# Methodology Report for the 2022 Energy Balance of Tanzania

Prepared by the National Bureau of Statistics (NBS)

March 2025

## Table of contents

1.	Introduction4				
2.	Role of an energy balance in policymaking5				
3.	Met	hodology6			
3	.1.	Definitions of Products and Flows6			
	Enei	rgy Products6			
	Enei	rgy Flows6			
3	.2.	Data Collection and Processing for Tanzania Mainland7			
	Coa	ι7			
	Cruo	de oil8			
	Petr	oleum products8			
	Natu	ural gas10			
	Biof	uels10			
	Elec	tricity11			
	Ren	ewable energy sources12			
3	.3.	Data Collection and Processing for Zanzibar13			
	Petr	oleum products13			
	Biof	uels13			
	Elec	tricity13			
	Ren	ewable energy sources14			
4.	Unit	s and Conversion Factors15			
5.	CO2	2 Emissions16			

## List of acronyms

African Energy Commission
European Union
Energy and Water Utilities Regulatory Authority
Gas Company Tanzania Limited
Gross Calorific Value
Gigawatt hour
High Heating Value
Impact of Access to Sustainable Energy Survey
International Energy Agency
International Renewable Energy Agency
International Recommendations for Energy Statistics
Kilotonne
Kilotonne of Oil Equivalent
National Bureau of Statistics
Net Calorific Value
Natural Gas Liquid
Office of the Chief Government Statistician (OCGS) in Zanzibar.
Petroleum Bulk Procurement Agency
Petroleum Upstream Regulatory Authority
Petroleum Upstream Regulatory Authority Rural Energy Agency
Petroleum Upstream Regulatory Authority Rural Energy Agency Standard International Energy Product Classification
Petroleum Upstream Regulatory Authority Rural Energy Agency Standard International Energy Product Classification Tanzania Electric Supply Company
Petroleum Upstream Regulatory Authority         Rural Energy Agency         Standard International Energy Product Classification         Tanzania Electric Supply Company         Tanzania Renewable Energy Association

## 1. Introduction

The energy balance is compiled annually by the National Bureau of Statistics (NBS) in collaboration with the Ministry of Energy, the Tanzania Petroleum Development Corporation (TPDC), the Petroleum Upstream Regulatory Authority (PURA), the Tanzania Electric Supply Company (TANESCO), the Energy and Water Utilities Regulatory Authority (EWURA), the Rural Energy Agency (REA), the Petroleum Bulk Procurement Agency (PBPA), The Mining Commission, the Tanzania Renewable Energy Association (TAREA), and other relevant stakeholders. The data sources include administrative records, surveys, reports, and publications from various energy producers, suppliers, and consumers.

The energy balance is an annual statistical report that shows the supply, transformation and final consumption of different energy products and flows in the country. An energy balance is constructed as a matrix showing both energy products (columns) and energy flows (rows). It is prepared for a given calendar year and expressed in a common energy unit. An energy balance provides a comprehensive and consistent picture of the energy situation and trends in Tanzania. Related to other socioeconomic variables (GDP, population, other), it is an efficient decision-making tool.

The 2022 energy balance of Tanzania is the first to be prepared and published by the Government of Tanzania. Tanzania's energy balance is produced in two versions:

- The energy balance for Mainland Tanzania
- The energy balance for the United Republic of Tanzania which includes an estimate of Zanzibar's energy products and flows for reporting to international organizations such as AFREC, IEA and the UN which need a complete view of Tanzania's energy system

The energy balance covers the following energy products: coal, crude oil, petroleum products, natural gas, biofuels, electricity, and renewable energy sources. It also covers the following energy flows: production, imports, exports, international bunkers, stock changes, transfers, transformation, energy sector own use, transmission and distribution losses, and final consumption by sector and subsector.

This document describes the methodology used to produce the 2022 energy balance of the United Republic of Tanzania, which is based on the International Recommendations for Energy Statistics (IRES)<sup>1</sup> developed by the United Nations Statistics Division (UNSD). It covers the following aspects: definitions of products and flows, classifications, conversion factors, CO2 emissions, data collection, estimations, etc.

<sup>&</sup>lt;sup>1</sup> UN, 2018. International Recommendations for Energy Statistics (IRES). Statistical Paper. United Nations. https://unstats.un.org/unsd/energystats/methodology/documents/IRES-web.pdf

## 2. Role of an energy balance in policymaking

Energy balances give a comprehensive picture of a country's energy situation, allowing policymakers to understand energy flows, identify issues, set targets, monitor progress, model impacts of policies, and ultimately make informed decisions for managing energy supply, demand, and environmental impacts. More specifically, energy balances:

- Provide comprehensive information on energy supply and demand to understand the energy security situation, functioning of energy markets, and other relevant policy goals, as well as to formulate energy policies.
- Serve as the essential basis for calculating various energy indicators, including indicators for monitoring progress towards energy policy targets (energy efficiency, share of renewable energy, energy dependency, etc.).
- Ensure comparability of statistical information between different time periods and countries/regions, allowing for benchmarking and analysis of policy impacts.
- Provide data for calculating greenhouse gas emissions from fuel combustion, which is critical for climate change mitigation policies.
- Act as a quality assurance tool to ensure completeness, consistency and comparability of underlying energy statistics, which underpins sound policy analysis.
- Provide an essential input for energy modeling and forecasting used to evaluate different policy scenarios and options.

## 3. Methodology

The 2022 energy balance of Tanzania was prepared using an Excel Balance Builder provided by AFREC<sup>2</sup>. This tool was developed using the definition and formats proposed by IRES. It is structured around commodity balances for coal, oil, natural gas, biofuels, and electricity in which quantities of energy products are reported in physical or natural units. The energy balance is calculated automatically by applying conversion factors and calorific values.

The resulting energy balance is expressed in one single energy unit: ktoe (kilotonne of oil equivalent). The balance is also reported in TJ (terajoules) and in TWh (Terawatt-hours) for practical purposes.

#### 3.1. Definitions of Products and Flows

The energy products and flows are defined according to IRES, which provide internationally agreed upon definitions for energy statistics.

#### **Energy Products**

According to IRES<sup>3</sup>, the key energy products defined in an energy balance are of two types:

1 - Primary Energy Products that are obtained from natural resources:

- Solid fossil fuels (coal)
- Crude oil
- Natural gas
- Renewable energy sources such as solar, wind, hydro, geothermal, biofuels, etc.

2 - Secondary energy products that are derived from the transformation of primary or other secondary energy products:

- Petroleum products (gasoline, diesel, kerosene, jet fuel, fuel oil, etc.)
- Derived solid fuels (e.g. coal briquettes)
- Electricity
- Heat sold
- Derived biofuels (charcoal)

#### **Energy Flows**

Energy flows are movements or transfers of energy products from one entity to another within the energy system. They include production, imports, exports, international bunkers, stock changes, transfers, transformation, own use, distribution losses, and final consumption.

- Production is the extraction or capture of energy products from natural sources, such as mining, drilling, harvesting, etc.
- Imports and exports are the physical movements of energy products across the national boundaries, regardless of ownership or contractual arrangements.

<sup>&</sup>lt;sup>2</sup> African Energy Commission (AFREC). Website. Accessed June 2024. https://www.au-afrec.org/

<sup>&</sup>lt;sup>3</sup> The IRES provides a Standard International Energy Product Classification (SIEC) to categorize these energy products for consistent reporting in energy balances.

- Stock changes are the changes in the level of inventories of energy products held by producers, suppliers, or consumers within the national territory.
- International marine bunkers report the quantities of oil delivered to ships of all flags that are engaged in international navigation. The international navigation may take place at sea, on inland lakes and waterways, and in coastal waters.
- International aviation bunkers include deliveries of aviation fuels to aircraft for international aviation. Fuels used by airlines for their road vehicles are excluded. The domestic/international split should be determined on the basis of departure and landing locations and not by the nationality of the airline.
- Transfers are essentially statistical devices to overcome practical classification and presentation issues resulting from changes in use or identity of a product.
- Transformation is the process of changing the form or quality of an energy product, such as refining, power generation, charcoal production, etc.
- Own use is the consumption of energy products by energy producers, transformers or electricity and natural gas suppliers for the operation of their facilities or equipment, such as fuel for coal mining, natural gas extraction, pipeline and grid operation, etc.
- Distribution losses are the losses of energy products that occur during the transportation, transmission, or distribution of energy products from the producers or transformers to the consumers, such as leakage, evaporation, theft, etc.
- Final consumption is the consumption of energy products by end users for their own purposes, such as households, industry, transport, services, agriculture, forestry and fisheries, etc.

### 3.2. Data Collection and Processing for Tanzania Mainland

The data sources used for the energy balance include administrative records, data from statistical surveys, data requests to energy institutions, reports and various publications.

#### Coal

- Tanzania currently has two main types of coal: other bituminous coal (hard coal) and subbituminous coal (brown coal).
- Data on coal production, exports and consumption are reported in tons by the Mining Commission through a dedicated data request from NBS. Tanzania imported very small quantities of coal in 2022. Tanzania imposed a ban on coal imports in August 2016, forcing all consumers to procure coal nationally.
- Data on coal stock is currently not available.
- Consumption data is not directly available from wholesalers or final users and is calculated as the difference between production and exports.
- Almost all coal volumes consumed in Tanzania are consumed in industry with the exception of a small power unit categorized in transformation.
- The breakdown of "other bituminous coal" consumption by branch is based on the information published by Intra Energy Corporation Ltd (previous operator of the Ngaka coal mine in Southern Tanzania) on the sales of Tancoal in its annual reports of 2019 and 2020<sup>4</sup>. Tancoal is one of the

<sup>&</sup>lt;sup>4</sup> Intra Energy, 2019. Annual Financial Report for the year ended 30 June 2019. <u>https://www.annualreports.com/HostedData/AnnualReportArchive/i/ASX\_IEC\_2019.pdf;</u> Intra Energy, 2020. Annual Financial

largest coal producers from the Rivuma basin. Based on this data it is assumed that 87% of "other bituminous coal" quantities are consumed in the "non-metallic minerals" branch. The remainder (13%) is allocated to "not elsewhere specified (industry)".

Tancoal client sectors	IRES classification	2020	2019
Cement	Non-metallic minerals	51	56
Ceramics	Non-metallic minerals	36	32
Others	Not elsewhere specified (Industry)	13	12
Total		100	100

#### Tancoal industrial sectoral breakdown of hard coal consumption in Tanzania, 2020 and 2021

Source: Intra Energy Corporation Ltd

- "Sub-bituminous coal" quantities are allocated entirely to "not elsewhere specified (industry)".
- Gross calorific values (GCV) are available for both "other bituminous" and "sub-bituminous" coal

#### Calculation of the average coal NCV values for Tanzania

Type of coal	NCV Range (kCal/kg)	Average NCV (kCal/kg)	Average NCV (GJ per tonne)
Other bituminous	6,259 to 7,319	6,789	28.41
Sub-bituminous	5,000 to 6,200	5,600	23.43

Source: NBS

#### Crude oil

- Tanzania does not currently produce crude oil. However, it produces Natural Gas Liquids (NGLs or condensates) from its natural gas production. NGLs belong to the "oil" category alongside crude oil.
- Condensate quantities are reported by the Tanzania Petroleum Development Corporation (TPDC) in tons through a data request from NBS.
- All NGLs are assumed to be consumed in industry for non-energy purposes (i.e., manufacturing of solvents or detergents).
- Calorific values are default international values provided by IRES.

#### Petroleum products

- In the absence of a refinery in Tanzania, all petroleum products are imported. Imports for use in Tanzania are called "local imports" by EWURA.
- Tanzania also serves as a key transit country for petroleum products destined for neighboring countries (e.g. Zambia, Malawi, Burundi, Rwanda, Uganda...) and refers to these imports as "transit imports." Some of the volumes from "transit imports" can be "localized," meaning they are reallocated for use within Tanzania.
- Currently, only "local imports" quantities are reported by EWURA. "Localized Imports" volumes are not reported by EWURA.

Report for the year ended 30 June 2020.

https://www.annualreports.com/HostedData/AnnualReportArchive/i/ASX\_IEC\_2020.pdf

- Oil data used to prepare the energy balance are reported by EWURA through a data request from NBS. Additional data were collected from the "The Mid and Downstream Petroleum Subsector Performance Review Report for Year 2022" report published by EWURA.
- The petroleum products consumed in Tanzania are listed in the table below.

Product Name	Full name	Energy Balance Heading
AGO	Automotive Gasoil	Diesel
PMS	Petroleum Motor Spirit	Gasoline
IK	Illuminating Kerosene	Other Kerosene
JET A1	JET A1	Jet Kerosene
HFO	Heavy Fuel Oil	Heavy Fuel Oil
LPG	Liquefied Petroleum Gas	Liquefied Petroleum Gas
Lubricants	-	Lubricants
Petcoke	-	Petroleum coke

#### Petroleum products used in Tanzania

Source: NBS

- Petroleum product quantities are reported in liters except for liquefied petroleum gas (LPG) quantities which are reported in tons.
- LPG is assumed to be consumed for cooking only in the household sector and the services sector.
- PMS (gasoline) is assumed to be used only in transportation although it is likely that some gasoline is consumed in power generation (generation sets). EWURA reports the amount of gasoline used as aviation fuel by small aircrafts. Gasoline for road transport is calculated by subtracting aviation gasoline from total quantities.
- All kerosene is imported as IK whether used for lighting or as jet fuel:
  - JET A1 kerosene is prepared from IK by adding Stadis 450, an additive for use in aviation turbine jet fuels. It is reported as transfer from IK.
  - Lighting kerosene (IK) is allocated entirely to the household sector.
  - JET A1 is only for aviation. International aviation bunkers are not known and were estimated using data from EWURA to be 85% of total JET A1 volumes consumed.
- Heavy fuel oil (HFO) is assumed to be used mostly in industry. Some power plants can run on HFO but that was not the case in 2022 since diesel was cheaper.
- Lubricants are entirely dedicated to non-energy use. Tanzania imports lubricants but most of the quantities are blended in Tanzania from "non-specified" oil products.
- The Mining Commission reports petroleum coke import data which is allocated to the "nonmetallic minerals" branch of industrial consumption in 2022.
- For diesel, an estimation of diesel consumption by road and rail was made.
- Calorific values are default international values provided by IRES
- The data on oil products reported by EWURA display some inconsistencies such as a demand which for most products is higher than imports. This may be due, on the supply side, to the fact that "localized volumes" are not known leading to lower reported imports. On the demand side, quantities sold by OMCs to other OMCs may be present in the sales data leading to double counting. It was decided to allocate the discrepancies to the statistical difference.

#### Natural gas

- Tanzania is a producer of natural gas from two different fields: Songosongo and Mnazi Bay
- Data on natural gas is reported by the Petroleum Upstream Regulatory Authority (PURA) and TPDC in million standard cubic feet (mmscf) through dedicated data requests from NBS.
- Data on volumes of natural gas produced, flared and used for the operation of processing plants is reported by both institutions. The breakdown between flared and fuel volumes had to be estimated for three of the four plants using data available from one of the processing plants.
- Data on natural gas consumption, including use for power production and breakdown by sector and industry branch, is reported by TPDC and for each individual industry, services and power generation client.
- TPDC reports consumption of households and road transport, or compressed natural gas (CNG), as two separate categories.
- Natural gas used in industrial processes and power generation are metered separately in most cases. In one instance, volumes for process and power generation are not broken down and have been estimated.
- Distribution losses for natural gas are not known.
- Calorific values are calculated as a weighted average of the calorific values of the two fields currently in production in Tanzania.

#### Calculation of the weighted average of natural gas GCV/HHV value for Tanzania

	Songosongo Field	Mnazi Bay Field	Tanzania Total
2022 Production (mmscf)	51,249	46,415	97,663
GCV/HHV in GJ per 1,000 m3	37.959	39.595	38.736

Source: NBS calculations from GASCO, TPDC and PURA data

Note: By comparison, the default GCV value for natural gas proposed by IRES is 39.020 GJ per 1,000 m<sup>3</sup>.

• This GCV value for Tanzania will be revised annually using the respective production of the Songosongo and Mnazi Bay fields. In case new gas fields come into production, the natural gas GCV value for Tanzania will be adjusted.

#### Biofuels

- The biofuels category includes fuelwood, agricultural and wood residues (e.g. coconut shells, bagasse), animal waste, charcoal, biogas etc. Biofuels is estimated to be the main energy product category in Tanzania both in terms of production and consumption.
- Biofuel quantities are difficult to track and measure due to the following challenges:
  - Biomass is a heterogeneous material due to differences in plant species, components, and potential content of water and other substances.
  - Lack of reliable and consistent data sources on biofuel supply and demand, especially for informal and traditional sectors (e.g. charcoal production, fuelwood collection for own use by households, etc.)
  - Lack of standardized definitions and classifications of biofuel types and categories, leading to confusion and inconsistency in data reporting and analysis.

- These challenges led NBS to launch a Household Energy Consumption Survey (HECS)<sup>5</sup>. This survey will be conducted in 2024 and will provide data on biofuels consumption for the calendar year 2023. Therefore, the data for 2022 was estimated using a simple model which makes the best possible use of existing national and international data.
- The model for solid biofuel consumption in Tanzania focuses mainly on final energy consumption
  of solid biofuels in Tanzanian households, considering household size, stove type, and fuel
  consumption. Model inputs include Census 2022 data and IASES survey 2021/2022 data. The
  model outcome includes household consumption and commodity balances for 2022. The model
  uses the most recent information available, and the calculation process is fully transparent. The
  model will be adapted and expanded to retropolate and extrapolate the results of the 2023 HECS
  for the past and subsequent years.
- Biogas production and solid biofuels used in industry and other sectors is based on an estimation done by IRENA for 2021.<sup>6</sup>

#### Electricity

- Electricity production data from regulated production units is reported by EWURA using a dedicated data request from NBS.
- EWURA reports electricity production as well as fossil fuel inputs (diesel, fuel oil) for each power plant. Natural gas inputs into power generation were provided by TPDC.
- Power plants' own consumption is estimated at 1% of gross production by TANESCO.
- Transmission and distribution losses are reported by EWURA.
- Tanzania has several electricity auto producers in industries known to EWURA which reports for each of them the type of fuel (coal, diesel, HFO, natural gas, biomass) and the total installed capacity in MW. Auto producers' electricity generation was estimated assuming a capacity factor of 50%. Fossil fuel inputs into power generation by autoproducers were estimated assuming an average energy efficiency of 36% for all plants.
- In the case of natural gas, volumes used for power generation by auto producers is available from TPDC. The same capacity factor and efficiency rate for other auto producers is used.
- Biofuel inputs into power generation (wood wastes, bagasse) is not available and were estimated. Solid biofuel inputs for power generation were assumed to be sourced from wood wastes (e.g. coconut shells) for one third and bagasse for two-thirds.
- Electricity production from biogas and corresponding inputs are taken from IRENA (see section on renewable energy sources below).

## Installed capacity owned by licensed autoproducers in Tanzania (in MW) and estimated power generation (GWh) assuming a 50% capacity factor

Energy Source	Installed Capacity (MW)	Estimated production (GWh)	Estimated inputs (GWh)	Estimated inputs (ktoe)
Oil	159.0	696.4	1,934.5	166.3
Coal	15.4	67.5	187.4	16.1

<sup>&</sup>lt;sup>5</sup> The 2023 HECS survey is funded by the European Union under the project "Tanzania Energy Statistics". The latter is implemented by Expertise France.

<sup>&</sup>lt;sup>6</sup> IRENA statistics data. Website. Accessed June 2024. https://www.irena.org/Data

Biomass	20.5	89.8	249.4	21.4
Natural gas	102.8	334.8	623.4	53.6
Total Auto producers	297.7	1,188.5	2,994.7	257.4

Source: NBS calculations from EWURA data

- The breakdown of electricity sales by sector (industry, services, household, other sectors) is not fully known since TANESCO sales data is only available by tariff (D1, T1, T2, T3-MV, T3-HV). A simplified breakdown of sales by sector was made according to the following assumptions:
  - D1: Households
  - T1: Households
  - o T2: Services
  - T3-MV and T3-HV: Industry
- In the Mainland Tanzania energy balance, the amount of electricity sold to ZECO is considered an export of electricity.

#### Renewable energy sources

- EWURA reports power production from large and small regulated and registered solar, hydro and biofuel power plants both on-and off-grid.
- The challenge resides in the assessment of the power production from non-regulated entities, mainly individual installations or mini- and micro-grids.
- Data on hydroelectricity production is reported by EWURA.
- Data on the production and use of biogas, wind and solar PV is sourced from IRENA<sup>7</sup>:
- As reported in the "electricity" section, inputs of solid biofuels (wood wastes and bagasse) were estimated.

<sup>&</sup>lt;sup>7</sup> IRENA statistics data. Website. Accessed June 2024. https://www.irena.org/Data

#### 3.3. Data Collection and Processing for Zanzibar

Energy data for Zanzibar was taken from the Ministry of Energy website of Zanzibar that reported energy data for most products, but generally only up until 2020. The data reported was analyzed and validated by NBS in Mainland Tanzania, while missing data was estimated and then validated. 2021 and 2022 estimations were calculated using real gross domestic production (GDP) growth rates from the Office of the Chief Government Statistician (OCGS) in Zanzibar.

#### Petroleum products

- Zanzibar has its own procurement process for petroleum products from Mainland Tanzania. Import data for Petrol (gasoline), Diesel (Gas/Diesel), Jet Fuel (JET A1), and Kerosene exists for varying years and only up to 2020 for most products. Estimations are made for 2021 and 2022 data using the real GDP growth rate from OCGS.LPG is imported into Zanzibar from Mainland Tanzania, so no additional data was added to avoid double counting. Consumption of petroleum products is estimated. The following assumptions are made for the sector breakdown of petroleum products:
  - Petrol (gasoline) consumption only taking place in road transport
  - Diesel (gas/diesel) consumption in industry and road transport using the same breakdown as Mainland Tanzania
  - Jet Fuel (JET A1) majority goes to international aviation bunkers and the rest to domestic aviation consumption
  - Kerosene consumption in households
  - LPG not accounted specifically for Zanzibar to avoid double counting with Mainland Tanzania

#### Biofuels

- Fuelwood and charcoal are reported in bundles and bogs, respectively. According to stakeholders, the island no longer imports either product, while charcoal imports ended in 2016. Both products are said to be produced on the island, but the government is further discouraging its use.
- Because data is not readily available, the same model for solid biofuel consumption on Mainland Tanzania was used for Zanzibar. This takes into account Zanzibar households, considering household size, stove type, and fuel consumption. Model inputs include Census 2022 data and IASES survey 2021/2022 data. See the "Data Collection and Processing for Mainland Tanzania" section of this report for further explanation.

#### Electricity

- Data for electricity imports was reported by Zanzibar's Ministry of Energy, but figures were taken from TANESCO for sales to ZECO as it was more up to date. However, TANESCO sales to ZECO do not match estimated 2022 consumption data from the Ministry of Energy website. The difference is assumed distribution losses by ZECO.
- Zanzibar 2022 electricity consumption was estimated using 2020 ZECO sales data and real GDP growth data.

- Electricity consumption data is broken down by tariff and assumptions were made as to electricity consumption by sector.
  - Prepay is shared between households (75%) and commercial and public services (25%).
  - Z0 (lifeline) was marginal and dedicated to households.
  - Z1 (General Services) was dedicated to commercial and public services.
  - Z2 (small industries) and Z3 (large industries) were dedicated to industry consumption. There was no attempt made to further disaggregate industrial consumption of electricity at this time, and all consumption was placed under "not elsewhere specified (industry)."
  - $\circ$   $\,$  Z4 (street lighting) was dedicated to commercial and public services.

#### Renewable energy sources

- ZECO has a solar plant on Pemba Island which is their first pilot utility-scale renewable energy development project that will also include battery storage. As of 2023, this project was still under agreement so is not considered in the 2022 balance.
- No additional data was accessible on renewable energy sources on Zanzibar Island and no further assumptions were made at this time.

## 4. Units and Conversion Factors

The energy products and flows are measured in different physical units, such as tonnes, liters, cubic feet, kilowatt-hours, etc. To enable the aggregation and comparison of different energy products and flows, they are converted into a common energy unit: ktoe (kiloton of oil equivalent) or TJ (Terajoule).

#### **Commodity balance units**

Commodity Balance	Energy Product	Unit in which data is reported	Unit of Commodity Balance
Coal	Coal	Tonne	kilotonne (kt)
Oil	NGLs	Tonne	kilotonne (kt)
	Oil products	Litres	kilotonne (kt)
Natural gas	Natural gas	Mmscf (million cubic feet)	mmcm (million cubic meters) or TJ (GCV)
Biofuels	Fuel wood	-	kilotonne (kt)
	Charcoal	-	kilotonne (kt)
	Biogas	-	TJ (GCV)
Electricity	-	GWh	GWh

Source: NBS

The conversion factors are the coefficients that express the energy content of one unit of a given energy product or flow in terms of the common energy unit. They are based on the net calorific value (NCV) of the energy products or flows, which is the amount of heat released by the complete combustion of a unit of an energy product or flow, minus the heat of vaporization of the water produced.

The conversion factors are derived from the NCVs of the energy products or flows, which are obtained from various sources, such as laboratory tests, international standards, literature reviews, expert judgments, etc. The conversion factors are updated periodically to reflect the changes in the quality and composition of the energy products or flows.

#### **Petroleum product densities**

	kg/liter
Gasoline	0.753
Gasoil	0.843
Jet Fuel / Kerosene	0.798
Naphtha	0.713
LSFO	0.969
HSFO	0.997
Lubricants	0.880

Source: NBS calculations based on IEA (IEA prices documentation March 202) and the Central Bureau of Statistics from the Netherlands for lubricants

## 5. CO<sub>2</sub> Emissions

The energy balance can be used to prepare a high-level estimate of CO<sub>2</sub> emissions related to the combustion of fossil fuels using both the reference approach and the sector approach. Other greenhouse gases (GHGs) (i.e., CH4, N2O, NOx, etc.) are not included. The data calculated are for information purposes only and should in no way replace the data presented in the national GHG inventory

The  $CO_2$  emissions are the amount of carbon dioxide released into the atmosphere as a result of the combustion of energy products. They are estimated by multiplying the amount of energy products or flows consumed by their corresponding emission factors, which are the coefficients that express the amount of  $CO_2$  emitted per unit of energy product consumed.

The emission factors used for Tanzania are international default values which are based on the carbon content and the oxidation rate of each specific energy product:

#### Default carbon content (kg/GJ) from IPCC

Energy product	carbon content (kg/GJ)
Other bituminous coal	25.8
Sub-bituminous coal	26.2
Natural gas liquids (NGL)	17.5
Liquefied petroleum gases (LPG)	17.2
Gasoline inc. Biofuels	18.9
Jet Kerosene inc. Biofuels	19.5
Other Kerosene (e.g. lighting)	19.6
Gas/diesel oil	20.2
Fuel oil	21.1
Lubricants	20.0
Petroleum coke	26.6
Natural gas	15.3

Source: IPCC

## Annex 1: NCV Values in GJ/metric Ton (IRES)

SIEC codes		SIEC headings	Lower value (IRES)	Upper value (IRES)	Default value (IRES)
			GJ/metric ton	GJ/metric ton	GJ/metric ton
0		Coal			
	01	Hard coal			
011	0110	Anthracite	21.6	32.2	26.7
012		Bituminous coal			
	0121	Coking coal	24,0	31,0	28.2
	0129	Other bituminous coal	19.9	30.5	25.8
02		Brown coal			
021	0210	Sub-bituminous coal	11.5	26,0	18.9
022	0220	Lignite	5.5	21.6	11.9
3		Coal products			
031		Coal coke			
	0311	Coke oven coke	25.1	30.2	28.2
	0312	Gas coke	25.1	30.2	28.2
	0313	Coke breeze			
	0314	Semi cokes	25.1	30.2	28.2
032	0320	Patent fuel	15.1	32,0	20.7
033	0330	Brown coal briquettes (BKB)	15.1	32,0	20.7
034	0340	Coal tar	14.1	55,0	28,0
035	0350	Coke oven gas	19.6	77,0	38.7
036	0360	Gas works gas (and other manuf. gases for	19.6	77,0	38.7
		distribution)			
037	0074	Recovered gases	1.2	5.0	2.47
	03/1	Blast furnace gas	1.2	5,0	2.47
	0372	Basic oxygen steel furnace gas	3.8	15,0	7.06
020	0379	Other recovered gases			
039	0390	Other coal products			
11		Peat and peat products			
111	1110	Pedi	70	10 E	0.76
111	1110	Sou peat	7.0	12.5	9.70
112	1120	Reat products	7.0	12.5	9.70
12	1210	Peat products	7 0	12 5	0.76
121	1210	Other peat products	7.8	12.5	9.70
2	1290	Oil shale/oil sands	7.0	12.5	5.70
20		Oil shale/oil sands			
20	2000	Oil shale/oil sands	71	11 1	80
4	2000	Oil	/.1	11.1	0.5
41		Conventional crude oil			
410	4100	Conventional crude oil	40.1	44.8	42.3
420	4200	Natural gas liquids (NGL)	40.9	46.9	44.2
430	4300	Refinery feedstocks	36.3	46.4	43.0
440	4400	Additives and oxygenates			25.12
450	4500	Other hydrocarbons			41.868
461	4610	Refinery gas	47.5	50.6	49.5
462	4620	Ethane	44.9	48.8	46.4
463	4630	Liquefied petroleum gases (LPG)	44.8	52.2	47.3
464	4640	Naphtha	41.8	46.5	44.5
465		Gasolines			

		SIEC headings	Lower value	Upper value	Default value
SIEC	codes		(IRES)	(IRES)	(IRES)
	4654		40.5		
	4651	Aviation gasoline	42.5	44.8	44.3
	4652	Motor gasoline	42.5	44.8	44.3
	4653	Gasoline-type jet fuel	42.5	44.8	44.3
466	4001	Kerosenes	12.0	45.0	44.4
	4661	Kerosene-type jet fuel	42,0	45,0	44.1
467	4669	Other kerosene	42.4	45.2	43.8
467	4074	Gas oil/diesel oil and Heavy gas oil		42.2	42.0
	4671		41.4	43.3	43,0
460	4672	Heavy gas oil	20.0	41 7	40.4
468	4680	Fuel oli	39.8	41.7	40.4
469	4604	Other oil products		40.2	40.2
	4691	white spirit and special boiling point industrial	33.7	48.2	40.2
	4602	spirits	ээ г	12.2	40.2
	4692	Lubricants Dereffin wayor	33.5 22 7	42.3	40.2
	4095	Patroloum coko	55.7 20.7	40.2	40.Z
	4094	Bitumon	29.7	41.9	32.5
	4695	Other ail products p.a.s.	33.J 22 7	41.2	40.2
E	4099	Biofuels	55.7	40.2	40.2
5	E 1	Solid biofuels			
E11	51	Solid biolidels	7.0	21.0	15.6
511	5111	Wood pollots (source: Austrian Energy Agoncy)	7.9	51,0	17.0
	5110	Other Evolwood wood residues and by			17.5
	2119	products (source: Austrian Energy Agency)			13.9
512	5120	Bagasse			7 72
512	5120	Animal waste			1.12
514	5140	Black liquor	5.9	23.0	11.8
515	5150	Other vegetal material and residues	5.5	23,0	11.0
516	5160	Charcoal	14 9	58.0	29.5
010	5100		1.10		2010
521	5210	Biogasoline (source: IFA)	13.6	54 0	26.8
522	5220	Biodiesels (source: IEA)	13.6	54.0	36.8
523	5230	Bio jet kerosene (source: IEA)	2010	0.1,0	44.6
529	5290	Other liquid biofuels	13.8	54.0	27.4
		Biogases	2010	5.,0	
531		Biogases from anaerobic fermentation			
	5311	Landfill gas	25.4	100.0	50.4
	5312	Sewage sludge gas	25.4	100.0	50.4
	5319	Other biogases from anaerobic fermentation	25.4	100.0	50.4
532	5320	Biogases from thermal processes		/-	
610	6100	Industrial waste			
620	6200	Municipal waste (Values refer to the	6.8 / 7.0	18.0 / 18.0	11.6 / 10.0
		biomass/non-biomass fraction, respectively)		•	•

# Annex 2: Energy values for selected animal and vegetal wastes (IRES)

Wastes	Approximate ash content (percentage)	Net calorific value (MJ/kg)	Average moisture content: dry basis (percentage)
Animal dung	23–27	13.6	15
Groundnut shells	4–14	16.7	3–10
Coffee husks	8–10	15.5–16.3	13
Bagasse	10–12	8.4–10.5	40–50
Cotton husks	3	16.7	5–10
Coconut husks	6	16.7	5–10
Rice hulls	15–20	13.8–15.1	9–11
Olives (pressed)	3	16.75	15–18
Oil-palm fibres	10	7.5–8.4	55
Oil-palm husks	5	7.5–8.4	55
Bagasse	10–12	12.6	30
Bagasse	10–12	8.4	50
Bark	1	11.3	15
Coffee husk. cherries	8–10	13.4	30
Coffee husk. cherries	8–10	6.7	60
Corncobs	1–2	19.3	15
Nut hulls	1–5	18	15
Rice straw & husk	15–20	13.4	15
Wheat straw & husk	8–9	19.1	15
Municipal garbage		19.7	
Paper	1	17.6	5
Sawdust	1	11.7	50

Source: IRES