ENERGY ACCOUNTS

STATISTICS ON ENERGY SUPPLY AND USE OF ECONOMIC ACTIVITIES AND HOUSEHOLDS

INTRODUCTION

The general purpose of environmental economic accounts is to describe the relationship between the environment and economic activities using the basic concepts and classifications of national accounts (ESA 2010). In line with this purpose, Physical Energy Flow Accounts (PEFA), a sub-module of the environmental economic accounts system, records the physical energy flows from the environment to the economy (natural energy inputs), its cycle in the economy (energy products) and from the economy to the environment (energy residuals).

The study of energy accounts has been conducted by the Turkish Statistical Institute (TurkStat) on the basis of Energy Balance Tables published by the Ministry of Energy and Natural Resources (MENR).

In this report, statistics on physical supply and use of energy are presented for the period 2017-2021. The concepts and definitions used in the study, data sources, calculation methods and other relevant explanations have been given in the first part of the report. In the main findings section, the leading economic activities with respect to energy use have been analysed in terms of their economic size, compared with the energy use of the sectors. Also, the indicators obtained as a result of the physical energy flow accounts study are included in the section.

A. Concepts, Definitions and Sources

1- Structure of Supply and Use of Energy Tables

The framework of supply and use of energy consists of a pair of tables having basically the same structure.

- In row level, they are divided into three categories as natural energy inputs, energy products and energy residuals. Each category is also divided into related sub-categories.
- In column level; they show origins (sources of physical energy) or users (destinations of physical energy) of energy flows. Economic activities have been classified as consumption activities of households, changes in stocks, rest of the world and environment.

Table 1: Structure of Supply and Use of Energy Tables

SUPPLY	Economic Activities	Households	Changes In Stocks	Rest of the World	Environment	TOTAL
Natural Energy Inputs						
Energy Products						
Energy Residuals						
TOTAL						

USE	Economic Activities	Households	Changes In Stocks	Rest of the World	Environment	TOPLAM
Natural Energy Inputs						
Energy Products						
Energy Residuals						
TOTAL						

2- Compilation of Energy Accounts Tables

The results of the PEFA study have been reported to the European Union Statistical Office (Eurostat) by the European Union member states on annual basis through the relevant questionnaire in line with their reporting obligations since 2017. The questionnaire consists of the following seven basic tables.

Physical supply table for energy flows (Table A): Table A is a physical supply table that records the supply of natural energy inputs, energy products, and energy residuals (row-wise) by origin. Natural energy inputs are not subject to final use or consumption and are only supplied by the environment. Energy products are supplied by economic activities by domestic industries and rest of the world (import). Energy residuals basically originate from economic activities and households that produce them mainly through transformation and end use of energy (energy losses in form of dissipative heat released to the environment). In addition to these, stocks, as non-energy products, supply energy residuals in form of waste for energy recovery or losses from storage. Waste associated with energy use can also be imported from the rest of the world.

Physical use table for energy flows (Table B): Table B is a physical use table that records the use of natural energy inputs, energy products, and energy residuals (row-wise) by destination. This table is formed as the result of the automatic sum of tables B.1 and B.2, that show the transformation and end use of energy flows. Natural energy inputs are used only by economic activities. In other words, natural energy inputs are used (harvested, extracted, etc.) by in order to produce energy products. Energy products, on the other hand, are used by economic activities and households in the form of net stock changes, and by the rest of the world (exports). Energy residuals are used by economic activities, especially in the form of processing wastes for energy purposes. In addition, energy residuals may be used in the form of waste absorbed as losses and consumed heat by environment. Stock column shows the amount of energy emerged as non-energy products (such as plastics, lubricant, etc.) in the form of stock.

Transformation Table of Physical Energy Flows (Table B.1): It is the transformation use table of physical energy. Natural energy inputs are used by economic activities (such as the use of wind and solar energy for electricity generation or the use of coal ore for coal production). Energy products, in the same way, are only used by the relevant economic activities in the transformation process (such as the use of natural gas and coal in electricity generation). In the transformational use of energy residuals by economic activities, the use of wastes in electricity and biogas production is mostly recorded. Energy residuals returned to the environment in the form of dissipative heat as a result of the transformation are recorded in the environment column.

End Use Table of Physical Energy Flows (Table B.2): It is the end use table of physical energy. Natural energy inputs are used by economic activities (such as use of wind and solar energy for electricity generation or use of coal ore for coal production). Energy products, on the other hand, are used by economic activities and households as final consumption in the form of net stock change and by the rest of the world (export). Energy residuals are used by economic activities, especially in the form of final consumption of wastes. The stock column shows the amount of energy emerged as non-energy stock.

Finally, energy residuals absorbed as heat dissipated as a result of all end-uses are recorded in the environmental column.

Table of Emission-relevant Use of Energy Flows (Table C): It records the emission-relevant use of energy. Emission-relevant use of energy shows the release of gaseous substances into the atmosphere as a result of energy production, consumption and stock change. It shows the emissions resulting from the use of energy products as a result of economic activities and production and consumption activities in households. The use of energy residuals is considered as emissions if the wastes are used for energy transformation.

Table of Key Indicators (Table D): This table is not in matrix format unlike previous tables. Table includes figures related to basic energy indicators in terms of supply, use and stock. These indicator vectors are automatically generated from tables A and B.

Bridge Table (Table E): This table shows the basic energy indicators derived within the scope of energy accounts according to resident principle (the total economic activities of residents of a country, inside or outside the country's borders) and basic indicators of energy statistics based on territory principle (total activities of residents or non-residents within the borders of the country) in a comparative way.

3- Classifications

Natural energy inputs are basically divided into two groups as non-renewable natural energy inputs and renewable natural energy inputs. In classification of energy product, Standard International Energy Product Classification (SIEC) has been used. There is not any standard classification for energy residuals. Classification of economic activities is compatible with NACE Rev. 2 classification system. The economic activities covered in the study are listed below:

- A-Agriculture, forestry and fishing
- B-Mining and quarrying
- C-Manufacturing
- D-Electricity, gas, steam and air conditioning production and distribution
- E-Water supply; sewerage, waste management and remediation activities
- F-Construction
- G-Wholesale and retail trade: repair of motor vehicles, motorcycles
- H-Transport and storage
- I-Accommodation and food service activities
- J-Information and communication
- K-Financial and insurance activities
- L-Real estate activities
- M-Professional, scientific and technical activities
- N-Administrative and support service activities
- O-Public administration and defence; compulsory social security
- P-Education
- Q-Human health and social work activities
- R-Culture, Arts, entertainment, recreation and sport
- S-Other service activities
- T-Activities of households as employers

4- Data Sources

Within the study, energy balance tables were used as the main data source. Energy balance tables have been published by MENR for many years. The tables published since 1972 can be accessed via the Ministry website (www.enerji.gov.tr). Each year, energy balance tables are disseminated in November, for the previous reference year.

Energy balance tables, on the one hand, include domestic production, import, export, bunker and stock changes related to energy supply on the basis of energy products; on the other hand, it provides sector-specific information on energy consumption. The tables are published in two different formats as the unit of measurement for energy products: original units and thousand tons of equivalent oil. Energy conversions for fuels are calculated on the basis of the average net calorific value. Since 2015, energy products and consumption sectors have been presented in more detailed manner in the energy balance tables. Particularly, the sub-sectors of the industry sector (from the "Mining Activities" sub-sector to the "Construction" sub-sector), it is published at the division level in accordance with NACE Rev. 2 classification system.

In determining energy use by sectors, the following sources have been used: annual joint questionnaires reported by the MENR to international institutions and organizations as well as energy balance tables, motor vehicles data from the General Directorate of Security and vehicle-km data from the Ministry of Transport and Infrastructure, data from the Revenue Administration, sectoral reports of Republic of Türkiye Energy Market Regulatory Authority, administrative registers of Turkish Electricity Transmission Corporation and Turkish Electricity Distribution Corporation and, Sectoral Energy Consumption Statistics published by Turkish Statistical Institute and results of the Pilot Study on Statistics on Energy Consumption Statistics by Households.

B. Main Findings

1- Key Indicators

The key indicators derived as the result of the Energy Accounts study are listed below:

- Natural energy inputs extracted by economic activities
- Domestic production of energy products
- Intermediate consumption of energy products
- Household consumption of energy products
- Use of waste for energy purposes
- Net domestic energy use
- Total energy input/output
- Emission-relevant use of energy

Table 2: Key indicators of physical energy flow accounts by years, 2017-2021

(Petajoule)

	2017	2018	Change (%)	2019	Change (%)	2020	Change (%)	2021	Change (%)
Natural energy inputs by economic activities	1 485	1 617	8,9	1 831	13,2	1 799	-1,7	1 896	5,4
Domestic production of energy products	4 102	4 084	-0,4	4 514	10,5	4 416	-2,2	4 870	10,3
Intermediate consumption of energy products	7 597	7 374	-2,9	7 524	2,0	7 398	-1,7	8 208	11,0
Household consumption of energy products	1 402	1 397	-0,3	1 475	5,6	1 569	6,3	1 690	7,7
Use of waste for energy purposes	17	54	210,2	56	3,6	59	6,2	72	21,9
Net domestic energy use	6 399	6 358	-0,6	6 372	0,2	6 408	0,6	6 997	9,2
Total energy input/output	10 519	10 497	-0,2	10 943	4,3	10 885	-0,5	11 939	9,7
Emission-relevant use of energy	5 672	5 593	-1,4	5 382	-3,8	5 360	-0,4	6 015	12,2

Considering the change in the key indicators, it can be seen that there is an increase in all indicators in 2021 compared to the previous year. It can be stated that the decrease in 2020 in sectoral-based consumption due to factors such as supply-chain disruptions, lockdowns/restrictions during COVID-19 pandemics is one of the reasons behind this change.

Since industrial wastes had been added as a separate energy product to the energy balance tables for the first time in 2018, the highest proportional increase occurred in the “use of waste for energy purposes” indicator.

2- Energy Use by Economic Activities

Net domestic energy use, one of the indicators produced within the scope of energy accounts, shows the amount of energy used/consumed by a certain economic activity in such a way that it cannot be used for energy purposes again. In this respect, there are two types of energy forms not being convenient for reuse:

1- Losses like waste heat released to nature

2- Energy temporarily stored for non-energy purposes in products like plastic, bitumen and lubricants.

Net domestic energy use, as described in energy statistics, is composed with final energy consumption that corresponds to the sum of internal consumption in energy sector, transformation (e.g. from natural gas to electricity), distribution losses, and international air and sea transportation bunkers. Bunker is defined as the fuel and mineral oil supplied with or without tax to sea vehicles adjacent to a country's territorial waters or to domestic and foreign aircraft at airports.

Table 3: Net Domestic Energy Use by Economical Activities and Households, 2021

(Petajoule)

	Net Domestic Energy Use	Share (%)
Total	**6 997**	**100,00**
Sectors Total	**5 307**	**75,85**
C-Manufacturing	2 197	**31,40**
D-Electricity, gas, steam and air conditining production and distribution	1 317	**18,82**
H-Transport and storage	683	**9,76**
G-Wholesale and retail trade: repair of motor vehicles, motorcycles	372	**5,32**
A-Agriculture, forestry and fishing	219	**3,13**
F-Construction	122	**1,74**
O-Public administration and defence; compulsory social security	86	**1,23**
I-Accommodation and food service activities	65	**0,93**
B-Mining and quarrying	58	**0,83**
P-Education	40	**0,58**
Q-Human health and social work activities	34	**0,49**
E-Water supply; sewerage, waste management and remediation activities	29	**0,41**
S-Other service activities	16	**0,22**
L-Real estate activities	15	**0,22**
M-Professional, scientific and technical activities	13	**0,19**
N-Administrative and support service activities	13	**0,19**
J-Information and communication	12	**0,17**
K-Financial and insurance activities	10	**0,14**
R-Culture, Arts, entertainment, recreation and sport	4	**0,06**
T-Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	1	**0,01**
HH-Consumption Activities of Households	**1 690**	**24,15**
Heating/cooling activities of households	795	**11,37**
Transport activities of households	595	**8,51**
Other activities of households	299	**4,28**

In 2021, the total net domestic energy use in Türkiye has approached 7 thousand petajoules. This use includes the total use of economic activities and households. The net domestic energy use was 75.85% and 24.15% by economic activities and households respectively.

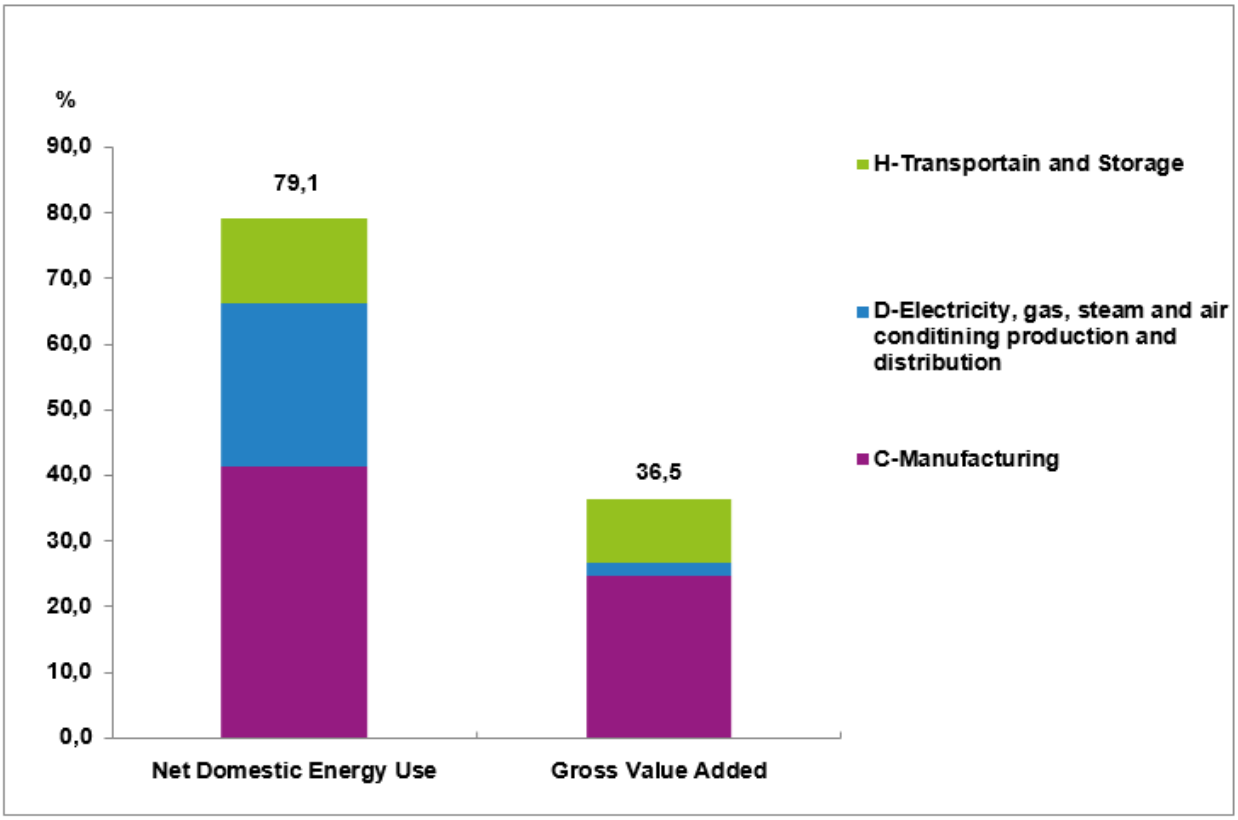
In net domestic energy use, "C-Manufacturing" had the largest share in economic activities with 31.40%. Within the manufacturing industry, energy-intensive sectors like basic metal industry and manufacture of other non-metallic mineral products and chemical industry, where non-energy consumption is intense, became leading sub-sectors. Manufacturing was followed by the "D-Electricity, gas, steam and air conditioning production and distribution" sector with a share of 18.82%. The energy use of the D sector consisted only of the transformation losses in the supply and distribution of electricity, natural gas and heat and domestic consumption. The end use of electricity, natural gas and heat is calculated under the relevant economic activity. Following these two sectors, the share of the "H-Transportation and storage" sector was 9.76% and that of the "G-Wholesale and retail trade; repair of motor vehicles and motorcycles" sector was 5.32%. In the road transport sub-sector, only the fuel consumption of companies operating in this sector is indicated. Transportation fuels (gasoline, diesel, LPG) consumed by households and other economic activities are calculated under the relevant economic activity.

The biggest part of the household consumption activities (11.37%), which constitutes 24.15% of the total net domestic energy use, resulted from the energy consumption of the households for heating/cooling purposes. The remaining parts mainly included household transportation consumption and other energy consumptions like lighting, cooking and use of electrical appliances.

3- Comparison of Energy Use with Gross Value Added and Gross Domestic Product (GDP)

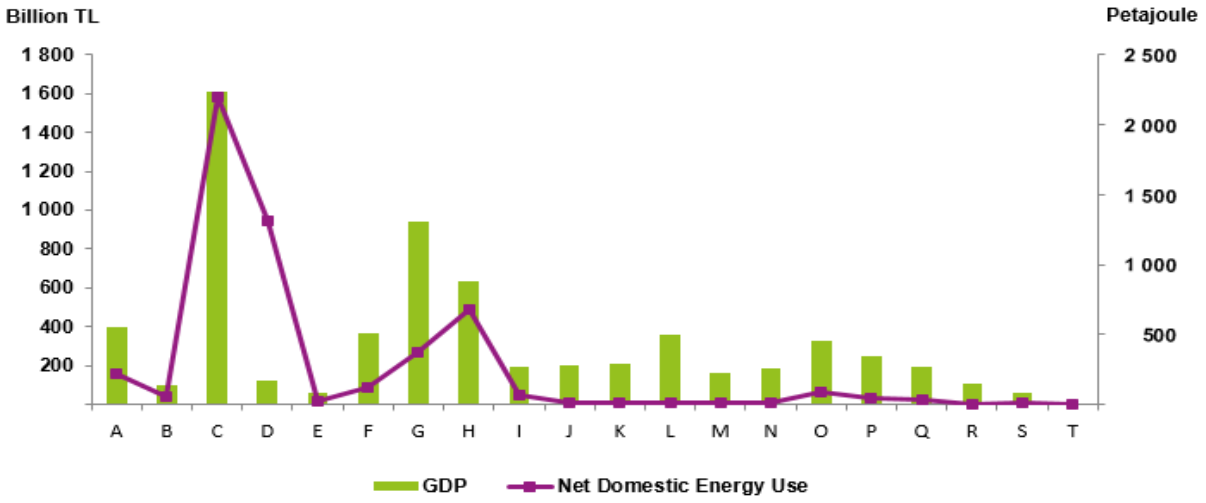
Net domestic energy use allows to compare energy use with economic indicators such as gross value added and gross domestic product, and to obtain indicators such as energy dependence and energy intensity.

Graph 1: Contribution of economic activities with high energy use to gross added value, 2021



In 2021, three sectors accounted for 79.1% of the total net domestic energy used by all economic activities. On the other hand, the total share of the same three economic activities in the gross value added was 36.5%. Whereas "C-Manufacturing" has the largest share in economic activities with a rate of 41.4%, it is followed by "D-Electricity, gas, steam and air conditioning production and distribution" with a share of 24.8% and "H-Transportation and storage" sectors followed with a share of 12.9%.

Graph 2: GDP and net domestic energy use by economic activity, 2021

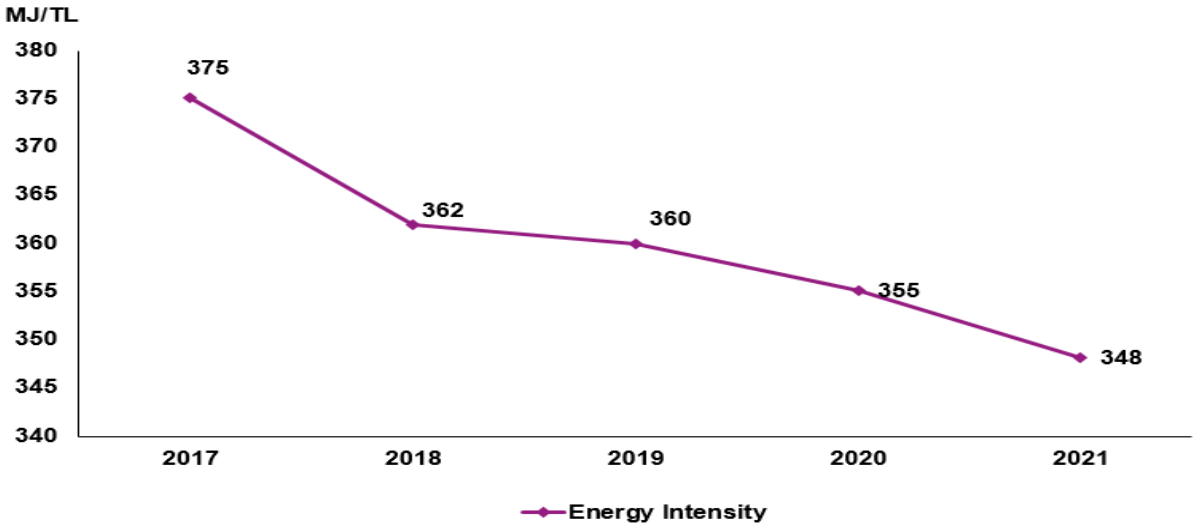


In 2021, in terms of their contribution to GDP at current prices, "C-Manufacturing", "G- Wholesale and retail trade; repair of motor vehicles and motorcycles" and "H-Transportation and storage" sectors occupied the top three ranks. In net domestic energy use, "C-Manufacturing" is followed by "D-Electricity, gas, steam and air conditioning production and distribution" and "H-Transportation and storage" sectors, respectively.

4- Energy Intensity

Energy intensity is one of the indicators that measure the energy needs of an economy and is used as an estimate of energy efficiency. Energy intensity, defined as energy use per unit of GDP, is calculated by dividing net domestic energy consumption to GDP at constant prices (2009=100). The decrease in the net domestic energy use required to produce a product or provide a service leads to a decrease in energy intensity as well.

Graph 3: Energy Intensity, 2017-2021

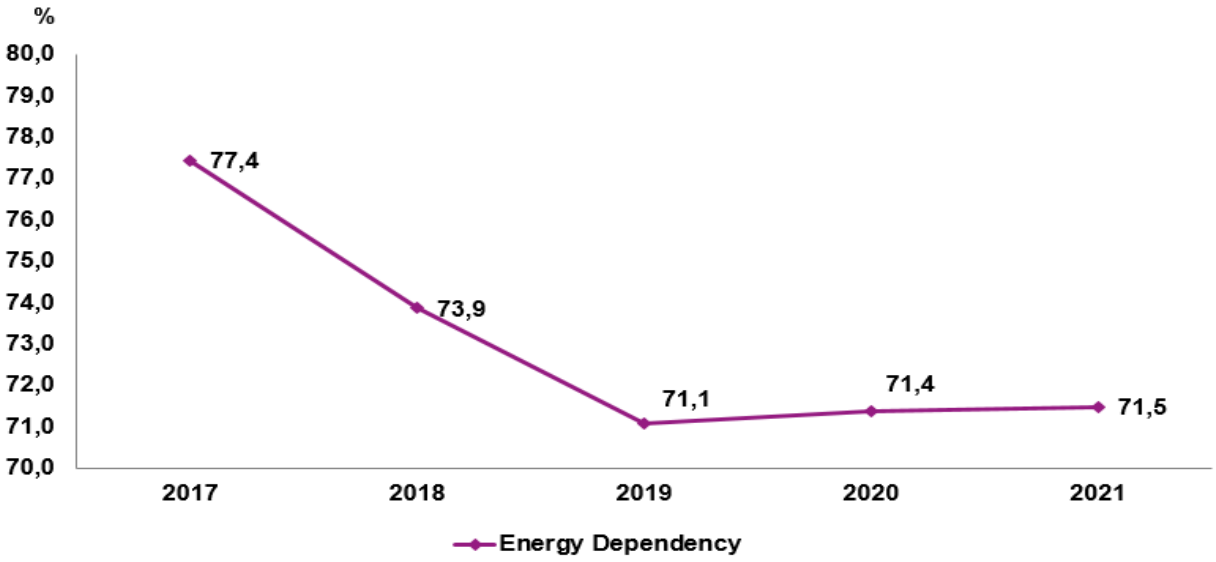


Energy intensity decreased by 2.0% in 2021 compared to the previous year.

5- Energy Dependency

Energy dependency ratio indicates the extent to which an economy needs imports to meet its energy needs. This indicator is calculated by dividing net imports (import-export) to net domestic energy use.

Graph 3: Energy Dependency, 2017-2021



The energy dependency ratio was 71.5% in 2021 increasing by 0.1% compared to the previous year.