: 2,000 kcal/kg
- Charcoal: 6,900 kcal/kg

The IEA also provided a standard density and heating value for solid biomass (Table 6.3).

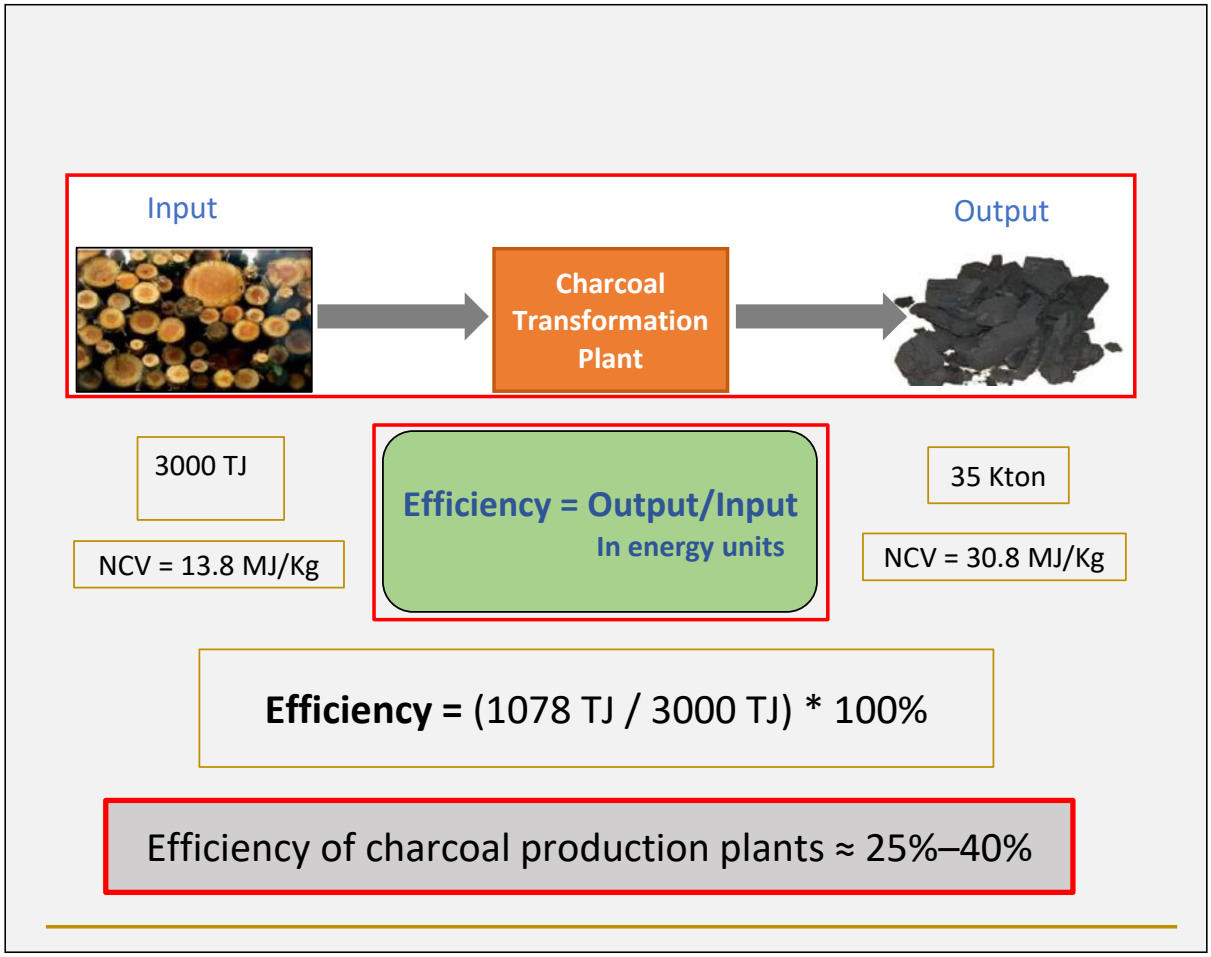
Table 6.3 IEA Standard Density and Heating Value of Solid Biomass

Product	Moisture (%, dry basis)	Density (kg/m^3)	Approx. Ash Content	Net Calorific Value (MJ/kg)
Woodfuels	30	0,725	-	13,8
Charcoal	5	-	-	30,8
Bagasse	40-50	-	10-12	8.4-10.5
Broundnut shells	3-10	-	4-14	16,7
Cotton husks	5-10	-	3	16,7
Coconut husks	5-10	-	6	16,7
Rice hulls	9-11	-	15-20	13.8-15.1
Oil-palm fibres	55	-	10	7.5-8.4
Oil-palm husks	55	-	5	7.5-8.4
Corncobs	15	-	1-2	19,3
Rice straw and husk	15	-	15-20	13,4

Source: IEA (2005).

Figure 6.4 is an example of a charcoal factory and the necessary data requirement. These are charcoal output, wood input, charcoal factory's efficiency, and the net caloric value of both wood and charcoal.

Figure 6.4 Production and Consumption of Charcoal



4. Definitions in the Lao PDR Commercial Biomass Questionnaire

The definitions in the Lao PDR commercial biomass questionnaire cover fuels and flows, including biofuels.

4.1. Definition of fuels

1) Solid biomass

a) Fuelwood (in log, brushwood, pellet, or chip form) – Obtained from natural or managed forests or isolated trees. Also included are wood residues used as fuel, in which the original composition of wood is retained. Charcoal and black liquor are excluded.

b) Wood waste – Yard trash and types of waste typically generated by sawmills, plywood mills, and woodyards associated with the lumber and paper industry. Examples are wood residue, cut-offs, wood chips, sawdust, wood shavings, bark, wood refuse, wood-fired boiler ash, and plywood or other bonded materials that contain only phenolic-based glues or other glues approved specifically by the administrative authority.

c) Bagasse – Refers to the fuel obtained from the fibre, which remains after juice is extracted during sugar cane processing.

d) Charcoal – The solid residue from the carbonisation of wood or other vegetal matter through slow pyrolysis.

e) Other Biomass – All other solid biomass products not specifically mentioned above. This includes agricultural wastes, such as straw, rice husks, nutshells, poultry litter, crushed grape dregs, palm oil bunches, etc. The quantity of fuel used should be reported based on a net calorific value.

2) Liquid biofuels

These are liquids derived from biomass and used as fuels. These are:

a) Biogasoline – Liquid fuels derived from biomass and used in spark ignition internal combustion engines. Biogasoline may be blended with petroleum gasoline or used directly in engines. The blending may take place in refineries or at or near the point of sale.

b) Bioethanol – Ethanol produced from biomass

c) Biodiesel – Liquid biofuels derived from biomass and used in diesel engines. Biodiesels may be blended with petroleum diesel or used directly in diesel engines.

d) Bio-jet kerosene – Refers to liquid biofuels derived from biomass and blended with or replace jet kerosene.

4.2. Definition of flows

1) Supply sector

a) Opening stock – Report the opening stock level on the first day of the year (for annual data) of stocks on national territory.

b) Indigenous production – For commercial biomass, report the sum of final consumption (in the industrial, commercial, and residential sectors) and input for gross electricity production, commercial biomass plant, and other energy conversion plants.

PRODUCTION = Consumption of Industry Sector + Consumption of Transformation Sector + Consumption of Other Sector (Commercial, Residential, etc.) + Input gross electricity production + Input for commercial biomass plant +/- Losses

Units should be thousand metric tonnes.

For liquid biofuels, report the final consumption, quantities blended with petroleum products such as diesel and gasoline, and the amount used as input to electricity generation. Units should be thousand metric tonnes.

c) Import and export – Report the quantity of commercial biomass obtained from or supplied to other countries. Amounts are considered imported or exported when they have crossed the country's political boundary, whether the customs office has cleared it or not. Data should be taken from importers' and exporters' declarations, although these may not be identical with customs data. The amount of fuels in transit (that is, on route through the country) should not be included.

d) Closing stock (actual) – Report the closing stock level on the last day of the year (for annual data) of stocks in the national territory.

e) Stock change – Report the difference between opening stock level on the first day of the year and closing stock level on the last day of the year of stocks held in the national territory. A stock build is shown as a negative number and a stock draw as a positive number.

f) Inland delivery (calculated) – defined as: Indigenous production + Imports + Exports + Stock changes.

g) Statistical difference – This is equal to the difference between the calculated inland delivery (as defined above) and the observed gross consumption, which corresponds to the final energy consumption plus the transformation sector, the energy sector, and distribution losses. National administrations sometimes obtain the data components of domestic availability from various sources. Owing to differences in concepts, coverage, timing, and definitions, observed and calculated inland consumptions are often not identical. The reasons for any major statistical difference should be stated in the section provided on the Remarks page.

2) Transformation sector

Report the quantities of commercial biomass and waste used for the primary or secondary conversion of energy (e.g. bagasse to electricity and biomass to charcoal) or used to transform to derived energy products (e.g. biogases used for blended natural gas). The Transformation sector is included the following sub-sectors:

a) Main activity producer of electricity – Report quantities of commercial biomass used to produce electricity by all main activity producers.

b) Main activity producer of combined heat and power (CHP) – Report quantities of commercial biomass used to produce electricity and heat by all main activity producers.

c) Main activity producer of heat – Report quantities of commercial biomass used to produce heat by all main activity producers.

d) Auto-producer of electricity – Report quantities of commercial biomass used to produce electricity by all auto producers. Otherwise, fuel used by plants containing at least one CHP unit is to be reported under auto producer of CHP.

e) Auto producer of CHP – Report quantities of commercial biomass used that correspond to the quantity of electricity produced and heat sold by all auto producers.

f) Auto producer of heat – Report quantities of commercial biomass used to produce heat sold by all auto producers.

g) Biofuel blending – Report quantities of liquid biofuels that are not delivered for final consumption directly but are blended and used with other petroleum products, such as diesel and gasoline.

h) Charcoal production plants – Report the quantity of wood used to produce charcoal.

i) Not elsewhere specified (Transformation) – Data should be reported here only as a last resort. If a final breakdown into the above sub-sectors is not available, administrations should provide estimates wherever possible. Please inform the Secretariat of the basis for these estimates.

3) Energy sector (losses and own use in production or transformation) – Report renewable energy consumed by the energy sector to support the transformation activities. For example, renewable energies and waste used for heating, lighting, or operating pumps or compressors. Note those quantities of renewable energies and waste transformed into another energy form should be reported under the Transformation sector.

4) Total final energy consumption

a) Industry – Report fuels derived from commercial biomass consumed by the industrial undertaking in support of its primary activities. Report quantities of fuels consumed in heat or CHP plants to produce heat used by the plant itself. Quantities of fuels consumed to produce heat that is sold and to produce electricity should be reported under the appropriate Transformation sector. The sub-sectors of industry are as follows:

- Iron and steel – ISIC Group 241 and Class 2431. The consumption in coke ovens and blast furnaces are defined as part of Transformation Processes and Energy Industry Own Use.
  - This class includes conversion operations by reducing iron ore in blast furnaces and oxygen converters, or ferrous waste and scrap in electric arc furnaces, or by directly reducing iron ore without fusion to obtain crude steel, which is smelted and refined in a ladle furnace. This is then poured and solidified in a continuous caster to produce semi-finished flat or long products. After reheating in rolling, drawing, and extruding operations, these products are used to manufacture finished products, such as plate, sheet, strip, bars, rods, wire, tubes, pipes, and hollow profiles.
  - This class also includes the casting of iron and steel, i.e. the activities of iron and steel foundries.
- Chemical and petrochemical – ISIC Divisions 20 and 21 (NACE Divisions 20 and 21)

  Note: This heading includes petroleum products used as fuel and as feedstock (non-energy use). However, consumption should be net after deducting backflows. The breakdown of net consumption by product should be calculated by applying the same proportion of product split for gross deliveries. The consumption by plants manufacturing charcoal or enrichment or production of nuclear fuels is excluded, as these plants are considered part of the energy industries.
  - These include the manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics, and synthetic rubber in primary forms (ISIC 201).
  - These also include other chemical products (ISIC 202), man-made fibres (ISIC 203).

- Non-ferrous metals – ISIC Group 242 and Class 2432 and (NACE Group 24.4 and Classes 24.53 and 24.54
    - These include the manufacture of precious and non-ferrous metals (ISIC 242), which are basic precious metals; production and refining of unwrought or wrought precious metals: gold, silver, platinum, etc. from ore and scrap.
    - These also include the casting of non-ferrous metals (ISIC 2432), which covers semi-finished products of aluminium, magnesium, titanium, zinc, etc.; light metals; heavy metals; precious metals; and die-casting of non-ferrous metals.
- Non-metallic minerals – ISIC Division 23, which covers glass, ceramic, cement, and other building materials industries.
    - Manufacture of glass and glass products (ISIC 231), such as flat glass, hollow glass, fibres, technical glassware, etc.
    - Manufacture of non-metallic mineral products (ISIC 239), such as ceramics, tiles, baked clay products, and cement.

    Manufacturing is from raw materials to finished articles. Also included is the manufacture of shaped and finished stone and other mineral products.
- Transport equipment – ISIC and NACE Divisions 29 and 30
    - Manufacture of bodies for motor vehicles (ISIC 291), trailers, and semi-trailers (ISIC 292). These divisions include the manufacture of motor vehicles to transport passengers or freight, various parts and accessories, as well as trailers and semi-trailers (ISIC 293).
    - Manufacture of other transport equipment – These divisions include the manufacture of transport equipment, such as ship building and boat making (ISIC 301), railway locomotives and rolling stock (ISIC 302), air and spacecraft-related machinery (ISIC 303), and transport equipment not elsewhere classified (ISIC 309).
- Machinery – Report fabricated metal products, machinery, and equipment other than transport equipment. ISIC and NACE Divisions 25–28.
- Mining (excluding energy-producing industries) and quarrying – ISIC Divisions 07 and 08 and Group 099 (NACE Divisions 07 and 08 and Group 09.9)
- Food, beverages, and tobacco – ISIC and NACE Divisions 10–12
- Paper, pulp, and printing – ISIC and NACE Divisions 17 and 18. Include production of recorded media
- Wood and wood products (other than pulp and paper) – ISIC and NACE Division 16
- Construction – ISIC and NACE Divisions 41–43
- Textile and leather – ISIC and NACE Divisions 13–15
- Not elsewhere specified (Industry) – Report consumption not included above.

5) Commercial and public services

Report fuels derived from commercial biomass consumed by business and offices in the public and private sectors. These also include fuel used by all non-transport activities of ISIC and NACE Divisions 49–51. ISIC and NACE Divisions 33, 36–39, 45–47, 52–66, 68–75, 77–82, 84 (excluding Class 8422 [ISIC] and Class 84.22 [NACE]), 85–96 and 99.

6) Residential

Report fuels derived from commercial biomass consumed by all households, including 'households with employed persons ISIC and NACE Divisions 97 and 98'.

7) Agriculture

Report fuels derived from commercial biomass consumed by users classified as agriculture, hunting, and forestry by ISIC as follows: ISIC Divisions 01 and 02 (NACE Divisions 01 and 02).

8) Fishing

Report fuels derived from commercial biomass delivered for inland, coastal, and deep-sea fishing. Fishing should cover fuels delivered to ships of all flags that have refuelled in the country (include international fishing). Also include energy used in the fishing industry as specified in ISIC and NACE Division 03.

9) Other – Not elsewhere specified

Report activities not included elsewhere. This category includes military fuel used for all mobile and stationary consumption (e.g. ships, aircraft, road, and energy used in living quarters), regardless of whether the fuel delivered is for the military of that country or another country.

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