



# Energy Industry in Iran

## General State of the Economy

Iran, the official name – the Islamic Republic of Iran, is one of the largest countries in the Middle East with its capital in Tehran. Neighbouring countries are Iraq (in the west), Azerbaijan, Armenia, Turkey, Turkmenistan (in the north), Afghanistan and Pakistan (in the east). Iran has access to the Caspian Sea, the Persian and Oman Gulfs. According to 2018 statistics, the country, which is 17<sup>th</sup> in the world in terms of area, is home to more than 86 million people. In terms of population density the country is

157<sup>th</sup> in the world [1,2,3]. The total length of the country's coastline is 2 440 km, and 740 km along the Caspian Sea [3].

The administrative map of Iran is divided into 31 provinces and the political form of government – Islamic republic. The official language is Persian [3].

The country's economy is based on its energy, agrarian, and industrial sectors, as well as its service sector.

The expansion of international sanctions and the reduction of oil exports in 2012, which constitute a significant part of the country's GDP; an inefficient domestic policy,



Sources:

1. GDP (purchasing power parity), 2020 est. / The World Factbook/Library/Central Intelligence Agency \*228
  2. GDP - per capita (PPP), 2020 / The World Factbook/Library/Central Intelligence Agency \*229
  3. Inflation rate (consumer prices), 2019 est. / The World Factbook/Library/Central Intelligence Agency \*228
  4. Charges for the use of intellectual property, receipts (BoP, current US\$), 2020 / International Monetary Fund, Balance of Payments Statistics Yearbook, and data files. / License: CC BY-4.0 \*88
  5. The Global Competitiveness Index 2019 / Rankings / Reports / World Economic Forum \*141
  6. High-technology exports (current US\$) 2019-2020 / United Nations, Comtrade database through the WITS platform / License: CCBY-4.0 / Data \*134
  7. 2021 Index of Economic Freedom / International Economics / The Heritage Foundation \*178
  8. Reserves of foreign exchange and gold, 2017 est. / The World Factbook / Library / Central Intelligence Agency \*195
  9. Annual average GDP growth in %, for the last 10 years (2011-2020) / World Bank national accounts data, and OECD National Accounts data files / License: CC BY-4.0 \*206
  10. Public debt (% of GDP), 2017 est. / The World Factbook / Library / Central Intelligence Agency \*210
- \* Total number of countries participating in ranking

Figure 1. Economic indices of Iran

a high level of dependence on oil and gas exports; all this negatively affects the economic performance of the country, which is reflected in the diagram (Fig.1). For five out of ten indicators, the country is either not represented, or is significantly below the world average. Between the early 1990s the country experienced sustained GDP growth at purchasing power parity, both in general and per capita [4,5]. GDP at purchasing power parity increased from \$666.2 billion in 2001 to \$1.045 trillion in 2011 [3]. Then the dynamics of GDP was changeable and amounted to 1.062 trillion in 2020 [4]. GDP per capita at purchasing power parity was \$10.5 in 2001, \$18.0 in 2011 and \$13.3 in 2020 [5], but according to [3] - \$12.4 in 2020 (120<sup>th</sup> in the world).

The inflation rate rose from 9.1% in 2016 to 9.6% in 2017. According to this indicator the country is 210<sup>th</sup> in the world [3]. In terms of the market value of publicly traded shares in 2015, the country was 43<sup>rd</sup> in the world, behind neighboring Qatar and Kuwait. According to The Global Competitiveness Report 2019, presented by the World Economic Forum, Iran is 99<sup>th</sup> from an estimated total of 137 countries. This rating reflects the effectiven-

ess of the use of the country's own resources for sustainable development. In addition to a number of economic indicators this index also takes into account such variables as education, health, level of innovation, etc.

According to the Index of Economic Freedom in 2021, which takes into account business freedom, freedom from government action, protection of property, and freedom from corruption, Iran was 168<sup>th</sup> out of 178 countries and is included in the group "mostly unfree". In terms of reserves of foreign exchange and gold, Iran was 22<sup>nd</sup> in 2017, behind only Saudi Arabia among the Arab countries.

According to the indicator for the average GDP growth in percentage over the last 10 years, in 2020 the country was 174<sup>th</sup> out of 206 countries, ahead of Egypt. In terms of public debt, calculated as a percentage of the country's GDP, Iran was ranked 132<sup>nd</sup> out of 210 countries considered in 2017.

*For more information on the Iranian economy click [here](#).*

## Energy resources

Iran has one of the largest reserves of proved oil and natural gas reserves (see Table 1). In terms of tons of oil equivalent, in 2015-2018 proved reserves of conventional hydrocarbons in Iran were: natural gas – 57.7%, oil – 40.7%, coal – 1.6% (Fig.5).

**Table 1. Fossil energy resources of Iran**

Resource/explanations	Crude oil	Natural gas	Coal	Shale Gas	Tight Oil
<b>Value</b>	157.2	33.72	1 203	No data	No data
<b>Unit</b>	billion bbl	Tcm	million tonnes	-	-
<b>Year</b>	2018	2018	2015	-	-
<b>Source</b>	[3]	[3]	[9]	-	-

Proved natural gas reserves in Iran at the end of 2017, according to the Oil and Gas Journal [6], were estimated at 1,191 Tcf, and at the beginning of 2018 were 33.72 trillion m<sup>3</sup> [3]. According to BP the natural gas reserves in the country at the end of 2020 were 32.1 trillion m<sup>3</sup> [7].

According to the National Iranian Oil Company, in 2016 oil reserves in the country are estimated at 711.53 billion barrels, of which 102.44 billion barrels are recoverab-

le, gas resources are estimated at 55.33 trillion m<sup>3</sup>, of which about 33.72 trillion m<sup>3</sup> can be extracted [8]. Coal reserves in 2015 were estimated at 1 203 million tons [9].

Iran has a variety of renewable resources for energy production. The sample of key indicators of this type of resource is presented in Table 2.

**Table 2. Renewable energy resources of Iran**

Resource/explanations	Solar Potential (GHI)*	Wind Potential (50 m)*	Hydro energy Potential**	Bio Potential Agricultural Area	Bio Potential Forest Area	Geothermal Potential	Municipal Solid Waste
<b>Value</b>	5.5 –6.0	6.0-7.5	50 000	28.2	6.6	800	0.16
<b>Unit</b>	kWh/m <sup>2</sup> /day	m/s	GWh/year	% of land area	% of land area	GWe	kg/per capita/day
<b>Year</b>	2018	2018	2013	2016	2016	2015	2012
<b>Source</b>	[10]	[11]	[12]	[13]	[14]	[15]	[16]

\*for most of the territory of the country

\*\*technically exploitable hydropower potential

The level of global horizontal irradiation for the majority of the country is low – 5.5-6.0 kWh/m<sup>2</sup>/day, the maximum level of solar radiation of 6.0-6.3 kWh/m<sup>2</sup>/day can be registered in the south-eastern part of the country [10]. The distribution of wind resources is as follows: for the majority of the country the wind speed does not exceed 6.0-7.5 m/s, and in the eastern part of the country, in the provinces of South Khorasan as well as along the borderline with Afghanistan at a height of 50 m, wind speed can reach over 7.5 m/s [11].

Technically exploitable hydropower capability was estimated at 50 000 GWh/year in 2013 [12], which theoretically allows intensive use of hydro resources for electricity generation.

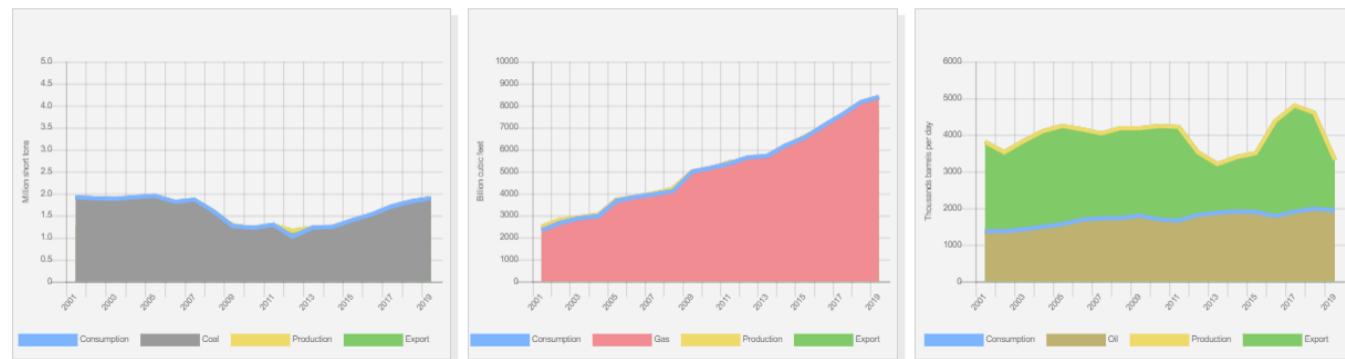
About 28.2% of Iran is covered by agricultural land, and 6.6% is forested [13,14]. Iran also has potential for geothermal energy, estimated by [15] in 2015 at 800 GWe. The level of generation of municipal waste in Iran (0.16 kg per person per day) is significantly lower than in other countries of the region, for example, Saudi Arabia (1.3 kg per person per day). A small increase of up to 0.6 kg per person per day is predicted by 2025 [16]. This resource can be a valuable raw material for secondary use or energy production.

For more information about energy resources in Iran click [here](#).

## Energy balance

According to BP's report, total primary energy consumption in 2020 amounted to 12.03 Exajoules, about 69.8% of which was natural gas, 27.5% – oil, 0.65% – coal, 0.6% – nuclear energy, 1.6% – hydroelectricity [7].

Iran is one of the top ten largest oil producers in the world [6]. The production of oil in Iran decreased slightly between 2011 and 2013 (Fig.2.), then again showed a slight increase and reached 4 695 000 barrels/day in 2017, consumption remained fairly stable with small annual fluctuations. In 2019 this figure was 3 332 thousand



Source: U.S. Energy Information Administration (Jan 2020) / <https://www.eia.gov/>

Figure 2. The production and consumption of fossil fuels in Iran (left – coal, in the center – gas, right – oil )

barrels/day [17]. The BP review presents next figures: the production and consumption of oil in Iran in 2020 – 3 084 000 barrels/day and 1 715 000 barrels/day, respectively [7].

Due to international sanctions, the production and export of crude oil and condensate from Iran fell in 2018-2019, in 2017 the country exported about 363 000 barrels/day

[6]. The main importers of Iranian oil and condensate are China (51%), Malaysia, Syria, UAE [6].

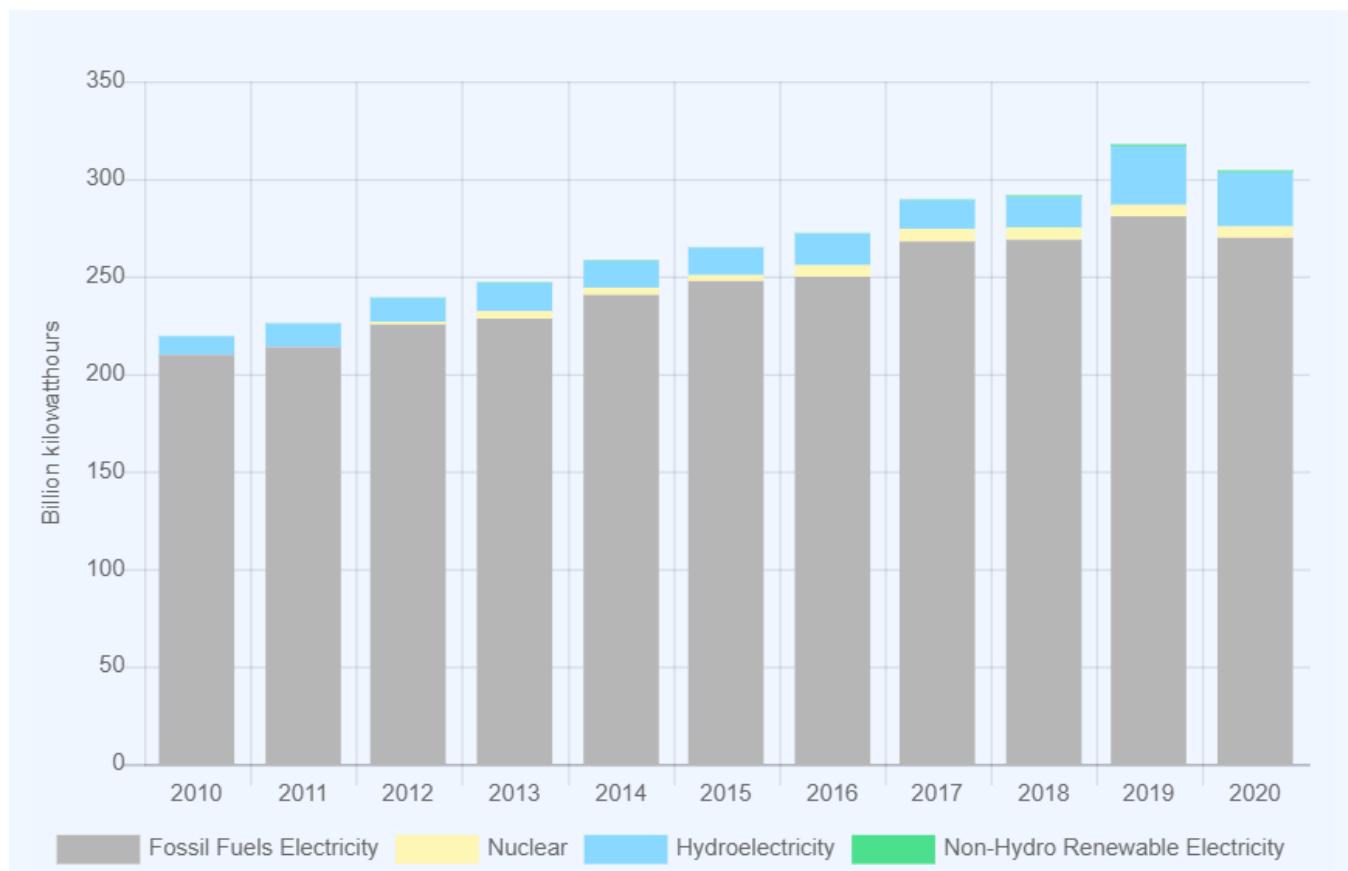
Iran is the third largest gas producer in the world after the US and Russia [6]. The production of natural gas in the country has grown since 2000, and in 2019 it was 8 389 Bcf [17]. According to BP gas production in the country at the end of 2020 amounted to 250.8 Bcm [7]. Natural gas consumption, as well as production in the country since 2000 grew rapidly (Fig.2), reaching 7 794 Bcf in 2019 [17]. According to BP Statistical Review of World Energy June 2021 [7], gas consumption was estimated at 233.1 Bcm in 2020.

The import of natural gas to Iran in 2017 was 3.993 bcm, with exports of 11.64 bcm [3]. Imports and exports of natural gas are carried through pipelines, imports come from Turkmenistan, the largest share of exports (73%) was sent to Turkey [6].

Coal production in the period from 2014 remained stable, not exceeding 1.88 million short tons [17]. Consumption of coal in the country between 2007 and 2014 decreased (allowing the export of this resource since 2011) and in 2020 reached a level of 1.6 million short tons [17], and according to BP's report in 2020, amounted to 0.07 Exajoules [7].

Historically, Iran mainly relies on fossil resources for electricity production (Fig. 3).

Electricity production in Iran in 2020 was 304 TWh, dominated by fossil fuels – 89%; the share of hydropower was 9.1%, nuclear power – 1.9%, renewable resources – 0.3% (Fig.6).

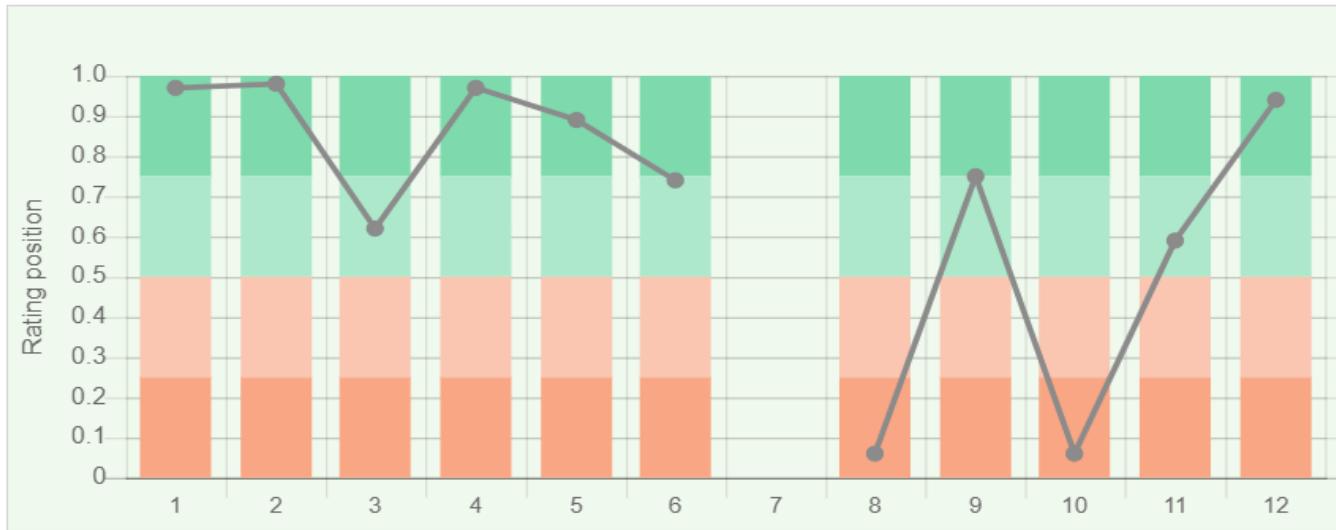


Source: U.S. Energy Information Administration (Jan 2020) / <https://www.eia.gov/>

Figure 3. Electricity production in Iran

Iran's position in the comparative diagram of energy index is shown in Figure 4. As already mentioned, Iran has significant reserves of fossil resources, so the first six indexes are mostly in the top quarter of the chart, therefore, among the top 25% of the best countries in the world included in the rating.

The share of renewable energy in electricity production in Iran is about 0.1%, and in 2015 the country was 159<sup>th</sup> out of 166 countries selected for consideration.


**Sources:**

1. Crude oil proved reserves, 2021 / International Energy Statistic/Geography / U.S. Energy Information Administration (Nov 2021)\*98
  2. Natural gas proved reserves 2021 / International Energy Statistic / Geography / U.S. Energy Information Administration (Nov 2021) \*99
  3. Total recoverable coal reserves 2019 / International Energy Statistic / Geography / U.S. Energy Information Administration (Nov 2021) \*81
  4. Combination production-consumption for Crude oil 2018 / International Energy Statistic / Geography / U.S. Energy Information Administration (Nov 2021) \*219
  5. Combination production-consumption for Natural gas 2019 / International Energy Statistic / Geography / U.S. Energy Information Administration (Nov 2021) \*123
  6. Combination production-consumption for Coal 2019 / International Energy Statistic / Geography / U.S. Energy Information Administration (Nov 2021) \*128
  7. Electricity – from other renewable sources (% of total installed capacity), 2017 est. / The World Factbook / Library / Central Intelligence Agency \*170
  8. GDP per unit of energy use (PPP per unit of oil equivalent), 2020 \*66
  - Primary energy consumption - BP Statistical Review of World Energy 2021/BP;GDP (purchasing power parity) - The World Factbook/Library/Central Intelligence Agency
  9. Energy use (primary energy use of oil equivalent per capita) 2020 \*127
  - Primary energy consumption – BP Statistical Review of World Energy 2021; Population - United Nations, Department of Economic and Social Affairs, Population Division (2019). World Population Prospects 2019, custom data acquired via website. Retrieved 15 November 2021\*66
  10. The Global Energy Architecture Performance Index Report (EAPI) 2017 / Rankings / Reports / World Economic Forum
  11. Electric power consumption (kWh per capita), 2016 \*217
  - Electricity Consumption - The World Factbook / Library / Central Intelligence Agency; Population - United Nations, Department of Economic and Social Affairs, Population Division (2019). World Population Prospects 2019, custom data acquired via website. Retrieved 15 November 2021
  12. Combination of electricity production-consumption (kWh)/The World Factbook/Library/Central Intelligence Agency \*216
- \* Total number of countries participating in ranking

*Figure 4. Energy indices of Iran*

In the Energy Architecture Performance Index 2017, which is based first on the level economic growth, environmental safety, and energy independence of the country, including access to energy, Iran lost 14 ranking positions over the previous year, and is 120<sup>th</sup> in the world, ahead of Saudi Arabia, Oman and Lebanon. Iran is in the bottom half of the ranked list of countries for such indicators as GDP per unit of energy use in 2017 – 58<sup>th</sup> out of 66 countries considered, while energy consumpti-

on per capita is much lower – 28<sup>th</sup> out of 66 countries. In terms of electricity consumption per capita, the country is 89<sup>th</sup> in the world, however, for the indicator of combination of electricity production-consumption, Iran is 14<sup>th</sup> in the ranked list of 216 countries.

*More information about the energy resources of Iran can be found [here](#).*

## Energy Infrastructure

A territorial map of the distribution of the largest infrastructure projects of the fossil fuel sector in Iran is shown in Figure 5.

As mentioned above, the proven reserves of natural gas account for 57.7% of the total energy potential of the country's mineral resources, crude oil reserves – 40.7%, coal 1.6% (Fig.5).

The main oil and gas fields are located in the west and south-west of the country in coastal areas. The South Pars gas field, which is located on the border between Iran and Qatar in the Persian Gulf, contains about 14 trillion m<sup>3</sup> of natural gas and 18 billion barrels of gas con-

densate, which is about half of the gas reserves in Iran. South Pars field daily produces 790 million m<sup>3</sup> of natural gas [18]. The largest oil field – Ahvaz, owned by the National Iranian South Oil Company, potentially possesses 65.5 billion barrels, and production is carried out at the level of 750 000 barrels/day [19].

Iran's refineries have a total installed capacity of 1 901 million barrels/day (Fig.5). The country's largest refinery is Abadan, owned by NIORDC, with an installed capacity of 399 000 barrels/day [20]. The main oil terminal of Iran is Khark Oil Terminal, which can ship up to 8 million barrels a day, and the largest oil storage is Kharg Island (28 million barrels) [21]. Crude oil is transported through pipelines with a total length of 8 625 km. The total

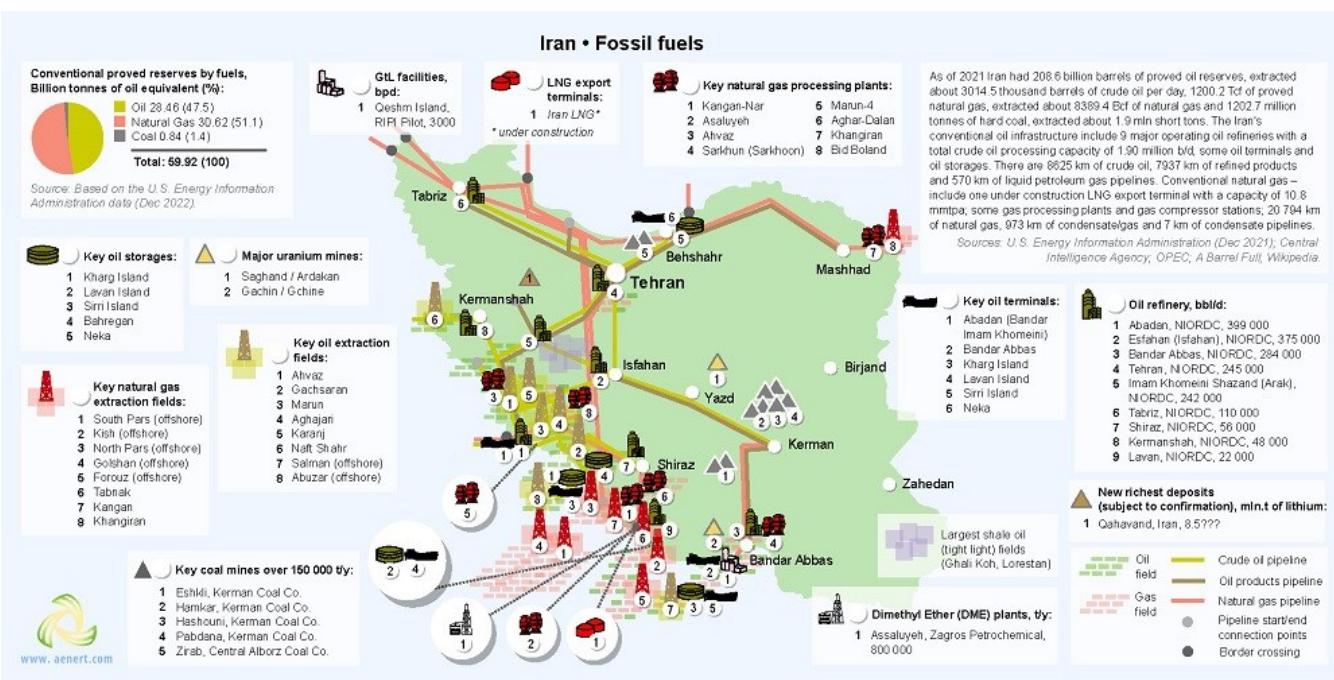


Figure 5. Basic infrastructural facilities of the fossil fuel sector in Iran

length of oil product pipelines is 7 937 km, and transportation of liquefied hydrocarbon gas is carried through pipelines with a total length of 570 km (Fig.5).

The natural gas processing infrastructure in Iran is represented by 8 large, and several smaller plants (Fig.5). The most powerful of these is Kangan-Nar with an installed capacity of 80 mcm/d [22]. The country's first LNG-terminal, Iran LNG, which is currently under construction, will have an installed capacity of 10.8 million tons per year and will be located in an area of 200 hectares on the western coast of the Islamic Republic of Iran in Tom-baka [23]. Natural gas is transported through pipelines with a total length of 20 794 km; transportation of gas condensate is carried through pipelines with total lengths of 973 km and 7 km (Fig.5).

In 2014, GTL QESHM was established in Iran to build the first GTL plant in the country. In the free zone QESHM, with a area of 40 hectares, the company is continuing to build a plant with an installed capacity of 3 000 barrels of various petroleum products per day, with the possibility of expanding to 12 000 barrels per day [24]. Zagros Petrochemical Company methanol plant with an installed capacity of 3 300 000 tons/year is located in the economic zone of South Pars in the city of Assaluyeh [25].

The annual production of uranium from the Saghadj mine located in Yazd in the central part of Iran is about 50 tons per year. The reserves of this field are estimated by experts of the IAEA to be at 1 000 tons [26]. Coal production from the country's largest field, Eshkli, is maintained at the level of 360 000 tons per year [27].

The map of the territorial distribution of Iran's largest infrastructure facilities for electricity generation is presented in Figure 6.

According to U.S. Energy Information Administration the share of fossil fuels in electricity production in Iran in 2020 was 89% (Fig.6).

The country has a significant number of stations for the production of electricity from fossil fuels, including six oil stations with a capacity of more than 500 MW, ten gas-fired power plants with more than 1 000 MW, nine combined-type power plants with a capacity of more than 500 MW, and one nuclear power plant (Fig.6). The largest gas power plant is Damavand, with an installed capacity that has been estimated at 2 862 MW [28], oil – Shahid Montazeri, with an installed capacity of 1 600 MW [29], combined type – Shahid Salimi with an installed capacity of 2 195 MW [30,31], Nuvlear – Bushehr-1 with a capacity of 915 MW [32].

As mentioned above, the hydropower industry in Iran does not have a significant share in the generation of electricity, it is represented by several hydro and pumped storage power plants, that altogether produced 15.3 TWh in 2017 (Fig.6). The generation leader among the hydroelectric power stations is Karun-3 with an installed capacity of 2 280 MW [33]; among the pumped storage power plants – Siabisheh, with an installed capacity of 1 040 MW [34]. In addition, in the country, as of early 2016, there are about 20 small hydropower stations with a total capacity of 50 MW (Fig.6).

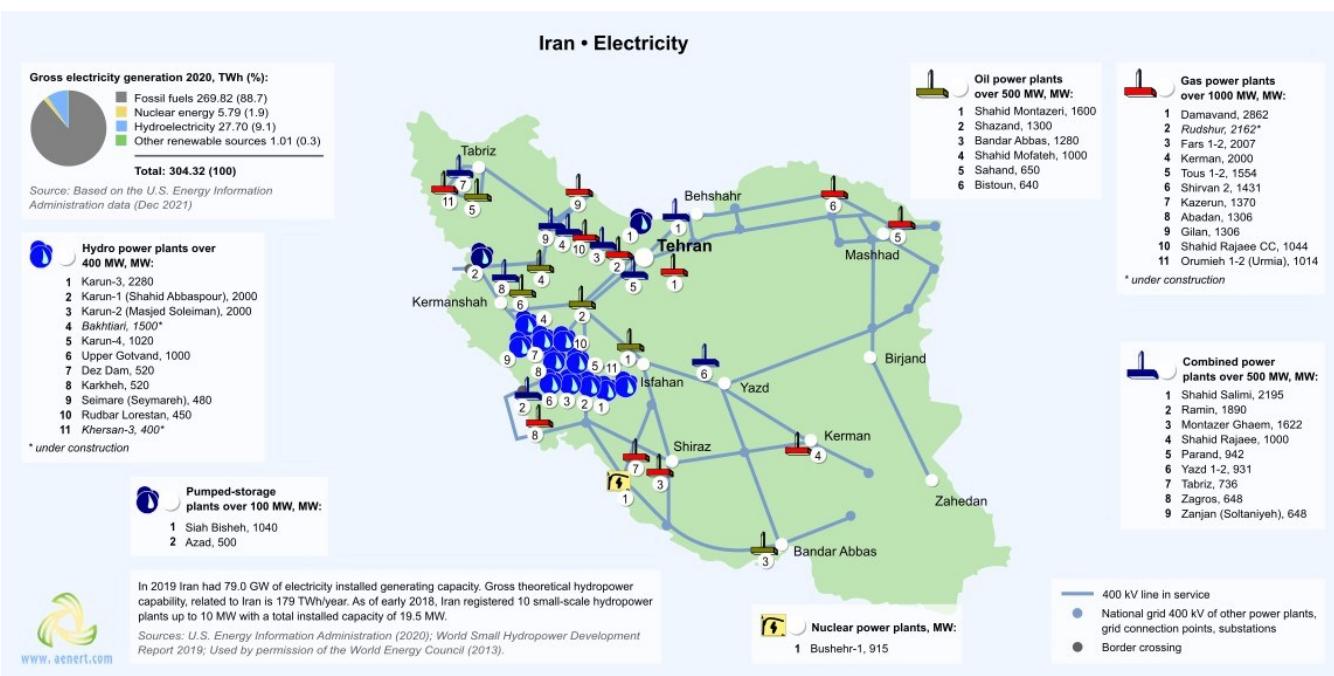


Figure 6. Electricity production in Iran

Figure 7 shows the main infrastructure facilities of Iran for the production of renewable energy.

Renewable energy, excluding hydropower, has a minimal share in electricity production in Iran, the total electricity production from renewable sources was 1.01 - 1.15 TWh in 2019-2020 (Fig.6 and 7).

In the coastal areas and in the north-east of the country, in the zones of relatively high wind activity, there are 6 large wind farms with a capacity of more than 1 MW

each. In 2018, Iranian wind farms had a total installed capacity of 203 MW [35]. The largest is Manjil with an installed capacity of 90.2 MW [36].

As mentioned earlier, the level of global horizontal solar irradiation in some regions of the country can reach 6.3 kWh/m<sup>2</sup>/day, which is a significant resource for the production of energy through photovoltaics [10]. As a result, there is a number of solar energy facilities including 4 photovoltaic stations with a capacity of more than 1 MW

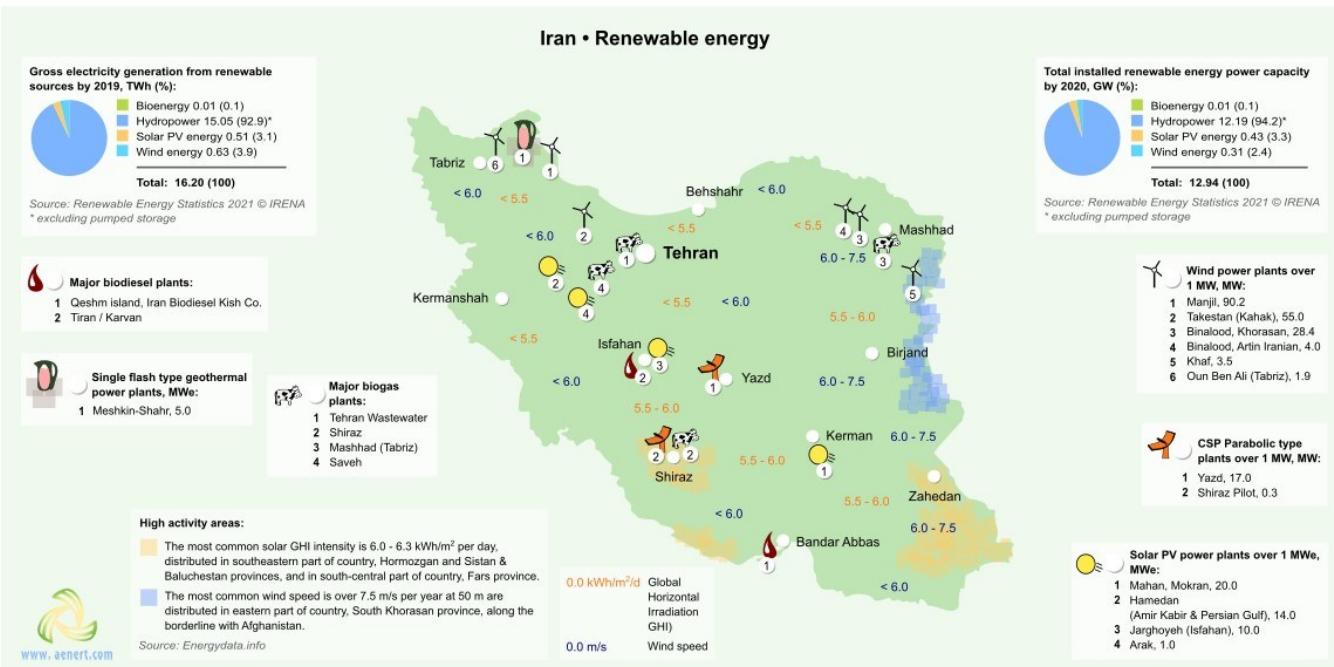


Figure 7. Renewable energy in Iran

each and CSP parabolic type plants (Fig.7). The largest photovoltaic station is the Mokran PV Solar Power Plant, opened in 2017, with an installed capacity of 20 MW [37], and the largest parabolic type station is Yazd CSP with an installed capacity of 17 MW [38].

As previously mentioned, Iran possesses no significant geothermal potential. In 2017, Moshanir plans to launch the first geothermal power plant in the country at the Meshkin-Shahr Single Flash Geothermal Power Plant on the slope of Mount Sabalan in northwestern Iran, which has an installed capacity of 5 MW with a possible increase in power to 25 MW [39].

Bioenergy has not received active development in the country to date, and in 2019, only 0.01 TWh was generated from biomass (Fig.8). The country has biogas and biodiesel plants. The Qeshm Island plant, owned by Iran Biodiesel Kish Co in 2009 uses CVR technology (Cavitation Reactor) and can produce 350 000 million tons of biodiesel [40]. Tehran Wastewater biogas power plant, which produces biogas from wastewater and waste to generate electricity, has an installed capacity of 5 MW [41].

According to the Ministry of Energy of Iran it is planned to produce 5 000 MW of electricity using renewable energy in the next 5 years [42]. This figure will also be achieved through the introduction of new capacities, so by the end of 2016 it is planned to put into operation 14 renewable energy facilities with a total capacity of 100 MW, which is 700% higher compared to previous year. In 2017, it is planned to increase the capacity of the entire renewable energy complex by another 300 MW. Iran also took part in the Paris Agreement on Climate Conservation and pledged to increase the capacity of the renewable energy sector to 7 500 MW by 2030 [43].

The country is actively engaged in attracting foreign investment, so in 2016 Germany invested about 170 million euros for the development of solar energy in Iran [44]. Also in the field of solar energy, it is worth noting the planned construction of a 20 MW solar park in the Kurdistan Province [45] and the commissioning of a 5 000 W

Karoon Oil and Gas Solar Power Plant by the oil company for its own needs [46].

In the field of hydropower, it is worth noting the opening of the 450 MW Rudbar Lorestan hydroelectric power station and the construction of 130 MW Chamshir hydroelectric power stations in the province of Kohgiluyeh-Boyer Ahmad and the Bakhtiari station with a capacity of 750 MW in Lorestan province [47].

Also under construction is the Bushehr Petrochemical Complex, which will produce methanol and will occupy an area of 10 000 hectares in the Bushehr petrochemical complex. The launch will take place approximately at the end of 2017 [48].

Municipal waste utilization is a new direction for Iran. In Tehran province, the methane emission potential from landfills, which amounts to 438 million cubic meters per year, can generate about 2 400 MW of electricity. Soon the provincial municipality plans to launch a municipal waste utilization pilot project [49].

There are several areas of development in the field of fossil resources. One of the main undertakings is the extraction of shale oil. The National Iranian Oil Company stated that shale oil deposits were discovered in the province of Lorestan, and the potential was estimated at 2 billion barrels. The research will be completed in 2017 [50].

Diversification of export destinations is also one of the main priorities of the country's energy agenda. To this end, negotiations continue between Iran and Pakistan on the construction of a gas pipeline from Gwadar to Nawabshah [51]. In addition, in 2016, the National Oil Company of the South signed a contract for the supply of associated gas to the private sector to the amount of 42 million cubic feet per day, which could reduce the flaring of gas [52].

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*Current news on the development of energy in the country can also be viewed [here](#). More information about the energy infrastructure of Iran is also available [here](#).*

country and abroad, the country ranks 23<sup>rd</sup> in the world, however in terms of patents in force, the country is 34<sup>th</sup> out of 109 countries considered. Iran is very well positioned when considering the number of publications of specialists in scientific and technological journals – 15<sup>th</sup> place out of 197 countries considered. It is also regarded highly by the Scimago Journal and Country Rank (21<sup>st</sup> place).

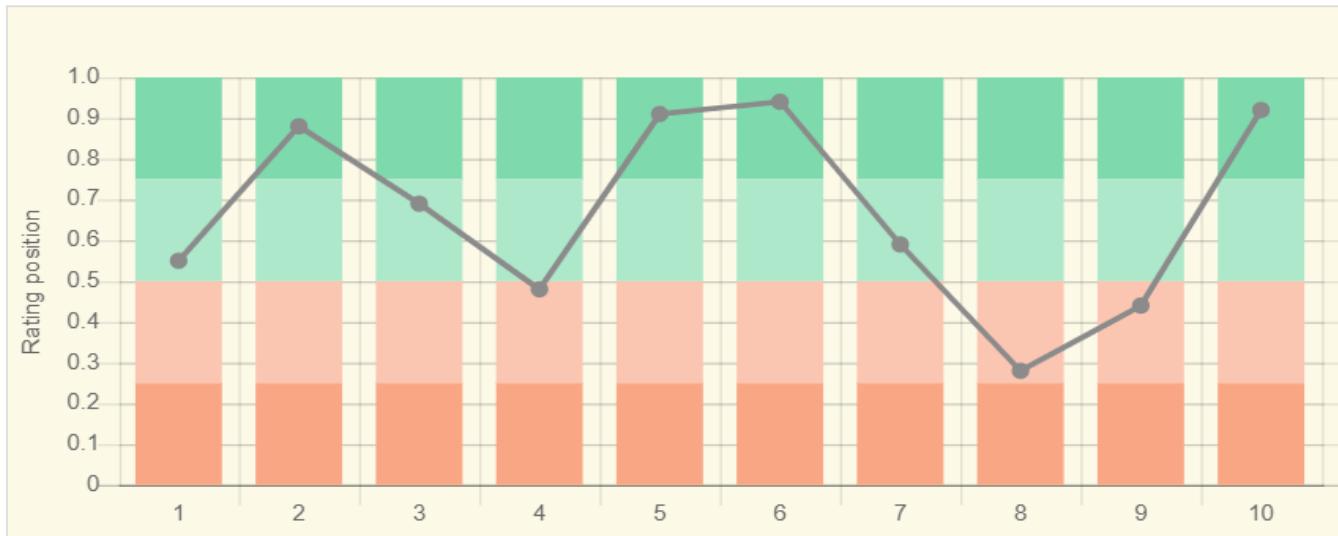
In terms of government expenditure on education as a percentage of the country's GDP, the country demonstrates a low result – 127<sup>th</sup> out of 177 countries selected for consideration.

## Education and Innovation

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The set of indices reflecting the position of Iran among other countries in the field of education and innovation can be seen in Figure 8.

According to the Global Innovation Index 2021, Iran is ranked 60<sup>th</sup> out of 132 countries (see diagram for links). According to the second and third index, the country can be grouped in the number of countries with a sufficiently high level of patent activity. According to the number of patents granted to Iranian residents, both inside the



Sources:

1. The Global Innovation Index 2021, Rankings / Knowledge / World Intellectual Property Organization / Cornell University, INSEAD, and WIPO (2021); Energizing the World with Innovation. Ithaca, Fontainebleau, and Geneva \*132
  2. Patent Grants 2011-2020, resident & abroad / Statistical country profiles / World Intellectual Property Organization \*185
  3. Patents in Force 2020 / Statistical country profiles / World Intellectual Property Organization \*109
  4. QS World University Rankings 2022 \*97
  5. SCImago Country Rankings (1996-2020) / Country rankings / SCImago, (n.d.) SIR-SCImago Journal & Country Rank [Portal]. Retrieved 17 Nov 2021 \*240
  6. Internet users in 2018 / The World Factbook / Central Intelligence Agency \*229
  7. Internet users in 2018 (% Population) / The World Factbook / Central Intelligence Agency \*229
  8. Government expenditure on education, total (% of GDP), 2019 / United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics. License: CC BY-4.0 / Data as of September 2021\*177
  9. Research and development expenditure (% of GDP), 2018 / UNESCO Institute for Statistics. License: CC BY-4.0 / Data \*119
  10. Scientific and technical journal articles, 2018 / National Science Foundation, Science and Engineering Indicators. License: CC BY-4.0 / Data \*197
- \* Total number of countries participating in ranking

Figure 8. The indices of education and innovation in Iran

Nevertheless, 6 Iranian universities are included in the QS University Rating. It is also worth noting that the country's GDP is high enough, therefore, in absolute terms, government expenditure on education are nevertheless significant. In terms of research and development expenditure as a percentage of GDP, the country is 67<sup>th</sup> – slightly below the global average.

Iranian universities, such as the University of Tehran, Sharif University of Technology, Iran University of Science & Technology Tehran, K. N. Toosi University of Technology, Tarbiat Modares University, Shiraz University of Technology, and Isfahan University of Technology Leoben train specialists in various fields of energy, including Petroleum Engineering, Materials Science and Engineering, Energy Systems Engineering, and Mechanical Engineering, etc.

In the fields of synthetic fuel production and extraction and processing of unconventional oil, the leader in patenting among Iranian companies are the Research Institute of Petroleum Industry (RIPI) and Sensiran. Research and development in this field is carried out by Shiraz University, Islamic Azad University, the University of Sistan and Baluchestan, the University of Teheran etc. In the field of extraction and processing of unconventional oil, one can note the research activities of such universities as the Petroleum University of Technology (PUT), Sharif University of Technology, Islamic Azad Uni-

versity, University of Teheran.

The leaders among the Iranian companies in fields such as the study of gas hydrates, are the National Iranian Oil Company (NIOC), Amirkabir University of Technology, Research Institute of Petroleum Industry (RIPI); and in the field of research of hydrocarbon production from reservoirs with low permeability – Islamic Azad University, Amirkabir University of Technology, and the Petroleum University of Technology (PUT).

Leading research organizations in this field of associated gas are Islamic Azad University, Petroleum University of Technology (PUT), Sharif University of Technology. University of Teheran, Islamic Azad University, Isfahan University of Technology, have the highest number of publications in the field of bioenergy.

A large number of Iranian companies conduct research in the field of energy production from renewable sources. In the field of solar energy University of Teheran, Islamic Azad University, Ferdowsi University of Mashhad, Tarbiat Modares University, Sharif University of Technology should be mentioned. In the field of wind energy – University of Teheran, Islamic Azad University, Sharif University of Technology, Amirkabir University of Technology.

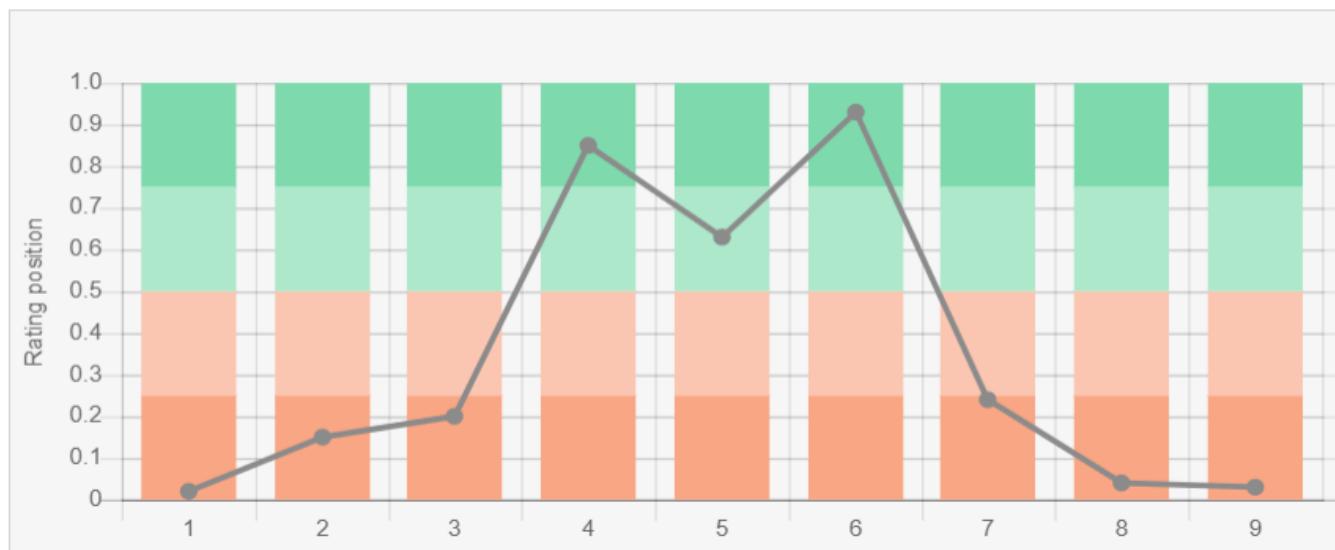
Detailed information about energy education and research in Iran is to be found [here](#).

## Ecology and Environment Protection

The environmental index diagram presented in Figure 9 reflects to some extent the ecological situation in the country.

First of all, the country demonstrates a relatively high level of CO<sub>2</sub> emissions in general, and per capita. At the same time, the situation is aggravated by the fact that Iran is 62<sup>nd</sup> out of 64 countries responsible for more than

90% of global CO<sub>2</sub> emissions related to energy in the Climate Change Performance Index (CCPI) 2022. The situation is brightened, however, by a relatively high valuation of Iran in the Environmental Performance Index rankings (EPI) 2018, which focuses primarily on assessing the environmental performance of national governments. In this rating Iran is above of Algeria, Egypt, Morocco, and Qatar and is 67<sup>th</sup> out of 180 member countries.



### Sources:

1. CO2 total emission by countries 2020 / European Commission / Joint Research Centre (JRC) / Emission Database for Global Atmospheric Research (EDGAR)\*208
  2. CO2 per capita emission 2020/European Commission/Joint Research Centre (JRC) / Emission Database for Global Atmospheric Research (EDGAR) \*208
  3. Forest area 2020 (% of land area) / The Global Forest Resources Assessment 2020 / Food and Agriculture Organization of the United Nations \*234
  4. Forest area change 2010-2020 (1000 ha/year) / The Global Forest Resources Assessment 2020 / Food and Agriculture Organization of the United Nations \*234
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- \* Total number of countries participating in ranking

Figure 9. Environmental indices of Iran

The overall negative picture is worsened by the Ecological Footprint Atlas rating, according to which Iran is among a number of ecological debtors.

In terms of forest area as a percentage of the country, Iran is 188<sup>th</sup> in the world; however, the trend associated

with its change looks much better. According to this indicator the country is 36<sup>th</sup> in the world.

For more information on Iranian energy industry, please click [here](#).

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The sources of charts and curves are specified under the images.