Statistical Centre of Iran

Introduction of energy balance

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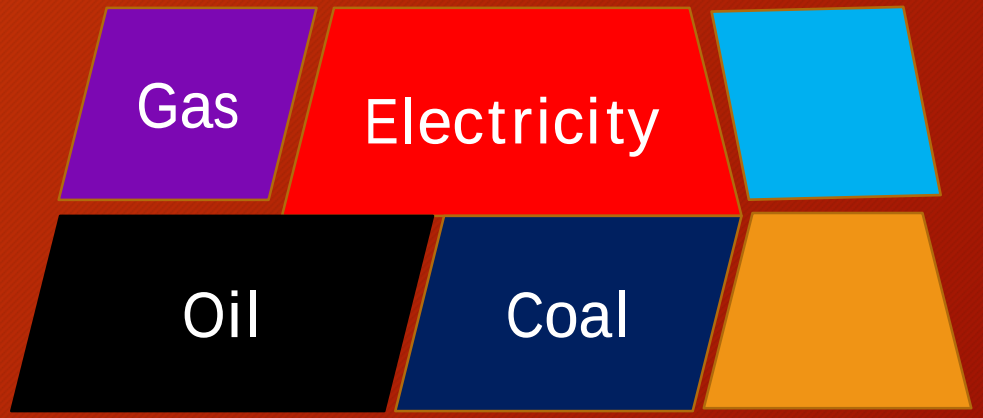
What is energy balance?

An accounting **framework** for ***compilation*** of data on **all energy products entering, exiting and used *within the national territory*** of a given **country** during a ***reference period***.

Source: International Recommendations on Energy Statistics, UNSD, 2016

The importance of energy balances:

- **Bringing all pieces of information together**



Source: International energy course, Online Statistics Summer School

Energy balance

- Energy balance express all forms of energy in a *common accounting unit*.
- It shows the relationship between the inputs to and the outputs from the energy transformation processes.
- The energy balance should be as complete as possible that is all energy flows should be accounted for in the balance.

Purpose of energy balance

- It reflects the relationships between:
  - The primary production of energy,
  - its transformation and,
  - Final consumption.
- Ensure comparability between different reference periods and between different countries;
- Provide data for estimation of CO2 emissions;

Purpose of energy balance

- Provide the basis for indicators of the energy's role in the country's economy;
- Calculate efficiencies of transformation processes occurring in the country.
- Calculate the relative shares of the supply/consumption of various products of the country's total supply/consumption

Structure of energy balance

The energy balance is a matrix represented by rows and columns.

Columns represent :

Energy products that are available for use in the national territory.

Rows represent: Energy flows.

Iran, Islamic Republic of: Balances for 2015

in thousand tonnes of oil equivalent (ktoe) on a net calorific value basis

2015 | Indicators | Balances | Coal | Electricity and Heat | Natural Gas | Oil | Renewables and Waste

	Coal*	Crude oil*	Oil products	Natural gas	Nuclear	Hydro	Geothermal, solar, etc.	Biofuels and waste	Electricity	Heat	Total**
Production	727	165272		155							
Imports	479	1561		7							
Exports	-133	-67282		-7668	0	0	0	0	-587	0	-94983
International marine bunkers***	0	0		0	0	0	0	0	0	0	-4656
International aviation bunkers***	0	0		0	0	0	0	0	0	0	-1386
Stock changes	0	1075		0	0	0	0	0	0	0	871
TPES	**1073**	**100626**		**155265**	**759**	**1212**	**19**	**510**	**-230**	**0**	**236528**
Transfers	0	-10465		0	0	0	0	0	0	0	1422
Statistical differences	411	-772		439	0	0	0	0	-1257	0	-1958
Electricity plants	-158	0		-49413	-759	-1212	-19	-4	24134	0	-39035
CHP plants	0	0		0	0	0	0	0	0	0	0
Heat plants	0	0		0	0	0	0	0	0	0	0
Gas works	0	0		0	0	0	0	0	0	0	0
Oil refineries	0	-87734		0	0	0	0	0	0	0	-798
Coal transformation	-610	0		0	0	0	0	0	0	0	-610
Liquefication plants	0	0		0	0	0	0	0	0	0	0
Other transformation	0	0		0	0	0	0	-1	0	0	-1
Energy industry own use	-165	-1654		-10966	0	0	0	0	-921	0	-16200
Losses	-71	0		-49	0	0	0	0	-3574	0	-3695
Total final consumption	470	0		95275	0	0	0	505	18452	0	176654

Columns represent energy products that are available for use

Rows represent flow across different products

TPES:
Total primary energy supply

Source: http://www.iea.org/statistics

Convert to a Common energy unit

Azerbaijan: Balances for 2015

thousand tonnes of oil equivalent (ktoe) on a net calorific value basis

2015 | Indicators | Balances | Coal | Electricity and Heat | Natural Gas | Oil | Renewables and Waste

	Coal*	Crude oil*	Oil products	Natural gas	Nuclear	Hydro	Geothermal, solar, etc.	Biofuels and waste	Electricity	Heat	Total**
Production	0	41867	0	16147	0	141	1	154	0	0	58309
Imports	0	0	276	0	0	0	0	0	9	0	285
Exports	0	-35276	-2299	-6837	0	0	0	0	-23	0	-44435
International marine bunkers***	0	0	-51	0	0	0	0	0	0	0	-51
International aviation bunkers***	0	0	-272	0	0	0	0	0	0	0	-272
Stock changes	0	60	187	272	0	0	0	1	0	0	520
TPES	**0**	**6651**	**-2159**	**9582**	**0**	**141**	**1**	**155**	**-14**	**0**	**14356**
Transfers	0	-41	44	0	0	0	0	0	0	0	3
Statistical differences	0	-37	-60	-38	0	0	0	0	-9	0	-144
Electricity plants	0	0	-54	-2990	0	-141	-1	-72	1429	0	-1829
CHP plants	0	0	-323	-1582	0	0	0	0	694	26	-1185
Heat plants	0	0	0	-155	0	0	0	0	0	130	-26
Gas works	0	0	0	0	0	0	0	0	0	0	0
Oil refineries	0	-6572	6441	0	0	0	0	0	0	0	-132
Coal transformation	0	0	0	0	0	0	0	0	0	0	0
Liquefication plants	0	0	0	0	0	0	0	0	0	0	0
Other transformation	0	0	0	0	0	0	0	-5	0	0	-5
Energy industry own use	0	0	-364	-422	0	0	0	0	-338	-15	-1140
Losses	0	0	0	-912	0	0	0	0	-247	-18	-1177
Total final consumption	**0**	**0**	**3525**	**3481**	**0**	**0**	**0**	**77**	**1515**	**123**	**8721**
Industry	**0**	**0**	**67**	**907**	**0**	**0**	**0**	**0**	**272**	**0**	**1246**
Transport	**0**	**0**	**2348**	**4**	**0**	**0**	**0**	**0**	**41**	**0**	**2393**
Other	**0**	**0**	**359**	**2540**	**0**	**0**	**0**	**76**	**1202**	**123**	**4300**
Residential	0	0	32	2309	0	0	0	52	683	102	3178

Total

Total energy is computed

Source: http://www.iea.org/statistics

Energy flow

www.shutterstock.com

"Energy flow" refers to:

production,
import,
exports,
bunkering,
stock changes,
transformation,
energy use by energy industries,
losses during the transformation
final consumption of energy products

within the territory of reference for which these statistics are compiled.

Supply

Transformation

Final consumption

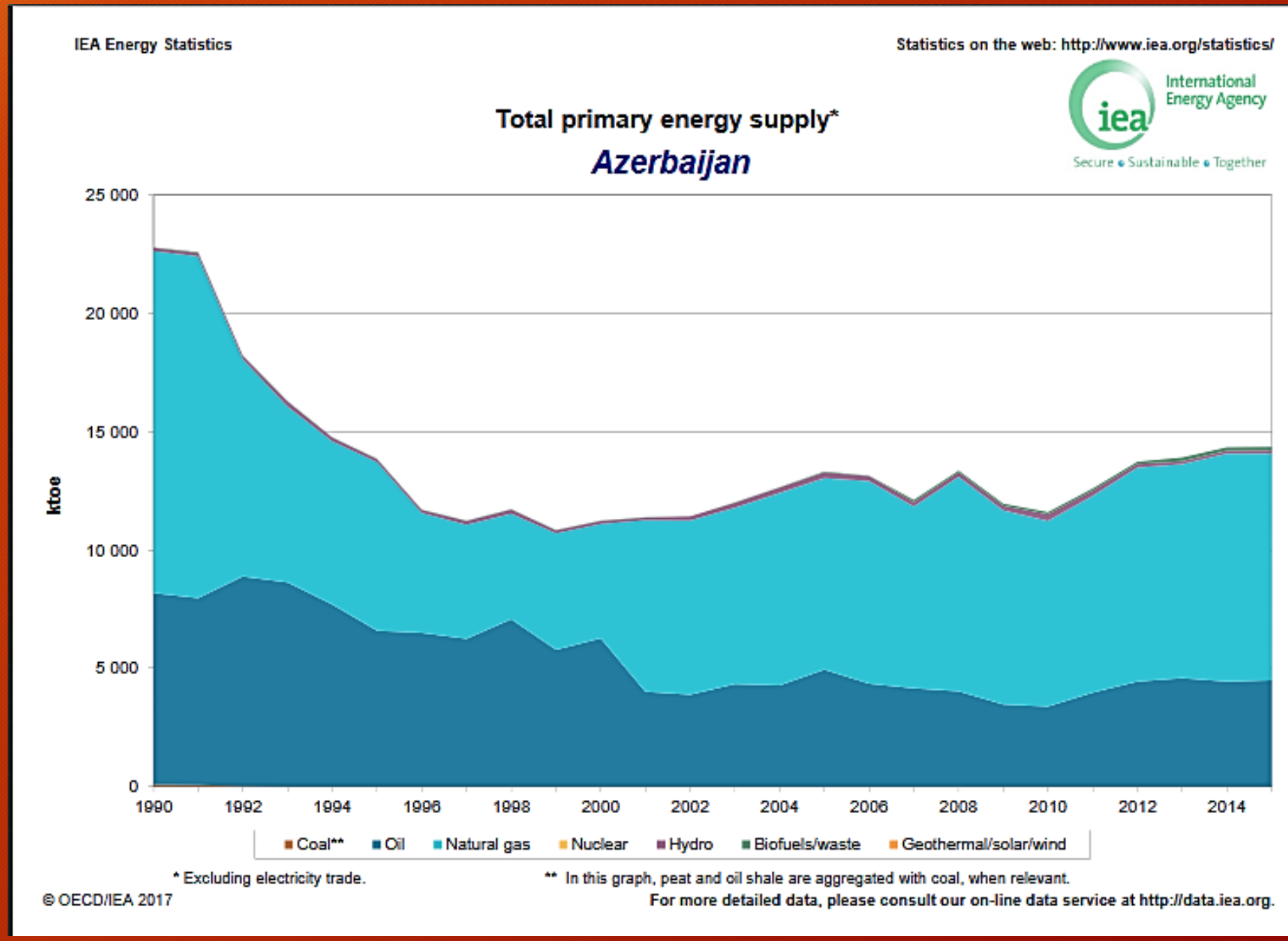
Azerbaijan: Balances for 2015

In thousand tonnes of oil equivalent (ktoe) on a net calorific value basis

2015 | Indicators | Balances | Coal | Electricity and Heat | Natural Gas | Oil | Renewables and Waste

	Coal*	Crude oil*	Oil products	Natural gas	Nuclear	Hydro	Geothermal, solar, etc.	Biofuels and waste	Electricity	Heat	Total**
Production	0	41867	0	16147	0	141	1	154	0	0	58309
Imports	0	0	276	0	0	0	0	0	9	0	285
Exports	0	-35276	-2299	-6837	0	0	0	0	-23	0	-44435
International marine bunkers***	0	0	-51	0	0	0	0	0	0	0	-51
International aviation bunkers***	0	0	-272	0	0	0	0	0	0	0	-272
Stock changes	0	60	187	272	0	0	0	1	0	0	520
TPE 8	**0**	**6861**	**-2159**	**9682**	**0**	**141**	**1**	**155**	**-14**	**0**	**14368**
Transfers	0	-41	44	0	0	0	0	0	0	0	3
Statistical differences	0	-37	-60	-38	0	0	0	0	-9	0	-144
Electricity plants	0	0	-54	-2990	0	-141	-1	-72	1429	0	-1829
CHP plants	0	0	-323	-1582	0	0	0	0	694	26	-1185
Heat plants	0	0	0	-155	0	0	0	0	0	130	-26
Gas works	0	0	0	0	0	0	0	0	0	0	0
Oil refineries	0	-6572	6441	0	0	0	0	0	0	0	-132
Coal transformation	0	0	0	0	0	0	0	0	0	0	0
Liquefication plants	0	0	0	0	0	0	0	0	0	0	0
Other transformation	0	0	0	0	0	0	0	-5	0	0	-5
Energy industry own use	0	0	-364	-422	0	0	0	0	-338	-15	-1140
Losses	0	0	0	-912	0	0	0	0	-247	-18	-1177
Total final consumption	**0**	**0**	**3526**	**3481**	**0**	**0**	**0**	**77**	**1616**	**123**	**8721**
Industry	**0**	**0**	**87**	**907**	**0**	**0**	**0**	**0**	**272**	**0**	**1248**
Transport	**0**	**0**	**2348**	**4**	**0**	**0**	**0**	**0**	**41**	**0**	**2393**
Other	**0**	**0**	**369**	**2640**	**0**	**0**	**0**	**78**	**1202**	**123**	**4300**
Residential	0	0	32	2309	0	0	0	52	683	102	3178
Commercial and public services	0	0	10	185	0	0	0	22	441	21	679
Agriculture / forestry	0	0	317	47	0	0	0	2	78	0	443
Fishing	0	0	0	0	0	0	0	0	0	0	0
Non-specified	0	0	0	0	0	0	0	0	0	0	0
Non-energy use	**0**	**0**	**761**	**30**	**0**	**0**	**0**	**0**	**0**	**0**	**791**
-of which chemical/petrochemical	*0*	*0*	*662*	*30*	*0*	*0*	*0*	*0*	*0*	*0*	*692*

Source: http://www.iea.org/statistics/statisticssearch/report/?country=AZERBAIJAN&product=balances&year=2015



http://www.iea.org/stats/WebGraphs/AZERBAIJAN5.pdf

International Energy Agency

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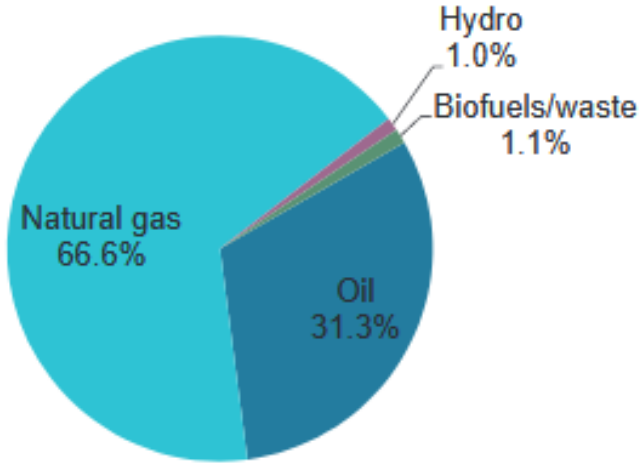
Share of total primary energy supply* in 2015

Azerbaijan



14 356 ktoe

* Share of TPES excludes electricity trade.

** In this graph, peat and oil shale are aggregated with coal, when relevant.

Note: For presentational purposes, shares of under 0.1% are not included and consequently the total may not add up to 100%.

For more detailed data, please consult our on-line data service at http://data.iea.org.

http://www.iea.org/stats/WebGraphs/AZERBAIJAN4.pdf

Top block- Energy supply

Total energy supply=

+ Primary energy production
+ Import of primary and secondary energy
- Export of primary and secondary energy
- International (aviation and marine) bunker
- Stock changes

Definitions

- **Production**: is capture, extraction or manufacture of fuels or energy in forms which are ready for general use.
- **Primary production** is the capture or extraction of fuels or energy from natural energy flows.
- **Secondary production** is the manufacture of energy products through the process of transformation of primary fuels or energy.

Definitions

- **Imports of energy products** comprise all fuel and other energy products entering the national territory.

- **Exports of energy products** comprise all fuel and other energy products leaving the national territory.

Definitions

- **International Marine Bunkers** are quantities of fuels delivered to merchant (including passenger) ships, of any nationality, for consumption during international voyages transporting goods or passengers.

- **International Aviation Bunkers** are quantities of fuels delivered to civil aircraft, of any nationality, for consumption during international flights transporting goods or passengers.

The middle block

- The middle block show:

- *Transfers,*
- *Energy transformation,*
- *Energy industry own use,*
- *Loses.*

Transformation

- The energy transformation describes the processes that convert an energy product into another energy product which is more suitable for specific uses.
- Energy entering transformation processes are shown with a negative sign to represent the input.
- Energy which is an output of transformation activities is shown as a positive number.

Transformation

- The sum of cells in each row appearing in the column “Total” should therefore be:

- A negative as transformation always results in certain loss of energy when expressed in energy units.

Example of transformation

- Fuels into electricity generation and heat generation,
- Crude oil into oil refineries for the production of petroleum products,
- Coal into coke ovens gas for the production of coke and coke oven gas

	Coal*	Crude oil*	Oil products	Natural gas	Nuclear	Hydro	Geothermal, solar, etc.	Biofuels and waste	Electricity	Heat	Total**
Production	727	165272	0	155688	759	1212	19	506	0	0	324182
Imports	479	1561	2854	7246	0	0	0	4	357	0	12500
Exports	-133	-67282	-19314	-7668	0	0	0	0	-587	0	-94983
International marine bunkers***	0			0	0	0	0				-4656
International aviation bunkers***	0						0				-1386
Stock changes	0			0	0	0	0				871
TPES	**1073**	**100626**	**-22706**	**155265**	**759**	**1212**	**19**	**510**	**-230**	**0**	**236528**
Transfers	0	-10465	11887	0	0	0	0	0	0	0	1422
Statistical differences	411	-772	-778	439	0	0	0	0	-1257	0	-1958
Electricity plants	-158	0	-11604	-49413	-759	-1212	-19	-4	24134	0	-39035
CHP plants	0	0						0	0	0	0
Heat plants	0	0						0	0	0	0
Gas works	0	0	0	0	0	0	0	0	0	0	0
Oil refineries	0	-87734	86936	0	0	0	0	0	0	0	-798
Coal transformation	-610	0	0	0	0	0	0	0	0	0	-610
Liquefication plants	0	0	0	0	0	0	0	0	0	0	0
Other transformation	0	0	0	0	0	0	0	-1	0	0	-1
Energy industry own use	-165	-1654	-2494	-10966	0	0	0	0	-921	0	-16200
Losses	-71	0	0	-49	0	0	0	0	-3574	0	-3695

Input (Coal)

Transformation

Output (Electricity)

Efficiency=Output/Input

Source: http://www.iea.org/statistics/statisticssearch/report/?country=IRAN&product=balances&year=2015

Recording of energy industry own use.

- Energy industry own use is defined as the consumption of fuels, electricity and heat for the direct support of the production, and preparation for use of fuels and energy.

- EXAMPLE:
  - Consumption of electricity in power plants for lighting, compressors and cooling systems

  - The fuels used to maintain the refinery process.

Losses

- Losses occur during the transmission, distribution and transport of fuels, electricity and heat.

- Losses also include venting and flaring of manufactured gases, losses of geothermal heat after production and pilferage of fuels or electricity.

The bottom block- final consumption

Total final consumption	**0**	**0**	**3525**	**3481**	**0**	**0**	**0**	**77**	**1515**	**123**	**8721**
Industry	**0**	**0**	**67**	**907**	**0**	**0**	**0**	**0**	**272**	**0**	**1246**
Transport	**0**	**0**	**2348**	**4**	**0**	**0**	**0**	**0**	**41**	**0**	**2393**
Other	**0**	**0**	**359**	**2540**	**0**	**0**	**0**	**76**	**1202**	**123**	**4300**
Residential	0	0	32	2309	0	0	0	52	683	102	3178
Commercial and public services	0	0	10	185	0	0	0	22	441	21	679
Agriculture / forestry	0	0	317	47	0	0	0	2	78	0	443
Fishing	0	0	0	0	0	0	0	0	0	0	0
Non-specified	0	0	0	0	0	0	0	0	0	0	0
Non-energy use	**0**	**0**	**751**	**30**	**0**	**0**	**0**	**0**	**0**	**0**	**781**
-of which chemical/petrochemical	*0*	*0*	*552*	*30*	*0*	*0*	*0*	*0*	*0*	*0*	*582*

Source: http://www.iea.org/statistics/statisticssearch/report/?country=AZERBAIJAN&product=balances&year=2015

The bottom block- final consumption

- final consumption (final energy consumption) is flows reflecting energy consumption by energy consumers, as well as non energy use of energy products.

- final consumption covers all the consumption on the national territory independently of the residence of the consuming units. Thus the energy consumption by residents abroad is excluded, and the energy consumed by nonresidents (foreigners) on the national territory is included.

Energy consumers

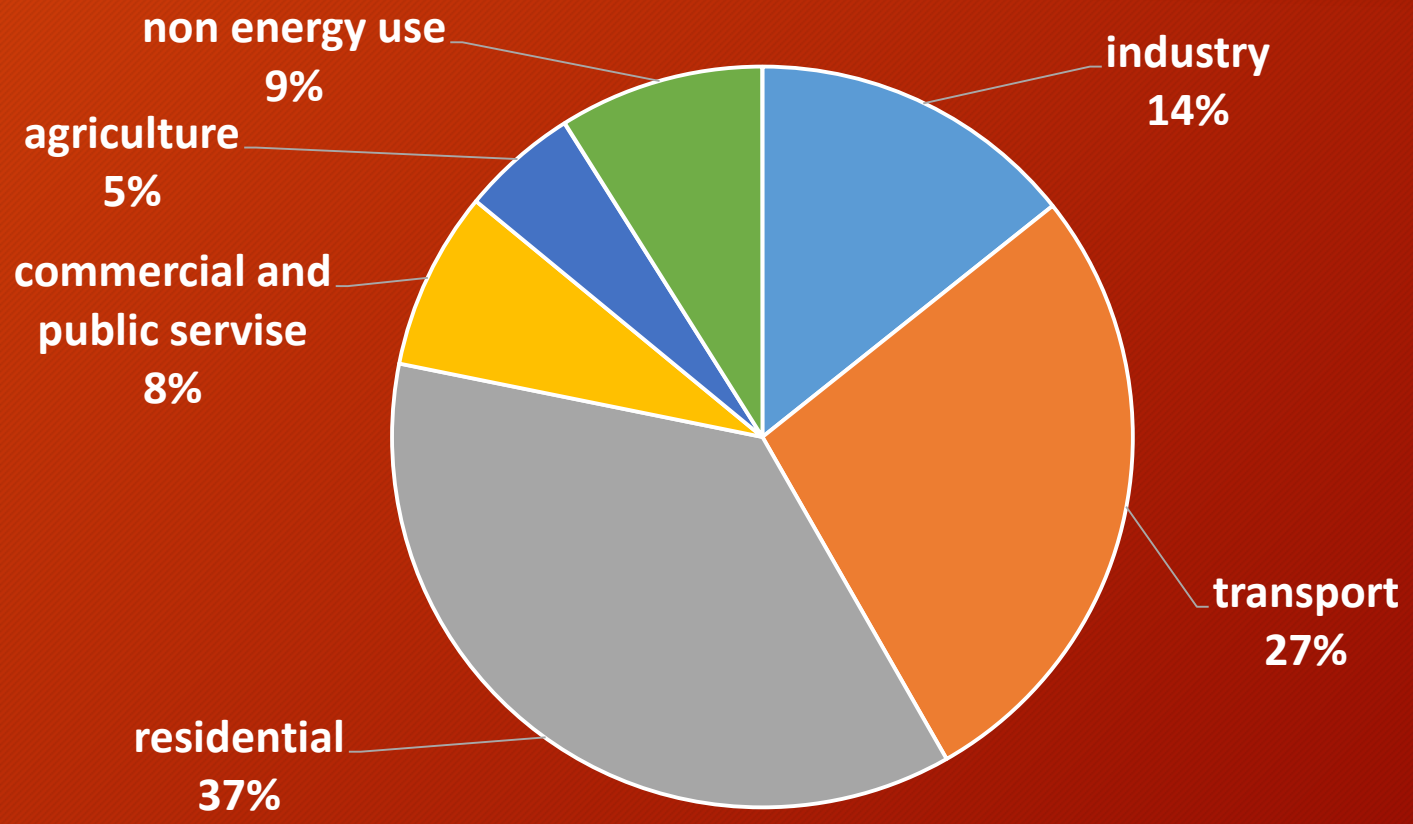
- Energy consumers are grouped into three main categories:

(i) *Manufacturing, construction and non-fuel mining industries*

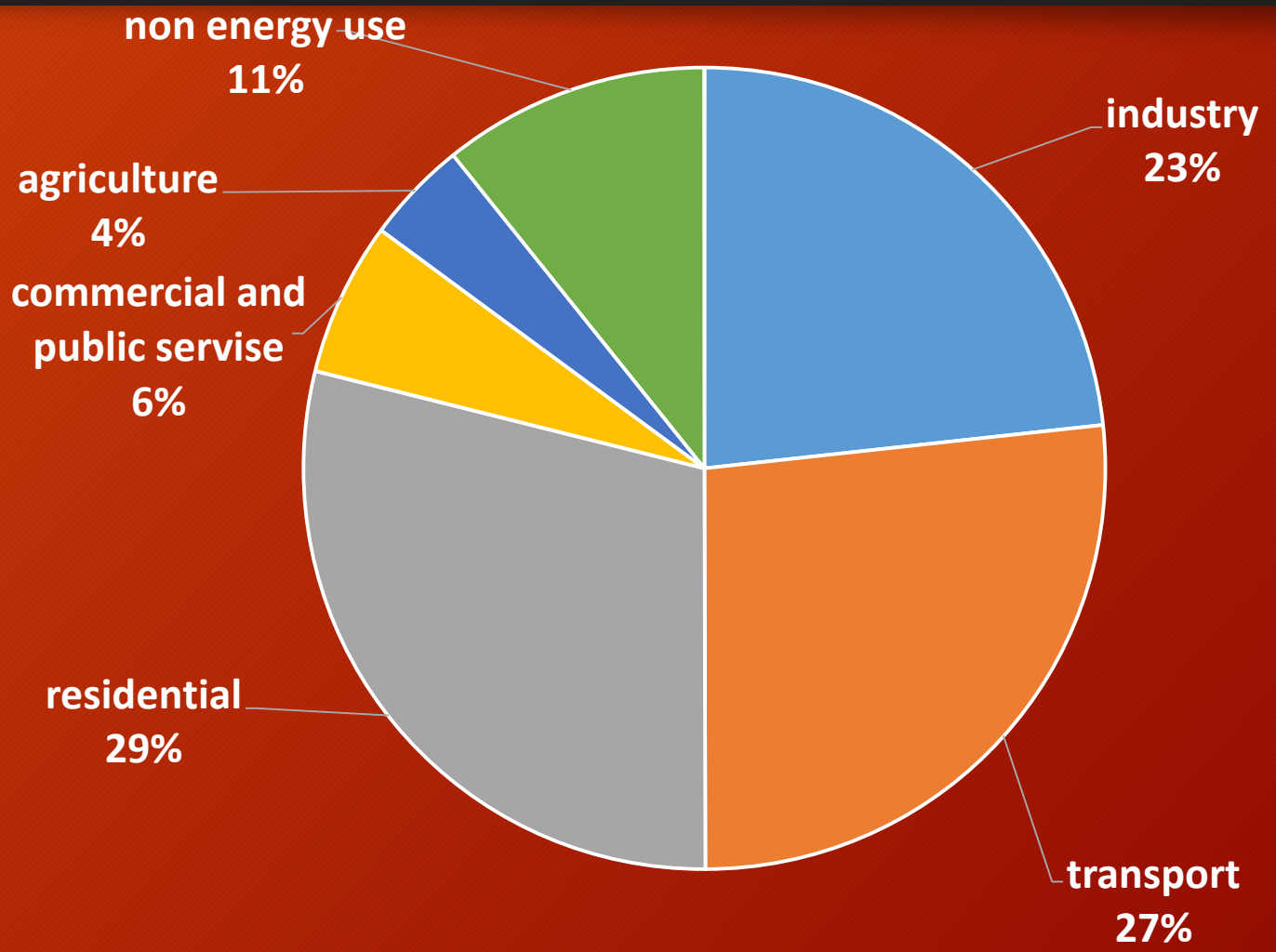
(ii) *Transport (road, rail, etc)*

(iii) *Other (household, commerce and public service, agriculture, forestry, fishing)*

Total final consumption of Azerbaijan-2015



Total final consumption of Iran-2015



Azerbaijan: Indicators for 2015

2015 | Indicators | Balances | Coal | Electricity and Heat | Natural Gas | Oil

Key Indicators:	
Population (millions)	9.65
GDP (billion 2010 USD)	59.03
GDP PPP (billion 2010 USD)	157.87
Energy production (Mtoe)	58.31
Net imports (Mtoe)	-44.15
TPES (Mtoe)	14.36
Electricity consumption* (TWh)	21.66
CO2 emissions** (Mt of CO2)	30.80

Key Indicators:	
TPES/population (toe/capita)	1.49
TPES/GDP (toe/thousand 2010 USD)	0.24
TPES/GDP PPP (toe/thousand 2010 USD)	0.09
Electricity consumption / population (MWh/capita)	2.24
CO2/TPES (t CO2/toe)	2.15
CO2/population (t CO2/capita)	3.19
CO2/GDP (kg CO2/2010 USD)	0.52
CO2/GDP PPP (kg CO2/2010 USD)	0.2

*Gross production + imports - exports - losses

**CO_2 Emissions from fuel combustion only. Emissions are calculated using IEA's energy balances and the 2

More detailed data are available at our online data services.

http://www.iea.org/statistics/statisticssearch/report/?country=AZERBAIJAN&product=indicators&year=2015

Sources

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- **OECD, 2014, International Energy Agency, Energy Efficiency Indicators: Fundamentals on Statistics**
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