



Environmental Report

For the year 2019



חברת החשמל
Israel Electric





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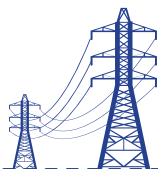
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Introduction

The Israel Electric Corporation (IEC) operates as an integrated and coordinated system that engages in all stages of the electricity supply chain, starting from the production of electricity through its transmission and transformation and ending with its sale and distribution to its customers. As a result the IEC considers itself committed to the supply of available and high-quality electricity from a variety of production sources available to the national electricity market, both by the IEC production system, and by the production system of private electricity producers that operate under the Electricity Market Law that entered into force in 1996.

The Company engages in 3 main spheres of activity along the electricity chain, divided into the following segments:

- A. The production segment – the coastal electricity production system that includes steam power plants, combined cycle and aeroderivative gas turbines, and an inland production system of combined cycle gas turbines, industrial gas turbines and aeroderivative gas turbines.
- B. The transmission and transformation segment – the electricity transmission system from the production sites by transmission lines at extra-high voltage (400 kV) and "very-high" voltage (161 kV) to the switching stations and the substations and from there to the transformation stations (distribution/transformation transformers). In the switching stations, the substations and the transformation substations, the transformation operations change the voltage levels from extra-high to "very-high" voltage and from "very-high" to high-voltage, so that it can be supplied safely in the distribution segment to the end consumers (the customers).
- C. The distribution segment – the electricity distribution system to the customers from the substations by high-voltage and low-voltage lines.

We hereby respectfully present to you the annual environmental report for the year 2019. This report has been published voluntarily since the year 2000.

Further information regarding the electricity production segment

The IEC electricity production system is based on steam power plants as well as aeroderivative and industrial gas turbines – most of which operate in the CCGT (combined cycle gas turbine) method.

IEC produces, transmits, distributes and supplies the main part of the electricity that is consumed by the Israeli economy and holds an essential service provider license. The total nominal production capacity at the end of 2019 reached 12,752 megawatt. In 2019 IEC owned and operated 58 production units in 17 power plant sites, according to the following breakdown:

16 steam production units

42 gas turbines including:

26 industrial gas turbines, of which 13 are part of a CCGT

16 aeroderivative gas turbines.

Steam production units:

The IEC steam production units produce electricity with steam turbines (at Orot Rabin, Rutenberg, Reading, Eshkol power plants). All production units are "dual fuel" units except for the Reading power plant that is operated with natural gas only. Some of the power plants are operated with coal as primary fuel and with heavy fuel oil or diesel oil as secondary fuel, and the other ones with natural gas as primary fuel and heavy fuel oil or diesel oil as backup fuel.

In 2019 IEC operated 16 steam production units.

Gas turbines:

These units produce electricity by the rotation of turbines with emission gas (gas turbines). Most of these gas turbines are "dual-fuel" turbines and can be operated with natural gas as primary fuel and with diesel oil as backup fuel.

The gas turbines split into two types: aeroderivative gas turbines and industrial gas turbines

Aeroderivative gas turbines:

Gas turbines whose nominal capacity is small. In IEC the maximal nominal capacity of each aeroderivative gas turbine is 50 megawatt.

Since it is possible to start and stop these production units relatively quickly, these production units provide a quick and specific response to peak electricity demands. All production units of this type are operated with diesel oil only, and defined as backup units.

Industrial gas turbines:

Gas turbines based on the operation principle of the aeroderivative gas turbines, but

with a different structure that enables the production of electricity in a larger scale.

The industrial gas turbines split into two types:

- Open cycle gas turbines: most units of this type are operated with natural gas as primary fuel and diesel oil as backup fuel.
- CCGT gas turbines: a combination of an industrial gas turbine and a steam turbine. In CCGT the industrial gas turbine produces electricity as usual, and the residual heat of the emission gas is used for the purpose of producing steam that propels the steam turbine to produce additional electric energy, without additional fuel use. With this operation mode, the energetic efficiency is increased.

Table no. 1 | List of the IEC production units with their production capacity (megawatt, on December 31, 2019), according to the IEC supervision and control system *

Unit type	Site	Number of units	Nominal production capacity (Megawatt)
Steam production units			
Coal units			
Coal primary fuel, heavy fuel oil secondary fuel (for units 5 and 6 only)	Orot Rabin (Maor David A, B)	6	2,590
Coal primary fuel, heavy fuel oil secondary fuel	Rutenberg	4	2,250
Total - coal units		10	4,840
Units converted to natural gas			
Natural gas primary fuel, heavy fuel oil secondary fuel	Eshkol	4	912
Natural gas primary fuel	Reading	2	428
Total - units converted to gas		6	1,340
Total - steam production units		16	6,180
Gas turbines			
Industrial gas turbines			
	Ramat Hovav	4	436
	Zafit	2	220
	Eilat	1	34
	Atarot	2	68
	Gezer	4	592
Total - industrial gas turbines		13	1,350
Aeroderivative gas turbines			
	Har Reclamation	1	40
	Eitan	1	40
	Ra'anana	1	11
	Caesarea	3	130
	Haifa	2	80
	Kinarot	2	80
	Orot Rabin	1	15
	Rutenberg	2	40
	Eshkol	1	10
	Eilat	2	58
Total - aeroderivative gas turbines		16	504
Total - gas turbines		29	1,854

CCGT gas turbines			
	Ramat Hovav	2	701
	Hagit	4	1,394
	Eshkol	2	771
	Gezer	2	744
	Zafit	1	360
	Haifa	2	748
Total - CCGT units		13	4,718
Total - production units in the company		58	12,752

* In the next few years, the nominal capacity of the power plants owned by IEC is expected to decrease according to the rate of sale of the production units according to the reform performed in the electricity market.



IEC environmental protection policy

The IEC operates in accordance with environmental protection policy principles that were first approved in 1997 and were updated from time to time. The principles include:

- A. Incorporating environmental considerations in all areas of activity, including decision-making processes
 - A-1) Incorporating environmental considerations in the preparation of the development plans of the company.
 - A-2) Preparation of environmental protection guidelines documents for projects and major activities.
 - A-3) Incorporating mandatory environmental protection criteria in the procurement tenders published by the company.
- B. Designing and operating the facilities while ensuring continuous reduction of the environmental impacts, taking into consideration sustainable development principles, while adopting the best proven and economical technologies
 - B-1) Adopting the best available techniques (BAT).
 - B-2) Promoting the use of high-quality fuels from environmental aspect – mainly natural gas.
 - B-3) Promoting the installation and operation of facilities preventing environmental impact, such as the installation of air pollution control facilities at the coal-fired power plants, for the reduction of sulfur dioxide emissions (FGD) and the reduction of nitrogen oxide emissions (SCR).
 - B-4) Adopting the "prudent avoidance" principle to reduce electric and magnetic fields in the electricity transmission and distribution grid.
 - B-5) Expanding the use of environmental-friendly materials.
 - B-6) Performing regular monitoring and control on the environmental impacts of IEC installations' operation on the soil, air, water bodies and sea.
 - B-7) Performing transmission of real time monitoring data and free public access to information.
 - B-8) Implementing environmental protection standard ISO 14001 and environmental management and control system.
- C. Adopting advanced and proven environmental protection criteria
 - C-1) Operating work teams for the follow up of pluriannual work plans and implementing them in accordance with the environmental protection policy of the company.

- C-2) Following Israeli and international legislation and standardization and evaluating their future trends.
 - C-3) Promoting active involvement in environmental standardization and legislation processes.
 - C-4) Promoting the organization of the company management in the environmental protection field, using hierarchical supervision and establishing, inter alia, appropriate manpower and budget allocations, and business procedures.
- D. Integrated natural resource management: soil, air, water and fuels
- D.1) Protecting air quality by reducing pollutant emissions.
 - D.2) Reducing the use of soil area when designing and building new facilities, optimizing its use in existing sites and promoting integration with other infrastructures.
 - D.3) Performing routine activities for the purpose of saving fuels.
 - D.4) Reducing the use of fresh water and promoting the use of poor quality water resources.
- E. Reduction and recycling of waste and by-products
- E.1) Managing waste at the company and site levels (reduction of the production of waste, increase of recycling and reduction of waste disposal).
 - E.2) Promoting the uses of by-products: coal ash and FGD gypsum.
 - E.3) Promoting the uses of treated waste water and brine produced in-site, and the use of poor quality water from external source.
- F. Incorporating landscaping, spatial and environmental considerations in the design of new facilities and in the maintenance of existing facilities
- F.1) Promoting actions for improving aesthetic aspects of existing facilities.
 - F.2) Building new production, transmission and transformation facilities while taking into consideration the landscape and the environment.
 - F.3) Including the participation of a landscape architect in the design of new projects already at the beginning of the process, for insuring proper consideration for nature and landscape conservation.
 - F.4) Including the rehabilitation of the natural landscape and environment as part of the completion of the project.
- G. Establishing an open and transparent dialogue with the public for plans with environmental impact
- G.1) Applying the free access of the information to the public for activities with environmental impact.
 - G.2) Cooperating and establishing a dialogue with the public in planning processes

related to the location and the licensing of projects.

- G.3) Working in cooperation and coordination with the environmental authorities at national, regional and local levels in order to reach agreements in a continuous work process.
- G.4) Tightening and improving the existing relations with nature protection organizations.
- G.5) Maintaining relations with public and private environmental protection associations.
- G.6) Publishing a periodic environmental protection report.
- H. Reducing the emission of greenhouse gases, in agreement with the principles of international conventions signed by the State of Israel, by increasing the efficiency of the power plants, expanding the use of environmentally friendly fuels and energy resources and encouraging the saving of electricity
 - H.1) Incorporating the use of natural gas considered a clean fuel as a primary fuel in existing power plants, in order to reduce the emission of pollutants, including greenhouse gases.
 - H.2) Installing production units with high efficiency such as combined cycle gas turbines, burning natural gas as a primary fuel. These power units are characterized by particularly low emissions of air pollutants, including greenhouse gases.
 - H.3) Promoting activities for improving energy efficiency, both at the IEC sites and by advising the customers of the company in the fields of energy saving and smart use of electricity. These activities contribute to the reduction in the electricity demand, thereby reducing the consumption of fuels and consequently reducing the emission of pollutants, including greenhouse gases.
- I. Promoting joint activities in the field of environmental protection with academic institutions, at national and international levels, including participation in environmental researches and development of advanced technologies
 - I.1) Assisting the State of Israel to fulfill its commitments as part of international environmental protection conventions.
 - I.2) Promoting and performing renewable energy projects, subject to the regulatory limitations imposed on IEC.
 - I.3) Developing cooperation with electricity companies around the world.
 - I.4) Allocating research and development budgets for environmental protection issues.
 - I.5) Following development and application of new technologies.
 - I.6) Promoting environmental innovation by providing support and supervision to environmental research.
 - I.7) Cooperation with research and academic institutions.

- J. Integrating environmental values in the organizational culture, increasing environmental awareness and commitment of the company employees and integrating environmental issues in its activities in the community
 - J.1) Integrating environmental protection policy principles as part of the IEC organizational culture.
 - J.2) Encouraging awareness and commitment among the employees of the company to environmental issues, especially to the company activities and objectives in this field.
 - J.3) Integrating environmental protection subjects in courses that are part of the training program of the company.
 - J.4) Organizing conferences, workshops, study tours at power plants and activities in the internet website of the company.

Environmental protection constitutes an integral part in the operation, maintenance, design and development of IEC facilities. The activities of the company are subject to extensive regulation in this field. The company checks the impact of new environmental protection laws, acts to prevent or mitigate the environmental risks connected with its activities, makes preparations to deal with the financial, legal and operational impacts of these environmental protection laws, and allocates budgets for this purpose.





Promoting environmental awareness among employees

The IEC acts for raising awareness of environmental protection issues and proposes training sessions to its employees on a variety of subjects:

- Development and implementation of study programs on environmental protection issues for company employees and managers for the purpose of raising awareness of the environmental subjects and providing knowledge on them.
- In the past few years, the company organized the "Green-Blue-Orange – CEO environmental protection prize" competition, that was intended to mention employees who excelled in environmental protection issues. This competition encourages the adoption and integration of environmental protection values among the employees of the company, through the promotion of personal responsibility, the initiative of environmental values. The prize is attributed for an activity leading to a measurable improvement, in the fields of environmental protection issues and resources smart use, at work and at all. It is expected to resume next year.



Free access for the public to information regarding environmental issues

In accordance with the Free Access to Information Regulations ("Providing Environmental Information for Public Review, 2009"), IEC publishes on its internet website environmental information.

Recent announcements can be consulted on the company website (www.iec.co.il).

More information can be found on the IEC website, inter alia, in the following publications:

- Annual environmental reports since year 2000
<http://www.iec.co.il/environment/Pages/environmentalReports.aspx>
- Reporting within the framework of voluntary mechanism on recording and reporting of greenhouse gas emissions, mainly as a result of fuel combustion for electricity production
<https://www.iec.co.il/environment/2017/20%הוולונטרי20%למנגנון20%דיווח20%טופס20%פליטת20%חממה20%חברת20%החשמל20%-שנת20182020.pdf> 
- A carbon dioxide calculator that allows electricity consumers to calculate the amount of carbon dioxide (CO₂) emitted to the atmosphere as a result of their electricity consumption for a given year, and to compare between different years
<https://www.iec.co.il/environment/pages/pollcalculator.aspx>
- "Corporation Business Description" reports
<https://www.iec.co.il/investors/DocLib1/meshulav1217.pdf>
<https://www.iec.co.il/investors/DocLib1/meshulav1218.pdf>
<https://www.iec.co.il/investors/DocLib1/meshulav1219.pdf>
- Air pollution monitoring reports
<https://www.iec.co.il/environment/2017/202019%אוויר20%איכות20%ניטור20%ממצאי20%ממצי20%ניטור20%איכות20%אוויר2020192017202019.pdf> 
- Real-time air monitoring data from the Ministry of Environmental Protection website
<http://www.svivaqpm.net/>
- Reports in accordance with emission permits
<https://www.iec.co.il/environment/2017/20%פליטה20%להיתרי20%בהתאם20%דוחות20%שנת20182020.pdf> 

Note: Similar reports for the year 2019 will be available only in the second half of 2020.



Use of materials, energy consumption and energetic efficiency

The main raw materials that are used by the company for the purpose of producing electricity are different types of fuels: coal, natural gas, liquefied natural gas, heavy fuel oil and diesel oil. In addition, the company owns a fleet of vehicles that use gasoline and diesel oil.

Table no. 2 provides information on IEC direct fuel consumption for the production of energy ("energy consumption"), as amounts expressed in thousands of tons/thousands of liters, and as thermal energy in terajoules. In addition, this table shows the annual consumption of incombustible raw materials (limestone) and the gasoline and diesel oil annual consumption of IEC fleet of vehicles. Most of the fuels consumed by IEC are used for the purpose of producing electricity.

According to the information presented in this table, in the past few years there has been a considerable decrease in the use of coal and a considerable increase in the use of natural gas. This trend contributed to a significant reduction in emission of air pollutants, including greenhouse gases, as mentioned in the section "emission of major pollutants to the air" in this report.

Regarding the efforts that were made in order to reduce the consumption of gasoline and gasoil for transportation (for the vehicle fleet of the company), see information given in the section "transportation and IEC vehicles use" in this report.



Table no. 2 | Summary of "energy consumption" by kind of fuel and incombustible raw material consumption (consumption of fuels for electricity production + consumption of limestone + consumption of fuels for transportation) - 2014 to 2019

	2014	2015	2016	2017	2018	2019
Coal						
Thousand tons	11,000	10,700	9,100	8,200	7,800	8,300
TJ	273,501	266,804	226,216	205,001	194,994	207,504
Natural gas including LNG						
Thousand tons	2,976	2,989	3,390	3,700	3,900	3,600
TJ	148,173	148,803	168,770	185,002	194,975	179,981
Diesel oil						
Thousand tons	12	91	46	115	55	107
TJ	502	3,881	1,939	4,906	2,370	4,366
Heavy fuel oil						
Thousand tons	4	18	19	26	22	20
TJ	159	704	781	1,025	864	760
Limestone for use in FGD scrubbers						
Thousand tons	39	41	33	44	66	78
Regarding the use of raw materials – we shall note that no recycled materials were used as part of the production process						
Gasoline for transportation (vehicle fleet of the company only)						
Thousand tons	3,356	3,366	3,835	3,340	3,562	3,431
TJ	115	116	132	115	123	118
Diesel oil for transportation (vehicle fleet of the company only)						
Thousand tons	10,304	9,831	9,106	7,882	9,528	10,034
TJ	374	357	331	287	347	365

Tables no. 3-4 below present data on the summarized "energy consumption" by IEC and data on energy efficiency, expressed as heat rate of electricity production. The improvement in the "energy consumption" and energy efficiency at the company level is due to two reasons: a decrease in the total electricity production, and therefore also in the consumption of fuels for the production of electricity, as a result of the contribution of private electricity producers; an improvement in the heat rate, i.e. in the amount of energy required for producing one megawatt per hour, as a result of the shift from production of electricity by coal-fired unit to production by combined cycle units that are primarily operated with natural gas, with a consistently higher percentage of efficiency.

Table no. 3 | Summary of "energy consumption" by kind of fuel (consumption of fuels for electricity production + consumption of fuels for transportation + self-consumption of electricity) - 2014 to 2019

	2014	2015	2016	2017	2018	2019
Coal						
TJ	273,501	266,804	226,216	205,001	194,994	207,504
Natural gas including LNG						
TJ	148,173	148,803	168,770	185,002	194,975	179,981
Heating diesel oil						
TJ	502	3,881	1,939	4,906	2,370	4,625
Heavy fuel oil						
TJ	159	704	781	1,025	864	760
Transportation gasoline (vehicle fleet of the company only)						
TJ	115	116	132	115	123	118
Transportation diesel oil (vehicle fleet of the company only)						
TJ	374	357	331	287	347	365
self-consumption IN electricity power plants						
TJ	7,138	6,909	6,802	6,666	6,501	6,614
Self-consumption of electricity in administrative and other sites						
TJ	688	360	231	216	216	216
Total TJ	430,650	427,934	405,489	405,202	400,390	400,183

Table no. 4 | Energy efficiency in the electricity production segment, heat rate for electricity production – 2014 to 2019

Heat rate for electricity production [GJ/MWh]	Total electricity production [MWh*1000]	Total thermal energy consumption [G]	Total thermal energy consumption [T]	Year
8.16	51,726	422,335,000	422,335	2014
8.30	50,641	420,192,000	421,920	2015
8.16	48,718	397,706,000	397,706	2016
8.12	48,788	395,934,000	395,934	2017
8.21	47,905	393,203,000	393,203	2018
8.22	47,784	392,870,000	392,870	2019

Table no. 5 | Energy efficiency in the electricity self-consumption segment in power plants – 2014 to 2019

Year	Actual production [MWh*1000]	Self-consumption of electricity in power plants [MWh*1000]	Self-consumption as total production percentage [%]
2014	51,726	1,983	3.83%
2015	50,641	1,919	3.79%
2016	48,718	1,890	3.88%
2017	48,788	1,852	3.80%
2018	47,905	1,806	3.77%
2019	47,784	1,837	3.84%

Energetic efficiency projects promoted by IEC in the last few years

IEC performed a number of energetic efficiency projects in the past few years including:

- Various activities in order to increase energy efficiency in existing production units.
- Replacement of the air conditioners in various sites of the company by newer air-conditioning units with a high energy rating.
- Replacement of lighting fixtures with new models that save energy.
- Promoting the construction of "green roofs."
- Activities in order to increase awareness of energy efficiency among employees.

In addition, IEC also observes the provisions of the Energy Sources Law 5750-1989 and the regulations promulgated thereunder, that concern energy efficiency, and the Government Resolutions that are published from time to time regarding energy efficiency and the reduction in the emissions of greenhouse gases. The company is committed to keep this regulation and studies its impact, together with the impact of new regulatory initiatives in this field.



Environmental emissions

The IEC considers as highly important to perform the design and operation of its facilities while taking care of a continuous reduction of environmental impacts, and taking into consideration the principles of sustainable development through adopting the best technologies from environmental protection and economic points of view.

This section will provide a survey of pollutants emission to air from electricity production sites, which is a main issue that the company deals with, in the context of environmental emissions.

Further information can be found in the reports submitted to the Ministry of Environmental Protection according to the Environmental Protection Law (Releases and Transfers to the Environment – Reporting and Registration Obligations), 5772-2012. According to this law, IEC submitted Pollutants Release and Transfer Register (PRTR) reports for 17 sites that require reporting, using a digital form.

- PRTR reports on the IEC website: <https://www.iec.co.il/environment/2017/prtr-2018-IEC.pdf>
- In addition, these reports are published on the website of the Ministry of Environmental Protection: <https://www.gov.il/he/departments/topics/prtr>

These report includes, inter alia, the quantities of pollutants emitted to the air, water resources and soils (above the threshold values defined in technical manuals), including the quantities of pollutants transferred in wastewaters to the environment routinely and during malfunction, as well as the quantities of the different types of waste transferred off-site.

Note: Similar reports for the year 2019 will be available only in the second half of 2020.



Emission of major pollutants to the air

During the electricity generation process different types of gases are emitted to the atmosphere as a result of fuel combustion. The main gases emitted are: sulfur dioxide (SO₂), nitrogen oxides (NO_x), particulate matter (PM) and carbon dioxide (CO₂).

There is a trend of continuous reduction of emissions to the air due to the main following factors:

- Expanding the use of natural gas whose sulfur content is negligible;
- Successful completion of the air pollution control project at Orot Rabin site;
- Advanced performance of the air pollution control project at Rutenberg site;
- Operation of the combined cycle generation units with particularly high efficiency;
- Reduction of the use of coal according to the instructions of the Minister of Energy and according to the emission permits instructions;
- Using low-sulfur liquid fuels only for backup.

Table no. 6 | Data on electricity generation by fuel in the years 2010-2019

The shift of electricity generation from coal and liquid fuels to natural gas can be seen. It contributed to a significant reduction in emissions of air pollutants and greenhouse gases

Year	Generation percentage using coal	Generation percentage using natural gas	Generation percentage using liquefied natural gas LNG	Generation percentage using diesel oil	Generation percentage using heavy fuel oil
2012	63.4	14.3	0.0	15.2	7.1
2013	56.2	5.36	4.1	2.6	0.6
2014	58.2	41.1	0.6	0.1	0.0
2015	57.6	40.3	1.3	0.7	0.1
2016	49.6	46.3	3.6	0.4	0.1
2017	45.2	48.5	5.0	1.1	0.2
2018	43.0	49.1	7.4	0.4	0.1
2019	45.8	45.1	8.0	1.0	0.1

Table no. 7 | Comparison of actual air emissions reduction rates with the targets for 2020 stated in the corporate sustainability report *

Air pollutant	reduction target [ton/year]: 2020 compared to 2012	Actual emissions reduction [ton/year]: 2018 compared to 2012	Actual emission reduction [ton/year]: 2019 compared to 2012
Nitrogen oxide NO _x	-60%	-62%	-68%
Sulfur dioxide SO ₂	-60%	-71%	-79%
Carbon dioxide CO ₂	-20%	-37%	-36%
Carbon footprint CO ₂ eq	-20%	-37%	-36%

* The targets for 2020 were published in the 2018 corporate sustainability report

Table no. 8 | Emissions of pollutants to the air as a result of fuel combustion for electricity generation by IEC in the years 2010-2019 [g/kWh produced]

Year	Electricity generation [thousands of Mwh]	NO _x emission [g/kWh produced]	SO ₂ emission [g/kWh produced]	PM emission [g/kWh produced]	CO ₂ emission [g/kWh produced]	CO ₂ eq emission [g/kWh produced]
2010	56,102	1.60	1.50	0.051	699	702
2011	57,146	1.70	1.60	0.053	707	709
2012	61,074	1.80	1.68	0.056	754	757
2013	57,119	1.59	1.47	0.047	674	677
2014	51,726	1.42	1.36	0.035	659	661
2015	50,641	1.32	1.34	0.046	667	669
2016	48,718	1.07	1.08	0.042	635	637
2017	48,788	0.92	0.77	0.038	614	617
2018	47,905	0.88	0.63	0.032	605	608
2019	47,784	0.74	0.45	0.027	618	620
2019 VS 2012	-22%	-59%	-73%	-52%	-18%	-18%
2019 VS 2018	-0.3%	-15%	-29%	-16%	+2.1%	+2.0%

Table no. 9 | Emissions of pollutants to the air as a result of fuel combustion for electricity generation by IEC in the years 2010-2019 [ton/year]

Year	Electricity generation [Mwh]	NOx emission [ton/year]	SO2 emission [ton/year]	PM emission [ton/year]	CO2 emission [ton/year]	CO2eq emission [ton/year]
2010	56,102	92,324	82,860	2,873	39,214,127	39,375,206
2011	57,146	95,419	93,051	3,028	40,373,568	40,543,180
2012	61,074	109,920	102,648	3,403	46,035,963	46,240,061
2013	57,119	90,680	84,167	2,661	38,500,369	38,655,755
2014	51,726	73,577	70,423	1,835	34,069,079	34,207,232
2015	50,641	66,925	67,636	2,336	33,757,748	33,893,752
2016	48,718	51,888	52,663	2,041	30,938,165	31,055,231
2017	48,788	44,800	37,592	1,856	29,978,814	30,087,822
2018	47,905	41,957	29,951	1,516	29,006,456	29,109,700
2019	47,784	35,586	21,389	1,295	29,525,691	29,634,047
2019 VS 2012	-22%	-68%	-79%	-62%	-36%	-36%
2019 VS 2018	-0.3%	-15%	-29%	-15%	+1.8%	+1.8%



The air pollution control project at coal-fired production units of Orot Rabin and Rutenberg sites

In recent years, IEC has built air pollution control facilities at Orot Rabin site in Hadera, and is currently in very advanced stages of completing also air pollution control facilities at Rutenberg site in Ashkelon. This is a complex project whose construction takes many years with a final cost of about NIS 7 billion (not including interest during the construction period).

At the date of this report, and according to the emission permits that were issued to the coal-fired units, units 5-6 at Orot Rabin site operate successfully with air pollution control facilities, and units 1-2 at Rutenberg site operate successfully with the same facilities, this in compliance with the emission values set in the emission permits. Units 3-4 at Rutenberg site are in advanced stages of the completion of the air pollution control system, i.e. the addition of facilities to reduce nitrogen oxide emissions (most of the pollution control facilities have been installed already before the date of their operation).



This project is a milestone in the investments made by IEC in the environmental protection field and after its completion Israeli residents will continue to enjoy reliable and available electricity but this when it is provided in a more "cleaner" and environmentally-friendly way.

The projects at power plants Orot Rabin in Hadera and Rutenberg in Ashkelon include the upgrade of existing systems in the units (primary methods), the installation of scrubbers to reduce sulfur dioxide emissions (FGD) and the installation of catalytic systems (SCR) to improve the reduction of nitrogen oxide emissions. The FGD scrubber operation is based on reaction of the sulfur dioxide in the flue gases with a limestone suspension. After the FGD flue gases are emitted at low temperature. As a result of the "wet" reaction process, the treated gases are saturated with water vapor and therefore a white plume can be observed, it results from the humidity of the emitted gases. This plume is not constituted of smoke but water vapor, and its white color is a proof of the success of the process and the proper function of the FGD.

The Flue Gas Desulfurization facilities (FGD) could not be fitted and connected to the existing stacks at the sites, so new stacks were established at both sites. The new stacks are used for production units 5 and 6 at Orot Rabin, and units 1-2 at Rutenberg site (a FGD facility already existed units 3-4 at Rutenberg site since the date of their operation).

The by-product of the sulfur dioxide removal process is gypsum, with a quality suitable for the cement industry and the gypsum wall manufacturing industry.



The IEC air monitoring system

IEC has established and operates an air quality monitoring system including in 2019 31 air quality and meteorology monitoring stations in various parts of the country. This monitoring system is part of a national air quality monitoring system, operating according to the Clean Air Law. The members of this monitoring system are Environmental Cities Associations (Haifa, Hadera, Ashdod and Ashkelon), the Ministry of Environmental Protection and the IEC.

The IEC monitoring plants operate in the following areas:

Haifa area – 3 stations; in the Hadera area – 3 stations; in the Tel Aviv area – 7 stations, in the Ashdod area – 4 stations; in the Ashkelon area – 3 stations; in Alon HaTavor – 3 stations; in the Gezer area – 4 stations; in the Ramat Hovav area – 2 stations; and in the Eilat area – 2 stations.

The air pollutants (all or part of them) measured by the IEC monitoring systems in 2019 were: sulfur dioxide (SO₂), nitrogen oxides (NO_x), nitrogen dioxide (NO₂), ozone (O₃), and suspended fine particulate matter. In addition, measurements of wind direction, wind speed and other meteorological parameters are performed at several sites.

Findings from the air quality measurements obtained from the IEC monitoring plants in 2019 show that the concentrations of SO₂ (a typical pollutant for coal, heavy fuel oil or diesel oil combustion) are in a downward trend and are significantly lower than the environmental standards fixed according to the "Clean Air Regulations (Air Quality Values) (Temporary Provisions), 5771-2011". This is in line with the reduction in emissions by IEC electricity production units, as described above.

For other pollutants, IEC monitoring stations recorded occasionally concentrations of nitrogen oxides, nitrogen dioxide, ozone and fine particulate matter, that were relatively high and sometimes even higher than the air quality standards. These cases appear to be unrelated, or at least not directly related to emissions from the power plants. High concentrations of nitrogen oxides and nitrogen dioxide are associated with the transportation sector, high ozone concentrations are attributed to photo-chemical processes in the atmosphere and high concentrations of suspended fine particulate matter were measured during dust storms and haze events coming from remote desert locations.

Below is the link to the environmental air monitoring reports (IEC website):

<https://www.iec.co.il/environment/2017/202019%ממצאי20%ניטור20%איכות20%אוויר>



In 2019, the IEC completed the upgrading of the monitoring devices, buildings and infrastructures at all existing monitoring plants. It ensures improvement of the data reliability

and availability.

The IEC air monitoring laboratory is certified according to the ISO 17025 standard, for the performance of monitoring and calibration of instruments and environmental air quality monitoring systems.

Illustration no. 1 | Air quality monitoring stations – nationwide deployment

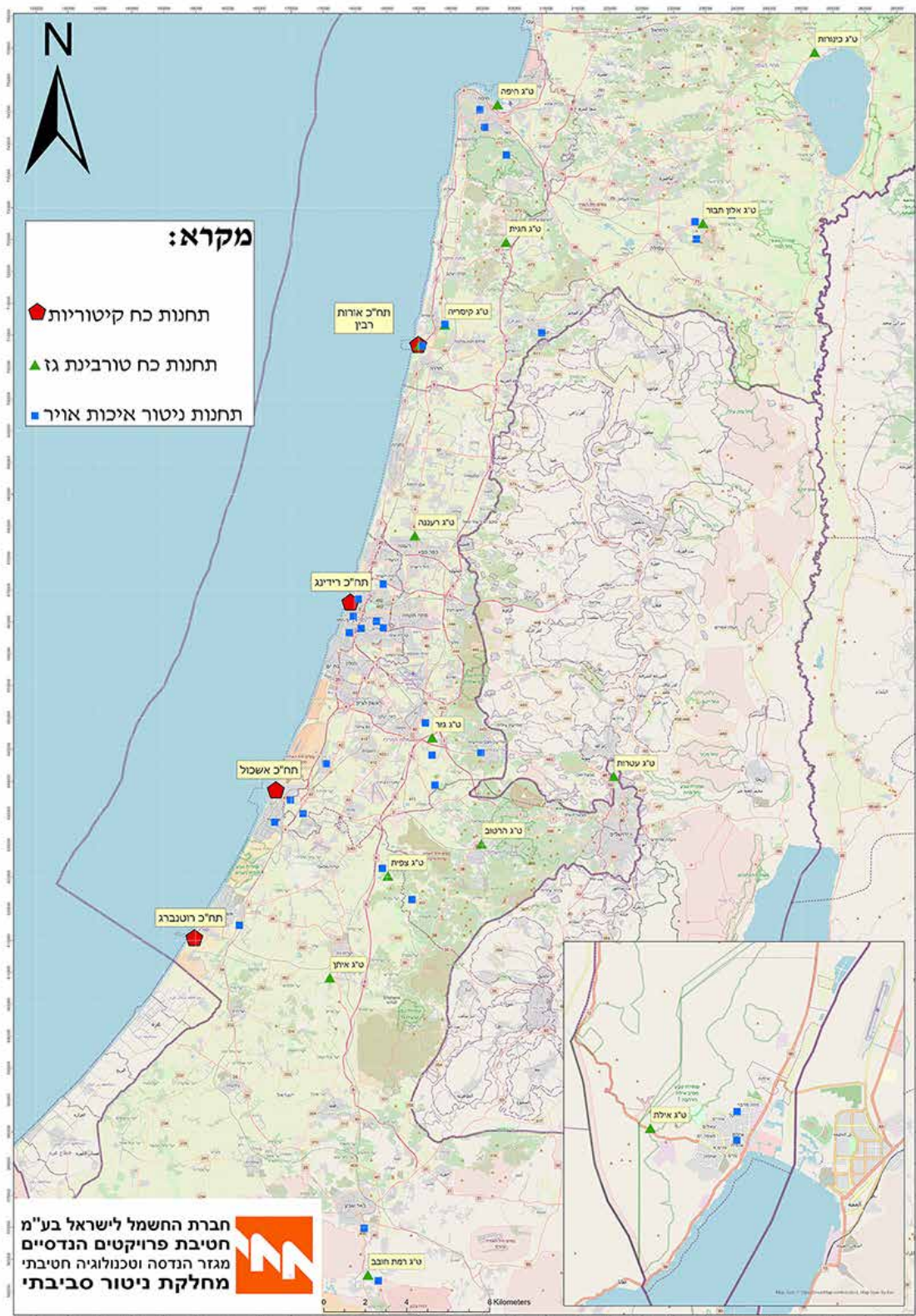


Table no. 10 | List of IEC air quality monitoring stations and meteorology stations, updated in 2019

Station	Station address	Altitude above sea level	Parameters measured
Hifa area			
Carmel center	Hugim school, 4 Yair Katz St., Haifa	(+20)74 m	SO ₂ NO ₂ NO _x O ₃ w/s w/d
Carmel Park	Carmel Park offices, Haifa	507 m	SO ₂ NO ₂ NO _x O ₃ PM2.5 w/s w/d
Einstein	135 Einstein St., Haifa	363 m	SO ₂ NO ₂ NO _x O ₃
Hadera area			
Katzir	Katzir community settlement	390 m	SO ₂ NO ₂ NO _x O ₃ PM10 w/s w/d
Orot Rabin	Orot Rabin power plant site	13(+13) m	PM10 w/s w/d
Caesarea	Caesarea gas turbine site in front of Or Akiva	19(+7) m	PM10 w/s w/d
Tel Aviv area			
Yad LaBanim	Beit Yad LaBanim, 15 Maale HaBanim St., Ramat Gan	77(+14) m	PM10 PM2.5
Fire department	Fire station – 13 Ben Eliezer St.	50(+10) m	SO ₂ NO ₂ NO _x O ₃
Bizron	Technical center – 7 Kremenetsky St., Tel Aviv	17(+16) m	w/s w/d
Petah Tikva Rd.	Old central station – 13 Petah Tikva Rd. Tel Aviv	28(+20) m	SO ₂ NO ₂ NO _x O ₃ PM10 PM2.5 w/s w/d
Antokolski	Public University, 4 Antokolski St., Tel Aviv	34(+20)m	SO ₂ NO ₂ NO _x O ₃ PM2.5
Hamashtela	Meteorology tower, national supervision, Ramat HaSharon	65(+10+65) m	SO ₂ NO ₂ NO _x O ₃ + בשני גבהים Temp w/s w/d
Lamed neighborhood	Area school – 25 Burla St., Tel Aviv	17(+15) m	PM10

Station	Station address	Altitude above sea level	Parameters measured
Ashdod area			
Nir Galim	Moshav Nir Galim	20 m	SO ₂ O ₃ PM ₁₀ NO ₂ NO _x w/s w/d
F Quarter	Clalit Health Services clinic, F Quarter, Ashdod	25(+10) m	w/s w/d
Gan Darom	Moshav Gan Darom	45 m	SO ₂ NO ₂ NO _x O ₃
Yavne (city)	Clalit Health Services – HaDekel St., Yavne	38(+15) m	
Ashkelon area			
Bat Hadar	Hof Ashkelon Regional Council	59(+4) m	SO ₂ NO ₂ NO _x O ₃ PM ₁₀
Kfar Menachem	Zafit high school, Kfar Menachem	119(+11) m	SO ₂ NO ₂ NO _x O ₃ w/s w/d
Luzit	Dadon family, Moshav Luzit	189 m	SO ₂ NO ₂ NO _x O ₃ w/s w/d
Alon HaTavor area			
Dovrat	Kibbutz Dovrat, by the gas station	175 m	SO ₂ NO ₂ NO _x O ₃
Givat HaMoreh	Dehi, Givat HaMoreh	495 m	SO ₂ NO ₂ NO _x O ₃ w/s w/d
Ein Dor	Kibbutz Ein Dor	126 m	SO ₂ NO ₂ NO _x O ₃
Gezer area			
Beit Hashmonai	Herzog high school, Beit Hashmonai	103 m	SO ₂ NO ₂ NO _x O ₃ w/s w/d PM ₁₀
Karmeit Yossef	Commercial center, Karmeit Yossef	260 m	SO ₂ SO ₂ NO ₂ NO _x O ₃ w/s w/d
Modiin	Mekorot facility 2035	267 m	SO ₂ NO ₂ NO _x O ₃ PM ₁₀ w/s w/d
Achisemech	Public shelter, secretariat, Moshav Achisemech	80 m	SO ₂ NO ₂ NO _x O ₃ w/s w/d

Station	Station address	Altitude above sea level	Parameters measured			
Ramat Hovav						
HaShemen site	Givat Shemen, Ramat Hovav	386 m	SO2	NO2 w/s	NOX w/d	O3
Natan Camp	Natan Camp	280 m	SO2	NO2 w/s	NOX w/d	O3
Eilat						
Eilat office	Regional IEC office, Eilat	68(+10) m		w/s	w/d	
Eilat Goldwater	Eilat Goldwater high school	(15+)49 m	SO2	NO2 w/s	NOX w/d	O3

Notes: sulfur dioxide – SO₂; nitrogen oxides – NO_x; nitrogen dioxide – NO₂; Ozone – O₃; suspended fine particulate matter – PM₁₀ and PM_{2.5}; wind direction – w/d; wind speed ;– w/s

IEC monitoring system of pollutants emitted through stacks

According to the emission permits instructions, the IEC operates devices for continuous emission monitoring of pollutants emitted from the stacks of the production units. The data are transmitted online and in real time to the Ministry of Environmental Protection. In addition, various operational data are transmitted.

The company also operates a manual sampling system according to an internal "stack sampling manual" and a work plan approved by the Ministry of Environmental Protection. Manual sampling is also used to calibrate the devices for continuous emission monitoring of air pollutants installed in the stacks.

The sampling work is carried out by the pollutants sampling laboratory of the IEC environmental monitoring and hygiene department, that, as mentioned above, has undergone certification to the ISO 17025 standard.



Climate change mitigation and reduction of greenhouse

Greenhouse gases emissions

Starting in 2010 IEC takes an active part in the "voluntary mechanism reporting project" whose aim is recording and reporting greenhouse gases emissions. This project, that was established by the Ministry of Environmental Protection, allows companies involved to participate to the preparation of the project regulatory document, as well as to get experience in gathering the necessary information and processing it for this reporting framework.

Details of the various calculation methodologies set out in the project can be found on the Samuel Neaman Institute website:

<https://www.neaman.org.il/Green-House-Gases-emissions-registry-in-Israel-accounting-and-reporting-protocol>

But even before this project, since the year 2000 IEC has reported continuously on the greenhouse gases emissions resulting from fuel combustion for electricity production, as part of its environmental reports. These emissions account for about 99.7% of direct emissions of greenhouse gases emissions resulting from the IEC operations.

An updated report for 2018, prepared within the framework of the "voluntary mechanism reporting project", can be found on the IEC website.

<https://www.iec.co.il/environment/2017/20-%20הוולונטרי20%למנגנון20%דיווח20%טופס202018%שנת-20%החשמל20%-חברת20%-חממה20%גזי20%פליטת20%.pdf>



Notice: The report updated for 2019 will be available only in the second half of 2020.

Carbon dioxide (CO₂) calculator:

Carbon dioxide (CO₂) is considered to be the main greenhouse gas emitted to the atmosphere. In 2012 the company developed a carbon dioxide calculator, that allows electricity consumers to calculate the amount of CO₂ emitted to the atmosphere as a result of electricity consumption for a given year, and to compare between different years.

The calculator is based on fuel combustion emission coefficients.

The calculator is available on IEC website:

<http://www.iec.co.il/environment/Pages/PollCalculator.aspx>

Table no. 11 presents the distribution of the greenhouse gases emissions according to the "voluntary mechanism" for the years 2018-2019. We can see that the major part of the direct emissions of greenhouse gases (scope 1) result from fuel combustion to produce electricity.

Table no. 11 | Distribution of direct greenhouse gases emissions (Scope 1) by sources, for the years 2018-2019

Year	Percentage of direct emissions	Amount [metric ton of carbon [equivalent	Source
2018	99.60%	29,109,700	Direct emissions (Scope 1) as a result of fuel combustion for electricity production
2018	0.40%	118,242	Direct emissions (Scope 1) not resulting from fuel combustion for electricity production (mainly emissions from the vehicle fleet, sulfur hexafluoride emissions, emissions from the chemical process in the FGD scrubbers)
2019	99.58%	29,634,047	Direct emissions (Scope 1) resulting from fuel combustion for electricity production
2019	0.42%	125,788	Direct emissions (Scope 1) not resulting from fuel combustion for electricity production (mainly emissions from the vehicle fleet, sulfur hexafluoride emissions, emissions from the chemical process in the FGD scrubbers)

Table no. 12 | IEC greenhouse gases emissions reported in the framework of the voluntary mechanism reporting project to the Ministry of Environmental Protection for the years 2010-2019

YEAR	CO2eq emissions – Scope 1 [metric tons of carbon equivalent]	CO2eq emissions – Scope 2 [metric tons of carbon equivalent]	Total CO2eq emissions [metric tons of carbon equivalent]
2010	39,467,669	1,568,718	41,036,387
2011	40,661,709	1,558,797	42,220,506
2012	46,366,484	1,838,728	48,205,212
2013	38,762,789	1,547,592	40,310,381
2014	34,312,517	1,811,959	36,124,476
2015	33,997,496	1,476,177	35,473,673
2016	31,152,001	1,429,760	32,581,761
2017	30,188,779	1,386,878	31,575,657
2018	29,227,942	1,349,698	30,577,640
2019	29,761,504	1,391,330	31,152,834



Table no. 13 | IEC greenhouse gases emissions reported in the framework of the voluntary mechanism reporting project to the Ministry of Environmental Protection for the years 2010-2014 – breakdown of the direct emissions according to the types of greenhouse gases

Gas	2010	2011	2012	2013	2014
Carbon dioxide CO ₂	39,272,597	40,440,866	46,108,389	38,554,817	34,123,738
Nitrous oxide N ₂ O	150,993	158,381	188,309	145,145	128,097
Methane CH ₄	10,930	12,178	16,770	10,904	10,684
Sulfur hexafluoride SF ₆	33,149	50,283	50,519	51,922	49,998
Hydrofluorocarbon HFC	--	--	2,496	Negligible	Negligible
Total	39,467,696	40,661,709	46,366,484	38,762,789	34,312,517

Emissions given in metric tons of carbon equivalent

Table no. 14 | IEC greenhouse gases emissions reported in the framework voluntary mechanism reporting project of the Ministry of Environmental Protection for the years 2015-2019 – breakdown of the direct emissions according to the types of greenhouse gases

Emissions given in metric tons of carbon equivalent

Gas	2015	2016	2017	2018	2019
Carbon dioxide CO ₂	33,810,454	30,983,438	30,027,557	29,070,696	29,596,988
Nitrous oxide N ₂ O	125,834	107,533	99,394	94,042	99,030
Methane CH ₄	10,773	10,107	10,169	9,846	9,984
Sulfur hexafluoride SF ₆	50,435	50,923	51,659	53,359	53,832
Hydrofluorocarbon HFC	Negligible	Negligible	Negligible	Negligible	Negligible
Total	33,997,496	31,152,001	30,188,779	29,227,942	29,759,835

Table no. 15 | Global warming coefficients of the various greenhouse gases, as set out in the calculation methodology of the voluntary mechanism

Gas	Global warming potential GWP – until 2013	Global warming potential GWP – starting from 2014
Carbon dioxide CO ₂	1	1
Nitrous oxide N ₂ O	310	298
Methane CH ₄	21	25
Sulfur hexafluoride SF ₆	23900	22800
Hydrofluorocarbon HFC	1810-1300	1430-2088



Table no. 16 | Total IEC direct greenhouse gases emissions and specific emissions with relation to the sales and with relation to the electricity production, for the years 2010-2019

GHG Intensity expressed in metric tons of carbon equivalent /million USD sales & in metric tons of carbon equivalent /thousands MWh

YEAR	CO₂eq emissions – Scope 1 [metric tons of carbon equivalent]	GHG Intensity [metric tons of carbon equivalent/million USD sales]	GHG Intensity [metric tons of carbon equivalent / thousands MWh]
2010	39,467,669	6945.84	703
2011	40,661,709	6120.25	712
2012	46,366,484	6124.14	759
2013	38,762,789	4874.66	679
2014	34,312,517	5292.77	663
2015	33,997,496	5755.46	671
2016	31,152,001	5278.93	639
2017	30,188,779	4478.58	619
2018	29,227,942	4644.96	610
2019	29,759,835	4175.55	623

Table no. 17 | Specific emission factors for the various greenhouse gases in grams/net kWh (g/kWh transmitted to the electricity transmission and distribution grid from the power plants, i.e., after deduction of the electricity self-consumption) for the years 2010-2019

Data given in grams per net kWh

YEAR	CO ₂	N ₂ O	CH ₄	CO ₂ eq
2010	726	0.00899	0.00940	729
2011	733	0.00925	0.01021	737
2012	783	0.01030	0.01329	787
2013	700	0.00848	0.00936	703
2014	685	0.00860	0.00856	688
2015	693	0.00863	0.00881	696
2016	661	0.00767	0.00860	663
2017	639	0.00707	0.00864	641
2018	629	0.00680	0.00850	631
2019	642	0.00718	0.00865	645

Table no. 18 | Specific emission factors for the different greenhouse gases in grams/gross kWh (g/kWh produced, i.e. based on the actual amounts emitted) for the years 2010-2019

Data given in grams per net kWh

YEAR	CO ₂	N ₂ O	CH ₄	CO ₂ eq
2010	699	0.00865	0.00905	702
2011	707	0.00891	0.00984	709
2012	754	0.00991	0.01278	757
2013	674	0.00817	0.00901	677
2014	659	0.00827	0.00823	661
2015	667	0.00830	0.00848	669
2016	635	0.00737	0.00827	637
2017	614	0.00680	0.00831	617
2018	605	0.00655	0.00818	608
2019	618	0.00691	0.00831	620



Table no. 19 | Greenhouse gases indirect emissions (Scope 2) resulting from the self-consumption of electricity in power plants and in administrative/other sites for the years 2010-2019

Emissions given in metric tons of carbon equivalent

YEAR	Self-consumption of electricity in power plants	Self-consumption in administrative/ other sites	Total – Scope 2
2010	1,489,936	78,782	1,568,718
2011	1,488,828	69,969	1,558,797
2012	1,751,380	87,348	1,838,728
2013	1,448,455	99,137	1,547,592
2014	1,680,614	131,345	1,811,959
2015	1,406,606	69,571	1,476,177
2016	1,391,053	38,707	1,476,029
2017	1,352,746	34,132	1,386,878
2018	1,299,959	49,739	1,349,698
2019	1,341,086	49,739	1,390,825

Table no. 20 | Emissions of carbon dioxide, electricity production and specific emission of carbon for whole IEC

Whole IEC	2016	2017	2018	2019
CO₂ emissions (metric tons of carbon equivalent)	30,938,165	29,978,814	29,006,456	29,525,691
Gross electricity production (thousands MWh)	48,718	48,788	47,905	47,784
Carbon intensity (grams/kWh)	635	614	605	618

Table no. 21 | Carbon dioxide emissions, electricity production and specific emission of carbon for coal-fired power plants

Coal Power Plants - IEC	2016	2017	2018	2019
CO₂ emissions (metric tons of carbon equivalent)	21,519,375	19,574,308	18,447,933	19,486,999
Gross electricity production (thousands MWh)	24,164	22,052	20,599	21,885
Carbon intensity (grams/kWh)	891	888	896	890

Table no. 22 | Carbon dioxide emissions, electricity production and specific emission of carbon for natural gas-fired power plants

Natural Gas + LNG Power Plants - IEC	2016	2017	2018	2019
CO₂ emissions (metric tons of carbon equivalent)	9,298,913	10,036,806	10,411,997	9,721,492
Gross electricity production (thousands MWh)	24,310	26,102	27,066	25,373
Carbon intensity (grams/kWh)	383	385	385	383



Gases emissions from air-conditioning systems, including gases harmful to the stratospheric ozone layer

IEC uses air-conditioning and cooling systems both in office buildings and in order to cool operation equipment in the company facilities.

IEC operates in this area according to the Hazardous Substances Regulations (Implementation of the Montréal Protocol on Substances that Deplete the Ozone Layer), 5764-2004. No refrigerants that harm the ozone layer are used in the large and medium air-conditioning systems since 2000, and in the small air-conditioning units since 2005.

In the past few years IEC conducted surveys for the purpose of characterizing the inventory of air-conditioning systems used and the types and amounts of refrigerants used. The annual release percentage and the global warming potential were calculated according to the methodology set out in the "voluntary mechanism". The damage potential to the ozone layer of the gas R22 was set out according to the Montréal Protocol Regulations.



Table no. 23 | Data regarding the emissions of air conditioner refrigerants: amounts emitted, ozone depletion potential and global warming potential for power plants, as reported in PRTR report for 2019

Name of liquid / refrigerant mix	CAS NUMBER	Chemical formula	Global warming potential GWP	Ozone damage potential ODP	Amount of gas released in 2019 (tons)	Amount of gas released in 2019 (tons of CFC-11 equivalent)	Refrigerant amount released in 2019 (tons of carbon equivalent)
R22=HCFC-22	75-45-6	CHF ₂ Cl	1810	0.055	0.061	0.003	110
R-407C	refrigerant mix	refrigerant mix	1774	0	0.105	0	186
	75-10-5	CH ₂ F ₂					
	354-33-6	C ₂ H ₂ F ₅					
	811-97-2	C ₂ H ₂ F ₄					
R-410A	refrigerant mix	refrigerant mix	2088	0	0.521	0	1088
	75-10-5	CH ₂ F ₂					
	354-33-6	C ₂ H ₂ F ₅					
R-134A	811-97-2	C ₂ H ₂ F ₄	1430	0	0.018	0	26
Total					0.705	0.003	1410

Table no. 24 | Data regarding the emission of air conditioner refrigerants: amounts emitted, ozone depletion potential and global warming potential, for power plants, as reported in PRTR report for 2018

Name of liquid / refrigerant mix	CAS NUMBER	Chemical formula	Global warming potential GWP	Ozone damage potential ODP	Amount of gas released in 2018 (tons)	Amount of gas released in 2018 (tons of CFC-11 equivalent)	Refrigerant amount released in 2018 (tons of carbon equivalent)
R22=HCFC-22	75-45-6	CHF2Cl	1810	0.055	0.232	0.013	420
R-407C	refrigerant mix	refrigerant mix	1774	0	0.030	0	53
	75-10-5	CH2F2					
	354-33-6	C2HF5					
	811-97-2	C2H2F4					
R-410A	refrigerant mix	refrigerant mix	2088	0	0.425	0	888
	75-10-5	CH2F2					
	354-33-6	C2HF5					
R-134A	811-97-2	C2H2F4	1430	0	0.018	0	26
Total					0.705	0.013	1386



Compliance with environmental regulations

The activities of the company are legally exposed as result of the various environmental hazards that may occur. including pollutants emission to air as a result of fuel combustion, storage and use of hazardous and flammable substances, soil and water sources pollution, discharge of industrial wastewater, asbestos dispersal, improper treatment of fly ash, noise, non-ionizing radiation and more.

Therefore, the activities of IEC are subject to extensive environmental protection regulations. In the past few years, the environmental regulatory requirements became more stringent (part of these regulations are currently in various steps before adoption). These requirements concern both the activities of the company, and the supervision/enforcement measures. The company estimates that this trend is expected to continue and even to worsen in the upcoming years, in view of the growing awareness to the environment and international requirements following current practices in the western countries. The environmental protection laws affecting IEC activities include, inter alia: the Prevention of Sea Pollution from Land-Based Sources Law; the Hazardous Substances Law; the Protection of the Coastal Environment Law; the Clean Air Law; the Prevention of Hazards from Asbestos and Harmful Dust Law; the Freedom of Information Law; the Non-Ionizing Radiation Law; the Energy Sources Law; the Environmental Protection Law (Releases and Transfers to the Environment – Reporting and Registration Obligations); the regulations promulgated under these laws and various bylaws.

IEC checks the impact of environmental laws and operates in order to prevent or minimize environmental risks that might occur following these operations. In addition, IEC makes necessary preparations in view of the economic, legal and operational effects of the environmental laws, and allocates budgets in order to respect the parts of these environmental protection laws applicable to the company. The company operates according to its environmental protection blueprint, taking responsibility for the environment, in a long-term and sustainable approach.

Non-compliance with environmental protection laws and to conditions included in permits issued to IEC might expose the company and its managers to criminal and administrative proceedings, including the imposition of fines, as well as to the payment of environmental cleaning and rehabilitation costs. IEC estimates that at the date of this report it generally observes the instructions of environmental protection laws. IEC holds the environmental permits required for its operations, and if a few are missing, it is active to obtain them as soon as possible.

Environmental costs and investments made by the company in environmental protection

The following table presents information on the investments made by IEC in the environmental protection field for the years 2014-2019:

Table no. 25 | Data on environmental protection costs and investments made by IEC in the environmental protection field [NIS million, current prices ("measurements deductible") – for the twelve month period until December 31]

Year	2014	2015	2016	2017	2018	2019
Total investments	~ 915	~ 956	~ 765	~ 831	~ 610	~ 465
Current costs (without depreciation)	~ 91	~ 89	~ 105	~ 88	~ 82	~ 142

A) Investments and expenses during 2019

In 2019, IEC invested about NIS 451M in environmental protection measures in the production sector (with also about NIS 14M in special projects), mainly in the installation of air pollution control facilities at Orot Rabin and Rutenberg power plants (such as "primary methods", FGD scrubbers and catalytic SCR systems).

In addition to these investments, in 2019 IEC expended, as part of the operating costs of power plants and additional expenses for fuels, an amount of about NIS 140M in order to comply with environmental protection regulations (not including NIS 2M for compliance in activities not connected with production). IEC estimates that the environmental expenses in 2019 were mostly intended to environmental effects prevention and in environmental damage minimization, and the rest was intended to environmental cleaning and rehabilitation.

B) Budget for 2020

IEC allocates money in its budgets in order to comply with environmental regulations and licenses conditions. In 2020 IEC allocated, as part of its current operation and development budgets, an amount of about NIS 599M ("deducted from measurements and depreciation")

in order to comply with environmental protection requirements including, inter alia: waste management, protection of flora and fauna, air, soil, groundwater and surface water, treatment of wastewater, protection against radiation and noise reduction.

C) Air pollution control project budget

As part of its investment and development budget, updated in 2020, IEC allocated for the air pollution control project for 2020 about NIS 262M, without interest during the construction period, from a total investment budget reaching about NIS 7.1 billion. This budget is intended to build the air pollution control project facilities at Orot Rabin and Rutenberg sites (FGD scrubbers and SCR catalytic systems).

The estimations of IEC management regarding the planned scope of investments in environmental protection are "forward-looking information", as its meaning in the Securities Law, and are based on the budget and the work plans of IEC. These estimations might not be realized or be realized partially or in a different manner, as a result of factors not controlled by IEC. These factors include changes in the regulatory requirements applicable to the company, changes in the scope of production activities of IEC and fuels purchased by IEC for production operations, and other events, including events due to the realization of "legal risks" affecting IEC.



Environmental incidents that occurred in 2019

A number of environmental incidents occurred in IEC installations in 2019, they were reported to the Ministry of Environmental Protection as required in the permits issued to IEC. A few legal proceedings are in progress on this subject.

On June 19, 2019 a hearing was held to IEC by the Ministry of Environmental Protection following complains made by kibbutz Zikim regarding odor nuisances that were allegedly caused by the coal storage site at Rutenberg power plant, when the ministry pretended that IEC allegedly violated the conditions set down in the emission permit issued to this plant. During this hearing IEC argued, inter alia, that according to inspections conducted in this site, the source of the odor nuisances did not originate from operations in the power plant. In July 2019 IEC got a letter from the Ministry of Environmental Protection, with the recommendation to begin enforcement proceedings against IEC. However at the date of this report IEC is unaware of actual enforcement proceedings in this matter.



Transportation and IEC vehicles

IEC is constantly active in order to improve the transportation and IEC vehicles sector. These activities are performed, inter alia, in order to reduce emissions of air pollutants and greenhouse gases, to reduce traffic congestion, to educate employees to an economical and environmentally-friendly use of resources, and to create a work environment sensitive to environmental, economic and energy efficiency aspects.

In this framework IEC performs various activities such as:

- Providing shared means of transportation to employees, as well as encouraging the use of public transport, with emphasis on Israel Railways, in order to reduce the individual use of private vehicles.
- Increasing the use of videoconference systems for meetings, in order to reduce IEC vehicles mileage.
- Campaigning on proper tire air pressure that results in fuel saving.
- Training employees economic and ecological driving.
- Publication of comparative information to users of IEC vehicles on fuel consumption and mileage, in order to increase their awareness on smart use of vehicles.



Data on vehicles consuming gasoline

Table no. 26 | Gasoline consumption by administrative vehicles 2010-2019

km per liter gasoline	Annual travelled distance (km)	Total gasoline consumption (l)	Number of hybrid vehicles	Number of vehicles (gasoline vehicles)	Year
10.8	22,575,893	2,088,228.56	80	738	2010
11.4	24,926,365	2,191,954.75	191	817	2011
11.7	24,373,589	2,076,989.24	191	816	2012
11.6	25,102,182	2,163,530.18	212	874	2013
11.5	25,768,293	2,235,840.61	211	920	2014
11.5	24,307,451	2,110,628.09	231	904	2015
11.7	24,269,790	2,075,730.96	202	883	2016
12.1	21,556,310	1,775,264.44	244	914	2017 including leased vehicles
14.0	29,643,234	2,110,956.79	323	943	2018 including leased vehicles
17.5	36,904,373	2,114,051.61	417	931	2019 including leased vehicles

Table no. 27 | Information on commercial vehicles, light commercial vehicles and motorcycles consuming gasoline 2012-2019

km per liter gasoline	Annual distance travelled (km)	Total gasoline consumption (l)	Number of vehicles	Year
9.68	5,078,388	524,684	205	2012
9.74	6,105,933	626,634	238	2013
9.99	11,186,174	1,120,062	374	2014
10.06	12,631,236	1,255,502.11	532	2015
10.25	18,032,499	1,759,139.32	540	2016
10.43	16,321,212	1,564,536	513	2017 including leased vehicles
10.32	14,972,577	1,450,795.56	487	2018 including leased vehicles
11.42	15,037,839	1,316,586.7	286	2019 including leased vehicles

Data on vehicles consuming diesel oil

Table no. 28 | Information on the number of diesel oil vehicles and their fuel consumption 2010-2019

km/l diesel oil	Annual distance travelled (km)	Total diesel oil consumption (l)	Number of vehicles	Year
8.17	78,153,178	9,569,736	2,365	2010
8.49	76,539,332	9,013,856	2,204	2011
8.12	72,755,421	8,956,045	2,130	2012
8.10	70,984,204	8,768,466	2,125	2013
7.88	65,584,054	8,322,171	2,060	2014
7.83	62,990,128	8,048,065.72	1,815	2015
7.54	56,446,465	7,488,551.85	1,791	2016
7.64	51,762,346	6,771,445	1,711	2017 including leased vehicles
7.25	50,518,503	6,969,740.68	1,778	2018 including leased vehicles
7.62	52,599,419	6,900,132.87	1,885	2019 including leased vehicles

Table no. 29 | Information on diesel oil consumption and mileage for heavy equipment
2012-2019

Annual distance travelled (km)	Total diesel oil consumption (l)	Year
No data	1,891,508	2012
No data	1,936,317	2013
No data	1,982,000	2014
No data	1,783,271	2015
1,586,744	1,617,516	2016
1,290,937	1,110,285	2017
1,876,692	2,558,309	2018
1,737,091	3,133,982	2019



Water use and conservation

IEC promotes careful water consumption in all its sites. In 2019 the careful use of water continued in the power plants as well as in the administrative sites of the company. Water conservation is achieved, inter alia, by improving the control of water use processes and by increasing the reuse of waste water effluents.

IEC makes extensive use of low-quality water resources, from both internal and external origins, as detailed in the following tables. Regarding the consumption of drinking water, according to the law of the State of Israel, the Water Authority is responsible for determining water sources allowances (including the distribution of water resources). The drinking water supplied to power plants by the national water supply system includes aquifer water (wells), Sea of Galilee water (the national water carrier), desalinated seawater, desalinated brackish water and surface water from various sources.

The use of industrial waste water effluent and boron-enriched water in FGD facilities

As part of the air pollution control project, the coal-fired units were equipped in the past few years with scrubbers reducing sulfur dioxide emissions (below "FGD system").

The core of the system is an absorber column that serves as a sulfur dioxide filter. The principle of the FGD system operation is the reaction of the sulfur dioxide in the flue gases with a limestone suspension and air injection to the bottom of the absorber column in order to complete the oxidation process. The by-product obtained from this process is FGD gypsum, whose quality is suitable for the manufacturing of gypsum walls or for the cement industry. Part of the water remaining after the removal of formed gypsum is emitted through the stack, forming a white plume mainly constituted of water vapor.

As a result of the nature of this wet desulfurization process, the FGD system operation consumes huge amounts of water. As part of the national effort to save water resources, IEC has checked the possibility to use for the process poor quality waters, instead of drinking water. As part of the effort to reduce the amounts of purified industrial waste water effluents discharged to the sea, and to reduce drinking water consumption, part of treated industrial waste water effluents is used for the FGD system operation. In addition, a water effluent originating from the desalination plant adjacent to Orot Rabin power plant in Hadera is used. This kind of boron-enriched water, that is also called "boronic water" originates from the final stages of the desalination process and considered as high quality water, that is intended to be discharged to the sea only as a result boron concentration that may be harmful to agricultural crops. But there is no fear to use this kind of water for an industrial use such as the FGD system at the power plant.

In 2019 the consumption of poor quality water for use in FGD installations, from internal source (purified industrial waste water effluents from the power plants) and from an external

source (boronic water from the desalination plant), amounted over 1 million m³.

The use of treated sanitary waste water from an external source for the cooling towers at combined cycle power plants "Alon Tavor" and "Gezer"

Electricity production combined cycle units operate at the "Alon Tavor" and "Gezer" power plants, and they are cooled by wet cooling using cooling towers. This is a cooling method based on water as opposed to the prevalent dry cooling method that is based on air. The source of water for these cooling towers is treated sanitary waste water from regional waste water treatment plants. From the beginning of their operation, the use of treated waste water for this purpose saved the consumption of more than 50 million m³ of drinking water.

The use of treated sanitary waste water and brine for irrigation of gardening areas

Part of the power plants treat sanitary wastewater by their own treatment plant. These treated waste water effluents are used for irrigation of gardening areas inside these sites as a substitute to drinking water use, according to permits issued by the Ministry of Health. In addition, at the power plant brine (also called "concentrate water") originating from reverse osmosis facilities intended for the production of deionized water is reused in the area of the site for irrigation of gardening areas. On a cumulative basis, the use of treated sanitary waste water and brine for irrigation purposes saved the consumption of hundreds of thousands of m³ of drinking water.

Table no. 30 | Summary of drinking water consumption by the IEC for the years 2013-2019 (m³)

Total drinking water consumption by IEC power plants	Year
5,096,584	2013
4,285,882	2014
4,866,935	2015
4,565,698	2016
4,797,440	2017
4,851,136	2018
5,341,845	2019

Table no. 31 | Summary of poor quality water use for the years 2013-2019 (m³)

Total poor quality water used	Boron-enriched water amount used	Treated industrial waste water effluents and concentrate water reused	Treated sanitary waste water reused for gardening areas irrigation	Treated sanitary waste water effluents from external origin used in cooling towers	Year
5,096,584	0	652,162	94,643	4,349,836	2013
4,285,882	0	536,563	101,850	4,212,482	2014
4,866,935	0	643,934	97,039	3,867,815	2015
4,565,698	0	649,884	102,502	4,067,951	2016
4,797,440	410,946	554,362	101,774	4,443,348	2017
4,851,136	637,867	686,161	103,140	5,172,668	2018
5,341,845	768,715	583,122	87,241	4,144,109	2019

Table no. 32 | Summary of the use of water from all sources by IEC for the years 2013-2019* (m³)

Total water use – from all sources	Year
10,193,225	2013
9,136,777	2014
9,475,723	2015
9,386,035	2016
10,307,870	2017
11,450,972	2018
10,925,032	2019

Does not include seawater use for main cooling of coastal power plants *

Table no. 33 | Poor quality water use as percentage of total water use by IEC for the years 2013-2019 (%)

Use of poor quality water as percentage of the total water use	Year
50	2013
53	2014
49	2015
51	2016
53	2017
58	2018
51	2019

Table no. 34 | Summary of seawater use for main cooling of IEC coastal power plants for the years 2013-2019 (m³)

Seawater use for main cooling of IEC coastal power plants	Year
6,471,656,527	2013
5,867,958,700	2014
5,588,037,522	2015
5,464,694,022	2016
5,522,770,404	2017
5,896,219,446	2018
5,835,648,997	2019

Table no. 35 | Summary of amounts of treated waste water effluents discharged to the sea from IEC sites, according to authorities' permits, for the years 2013-2019 (m³)

Amount of treated waste water effluents discharged to the sea	Year
485,595	2013
411,035	2014
400,092	2015
370,722	2016
389,054	2017
357,940	2018
375,419	2019

Table no. 36 | Summary of the amounts of treated waste water effluents used or discharged to the environment for the years 2014-2019: Part A – Effluents of sanitary waste water treatment (m³)

2019	2018	2017	2016	2015	2014	
342,540	344,280	357,060	357,240	371,130	382,620	Sanitary waste water effluents total production
4,144,109	5,172,668	4,443,348	4,067,951	3,867,815	4,212,482	Treated sanitary effluents from external origin used in cooling towers
87,241	103,140	101,774	102,502	97,039	101,850	Treated sanitary effluents from internal origin reused for gardening areas irrigation
255,299	241,140	255,286	254,738	274,091	280,770	Sanitary waste water transferred to offsite treatment plants

Table no. 37 | Summary of the amounts of treated waste water used or discharged to the environment for the years 2014-2019: Part B – Treated industrial waste water effluents, boron-enriched water and concentrate water from demineralized water production facilities (m³)

2019	2018	2017	2016	2015	2014	
958,541	1,044,101	943,416	1,020,606	1,044,026	947,598	Treated industrial waste water and concentrate water total production
583,122	686,161	554,362	649,884	643,934	536,563	Treated industrial waste water and concentrate water – total amount reused
375,419	357,940	389,054	370,722	400,092	411,035	Treated industrial waste water effluents discharged to the sea
768,715	637,867	410,946	0	0	0	Boron -enriched water used in FGD facilities



Coal combustion by-products

Electricity generation in IEC coal-fired power plants leads to the production of two by-products: coal ash and FGD gypsum.

Coal ash is formed from the mineral fraction in the coal that remains after burning it.

FGD gypsum is produced in the Flue Gas Desulfurization facilities (FGD), as a result of the reaction of sulfur dioxide in the flue gases with limestone.

Production and uses of coal ash from the Orot Rabin and Rutenberg power plant sites

Coal ash is a by-product from coal combustion at Orot Rabin and Rutenberg power plants. About 88% of the ash produced is fly ash, composed of very fine particles with an average size of 10 microns, and the remaining 12% is bottom ash, composed of coarse, sand-like particles.

Since 1999 the whole amount of ash produced by IEC has been supplied for industrial, infrastructure and agricultural uses. The main ways of using coal ash are cement and concrete production, which are also the most common and preferred uses in the developed countries in the world.



The uses of coal ash are based on permits issued by the authorities, including the Ministry of Environmental Protection. IEC monitors the environmental quality of coal ash, once every six months. The results meet the criteria for "coal ash fitted to use", according to the guidelines issued by the Ministry of Environmental Protection.

Fly ash is a beneficial additive to construction products as a result of its bonding properties (fly ash is a "pozzolanic material"). Fly ash addition promotes the improvement of concrete properties: enhanced strength, improved workability and better corrosion resistance. From an environmental point of view, the use of ash as a raw material for the production of cement and concrete avoids the damages to the environment and to the landscape, which would result from the quarrying of raw materials that are replaced by the ash (in particular sand for construction that is becoming increasingly scarce in Israel). In addition, the use of fly ash for producing cement (inter-

grinding) and for producing concrete is associated with a reduction in the CO₂ emission by the cement industry.

According to studies performed by various research institutions – the Israel Geological Survey, the Technion and the Agricultural Research Organization Volcani Center – in order to assess the environmental impacts of coal ash, there is no risk of contamination of the water sources as a result of the open uses of coal ash in the country. These results were confirmed by the groundwater monitoring programs that were performed close to ash storage sites inside power plant areas and near the first road embankment built with coal ash below Jasser-a-Zarqa access road.

Coal ash, like other geological materials, contains low concentrations of radioactive elements, similarly to coal ash produced in European countries. According to the international standard of the International Atomic Energy Agency published in 2014 (International Basis Safety Standards, GSR Part 3), coal ash with radioactive elements' concentrations within the range known in Israel, should be "cleared" from the need of administrative control.

In Israel, as mentioned above, the use of ash is supervised by the Ministry of Environmental Protection through permits, as well as by the application of Israeli Standard 5098 for construction products, that limits the content of the radioactive elements in all construction products marketed in the State of Israel.

Table no. 38 | Production and uses of coal ash for the years 2010-2019 (thousand tons)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Total production of coal ash	1,160	1,186	1,370	1,200	1,083	1,055	848	804	719	758
Total use of coal ash	1,195	1,191	1,340	1,258	1,056	1,054	848	805	719	741
Use for cement production	673	659	703	645	548	603	519	480	382	344
Use for concrete and concrete products production	495	498	577	497	452	385	280	273	331	389
Use for infrastructures	0	0	0	57	0	30	14	17	0	0
Agricultural and other uses	27	34	60	59	56	36	35	35	6	8

Production and use of gypsum in the flue gas desulfurization facilities (FGD) at Orot Rabin and Rutenberg power plants

Flue gases generated by production units 1-4 at Rutenberg site, and production units 5 and 6 at Orot Rabin site pass through FGD facilities. In the FGD they are treated by a limestone suspension: sulfur dioxide (SO_2) reacts with calcium carbonate (CaCO_3) and gypsum ($\text{CaSO}_4, 2 \text{H}_2\text{O}$) is the final product of the process.

The gypsum obtained from this process is characterized by a quality similar to that of natural gypsum, so it is suitable for use as a replacement for gypsum obtained from quarrying. FGD gypsum use for beneficial purposes saves the mining of a natural resource as well as the environmental damages associated with quarrying.

In Israel, the FGD gypsum produced by IEC is mainly supplied for use in the cement industry, as a setting time retarder. In addition, small amounts of gypsum are used as a soil fertilizer for agriculture.

Table no. 39 | The consumption of limestone and the production of gypsum by FGD scrubbers at coal power plants for the years 2010-2019 (tons)

Year	FGD gypsum production	Limestone consumption
2010	65,500	37,200
2011	93,700	52,400
2012	86,500	46,800
2013	74,200	37,800
2014	72,100	39,400
2015	72,557	40,600
2016	61,771	33,290
2017	73,690	44,345
2018	118,660	65,585
2019	142,160	77,805



Hazardous materials and hazardous waste

IEC owns, uses and stores hazardous materials in some of its sites. IEC is acting continuously to reduce the potential risk resulting from the use of hazardous materials and production of hazardous waste that accompany the electricity generation and supply chain.

The IEC activity in this field includes the reduction of hazardous materials' consumption in the production processes (source reduction), the replacement of hazardous materials by lower-risk materials, the search of environmentally friendly substitutes, workers' training, the search of alternatives solutions to the disposal of hazardous waste to landfills, expanding the types of hazardous waste that receive dedicated treatment etc.

As part of its statutory obligations, IEC sends hazardous waste only to authorized sites.



Green purchasing

Green purchasing is another kind of activity with environment benefits. It is reducing the environmental impact of the organization. The preference given to green products is expected to reduce the environmental footprint of the company, as well as to reduce to the risk of health impacts. In addition, examining the purchasing of goods from its environmental aspects also enables a better knowledge of products and materials bought by the organization and integration of sustainability in the purchasing processes.

In recent years IEC has been active to extend green purchasing to a variety of operations such as:

- Transition to digital tenders
- Using recycled paper as the main source of paper for the needs of the company
- Investigating the possibility to purchase more environmentally acceptable oils and greases as substitutes for those previously used
- Use of green detergents
- Use of water-based silicon
- Use of environmentally friendly paints
- Purchase of energy-saving air conditioners and lamps
- Use of green materials to absorb oils
- Promoting the use of multi-use packages in warehouses

IEC examines from time to time proposals for various new environmentally friendly products and services, from green purchasing suppliers, with the objective of their integration in the green purchasing processes.



Solid waste

IEC treats waste generated as a result of its operations in the framework of the "total waste management" approach. In this approach, a variety of activities are conducted at the different stages of the waste generation and treatment chain (prevention, reduction, collection and treatment) to reduce as far as possible waste environmental effects. Among other things, activities are conducted to reduce materials' consumption and prevent waste generation (source reduction), and to reduce the amounts of waste disposed into landfills. For this objective, it is attempted to separate as far as possible between the different types of waste and increase the amounts transferred for reuse and recycling. All this activity depends on the development of the recycling markets in the State of Israel. To illustrate the wood waste reuse activity, pictures below show the reuse of wooden drums for the benefit of the community.

In addition, office waste reduction activities are carried out, which include:

- Transition to the use of "printing centers". The innovative printing centers combine three separate functions in one device (MFP – Multi-Function Printer): printer, photocopier and scanner. These centers allow to save money and office space, as well as to protect the environment by saving resources, such as paper, electricity and consumables. The default printing mode is two-sided.
- Purchasing recycled A4 paper for all the company's offices. The use of recycled paper is part of the smart use of natural resources, contributes to paper saving and raises the company's employees awareness for the importance of resource conservation.



Table no. 40 | Total hazardous and non-hazardous waste transfers from the IEC power plant sites for 2019* (kg)

Site	Hazardous waste	Non-hazardous waste	Total
Orot Rabin	2,040,013	514,486,905	516,526,918
Rutenberg	91,509	388,385,057	388,476,566
Haifa	288,639	266,348	554,987
Reading	176,674	70,448	247,122
Eshkol	123,575	1,250,997	1,374,572
Hagit	43,597,712	2,640,850	46,238,562
Gezer	453,144	4,495,857	4,949,001
Zafit	10,731,910	3,116,950	13,848,860
Ramat Hovav	5,753,578	154,030	5,907,608
Eilat	0	32,400	32,400
Atarot	63,260	0	63,260
Kinarot	36,110	0	36,110
Caesarea	26,650	8,230	34,880
Har Tuv	18,330	0	18,330
Eitan	10,660	0	10,660
Total	63,411,704	914,908,072	978,319,776

* Data reported in the Pollutant Release and Transfer Register report

Table no. 41 | Distribution of the amounts of hazardous waste transferred from the power plants according to treatment methods, for 2014-2019 (ton)

Data	2014	2015	2016	2017	2018	2019
Total hazardous waste – excluding industrial waste water	8,760	16,263	4,515	5,245	8,566	4,468
Landfilling	84	12	49	883	57	151
Recycling	389	13,458	2,871	454	5,462	1,395
Reuse	4	0	0	0	0	0
Disposal	8,284	2,792	1,595	3,908	3,047	2,922

Table no. 42 | Distribution of the amounts of non-hazardous waste according to treatment methods, for the period 2014-2019 (metric ton)

Data	2014	2015	2016	2017	2018	2019
Total solid waste – excluding by-products	19,383	23,594	29,779	29,407	21,441	20,726
Solid waste transferred to landfilling	11,444	13,175	12,655	16,916	9,470	7,217
Solid waste transferred to waste-to-energy facilities	---	---	10,344	5,232	3,944	3,605
Solid waste transferred to recycling	7,939	10,419	6,780	7,259	8,027	9,904
By-product transferred to reuse – gypsum	72,100	72,557	61,771	73,690	118,660	142,160
By-product transferred to reuse – coal ash (dry)	1,083,000	1,054,700	847,600	803,905	719,000	745,716



Noise reduction

The electricity generation and supply processes can be a source of noise to the environment. Noise is mainly generated from equipment used to produce electricity at power plants, and to lesser extent from transformers at substations or from insulators on transmission lines. This equipment is, for the most part, installed far away from inhabited areas.

Other parts of the transmission, transformation and distribution systems, that are adjacent to inhabited places (like electricity lines, distribution transformers, distribution boards and switches), are usually not a significant source of noise.

IEC is active to meet everywhere the permitted noise levels as specified in the governmental Prevention of Noise Regulations, and also to fulfill requirements mentioned in the documents issued during the licensing processes for the building and operation of its facilities. Noise control is performed during the entire life cycle of the equipment: from the design and purchase stages, through the initial operation stage, and during the routine operation, with the aim of allowing continuous operation without causing noise nuisances.

During the design stage of new electricity facilities, the expected noise levels are predicted for inhabited places near the installation site. The noise level prediction findings are submitted to the environmental authorities as part of the environmental impact assessments or other environmental licensing documents. On their basis, they issue environmental monitoring requirements and additional measures, if necessary.

Acoustic requirements are implemented during the purchase. These requirements will ensure compliance with the permitted noise levels near the facilities. In the initial operation of new facilities, noise measurements will be performed around the site and in nearby inhabited areas, in order to ensure compliance with the permit conditions, and to ensure that the regulatory thresholds are not exceeded. Afterwards during the routine operations stage, no increase above noise levels measured during the initial operation stage is expected.

Inquiries about noise nuisances are handled through field surveillance visits, noise measurements and, if necessary, acoustic treatment to reduce noise from the facility.



Environmental aspects of electric and magnetic fields

Electric and magnetic fields – What is it?

The transmission of electric energy through electric facilities creates electric and magnetic fields. The electric and magnetic field levels are determined mainly by the voltage and current level (respectively) for the facility as well as the distance from it.

These fields vary in their direction in a frequency of 50 cycles per second [50 Hz], a frequency that is considered to be extremely low [extremely low frequency – ELF]. The energy associated with this frequency is very low and in fact negligible.

Electric and magnetic field effects

Over the past four decades, many researches have been conducted around the world to examine the connection between long-lasting exposure to magnetic fields resulting from electricity grid facilities or home electric appliances, and the prevalence of illnesses, particularly pediatric leukemia. In November 2010 the guidelines published by the International Committee for Non-Ionizing Radiation Protection (ICNIRP) included a maximal exposure value from the electricity grid of 2,000 milligauss for short-term effects on the general population, on the basis of the known health effects induced by electric fields on the human body. In the same document the committee noticed that no sufficient information was accumulated to establish a lower threshold value, also with respect to epidemiological findings concerning health effects that might occur for continuous exposure to magnetic fields with lower levels than this threshold.

With regard to long-term health effects from continuous exposure to magnetic fields, the world health organization (WHO) and other institutions around the world support the application of the precautionary principle according to which even in the absence of certainty regarding the mere existence of a risk and its limited scope – if any – it is still justified to take certain measures, that are not far-reaching, to reduce exposure to magnetic fields.

Findings of researches conducted on the effects of ELF fields are presented in the following publications:

- The WHO report originally published in June 2007, entitled: ELF Fields - Environmental Health Criteria Monograph No. 238 www.who.int/peh-emf/publications/elf_ehc/en/
- The report published by the International Commission on Non-Ionizing Radiation Protection [ICNIRP] in November 2010, entitled: Guidelines for limiting exposure to time-varying electric and magnetic fields (1 Hz to 100 kHz) <http://www.icnirp.de/documents/LFgdl.pdf>

The International Agency for Research on Cancer [IARC], that is part of the WHO, classified magnetic fields in the Class 3 "not classified as to its carcinogenicity to humans" that is considered to be the lower classification level. This level also includes emissions from gasoline engines and hot beverages. Further information can be found in the following IARC summary report:

<http://monographs.iarc.fr/ENG/Monographs/vol80/index.php>

Legislation and policy in Israel

The precautionary principle with respect to magnetic fields is integrative part of the Non-Ionizing Radiation Law in Israel, and also applies to the company for the building and operation of radiation sources. In March 2005 the report of the expert committee on magnetic fields from the power grid was published (hereinafter: the "Experts Committee"). The Experts Committee adopted the threshold value for magnetic fields produced from the power grid as set by ICNIRP at this time, i.e. 1,000 milligauss, while in the same time it recommended to apply the precautionary principle when designing new facilities and operating existing facilities. For that purpose, IEC is applying gradually the precautionary principle in existing facilities according to the above Experts Committee recommendations. In addition, following the measurements performed, the IEC estimates that its electricity facilities comply with ICNIRP guidelines.

In accordance with the Non-Ionizing Radiation Law, the maximal permitted exposure levels to radiation for humans will be set in regulations that should be promulgated until January 1, 2007. The law states that as long as such regulations are not yet promulgated for the electricity sector, the decisions of the head of the Ministry of Environmental Protection radiation department (below "the supervisor") concerning construction and operation permits regarding the electricity market, inter alia, will be made according to the recommendations provided in the Experts Committee report.

http://www.sviva.gov.il/subjectsEnv/Radiation/Electrical_Facilities/Documents/vadat_mumchim_1.pdf

In addition, the law states that decisions of the supervisor in connection with subjects that affect the costs of electricity (for which a written notice was issued to the supervisor by the Minister of Environmental Protection or the Minister of Energy), require the approval of the Minister of Environmental Protection, the Minister of Finance and the Minister of Energy. In December 2011 the Minister of Energy informed the Minister of Environmental Protection that regulations that would set the threshold values for exposure to non-ionizing radiation originating from electric facilities might have a direct and significant effect on the costs of electricity.

IEC activities

For the purpose of building and operating radiation sources, with their meaning in the Non-Ionizing Radiation Law, IEC is required to hold proper permits issued by the Ministry of Environmental Protection and in accordance with this law.

IEC holds the permits required for the operation of the non-ionizing radiation sources which are built and operated, and if they are missing, IEC is active to obtain them. Some permits obtained include very restrictive conditions and IEC reached understandings or is currently negotiating to reach understandings with the Ministry of Environmental Protection. IEC also builds new electricity facilities in accordance with the terms of the construction and operation permits in order to implement measures that will limit exposure to radiation, such as access restriction, placement of warning signs, and submits all reports requested by permits.



Managing influence on biodiversity

IEC installations, that are infrastructure facilities sometimes located in open, unaffected areas (natural land areas) or close to these areas, may have an influence on biodiversity. This influence is due to the occupation of this area itself and also environmental influences derived from the regular operations of the facilities.

As part of the environmental impact statements and other environmental documents prepared for IEC projects, the impact of IEC facilities on the natural life and landscape values has been examined for many years. More recently, in parallel with the global development connected to the preservation of biodiversity, the scope of issues that are considered in this context was extended. Deepening and extending the ecological review allow to improve the management of the effects of existing and planned IEC facilities on biodiversity.

IEC owns thousands of kilometers of power lines, at different voltage levels, that are deployed throughout the entire country, and a large number of different types of facilities. The facilities situated in or close to natural areas may have an impact on terrestrial biodiversity, and other ones may have an impact on marine biodiversity (coastal power plants). Some of the power lines are close to declared nature reserves, and some of them even cross such areas.

Activities for the management and improvement of the interface with biodiversity – terrestrial aspects

When considering the alternatives for the location of new electricity facilities and lines, the company takes into consideration the need to reduce the passage in areas that are rich in biodiversity for the purpose of mitigating impact on these areas.

The following facilities are situated near declared nature reserves according to National Outline Plan (NOP) 8 – the national outline plan for parks and nature reserves (up to 500 m from the facility): Hagit power plant, near the "Tut Stream", the Yavne control station, close to the "White acacia" nature reserve, the Hula substation, close to the "Ein Teo" and "Kadesh Stream" nature reserves, the Nazareth substation, close to "Nazareth Iris" nature reserve, the Tzfat substation, close to Mount Meiron nature reserve, the "Tefen" substation, close to "Mount Sneh" nature reserve, and the "Steel Plants" substation, close to "Bay Sands" nature reserve.

The facilities close to declared national parks according to NOP 8 (up to 500 m) are: the Sha'ar HaGai substation, close to "Judea Mountains" national park, the Ein Harod substation, close to "Maayan Harod" national park, the Yoqneam and Daliyat el-Karmel

substations close to "Carmel" national park, and the Kinarot substation, close to "Kfar Nachum" national park.

Based on NOP 8, in 2019 approximately 1% of the very-high voltage lines (161 kW) pass in the areas declared nature reserves, and the company does not have any extra-high voltage lines (400 kW) passing in declared nature reserves.

In 2019 approximately 2% of the very-high voltage lines (161 + 110 kW) and 1% of the extra-high voltage lines (400 kW) pass in the areas of declared national parks in accordance with the above mentioned NOP.

Conducting ecological surveys as part of environmental impact assessments and integration of obligations in the outline plans

The impact on biodiversity is also considered as part of the environmental impact statements and environmental documents related to new IEC projects planned in ecologically sensitive areas. Reviewing the impact on biodiversity includes preparation of surveys to characterize the risk level for these areas in terms of habitats and ecological systems. Based on these findings, the appropriate measures, recommended to reduce and prevent the project impact at construction and operation stages, are incorporated in the outline plans submitted for the projects after coordination and approval of the environmental consultant of the relevant planning authority. According to the type and the location of the projects, relevant environmental guidelines are later on incorporated in the environmental impact statements, and still later in the outline plans. For example, with regards to substations, guidelines for the protection of habitats and species whose value is high, for landscape restoration by local species, for handling/preventing invasive species, for the reduction of light, etc., are incorporated in these documents. With regards to power lines, guidelines are given to shield electricity poles in order to prevent bird collision in sensitive areas, for handling or eradication of invasive species if necessary, etc.

Cooperation with environmental authorities and agencies regarding potential harm to birds

In addition to the activities performed purpose in this matter as part of the "porsim kanaf" ("Spread Wings") project, since 2013 IEC is engaged in cooperation with the Israeli Society for the Protection of Nature, the National Parks Authority and the Ministry of Environmental Protection, concerning "calls for research proposals" aimed to include biodiversity consideration in company management. In this regard two projects were performed in 2017-2019, in order to reduce the harm to biodiversity caused as by the company activities:

1. In October 2018 was finished a pilot project, first of its kind in Israel, for reducing the potential of bird collisions with power lines (it started in 2016). It was performed on an existing line passing through a high sensitivity area. The pilot project was conducted for approximately two years, with the following objectives: quantifying the extent of bird collisions with the studied line, checking the effect of land use on the number of collisions, checking the efficiency of anti-collision elements, and improving the monitoring protocol for follow-up research or future monitoring. The pilot project included comparative monitoring of the collision occurrences before and after the installation of anti-collision elements on the line wires. The findings showed, inter alia, that there was a high rate of bird collisions with the studied line, as compared to findings presented in the relevant international literature.
2. Following the findings of the above pilot, a research project was conducted in order to map the potential risk of bird collisions with electricity lines on the national level, and to issue recommendations and priorities in the treatment of this subject. The mapping is based on a GIS model which integrates environmental data (land use and sensitive areas) with bird population data (sensitive species) and power line data. The model is supposed to serve as a tool for IEC for adopting and implementing an improved policy on this subject, for existing and new lines.

Increasing intra-company awareness

Since 2014 IEC is active to increase the knowledge and awareness on biodiversity as affected by the IEC facilities, among the company employees and managers. This activity is part of the integration of this subject in the company, and appropriate training is provided to relevant workers.

The "Spread Wings" project – Adopting vultures and other raptors

There are documents from the beginning of the eighties showing that vultures and other large birds were electrocuted while using electricity poles as observation points, for night sleep or temporary standing place (for example to dry their wings after bathing). The greatest risk exists for with a wing span greater than 2 m and body length larger than 1 m. The reason for this is that their wings touch one electrical wire and one pole, or two wires simultaneously, occurrences that cause the closure of an electrical circuit and their electrocution.

The goals of the project were:

- To confirm the number of vultures and other raptors in Israel and to return extinct species back to nature.
- To reduce significantly electrocution occurrences among vultures and other raptors in Israel.
- To create alternative and available food sources for vultures and other raptors in order to reduce the risk of poisoning.
- To create reproductive nuclei with the aim to return species to nature and increase their population.
- To identify the other factors that may endanger raptors and mitigating these risks.
- To monitor the population of endangered species.
- To provide information and educational activities to increase public awareness to the subject.



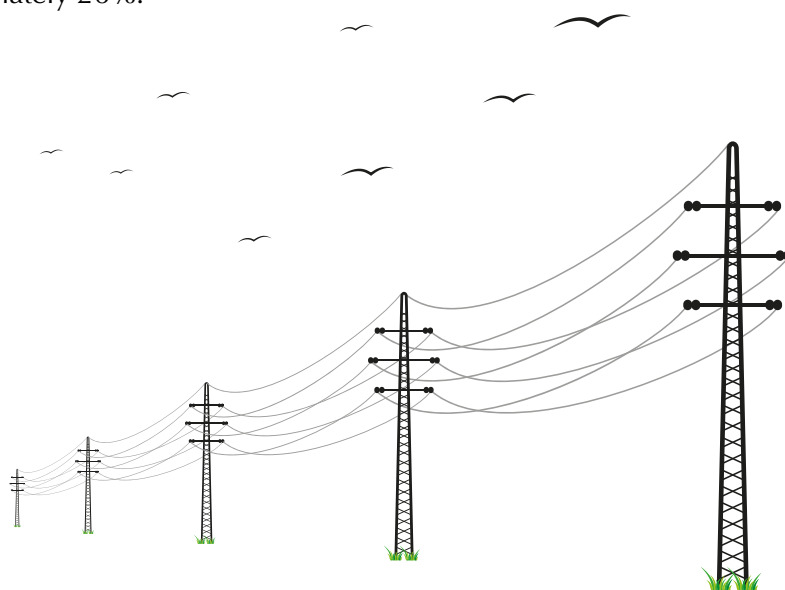
Reducing electrocution of large birds



In order to reduce the electrocution of large birds, IEC has developed various shielding elements types that are appropriate for the high-voltage and very-high voltage poles, each according to its characteristics. This shielding method was developed by IEC engineers, in collaboration with "Raychem Company" and the professional team of "Spread Wings" project for very-high voltage poles and to our best knowledge

constitutes a unique development of its kind in the world. This shield includes special landing plates installed on top of the poles and allow safe landing for the birds, without any contact with the wires, as well as isolation sleeves from an insulated material designated for the electricity wires themselves, special thorns and spikes to prevent landing on dangerous places and more. The landing plates and isolation sleeves were developed and installed after a simulation using captive vultures. IEC has invested millions of NIS in this project since it began.

In a research conducted in the framework of activities to reduce the collision potential of birds with electricity lines, was checked the efficiency of marking means that were installed on the wires of an existing 161 kW very-high voltage line - between Afula substation and Muqeible. This line passes in Jezreel Valley that is a highly sensitive area with regard to collision potential during the whole year, and in particular during migration seasons. This research included monitoring of the collision number before the marking installation (year A), and after its installation (year B). The reduction in the collision number among all bird species following the marking installation that was found between the two research periods was approximately 26%.



Conducting ecological surveys

In the framework of ecological surveys that are performed in order to examine the effects of planned projects on biodiversity (included in the environmental licensing documents), IEC conducts surveys of flora and fauna species present in the planned project area. In order to get detailed ecological information, IEC conducts botanical and zoological surveys, as well as literature surveys, using as a reference the "Red Book of Vertebrate in Israel" that defines and classifies species in danger of extinction. If necessary, these surveys require action in order to prevent any effect on these endangered species. The definitions in the "Red Book" comply with the definitions of the IUCN "Red List of Threatened Animals".

As an example, data are presented here from an ecological survey conducted in the framework of the analysis of alternatives for a 400 kW extra-high voltage line planned to connect a planned production area in the Beit She'an area to the national transmission grid. The best alternative from this viewpoint was recommended on the basis of this ecological survey. The alternatives that were considered included two geographic regions:

1. Ramat Zvaim – northern alternative.
2. Emek Harod – southern alternative.

Based on all the environmental considerations (and not just the ecological ones) an alternative that combines the northern and the southern alternatives was selected.

The following tables present information regarding the observation of animals in the southern and northern alternatives areas, including extinction risk levels according to the key provided in the "Red List of Vertebrate in Israel" (Dolev and Perevolotsky 2002 – in hebrew):

EX = Extinct	VU = Vulnerable
RE = Regionally Extinct	NT = Near Threatened
CR = Critically Endangered	LC = Least Concern
EN = Endangered	DD=Data Deficient



Table no. 43 | Mammals, reptiles and birds species near the southern alternative route
(source: Biogis website, field survey 2018, Nature and Parks Authority data)

MAMMAL TYPES		REPTILE TYPES		BIRD TYPES			
GENUS	STATUS	GENUS	STATUS	GENUS	STATUS	GENUS	STATUS
Jackal	LC	black whipsnake	LC	Eurasian coot	NT	bluethroat	
European badger	LC	Palestine viper	LC	Horned owl	NT	Spoonbills	
Jungle Cat	VU	pond turtle	LC	Pernis		great egret	
Lutra	CR	Bridled mabuya	LC	European honey buzzard		little egret	LC
Hystrix	LC	Bosc's fringe- toed	LC	grey heron	RE	glossy ibis	LC
coypu	LC	Mediterranean house gecko	LC	Pycnonotus	LC	white wagtail	NT
Cape hare	LC	Ophisops elegans	LC	lesser kestrel	EN	Eurasian sparrowhawk	LC
Wild boar	LC	Micrelaps muelleri	VU	Eleonora's falcon		Levant sparrowhawk	
Microtus	LC	Chamaeleo	LC	common kestrel	LC	griffon vulture	VU
Red fox	LC	Stellagama	LC	peregrine falcon	RE	common moorhen	LC
Gazelle	VU	Levant water frog	LC	Eurasian hobby	NT	Alpine swift	LC

MAMMAL TYPES		REPTILE TYPES		BIRD TYPES			
GENUS	STATUS	GENUS	STATUS	GENUS	STATUS	GENUS	STATUS
		green toad	EN	red-footed falcon		common swift	LC
		Hyla savignyi	VU	common redshank		barn swallow	LC
						booted eagle	
				mallard	NT	lesser spotted eagle	
				black kite		steppe eagle	
				western marsh harrier	RE	greater spotted eagle	RE
				Montagu's harrier		Eastern imperial eagle	
				pallid harrier	NT	willow warbler	
				hen harrier		crested lark	NT
				Lark		common buzzard	NT

Table no. 44 | Species of mammals, reptiles and birds near the northern alternative route
(source: Biogis website, field survey 2018, Nature and Parks Authority data)

MAMMAL TYPES		REPTILE TYPES		BIRD TYPES			
GENUS	STATUS	GENUS	STATUS	GENUS	STATUS	GENUS	STATUS
Jackal	LC	black whipsnake	LC	Eurasian coot	NT	Armenian gull	
European badger	LC	Palestine viper	LC	Horned owl	NT	common teal	
Jungle Cat	VU	pond turtle	LC	common kestrel	LC	black kite	
Hystrix	LC	bridled skink	LC	Mallard	NT	Cinnyris	LC
Cape hare	LC	Bosc's fringe- toed	LC	Partridge	NT	wheatears	LC
Wild boar	LC	Mediterranean house gecko	LC	European goldfinch	NT	great white pelican	
Microtus	LC	Ophisops elegans	LC	Circaetus	LC	Psittacula	
Red fox	LC	Micrelaps muelleri	VU	Eurasian stone-curlew	NT	Eurasian collared dove	LC
Gazelle	VU	Chamaeleo	LC	Great egret		little grebe	NT
striped hyena	VU	Stellagama	LC	Shoveler	LC	wood sandpiper	
		Levant water frog	LC	Hooded crow	LC	Tringa	

MAMMAL TYPES		REPTILE TYPES		BIRD TYPES			
GENUS	STATUS	GENUS	STATUS	GENUS	STATUS	GENUS	STATUS
		green toad	EN	Garrulus	LC	Hoopoes	NT
						long-legged buzzard	NT
				Alectoris	NT	Francolinus	VU
				Circaetus	LC	graceful prinia	LC
				red-backed shrike	NT	great cormorant	
				lesser grey shrike		Egyptian vulture	VU
				white stork	NT	black-headed gull	
				black stork		white-throated kingfisher	NT
				common snipe		osprey	
				little grebe	VU		
				domestic pigeon		great white pelican	
				long-eared owl	LC	European bee-eater	VU
				great tit	LC Tyto	Tyto	NT

Biodiversity – marine aspects

The coastal power plants use seawater for cooling the steam vapor that drives the turbines in the electricity production process. The pumping of seawater to the cooling systems, its heating, and discharging it back to the sea, have impacts on the biodiversity both in the pipes and the condensers of the cooling system, as well as near the outlets of warm water discharged from the power plants back to the sea. IEC performs constantly a detailed monitoring of biodiversity in the cooling water outlet areas.

Biodiversity in the cooling water systems of the power plants

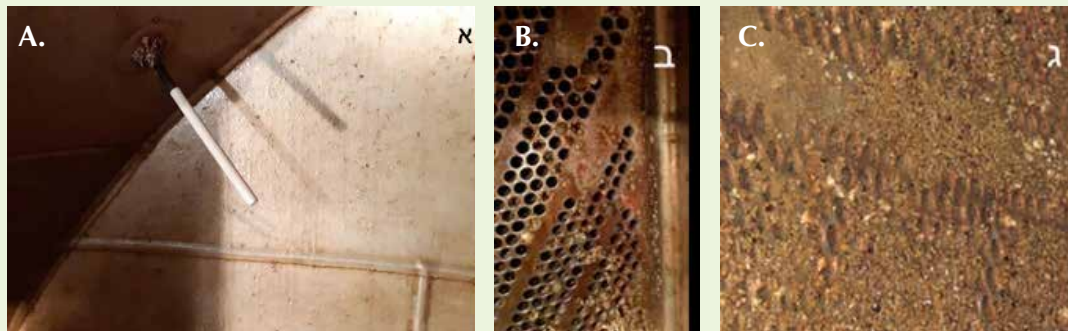
The cooling water systems pump large amounts of seawater. The cooling water also contains tiny organisms that are not caught in the filters. These include planktonic larvae (the young stage of marine animals), that use the walls of the cooling system's pipes as a settling place, and other plankton organisms that serve as food for the settled organisms and accelerate their growth. The organisms that develop on artificial objects are called marine fouling. The water that is flowing in the cooling systems of the power plants promotes the development of marine fouling that includes species that are adapted to the water flow, such as bivalves and barnacles. The marine fouling causes many operational problems, mostly reducing the efficiency of electricity production and even blockages that can cause shutdown of production units.

In order to prevent the settlement and accumulation of fouling in the cooling systems it is necessary to add to the seawater a settling-preventive product at low concentrations (the Ministry of Environmental Protection established the concentrations). IEC is active in finding ways to reduce the use of these products. Another way to maintain the main cooling system clean is using silicone-based anti-fouling paints that by their own composition prevent settling, without any change or impact on the seawater quality. These paints are used in most cooling systems of the coastline power plants. We can see in pictures 1A and 1B that the condenser is almost completely clean after two years of work. It can also be seen in picture 1C that the condenser stayed clean as a result of the antifouling paint, as a reference unpainted condenser is covered with fouling that clogs the piping.

Picture 1 | Photographs A) The condenser walls of the main cooling system painted with silicone anti-fouling product after two years of operation*.

B) The condenser walls of the main cooling system painted with silicone anti-fouling opened for cleaning after two years of work.

C) The condenser walls that were not painted, clogged with bivalves and barnacles



* Picture taken on 26/2/19 during renovation of unit 4 at Orot Rabin power plant. (represents the efficiency of antifouling paint in the years 2017-2018 since the previous cleaning that was performed on 6/4/17)

Biodiversity in the warm and salty water outlets' areas at Orot Rabin power plant

- Monitoring the invertebrate population living on the seafloor (benthos).

As part of the marine environmental monitoring programs implemented in accordance with the requirements laid down by the Ministry of Environmental Protection, IEC conducts once every two years a survey to characterize the benthic population, close to the warm water outlets' areas (discharged following the cooling of the production units) and the salty water outlets' areas (discharged from the desalination plants through the warm water outlets), at Rutenberg and Orot Rabin power plants. This survey compares between points distant from the outlets (from the north and south at a maximal distance of 2 km - control points), and close points distributed around the outlets at different depths (Illustration 2). To examine the influence of warm and salty water discharge on the marine environment, a comparison is made between the composition of organisms living in the sediment, since this group of species is affected by the environmental conditions that exist in its habitat, and can serve an indicator of long-term changes in environmental conditions.

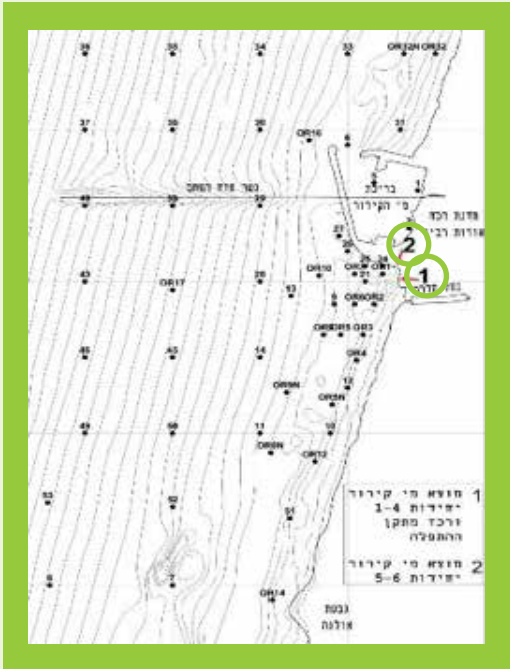
The organisms are classified according to primary taxonomical groups, Polychaeta, Crustacea, Mollusca and Nematoda (picture 2), to the lowest taxonomical level possible,

(i.e. the species level). As seen in illustrations 3-4, the impact of warm and salty water currents is observed at points OR2, OR3 and OR4 that are closest from the south to water outlets of units 1-4. The cause for the long-term effect at these points is the direction of the water current from the outlets to the south. The 2019 monitoring findings indicate a local impact of the warm and salty seawater outlets on organisms in the marine environment, that is not felt beyond 500 m south to the outlets, and 300 m to the west.



Data presented here are given as an example for Orot Rabin power plant, similar monitoring programs are performed at Rutenberg, Haifa and Reading power plants. Full reports of these monitoring programs can be found on the website of the Ministry of Environmental Protection – monitoring programs (in hebrew).

Illustration 2 | Map showing distribution of the sampling points in the area of Orot Rabin power plant. The points where organisms are sampled in the sediment are OR points.



- 1 Outlet of cooling water, units 1-4 and concentrate from desalination plant
- 2 Outlet of cooling water, units 5-6

Illustration 3 | Frequency (average of 3 replicates and standard deviation) of the organisms from the main groups in the Orot Rabin outlet area, with depth, temperature and salinity at the sampling point, spring 2019

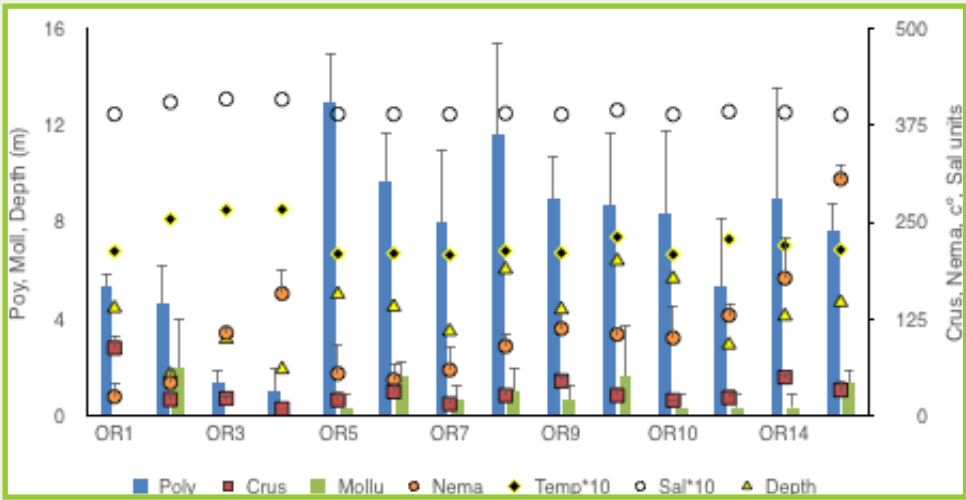
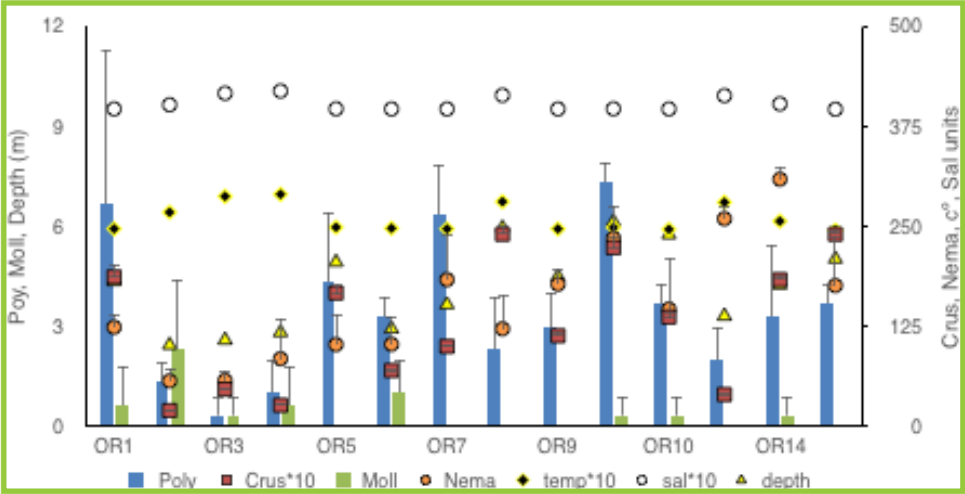
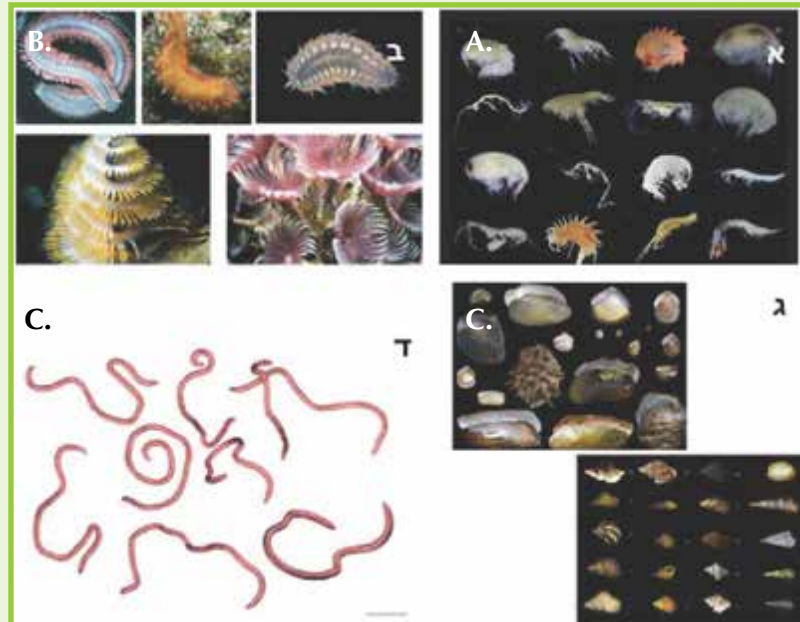


Illustration 4 | Frequency (average of 3 replicates and standard deviation) of the organisms from the main groups in the Orot Rabin outlet area, with depth, temperature and salinity at the sampling points, autumn 2019



Picture 2 | Photographs A) Crustacea B) Polychaeta; C) Mollusca (Bivalvia above, Gastropoda below); D) Nematoda



Marine biodiversity of micro-phytoplankton algae in the warm water and salty water outlet area, and at the pumping point of the desalination plant near the Rutenberg power plant

As part of the marine environmental monitoring programs that are implemented in accordance with the requirements laid down by the Ministry of Environmental Protection, IEC performs annual monitoring of the frequency of micro-phytoplankton (concentration of cells per liter) close to the cooling water outlets of the Rutenberg power plant. These outlets include cooling water from the Rutenberg and Dorad power plants, brine from the V.I.D desalination plant and brines from the Mekorot wells water desalination (that are enriched with nitrates). Changes in temperature, salinity and especially nitrate concentration might affect the micro-phytoplankton population, for the different groups. Since some of the micro-phytoplankton algae produce toxins that can harm, at high concentrations, filtering species such as bivalves, fish, birds and, indirectly also humans (by eating these animals), it is very important to monitor the algae concentrations in the outlet area and in the pumping area of the desalination plant, to assure that their concentration does not deviate from normal values. The three sampling points are situated on a line perpendicular to the beach: Rut 3 - 250 m from the cooling outlet of units 1 - 4 of Rutenberg power plant, Rut 9 - 800 m from the outlets and Rut 17 - 1,160 m west to the outlets (in proximity to the pumping points of the desalination plant). The micro-phytoplankton was classified into 5 groups according to their dimensions and taxonomical affiliation; (1) cells smaller than 2 μm , a group that includes mainly Cyanobacteria; (2) algae smaller than 5 μm that include mainly small Eukaryotes; (3) algae larger than 5 μm that include mainly Dinoflagellates; (4) Diatoms larger than 5 μm ; (5) Chlorophyceae [see picture 3].

In 2019, for the two seasons, the biodiversity of Cyanobacteria and Chlorophyceae species was lower in comparison to this of Diatoms and the Dinoflagellates species. For the sampling performed in the spring, the Diatoms and Cyanobacteria species biodiversity dropped as the distance from the outlets increased. And for the Dinoflagellates group the species biodiversity increased as the distance from the outlets increased. A single species was found for the Chlorophyceae group for point Rut 17, and two species for the other points (Illustration 5). In terms of the total cell concentration in the spring, the presence of micro-phytoplankton was similar in the two western points and lower for the point near the outlets (Illustration 6). For the three sampling points the Cyanobacteria were present in the highest amounts and constitute 82.2%, 95.4% and 94.5% of total micro-phytoplankton concentration for points Rut 3, Rut 9, and Rut 17 respectively. In the autumn the species biodiversity was significantly higher than in the spring for the Dinoflagellates and Diatoms groups, but no difference was noticed between the seasons for the Cyanobacteria and Chlorophyceae groups, except for higher amounts of some species of Cyanobacteria in the spring for point Rut 17. Also in the autumn the biodiversity of Diatoms and Cyanobacteria dropped as the distance from the outlets increased. For the Dinoflagellates group, there was no difference between the points Rut 3 and Rut 9 whereas point Rut 17 included the highest number of species. A single Chlorophyceae species appeared at points Rut 3 and Rut 9, and no Chlorophyceae species was found at point Rut 17. In the autumn also, the Cyanobacteria were present for the three sampling points in the highest amounts, and constitute 95% of the total micro-phytoplankton concentration. In the autumn the total

cell concentration was almost identical for the three sampling points, as well as the cell concentrations of the different groups. In the spring the cell concentration was three folds higher than in the autumn , except for point Rut 3 where the cell concentration in the spring was lower by a factor of magnitude.

In 2019 no micro-phytoplankton species appeared in concentrations that were higher than usual, and particularly species of micro-phytoplankton with a toxic potential. For example, species of *Pseudo-nitzschia* that produce the toxin DA (domoic acid) appeared in concentrations lower by two order of magnitudes from the threshold concentrations that can cause poisoning. The species *Prorocentrum minimum* that produces a number of toxins that can, in extreme circumstances, cause death to humans (this toxin is transmitted to humans by eating Bivalves consuming this alga) were found in low concentrations. Some species of the genus *Gymnodinium* that produce toxins that cause skin rash and eye burning and could result in death in extreme cases were also found in concentrations lower by two order of magnitudes from the toxicity threshold values. Another species, *Chaetoceros socialis*, that might cause fish mortality as a result of its cell structure including thorns that harm the fish gills at high concentrations, were found at low concentrations for the three sampling points in the autumn.

We may conclude that in terms of cell concentration, there are no consistent differences between the sampling points, except for the concentration of Cyanobacteria (that constitute the majority of the micro-phytoplankton cells) for the Rut 3 point in the spring. The biodiversity of the Diatoms and Cyanobacteria species is higher in the outlets area and this of Dinoflagellates is lower. The concentrations of species potentially toxic were lower by at least two order of magnitudes from concentrations that could be problematic. In summary, there is no negative impact of the water currents discharged through the outlets of Rutenberg power plant on the micro-phytoplankton population in the area.

Illustration 5 | Biodiversity of species of the different groups of micro-phytoplankton in the spring and autumn 2019

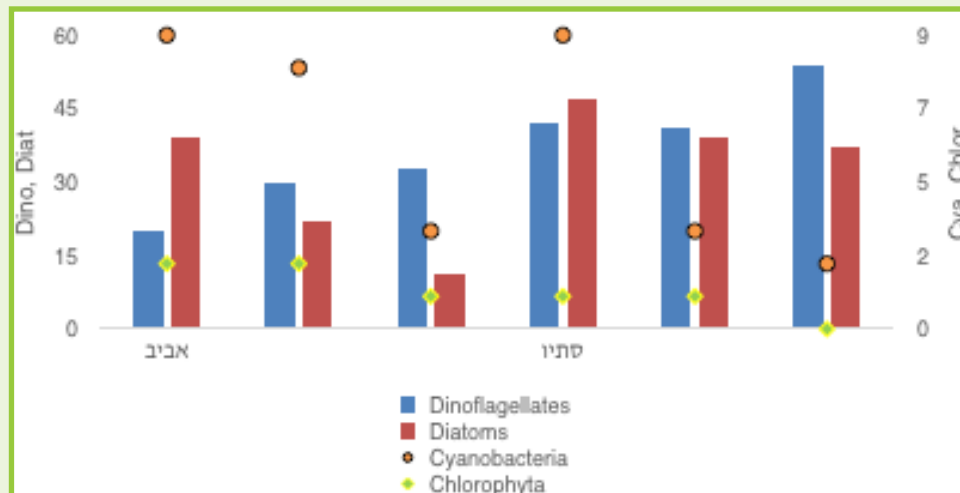
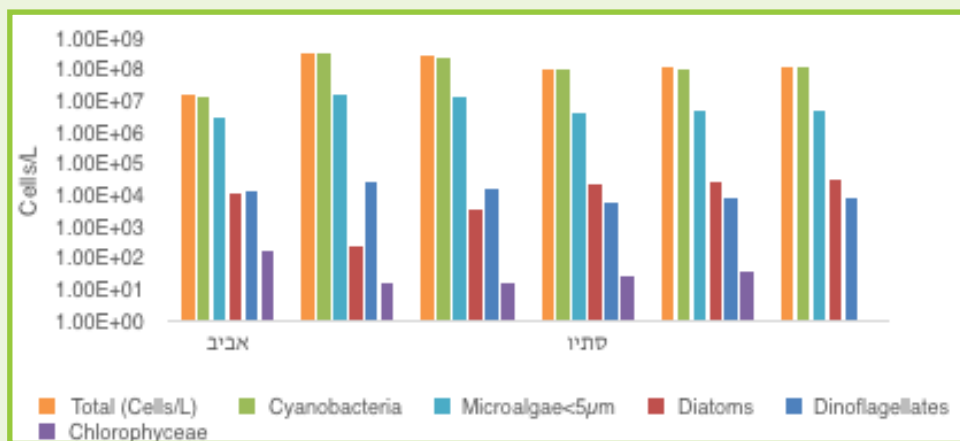
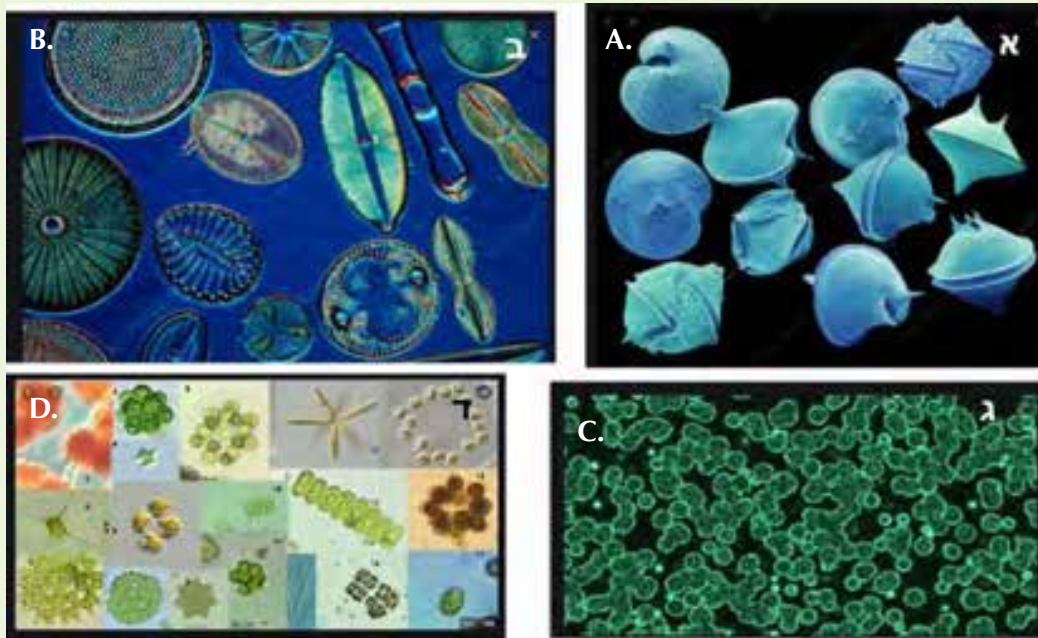


Illustration 6 | Concentration of cells for the different micro-phytoplankton groups in the spring and autumn 2019



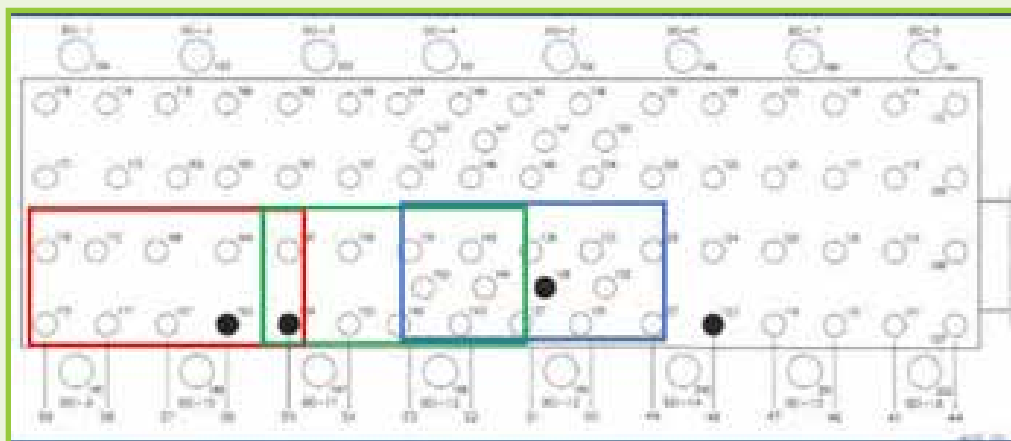
Picture 3 | Primary groups of micro-phytoplankton – A) Dinoflagellates larger than 5 μm ; B) Diatoms; C) Cyanobacteria smaller than 2 μm ; D) Chlorophyceae



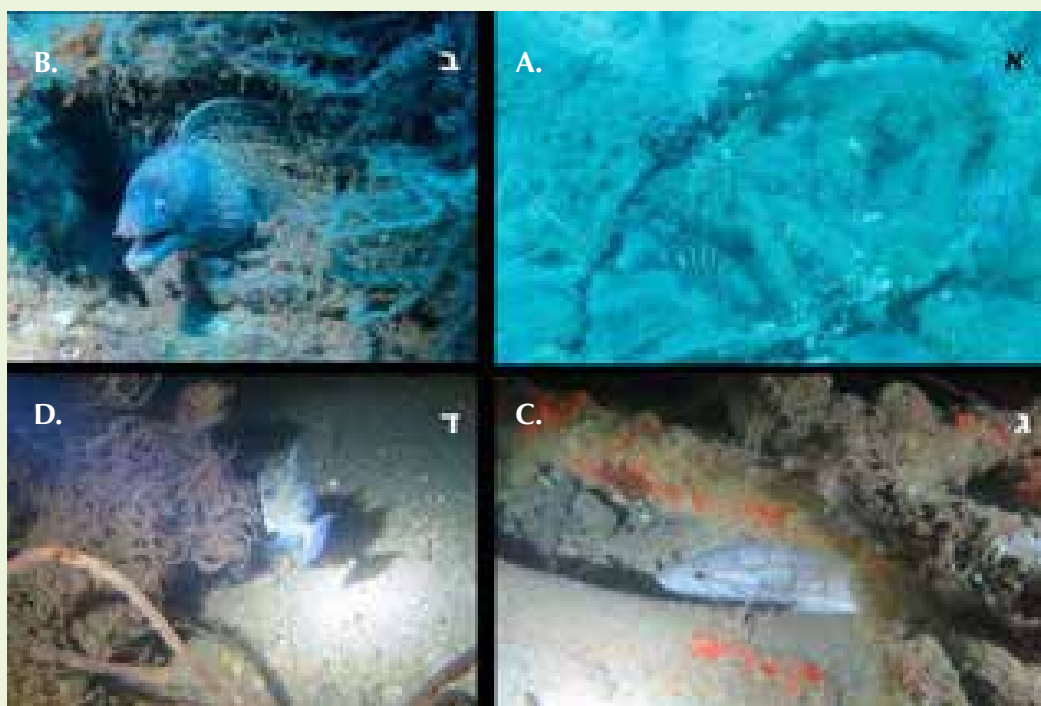
Organisms under the coal pier of Orot Rabin power plant

Different types of waste, such as cables, beams, stepping surfaces and pipes, are found under the coal unloading pier of the Orot Rabin power plant. This waste was discarded to the sea decades ago during the pier building. Since then a rich habitat of fish and invertebrates developed, and it is similar in composition and species richness to an ecological system on a rocky shore in a nature reserve (picture 3). In 2016, after the IEC representatives and the marine ecologist of the Ministry of Environmental Protection dove in the area together, it was decided that, given its contribution to the creation of niches for settlement and hideout of fish, the major waste mass, such as piles of cables, large beams etc. will stay at its place, and that the small additional waste elements without ecological contribution will be piled into three-dimensional structures that will also provide hideout and settling places for the organism communities (picture 4). Illustration 7 presents a schema of the pier unloading area, showing the areas including the small waste elements piled into "pyramids" that provide hideouts for organisms.

Illustration 7 | schema of the coal unloading pier area at the Orot Rabin power plant. The area cleaned in 2016-2017, 2018 and 2019 is shown in the red, green, and blue rectangle, respectively



Picture 4 | Local fish species rarely found in this area of the Israel coastline, photographed in the waste area under the coal unloading pier of the Orot Rabin power plant. A) *Epinephelus aeneus* B) *Muraena Helena*; C) *Mycteroperca rubra* D) *Balistes capriscus*



Picture 5 | A scuba diver near a pile of pipes and stepping surfaces that were collected on the sea floor



