

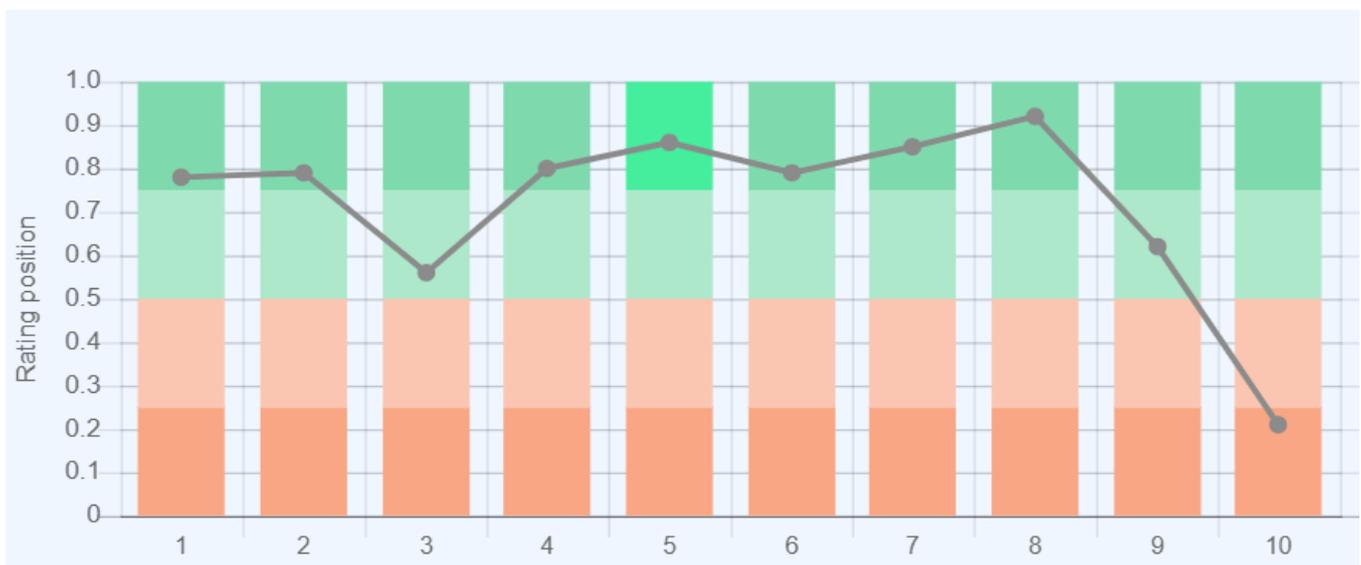
# Energy Industry in Israel



## General State of the Economy

Israel is a relatively small country located in the Middle East on the Mediterranean coast. In the east, Israel has a long land border with Jordan, and in the south it has access to the Red Sea. In terms of size, Israel is 152<sup>nd</sup> in the

world [1]. In terms of population density Israel is 29<sup>th</sup> in the world, with an average density of 432 people per 1 km<sup>2</sup>[2]. The length of the country's coastline is 273 km [3]. According to 2022 statistics, the country is home to around 8.9 million people [3]. The administrative map of Israel is divided into 6 districts, the official language is



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
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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 Economies / 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 Israel

Hebrew, and the political form of government is parliamentary democracy [3].

Israel's economy is highly advanced free market economy. Export of cut diamonds, high-tech equipment and

pharmaceuticals makes up the large share of the volume of GDP [3]. Economic indices of Israel are shown on the Figure 1, and the majority of indicators are in the upper

part of the chart, indicating a high level of economic development of the country.

Between 2009 and 2018 the country experienced a steady growth of GDP at purchasing power parity, both in general and per capita [4,5]. In 2020 GDP at PPP was 353.39 billion dollars (50<sup>th</sup> in the world) [3]. GDP at purchasing power parity per capita is at the same level (47<sup>th</sup> in 2020), although it has been demonstrating positive dynamics: from \$35,200 in 2015 to \$38,300 in 2020 [3]. Inflation in Israel in 2020 was at 1.8%, an increase of 1% compared to 0.8% in 2018 [3].

According to the Global Competitiveness Report 2019, presented by the World Economic Forum, Israel is 20<sup>th</sup>, from an estimated total of 141 countries. This rating reflects the effectiveness of the use of the country's own resources for sustainable development. In addition to numerous economic indicators this index also takes into account such variables as education, health, level of innovation, etc.

In the ranking of countries according to the level of export of high-technology products in 2019-2020, Israel was 28<sup>th</sup> out of 134 countries. In terms of gold reserves and foreign exchange reserves in 2017 Israel was 15<sup>th</sup> in the world.

According to the Index of Economic Freedom in 2021, which is based on business freedom, freedom from government action, protection of property, and freedom from corruption, Israel was 26<sup>th</sup>, ahead of a number of both Asian and European economically advanced countries.

According to the indicator for the average GDP growth in percentage over the last 10 years (2011–2020), in 2020 the country was 78<sup>th</sup> out of 206 countries. In terms of public debt, calculated as a percentage of the country's GDP, Israel was ranked 45<sup>th</sup> out of 210 countries considered in 2017.

For more information on the economy of Israel click [here](#).

## Energy resources

The most valuable and energy-rich fossil fuel in Israel is natural gas (Table. 1). Due to the recent discovery of gas deposits on the shelf of the Mediterranean Sea, Israel has become one of the key gas players along with Bangladesh and the United Kingdom [3].

In terms of tons of oil equivalent, proved reserves of conventional hydrocarbons in Israel are: natural gas – 98.9%, oil - 1.1% (Figure 5).

Natural gas reserves, according to [3] amount to 176 Bcm in 2020, and according to the BP report, in 2020 they were 0.6 Tcf [6].

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

Resource/ explanations	Crude oil	Natural gas	Coal	Oil shale*	Tight Oil	Coal mine methane	Extra heavy oil
<b>Value</b>	12.73	176	no data	4	no data	no data	no data
<b>Unit</b>	mmbbl	Bcm	-	BB	-	-	-
<b>Year</b>	2018	2018	-	2008	-	-	-
<b>Source</b>	[3]	[3]	-	[7]	-	-	-

\*in place resources

Proved crude oil reserves in the country were estimated at 12.73 million bbl in 2018 [3]. There are also small oil shale (kerogen oil) reserves found in Israel—4 billion bbl, according to [7].

In Israel, there is a certain potential for the development of some types of renewable energy. A selection of basic indicators of this type of resource is presented in Table 2. The level of global solar radiation in Israel is relatively high in the southern part of the country. The highest level of solar radiation level can be observed near the city

of Eilat - over 6.2 kWh/m<sup>2</sup>/day. In the central part of the country the level of global solar radiation drops from 5.7 to <5.5 kWh/m<sup>2</sup>/day. In the north of the country these figures are even lower [8].

The distribution of wind resources is as follows: in the north and in the central part of the country the average annual wind speed is below 6 m/sec [9]. The maximum registered wind speed was in the southern part of the country, where it may exceed 7.0 m/sec (at a height of 50 m) [9].

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

Resource/ explanations	Solar Potential (GHI)*	Wind Potential (50 m)*	Hydro energy Potential**	Bio Potential Agricultural area	Bio Potential Forest Area	Municipal Solid Waste
<b>Value</b>	5.5 – 6.2	<6.0	no data	23.8	7.1	2.12
<b>Unit</b>	kWh/m <sup>2</sup> /day	m/s	-	% of land area	% of land area	Kg/per capita/day
<b>Year</b>	2018	2018	-	2018	2018	2012
<b>Source</b>	[8]	[9]	-	[10]	[11]	[12]

\*for most of the territory of the country

\*\*gross theoretical hydropower potential

About 7.1% of Israel is forested with 23.8% covered by agricultural land [10,11].

This energy review of Israel would not be complete without mentioning municipal waste (2.12 kg per capita per

day), which in many countries has become a significant source of energy [12].

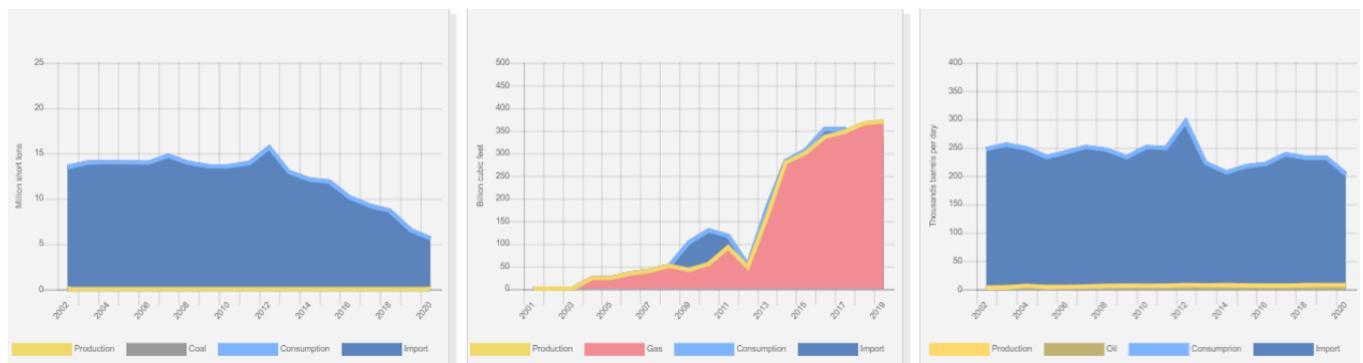
For more information about energy resources in Israel click [here](#).

## Energy balance

Primary energy consumption in Israel in 2020 was at the level of 1.05 Exajoules, dominated by oil—40%, natural gas - 39%, coal - 16% and renewable energy - 5% [6]. Israel's oil and condensate production has negligible for the last decade [13]. Oil consumption in the country has been relatively stable, reaching its peak of 296 thousand bbl/day in 2012, and dropping slightly to 203 thousand bbl/day in 2020 (Figure 2) [14]. In 2020 crude oil consumption was at the level of 213 thousand bbl/day [6]. Crude oil imports in 2017 were 231 600 thousand bbl/day [3].

Production of natural gas since 2012 has rapidly increased, having undergone a serious change from 48 Bcf in 2012 to in 2017 and 370 Bcf in 2019 347 Bcf [14]. Natural gas consumption showed the same trend, reaching 180 Bcf in 2013, compared to 52 Bcf in 2012, in 2017 it reached the level of 353 Bcf and 333 Bcf in 2019 [14]. According to BP natural gas consumption amounted to 11.3 Bcm in 2020 [6]. Natural gas imports to Israel were 509.7 million cubic meters in 2017 [3].

Coal consumption in Israel remained has declined over the last decade and in 2020 reached a level of 5.61 million short tons [14].

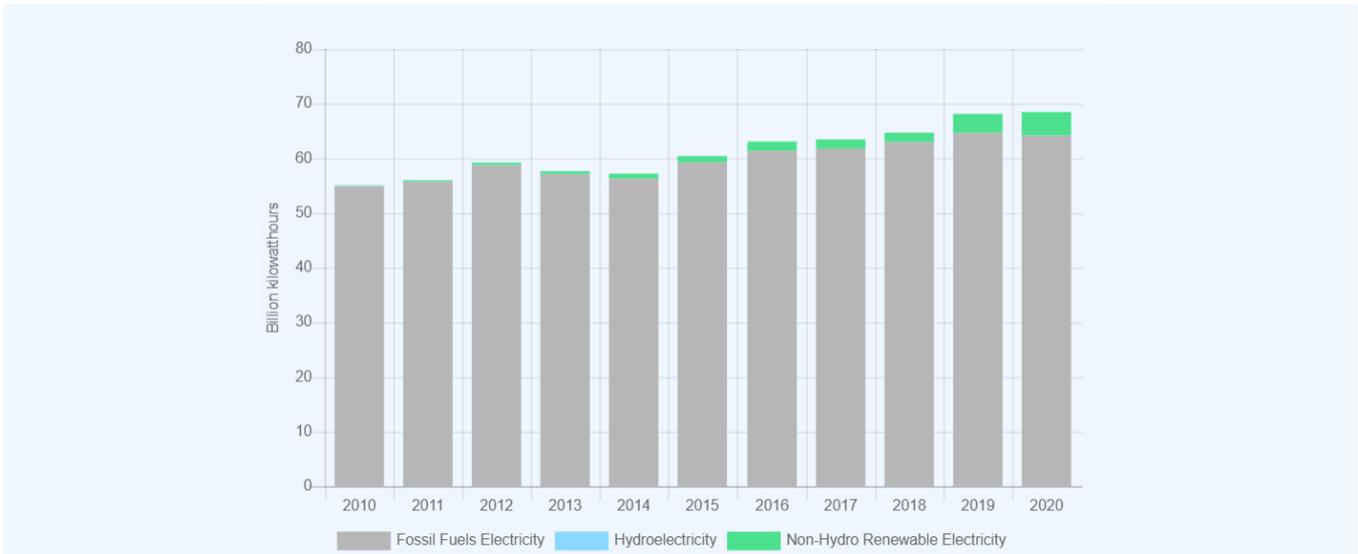


Source: U.S. Energy Information Administration (Dec 2021) / <https://www.eia.gov/>

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

Israel has a relatively high share of conventional resources in the production of electricity (Fig. 3.) According to the U.S. Energy Information Administration (Fig.6) in

2020, the country produced about 68.51 TWh of electricity, of which 93.7% was by thermal power plants and 6.3% by other renewable energy sources.

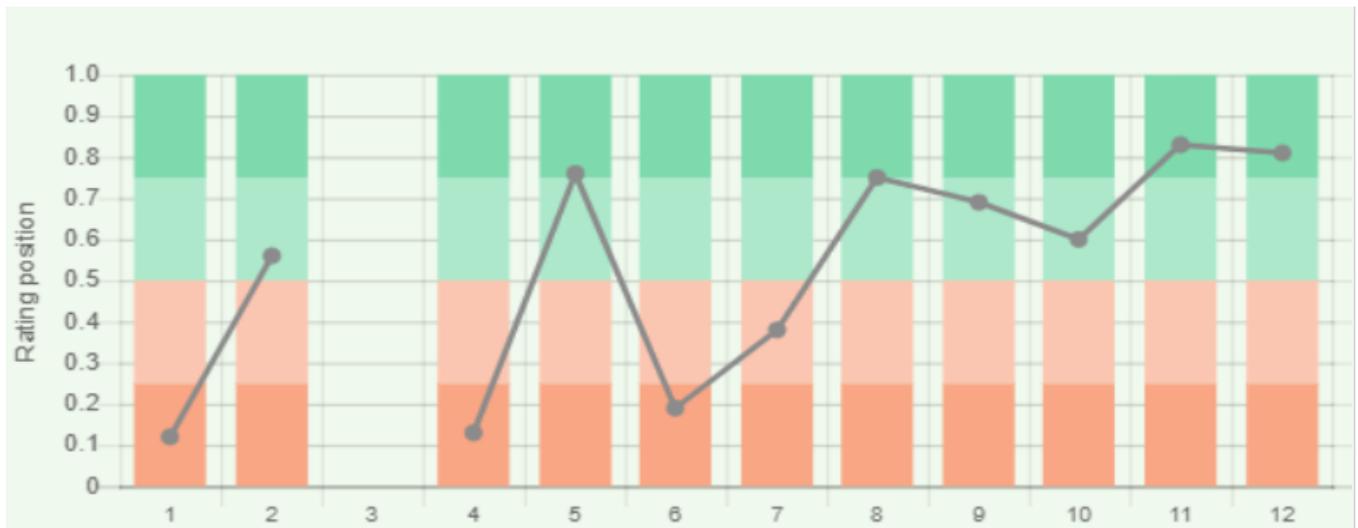


Source: U.S. Energy Information Administration (Dec 2021) / <https://www.eia.gov/>

Figure 3. Electricity production in Israel

Israel's position in the comparative diagram of energy index is shown in Figure 4. The first six indices based on reserves of fossil fuels and export opportunities, with the exception of gas, are located at the bottom of the chart.

In terms of the share of electricity production from renewable energy sources (excluding hydropower), Israel is 106<sup>th</sup> among 170 countries selected for consideration. In the EAPI (Energy Architecture Performance Index) 2017,



Sources:

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  3. Total recoverable coal reserves 2019 / International Energy Statistic / Geography / U.S. Energy Information Administration (Nov 2021) \*81
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  6. Combination production-consumption for Coal 2019 / International Energy Statistic / Geography / U.S. Energy Information Administration (Nov 2021) \*128
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  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
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  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 Israel

which is based first on the level of economic growth, environmental safety, and energy independence of the country, including access to energy, Israel is 51<sup>st</sup> out of 127 countries considered, behind Canada and South Korea, but ahead of Russia, USA. However, it should be noted that during the last 8 years the country has lost 5 ranking positions.

When considering the GDP per unit of energy use, Israel is 17<sup>th</sup> out of 66 countries surveyed, which is slightly

above the world average, while energy consumption per capita is slightly lower - 31<sup>st</sup> out of 66 countries. In terms of electricity consumption per capita, the country is 37<sup>th</sup> in the world, however, for the indicator of combination of electricity production-consumption, Israel is 41<sup>st</sup> in the ranked list of 216 countries.

More information about the energy balance of Israel can be found in the documents from our reference library [here](#).

## Energy Infrastructure

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

As mentioned above, the natural gas reserves amount to about 99% of the energy potential of mineral resources. The main natural extraction fields are located offshore. According to [15] the largest gas field, Tamar, has reserves estimated at 10 Tcf.

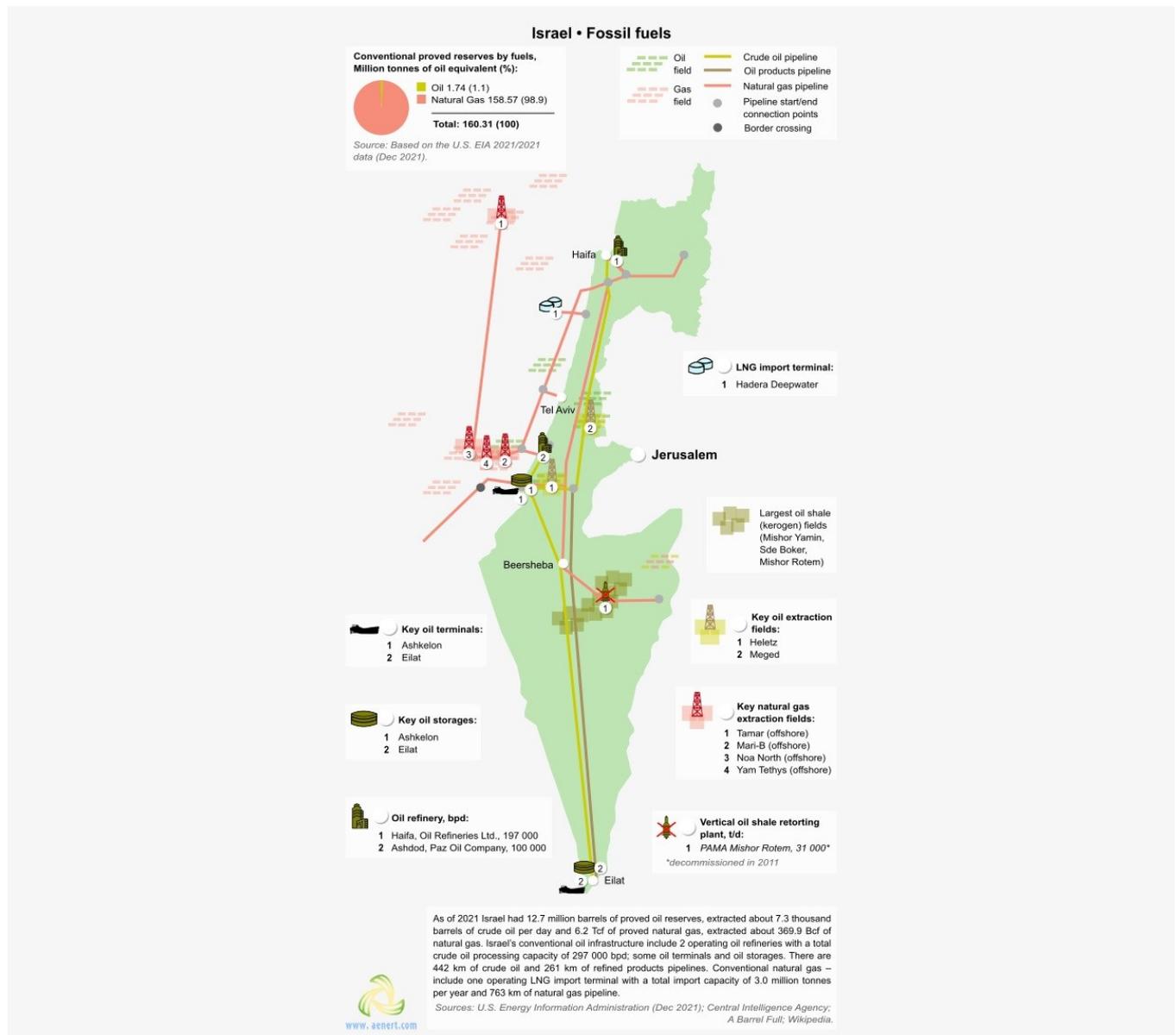


Figure 5. Basic infrastructural facilities of the fossil fuel sector in Israel

The Petroleum industry in Israel is represented by two refineries – The Haifa Refinery with a capacity of 197,000 bpd and The Ashdod Refinery with a capacity of 100,000 bpd [16,17]. The unique geographical location of Israel with two exits to the sea and two marine terminals, is supported by the pipeline infrastructure that combines these important strategic points. The pipeline system connects the oil terminals in Eilat and Ashkelon, as well as the oil refineries in Haifa and Ashdod. Two storage tanks with a total capacity of 3.7 million cubic meters ensure reliable operation of the oil sector of the country [18]. LNG terminal Hadera Deepwater is located 10 km from the coastline of Israel, allowing the country to annually import 2.5 billion m<sup>3</sup> of natural gas [19].

Figure 6 shows the most important facilities in Israel producing electrical energy.

As previously mentioned, electricity production in Israel relies heavily on fossil resources, such as coal and gas. There are 13 thermal power plants with a capacity of over 100 MW, 11 of which operate on gas.

The largest coal-fired plant is Orot Rabin, with a capacity of 2590 MW [20]. The largest gas power plant is Eshkol, with a capacity of 1449 MW [21]. There is one pumped storage plant under construction in Israel—Ma'ale Gilboa 300 MW [22].

In Figure 7, you can see the main facilities for the production of energy from renewable resources in Israel.



Figure 6. Electricity production in Israel

As noted above, renewable energy in Israel, has no decisive influence on the production of the main types of energy. Thus, the total production of electricity in 2020

from renewable sources, was 4.29 TWh, and was dominated by solar PV, followed by bioenergy and wind energy (Figure 7).

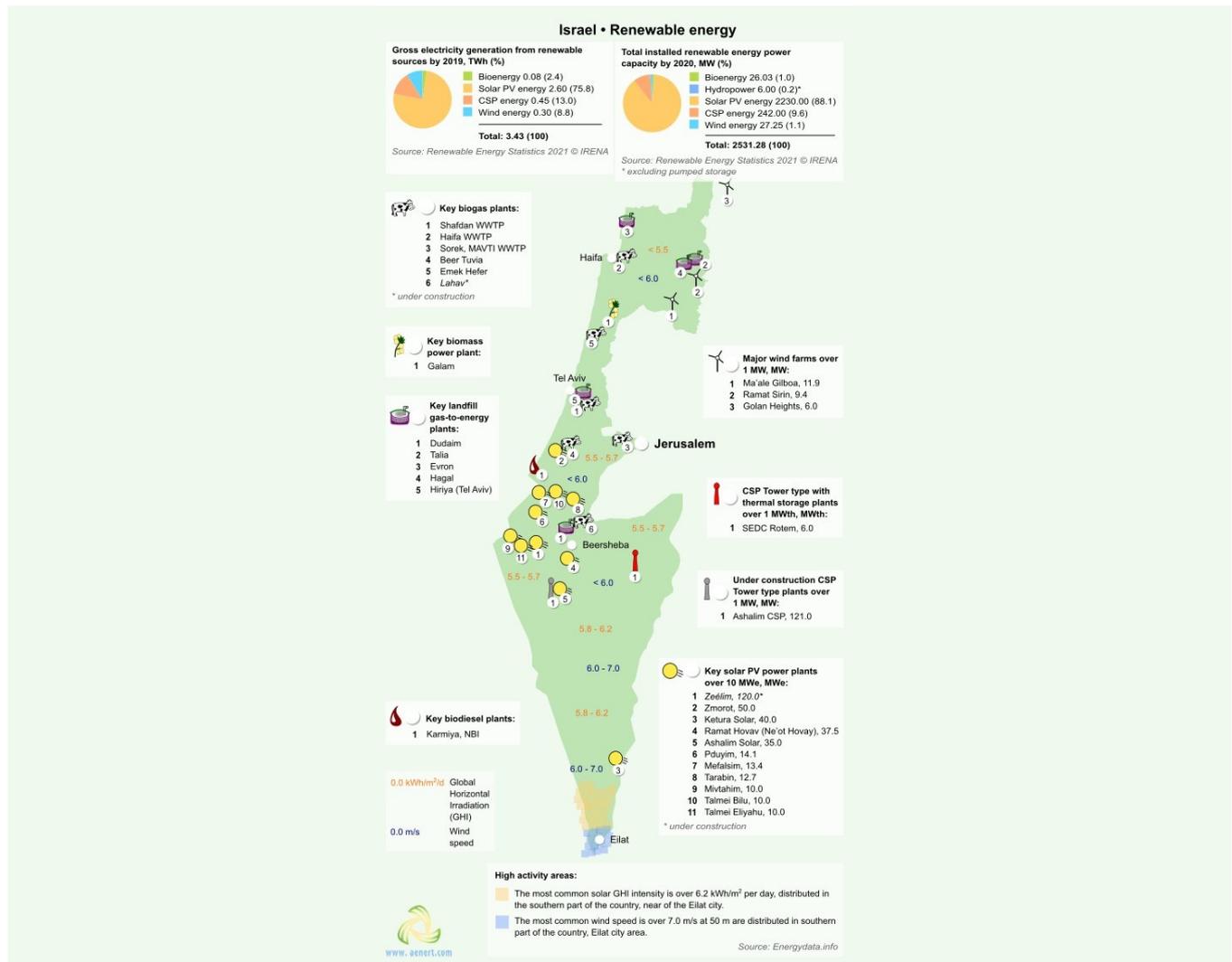


Figure 7. Renewable energy in Israel

The level of solar radiation in the southern part of the country can reach 6.2 kWh/m<sup>2</sup> per day, and the wind speed exceeds 7 m/s, which is a tangible resource for energy production. As a consequence, there is a large number of renewable energy facilities located in the area. The largest solar station is under construction, Zeelim solar power plant will have an installed capacity of 120 MW, and largest wind Ma'ale Gilboa has a capacity of 11.9 MW [23,24]. There is one installed CSP tower type with thermal storage—SEDC Rotem 6 MWth [25], and one large plant Ashalim CSP 121 MW is under construction [26].

Bioenergy has been actively developing in Israel, and as of 2020 its capacity was estimated at 26 MW. Nationwide, there are enterprises for biomass and biogas production. WWTP manages the largest biogas plant Shafdan,

that treats about 370 000 m<sup>3</sup>/day of wastewater [27]. Key biomass plant is Galam uses about 25 thousand tons of woodchips a year [28]. Landfill gas enterprise Dudaim, with an installed capacity of 2.2 MW is synchronized to the national grid [29].

Regarding the energy policy, the Israeli government has set a target to reduce CO<sub>2</sub> emissions per capita to 7.7 tons by 2030. To achieve this aim the government has established three main goals: to reduce electricity consumption by 17%, private vehicles by 20%, to increase the share of renewable energy in electricity consumption by 17%[30].

For current information on the development of energy in the country see [here](#). More information about energy infrastructure of Israel is also available [here](#).

## Education and Innovation

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

Figure 8 shows the indices that have an indirect impact on the energy sector, but largely determine its future in the country. Israel is ranked 15<sup>th</sup> out of 132 member countries according to the Global Innovation Index ranking of 2021, behind Germany, the U.S. and the UK.

The country has high levels of public funding for research, development of science and education in general. As a consequence, in the QS University Rating, Israeli universities are regarded very high.

It also has relatively high indexes associated with the assessment of the number of publications in scientific and technological journals. As such, in the Scimago ranking, Israel is 25<sup>th</sup> out of 240 participating countries, and in the ranking of Scientific and Journal Activities it is 33<sup>rd</sup> out of 197 countries.

According to the number of patents granted to residents of Israel, both inside the country and abroad, the country

ranks 18<sup>th</sup> in the world. Similarly, by the number of valid patents, the country is 35<sup>th</sup> in the world, which largely characterizes the country's patent attractiveness.

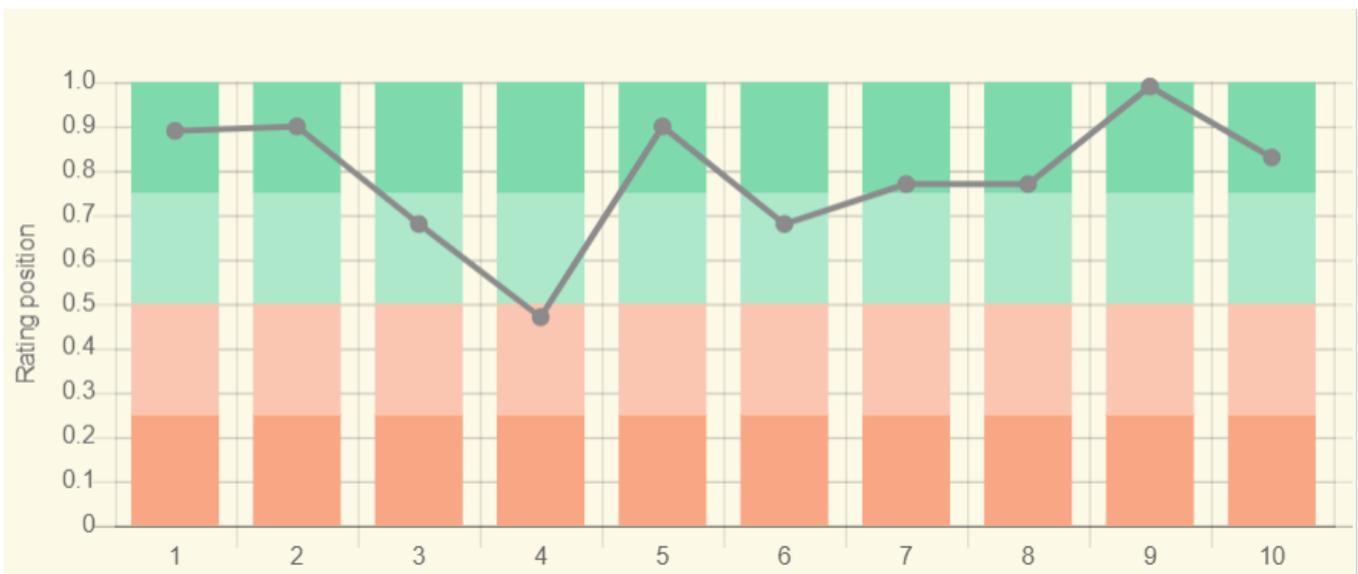
In the field of extraction and processing of unconventional oil, the leaders in patenting among Israeli companies are IDE Technologies Ltd, Solex Water Ltd, Ormat Industries Ltd.

Research and development in this field is carried out by the Geological Survey of Israel and Ben Gurion University of the Negev.

The leading patent holders in the field of synthetic fuel production are Yeda research and development Co., Ltd., and the Engineuity Research and Development Ltd, and Weizmann Institute of Science, Technion – Israel Institute of Technology, Tel Aviv University are conducting research in this field.

Solex Water are engaged in research and development in the field of hydrocarbon production from low permeability reservoirs. Research is being conducted by the Hebrew University of Jerusalem.

Another area where Israeli companies actively conduct research is the exploration of gas hydrates, where Tech-



Sources:

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9. Research and development expenditure (% of GDP), 2018 / UNESCO Institute for Statistics. License: CCBY-4.0 / Data \*119
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\* Total number of countries participating in ranking

Figure 8. The indices of education and innovation in Israel

nion—Israel Institute of Technology and Bar-Ilan University have the largest number of publications. The leading patent holders in the field of bioenergy are Trans Biodiesel Ltd., Ecogas Israel Ltd., Yeda Research and Development Co., Ltd and SGT Sustainable Green Technologies Ltd. Bar-Ilan University, Weizmann Institute of Science and Technion—Israel Institute of Technology conduct research in this field. A large number of Israeli companies patent technical solutions in the field of energy production from renewable sources. In the field of solar energy Siemens Concen-

trated Power, Ltd., Brightsource Industries (Israel) Ltd and Yeda research and Development Co., Ltd., have the largest number of patents. Leading research organizations in this field are Tel Aviv University and Weizmann University. Birdsvision Ltd are ahead in the number of patents in the field of wind power; research in this field is being conducted by Technion—Israel Institute of Technology and the Tel Aviv University.

Additional information about education in the country can be obtained [here](#), and the list of research institutes [here](#).

### Ecology and Environment Protection

A diagram of environmental indices is shown in Figure 9. The indices shown in the diagram to a certain extent reflect the environmental situation in the country. First of all Israel demonstrates high level of CO<sub>2</sub> emissions, both in general and per capita. However, the situation brightens by the fact that Israel is not a member of the Climate Change Performance Index (CCPI), which consists of 60 countries responsible for more than 90% of global CO<sub>2</sub> emissions related to energy.

According to the forest area as a percentage of land area, Israel is not among the world leaders, but the trend associated with its change looks positive. In this ranking Israel is 189<sup>th</sup> out of 234 countries. Israel also has a relatively high valuation in the Environmental Performance Index (EPI) 2020, and is 29<sup>th</sup> out of 180 participating countries. This index primarily focuses on the environmental performance of national governments aimed at reducing the negative impact of the environment and rational use of natural resources. Israel belongs to a group of countries with very high levels of methane emissions.



Sources:

1. CO<sub>2</sub> total emission by countries 2016/European Commission/Joint Research Centre (JRC)/Emission Database for Global Atmospheric Research (EDGAR) \*208
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3. Forest area 2015 (% of land area)/The Global Forest Resources Assessment 2015/Forestry Statistics/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 Israel

The Ecological Footprint Atlas rating complements the overall negative picture, according to which Israel is among the ecological debtors.

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*More information about energy infrastructure of Israel is to be found [here](#).*

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