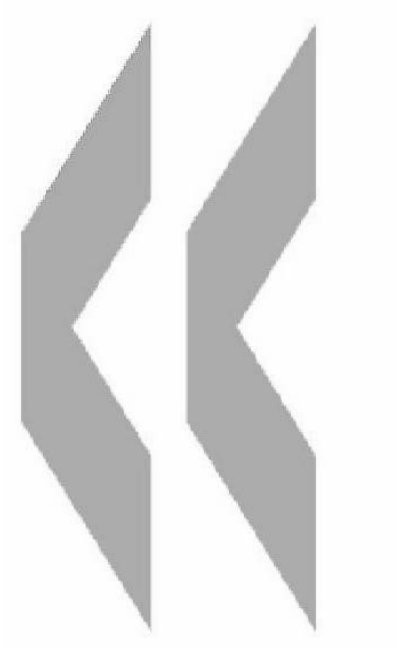

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Identifying Complementary Measures to Ensure the Maximum Realisation of Benefits from the Liberalisation of Environmental Goods and Services

Case Study: Israel

Joseph Golovaty
NETAFIM

OECD

Joint Working Party on Trade and Environment

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IDENTIFYING COMPLEMENTARY MEASURES TO ENSURE THE MAXIMUM REALISATION OF BENEFITS FROM THE LIBERALISATION OF ENVIRONMENTAL GOODS AND SERVICES

CASE STUDY: ISRAEL

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by Joshua Golovaty, Netafim

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ABSTRACT

This study examines the growing market for environmental goods and services in Israel. Following the market expansion in the 1990s, foreign trade in environmental goods and services has also grown in Israel largely due to low tariffs on imports of manufacture products and public preference for foreign equipment. Experience with Israel also reveals that the surge of investments in environmental goods and services in order to attain environmental standards similar to those in developed countries, can be attributable to the increasing number of companies supplying environmental goods and services.

Key words: environmental goods and services, environmental technologies, trade liberalization, trade and environment, wastewater treatment, Israel

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The report is available on the OECD website in English and French at the following URL addresses: http://www.oecd.org/trade.

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ABBREVIATIONS

BOT	Build-operate-transfer
EG&S	Environmental goods and services
EPS	Environment Protection Service
GPA	Government Procurement Agreement (WTO)
IEICI	Israel Export & International Cooperation Institute
JNF	Jewish National Fund
MFN	Most-favoured nation
MoE	Ministry of the Environment
R&D	Research and development
WTO	World Trade Organization

IDENTIFYING COMPLEMENTARY MEASURES TO ENSURE THE MAXIMUM REALISATION OF BENEFITS FROM THE LIBERALISATION OF ENVIRONMENTAL GOODS AND SERVICES

CASE STUDY: ISRAEL

Executive summary

Since Israel gained its independence in 1948, its population has increased rapidly. During its first 25 years, large infrastructure projects, meant to serve this growing population, were carried out without sufficient consideration being given to the resulting environmental damage. Around the mid-1970s, the Israeli public started to exhibit greater awareness of environmental issues, in line with the worldwide trend. This rise in public awareness, together with pressure from environment-minded academics, led in 1988 to the establishment of a Ministry of the Environment (MoE).

Israel's first comprehensive set of new environmental policies came into force in 1990, spurring an immediate increase in environment-related economic activity. The MoE, strengthened by new enforcement resources and incentives, forced the private sector to start investing in cleaner production technologies. Simultaneously, substantial public funds were allocated for the remediation of environmental damage suffered over the preceding decades. Major projects were initiated to:

- Construct new infrastructure for managing the environment, such as solid-waste and toxic-waste collection centres.
- Upgrade inappropriately designed or maintained facilities for treating sewage and other effluents.
- Rehabilitate, clean and better manage Israel's rivers, coastlines and other designated nature-protection areas.
- Find substitutes for agricultural technologies and practices causing damage to the environment.

As the market for environmental goods and services (EG&S) expanded in the 1990s, so did the number of companies supplying it. New companies were formed, providing environmental services previously unavailable, and companies already working in parallel fields began to move into the business. Companies producing agricultural water filters expanded into sewage treatment and water desalination, for example.

Foreign trade in EG&S also grew. Imports of manufactured products are not subject to high tariffs in Israel and so in many fields it pays to import technologies that have been demonstrated successfully abroad. Furthermore, because public tenders in Israel require participating companies to use proven technologies, a preference for foreign equipment over newer, less-established Israeli goods has developed. For these reasons, Israeli companies working on large environmental infrastructure projects have sought out alliances with foreign companies.

Until the 1990s, the principal activities of Israel's EG&S industry were managing and treating water resources and sewage and manufacturing environmental technologies for agriculture and solar energy

production. The new Israeli exports of EG&S, which compete in a market dominated by foreign suppliers, are based on developing innovations for industries with special needs. The Israel Export & International Cooperation Institute has estimated Israel's exports of environmental technologies at USD 300 million a year.

Israel's EG&S market is likely to continue to grow as industry makes investments to attain environmental standards similar to those in developed nations and the government continues to undertake major projects to redress environmental harm. In particular, the need to reuse treated effluent for irrigation and the decision to restore Israel's rivers necessitate major investments by municipalities and factories in order to meet the prevailing effluent standards. This investment programme will continue for years to come, even after the rivers become active ecosystems once again.

Introduction

This paper surveys Israel's environmental policies and their effects on the development of its market for environmental goods and services (EG&S). It presents the forces shaping the country's environmental policies and shows how the establishment of the Ministry of the Environment in 1988, and the accompanying rise in public awareness of environmental problems, have been driving forces behind the rapid development of the Israeli market for EG&S. The report identifies the strong and weak points of Israel's EG&S industry and shows how it is adjusting to changing environmental demands. Two serious environmental problems confronting Israel — water resource management and river restoration — are explored in some detail.

Environmental policies in Israel

Historical overview

Since the establishment of the State of Israel in 1948, the population has grown from around 800 000 to over 6 million. During its first quarter-century of existence, Israel concentrated on providing housing, public services and employment for waves of often-destitute immigrants, with little thought as to the effects of this development on the natural environment. For many years, Israel had no major body responsible for environmental policy. Under pressure from nature-preservation organisations and environmental professionals to address the mounting damage being inflicted on the environment, and heedful of the 1972 Stockholm Conference on the Human Environment, the government established the Environment Protection Service (EPS) in 1973.

The EPS was instrumental in making other government bodies, and the public at large, more aware of the need for environmental protection. One of its major accomplishments was to introduce mandatory "environmental risk assessments" in all requests to the planning and building committee for authorisation of large projects. The EPS was also instrumental in setting up systems to monitor water supply, coastal resources and air quality, and it instituted the first national programme for hazardous waste disposal.

Despite its success in increasing environmental awareness among decision makers, its regulatory and enforcement powers were limited, and this impaired its ability to plan and implement long-term environmental policies. Thus, in 1988, the government established a full Ministry of the Environment (MoE), bringing together environmental policy-making and enforcement responsibilities previously dispersed among several government authorities.

The MoE embarked immediately on a programme to develop new environmental policy guidelines. Drawing on experience and knowledge gained by developed countries, with adjustments to reflect Israel's specific situation, the ministry laid out a set of broad priorities. It benefited during this formative stage from the expertise provided by Israel's world-class research institutions.

The 1990s brought a new wave of immigration, this time from the former Soviet Union. A surge in construction followed, similar to that of the country's early years. It highlighted the conflict between demand for housing and infrastructure and the desire to protect natural resources. In contrast with previous periods of rapid development, governmental and non-governmental environmental bodies soon voiced concern about damage to the environment.

Israel's first comprehensive set of environmental regulations and programmes came into being during this period. New laws and regulations were enacted to address problems related to noise, marine pollution, hazardous materials, agricultural pollution and degradation of air quality. The MoE's approach generally combined command-and-control instruments with financial incentives. A national waste plan resulted in the closure of 400 small, unregulated dumps and the establishment of three central landfill sites. A national

environment council was set up to advise the environment minister, the government and the Knesset, Israel's parliament, on environment-related matters.

Today, the MoE has partial or full responsibility for more than 26 laws and 71 regulations pertaining to all areas of the environment. Its inspection unit carries out field inspection and supervision, and the ministry has a wide range of enforcement instruments at its disposal, including fines and injunctions. It can prosecute not only companies but also any company director found guilty of intentionally violating an environmental law.

Economic incentives

Environmental policy in Israel is guided by the polluter-pays principal: the polluter must repair, or recompense society for, any degradation of natural resources it causes. Nevertheless, the government provides some economic support to industries and local authorities in the form of grants to encourage them to deal with acute problems. In recent years, incentives have been made available to prevent pollution of groundwater from agricultural sources, to help industries adopt less-polluting technologies (e.g. to bring plants into conformity with international environmental standards) and to treat sewage before it reaches the Mediterranean Sea. Table 1 shows the trend in environmental expenditure by central and local government and non-profit institutions.

Table 1. Environmental expenditure by government and non-profit institutions, 1995-2000

(million new shekels, in 1995 prices*)

Institution	1995	1997	1998	1999	2000
Central government	403	425	486	458	537
Local authorities	3 501	3 885	4 085	4 024	3 979
Non-profit institutions**	333	325	314	322	326
Total	4 237	4 635	4 885	4 803	4 841

* At the 1995 exchange rate of USD1 = ILS 3.14.

**Organisations such as Kishon and Yarkon River rehabilitation authorities, Israel Nature and National Parks Protection Authority, Society for the Protection of Nature in Israel, Israel Union for Environmental Defence, Desert Research Institute.
Source: Central Statistics Bureau.

Under policies promoting the concept that "pollution prevention pays", the government also provides incentives for investment in and development of solutions based on less-polluting technologies, especially those considered environmentally preferable to existing methods. Examples of such assistance provided in the past include:

- Grants to cover up to 40%, but no more than ILS 200 000 (USD 45 000), of the cost of projects to reduce the generation of hazardous waste and up to 80% of the cost of exploring possibilities for reducing volumes of solid waste at the source.

- Partial financing (up to USD 11 000 but no more than 50%) of the cost of ISO 14001 certification for factories.

- Support for environmental investment in agriculture. In 1996, the MoE estimated that ILS 1 billion (USD 225 million) in investment would be needed to divert and collect agricultural effluents and treat them before they pollute water sources. The ministry set a goal of financing incentives worth 35% of the required investment.

Studies have shown that Israel does not support research and development in environmental technology to the same extent as developed countries (Ben-Aharon and Levin, 2001). Environment-related research accounts for 0.1% of the government budget for civil R&D, compared with an OECD average of 3%. Israel generally aims its financial support towards solving problems and making polluting technology cleaner rather than encouraging R&D in new environmental technology.

The role of civil society

Despite a rise in awareness in recent years, the Israeli public expresses less concern over environmental matters than do citizens of developed countries. One important reason is that the public's attention is more focused on security, economic and political problems than on protecting the environment. Another barometer of the relative importance accorded to environmental issues is the percentage of academic articles and monographs published in Israel that focus on the environment, which, as Table 2 shows, is smaller than that in the rest of the world.

Table 2. Academic publications focusing on the environment in Israel: comparison with the rest of the world

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
No. of publications focusing on environmental issues in Israel	175	180	215	211	340	231	272	245	299	288
% of env. publications to total publications in Israel	2.9	2.8	3.3	3.1	4. 5	2. 9	3.3	2.9	3.3	3.2
% of publications to no. of general publications worldwide	3.4	3.4	3.5	3.6	4.0	4.1	4.4	4.3	4.4	n.d.

Source: Ben-Aharon and Levin (2001).

Commercial lobbies in Israel see themselves as being harmed by changes in environmental law and are well organised, with strong connections to the ministries responsible for the economy. They have at times tried to mobilise public opinion against positions taken by environmental organisations. Their power, combined with the relatively low public awareness of environmental issues, limits the MoE's political influence with the economic ministries.

In an effort to minimise conflicts with the business community, the MoE began in the late 1990s to invite stakeholders, particularly those who would be affected by new environmental regulations, to participate in its planning. The aim was to achieve the broadest possible consensus and maximise the benefit for the environment, as well as to improve co-operation with industry.

In 1998, the MoE and the Industrialists' Organisation signed an accord on determining regulations for industrial emissions of pollution. The accord was also signed by 120 companies, including some of Israel's most serious polluters. But follow-up by the MoE has shown that many companies are not fulfilling their obligations.

One of the MoE's longer-term goals is to encourage more companies and institutions to adopt environmental policies voluntarily as a way of improving their public image (Box 1).

Box 1. Voluntary environmental standards in Israeli industry

Because its home market is small, Israeli industry is export-oriented. Hence, it began early on to adapt to the demand in developed nations for environment-friendly products. Israel has two environmental quality standards which

a company or organisation can receive from the MoE and the Israel Standards Institute: ISO 14001 and the Green Seal.

ISO 14001 certification opens up possibilities for selling goods and services abroad. Manufacturers reported in an MoE survey that more and more countries were making this certification a prerequisite. Especially in the United States and EU countries it is generally a condition for international tenders. The MoE offers grants to organisations and factories to help cover the cost of certification. As of 2003, more than 90 factories and organisations, including local authorities, had had their environmental management systems certified to the ISO 14001 standard.

The MoE and the Israel Standards Institute jointly award the Green Seal for products or services one or more of whose life-cycle stages have less environmental impact than those of similar products or services. After application for the label is made, inspectors determine whether the product or service meets standards and regulations relating to quality, safety and impact on health. Tests are undertaken to ensure that the product or service has a minimal or improved impact on the environment in at least one stage of its life. Products displaying the label are sold mainly in Israel.

International environmental obligations

Israel is a signatory to almost 30 international and regional environmental agreements (Annex Table 1). Among these, the Montreal Protocol, the 1972 London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter and the 1976 Barcelona Convention for the Protection of the Mediterranean Sea against Pollution have had a particular impact, requiring Israel to invest in upgrading and changing environmental practices and technologies.

Israel has ratified the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer as well as the London Amendment (1992), the Copenhagen Amendment (1992), the Vienna Amendment (1995) and the Montreal Amendment (2003). Israel is the world's second-largest producer of methyl bromide and a major user of the chemical in agriculture. The government announced that it would phase out the use of methyl bromide by 2005. The Ministry of Agriculture has spent more than ILS 1 million (USD 225 000) on R&D to find more environment-friendly soil disinfectants. During 2003, the MoE website says, Israel halved its use of methyl bromide.

Israel ratified the Barcelona Convention in 1978 and its 1980 Protocol for the Protection of the Mediterranean Sea against Pollution from Land Based Sources and Activities in 1991. Under the Mediterranean Action Plan, the country must gradually reduce discharges of pollutants directly into the Mediterranean Sea and stop them fully by 2025. To attain this goal, Israel must find alternative disposal methods for the sludge from wastewater-treatment facilities, currently discharged into the sea as entrained sediments in treated wastewater. Discharges of sludge from the Tel Aviv area's treatment plant, which is the biggest source of such pollution, is to stop in 2008. In addition, large chemical factories that discharge into the sea, or into rivers flowing into the sea, will have to upgrade their waste treatment to a level deemed not detrimental to the environment.

Current situation

Despite growing public awareness and increasing investment in environmental protection, Israel still faces serious environmental problems. The MoE's relatively small budget does not allow it to address all problems simultaneously, so it is trying first to tackle the most pressing ones: the supply and management of water resources; water pollution; environmental damage by the construction industry; coastal and marine pollution; and air pollution.

Water is the most critical problem. Several droughts in the 1990s led to the near collapse of the national water system. The crisis stemmed from the cumulative effects of several decades of overpumping and pollution of the coastal aquifer beneath densely populated central Israel. Today there is an urgent need

to begin making large investments in water desalination facilities; otherwise, one additional drought year could provoke a major ecological crisis. Israel's response to the water crisis is described in the section on water resource management.

The EG&S market in Israel

The domestic market

Suppliers

The environmental policies and programmes of the 1990s provided a catalyst for rapid development of Israel's domestic EG&S market. Not only the volume of demand increased but also the range of new technologies that were needed, notably for infrastructure repair, river restoration, hazardous-waste disposal and the establishment of a central garbage collection system.

During the period immediately following the introduction of new environmental regulations, know-how had to be imported. Israeli companies could not demonstrate that they had the experience needed to fulfil the conditions of the MoE's initial tenders, so they formed alliances with foreign companies. More recently, Israeli companies have narrowed the knowledge gap in almost all areas and have even begun to export environmental technology.

The current size of Israel's EG&S industry is not known. In the past, environmental technologies were assigned to statistical categories according to the characteristics of the industry they served (e.g. flocculants and salts to chemicals, filters to water technologies, environmental consultation to services), and separate statistics on them were not collected. In light of today's understanding that the environmental market is an important element of economic activity, the Central Bureau of Statistics recently began gathering data on the subsector.

Evidence of growth in the EG&S industry can be seen in estimates of the numbers of companies supplying EG&S and of those providing ancillary administrative services, such as legal services and accounting. According to a survey by the Israel Export & International Cooperation Institute (IEICI), some 1 000 companies supply EG&S in Israel. The institute estimates that the number has tripled since the beginning of the 1990s.

Initiatives to encourage environmental technology innovation have little influence on Israel's environmental policies today. Ben-Aharon and Levin (2001) found that one reason was lack of support from the office of the Chief Scientist in the Ministry of Industry, Trade and Labour. The ministry itself grants funds only to export products, not technologies and services. Goren *et al.* (2002) found that only 21 (10%) of all technologies under development in the ministry's technological incubator programme were environmental technologies. The ratio of environmental patents to total Israeli patents is 1.5%, while the global equivalent is 1.9%. Goren *et al.* observe that, given the level of development in the rest of Israeli industry, the environmental industry has not yet achieved its full potential. The private sector has also demonstrated a belief in the industry's potential: Israel has a venture capital fund devoted solely to investments in environmental technology, and several funds not specialising in environmental technology have made it part of their portfolio strategy.

Foreign suppliers to Israel

The World Trade Organization's most recent Trade Policy Review of Israel (1999) found that the country had progressed considerably, with the aid of legislation and free-trade agreements, in creating open and transparent trade policies. Israel lowered its most-favoured nation (MFN) tariffs from an average of 8.3% in 1993 to 7.6% in 1999 and continues to open its markets.

The WTO reported that, as of 1998, about 75% of Israeli trade took place within the framework of free-trade agreements. Israel has such agreements with its major trading partners, the European Union and the United States, and with Canada, the Czech Republic, Hungary, Jordan, Poland, the Slovak Republic, Slovenia and Turkey. As a result of these agreements, the average customs duty paid fell by half between 1993 and 1999, to 1%, in conjunction with the reduction in MFN tariff rates. Also, Israel is a signatory to the WTO Government Procurement Agreement (GPA), and maintained offset provisions of up to 35% of the value of a contract until January 2005, when the level was reduced to 20%.

The WTO report found, however, that the MFN tariff protection for agricultural products increased more than two and a half times over 1993-99 and that farming was still subject to significant government intervention, relying on subsidies, low water prices and protected markets for certain products (e.g. dairy products, fruits, vegetables). The reported also noted that applied MFN tariffs in general had become even more dispersed since the previous review in 1994.

The 1999 review also stated that, while Israel was making great efforts to privatise public companies, some subsectors were still under government control or in the hands of government companies. Little has changed since then in the area of environmental infrastructure. The state-owned Mekorot Water Company still produces and supplies most of the water used in Israel, while local authorities manage sewage and water treatment. A private company recently won a tender to supply large amounts of desalinated sea water to Mekorot, however, and municipalities have begun transferring responsibility for effluent treatment to private companies through build-operate-transfer (BOT) projects.

Israel's tariffs neither favour nor discriminate against environmental technologies. Though the scope of EG&S imports has not yet been adequately evaluated, it is clear that not only the public sector but also private industry has made considerable investments to meet new standards. As long as Israel maintains its policy of meeting developed-country standards, the trend in imports of equipment is likely to continue at a level similar to that of the 1990s.

As far as can be determined, given the lack of statistics on EG&S trade, most of Israel's EG&S imports come from EU member states and the United States. Israel, as noted above, has free-trade agreements with the European Union and is a fellow GPA signatory. The Israel-German Chamber of Commerce and Industry and the commercial divisions of the UK and US embassies, contacted for this study, were asked if they knew of any obstacles to trade in EG&S. Among those mentioned:

- **Standards and the compliance of Israeli equipment.** US officials said they believed that Israel's adoption of EU standards in many fields had caused difficulties for American companies.

- **Market size.** A US Embassy official and the head of Israel-German Chamber of Commerce and Industry said the small size of the Israeli EG&S market made it less attractive for companies interested mainly in large infrastructure projects. A UK official, however, called Israel an important market (it ranks 22nd among export destinations for British companies) and identified niche markets such as soil remediation, an area in which Israel lacks experience.

- **Security situation.** The head of the Israel-German Chamber of Commerce and Industry stated that German EG&S companies had dramatically reduced their activities in Israel in recent years because of deterioration in the security situation. The US Embassy official said that, despite the size of the Israeli market, large American EG&S companies had begun operating in Israel in the mid-1990s because they believed the peace process would transform Israel into a convenient base of operations in the Middle

East, but that the hiatus in the peace process led many of the companies to abandon Israel.

- **Growth rate.** All those contacted said the growth rate of the EG&S market in Israel was comparatively low because MoE project implementation and the application of recent laws were slower than planned. In the current economic situation, the MoE's budget will likely stay the same or even decrease, so no change in these circumstances is expected in the short term.

Exports

Until the 1990s, the environmental technologies most applied in Israel were related to water management (particularly for agriculture), sea-water desalination and thermal solar energy, and were tailored to Israel's specific needs.

Some Israeli companies gradually gained worldwide reputations and began exporting. Tahal, for example, started out as a state-owned enterprise responsible for the engineering and planning of water and sewage infrastructure for government projects in Israel. Now privatised, it exports goods and services worth hundreds of millions of US dollars annually, especially to underdeveloped countries.

Box 2. Commercialisation of solar technology

Israel is a world leader in the development and use of solar energy technology. Most homes in Israel use solar water heaters, reducing the country's fuel consumption by about 3% from what it would be if they used electric, oil or gas-fired water heaters.

The government has invested heavily in solar energy R&D, and Israeli scientists and engineers have designed the world's largest solar power stations. The Ben Gurion Solar Energy Research Center mainly carries out research on thermal and photovoltaic applications, and the Weizmann Institute of Science carries out research on concentrating solar energy in its solar tower.

Some of these new technologies have progressed towards a commercial phase, attracting attention from business and industry in Israel and abroad. The government stimulated this progress by sponsoring the formation and operation of a consortium called Consolar Ltd. to further develop and commercialise the technologies. Consolar is composed of four industrial corporations and three research institutes: MLM (a division of Israel Aircraft Industries), Ormat Industries, Silver Arrow, Rotem Industries, Tel Aviv University, Ben Gurion University of the Negev and the Weizmann Institute.

Solel Solar Systems Ltd has already had commercial success with new solar energy technology. The company develops and markets solar thermal products and services ranging from household water heaters to utility-scale power stations and other commercial and industrial applications. Solel's projects have included nine utility-scale solar electric generating systems in California's Mojave Desert with combined capacity of 354 MW, representing the bulk of the world's grid-connected solar power. Solel's recently developed compound parabolic collectors are described as highly suitable for Europe, North America and other temperate, populated regions.

Source: Ministry of National Infrastructures.

While Israeli water management, desalination and thermal solar technologies enjoy a good reputation and market advantage, Israeli service companies also have an advantage because their labour costs are lower than those of companies from developed countries with similar experience. The IEICI has estimated the value of Israel's exports of environmental technologies and services at ISL 300 million per year.

In other areas, Israeli technologies once had difficulty competing against foreign technologies with proven track records. Today, however, through innovations for industries with special needs, Israeli companies are beginning to compete in new markets dominated by foreign suppliers. This trend can be seen in the results of a 2001 survey by the IEICI (Table 3). The survey found that Israel's potential for exporting environmental technologies in non-traditional fields had increased. Among 85 companies stating that they intended to begin exporting, only about 40% provided goods or services in the traditional fields of water, agriculture and alternative energy, as opposed to the 60% of the companies already exporting.

The Israeli exporters in the survey indicated that Israeli products were technologically innovative and competitively priced, and should be able to penetrate new markets if financing and strategic partners can be found. Among barriers the exporters cited, in addition to a lack of financing and partnerships, was what they perceived as a self-perpetuating bias by governments against new technologies in public tenders.

Table 3. Comparison of areas of activity between companies currently exporting EG&S and companies intending to export EG&S

Area of activity	General	Air	Water &	Agriculture	Waste	Alternative	Other
Exporting companies	11%	10%	33%	20%	17%	6%	4%
Companies interested in exporting	22%	14%	18%	19%	14%	4%	9%

Source: Environmental Branch, IEICI, 2001.

Water resource management

Background

To expand the economy and agriculture in the country's semi-arid conditions, Israel's initial development strategy called for maximum utilisation of its natural water resources — only the smallest possible safety margin from a usage level that would harm the hydrological system. R&D in methods and technologies were funded to help implement this policy of "walking a tightrope". Today it is clear that the policy caused overpumping and depletion of water supplies. Water resource management has always been a problem for Israel but the current crisis demands intensive efforts if a complete collapse of the national water system is to be avoided. Table 4 shows the evolution of Israel's water production and consumption from the mid-1960s to 2001.

Development of utilisation policies and water resource technology

1950s-60s: establishment of infrastructure and growth in water management technology

Water was a limiting factor in the 1950s and 1960s, especially in the south. The chosen solution was to establish a central system to manage, produce and carry Israel's water wherever it was needed. To implement this enormous project, three government bodies were formed: Tahal Engineering and Consulting for engineering and planning, Mekorot to operate and maintain the water system, and the Water Commission to advise the government and the Knesset on policy and research. The importance of water resource management assured support for R&D, and Israeli expertise and technology developed quickly. The research institutions formed during these years were the basis for development of an industry that today exports goods and consulting and planning services worldwide.

Table 4. Water production and consumption, by source and purpose (million cubic metres)

	2001	2000	1999	1998	1997	1990	1979/80	1969/70	1964/65
	Production								
Total	1 885	1 996	2 151	2 226	2 074	1 939	1 743	1 711	1 393
Mekorot Water Co.- total	1 286	1 341	1 464	1 476	1 374	1 232	1 042	997	696
Wells(1)	751	725	974	723	620	733	. .	. .	. .
Hamovil water carrier (Kinneret)	160	230	94	376	386	153	273	. .	. .
Upper water	195	216	208	226	225	247	. .	. .	. .
Effluents(2)	180	170	188	151	143	99	-	-	-
Other producers – total	599	655	687	750	700	707	701	714	697
Wells	312	331	362	377	356	393	. .	. .	. .
Upper water	191	225	225	287	263	254	. .	. .	. .
Effluents	96	99	100	86	81	60	-	-	-
	Consumption								
Total	1 800	1 924	2 073	2 166	2 008	1 804	1 700	1 564	1 329
by supplier									
Mekorot Water Co.	1 199	1 269	1 382	1 416	1 307	1 127	1 010	853	620
Other suppliers(3)	601	655	691	750	701	677	690	711	709
by purpose									
Domestic(4)	658	662	682	672	621	482	375	240	199
Mekorot Water Co.	510	519	540	539	487	344	. .	. .	. .
Other suppliers	148	143	142	133	134	138	. .	. .	. .
Industrial	120	124	127	129	123	106	90	75	55
Mekorot Water Co.	79	83	84	86	80	79	. .	. .	. .
Other suppliers	41	41	43	43	43	27	. .	. .	. .
Agricultural – total	1 022	1 138	1 264	1 365	1 264	1 216	1 235	1 249	1 075
Mekorot Water Co.	610	667	758	791	740	704	700	660	470
Other suppliers	412	471	506	574	524	512	535	589	605

1. Excluding production from drilling for Dan Region Reclamation Project.
2. Including Dan Region Reclamation water.
3. Including self supply.
4. Including gardening, public use and similar uses.
5. The classification by type of locality is according to the records of the Water Commission.

Source: Water Commission (from 2003 Central Bureau of Statistics annual report).

Government policy encouraged maximum use of every available freshwater source to benefit economic development. Water was pumped energetically from aquifers, streams and springs, causing most smaller and medium-sized streams and springs to dry up. With the completion of the National Water Carrier (a system of pipelines, pumping stations, canals and reservoirs) from the Sea of Galilee in the north to the Negev Desert in the south, it was determined that the maximum amount of water that could be withdrawn annually without harming natural reservoirs was about 1.55 billion cubic metres, assuming the Sea of Galilee, Mountain Aquifer and Coastal Aquifer were completely full at the end of winter.

1970s to mid-1980s: increased development of technology to reuse wastewater for irrigation

As Israel's economy and agriculture grew, an urgent need to develop new water sources became clear. During this period, the annual water use target was close to the maximum potentially available. (Some 94% of available freshwater resources are now used; see Annex 2.) As the potential maximum was also based on optimistic assumptions, this policy led to overpumping during very dry years, when water reserves were not completely replenished at the end of the rainy season. One solution was to establish a central system to gather and treat effluents and reuse them in irrigation, thus reducing agricultural demand on primary water supplies. Water-saving agricultural technologies, such as drip irrigation and computerised regulation systems, were also developed during this period.

Mid-1980s to 2000: decline of investment in infrastructure and water technology

After several drought cycles and the emergence of a chronic imbalance between groundwater abstraction and aquifer recharge, hydrologists began warning against continuing a policy that depended on consuming so much water from natural sources. They noted that, in addition to overpumping, pollution was endangering aquifers. The situation, they said, could make it necessary to shut down pumps and decrease the amount of water made available for use. Despite these warnings, leaders showed no willingness to reform policies or invest in new technologies, such as sea-water desalination. The lack of will to push through longer-term, sustainable policies and technological development meant the government had to pursue interim solutions.

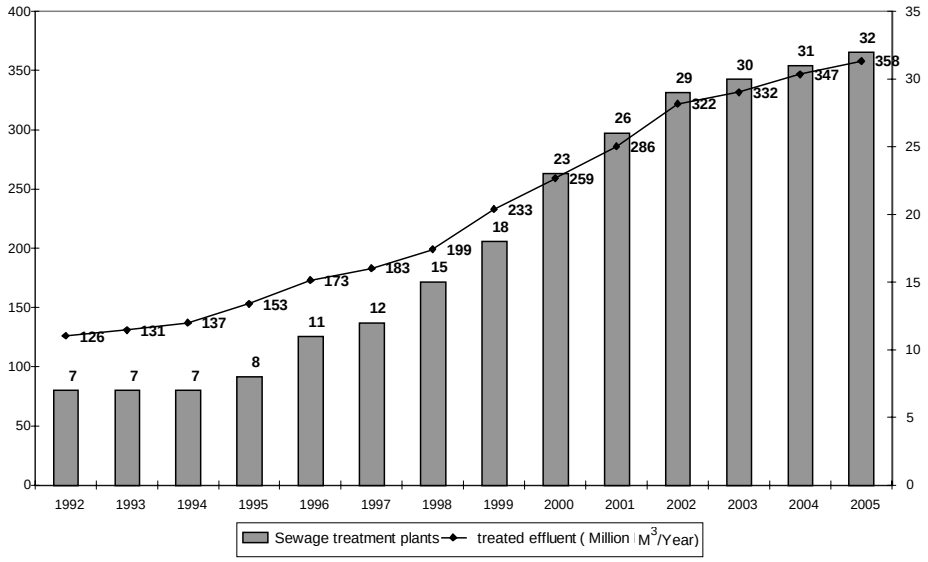
2000-03: renewed government investment and start of private investment in water infrastructure

Three drought years (1999-2001) brought the national water system to such a crisis that it was no longer possible to delay reform. In the short term, a state of emergency was declared in the national water system, volumes of water designated for agriculture were reduced and the price to farmers was increased almost to the price of water supplied to municipalities. Many Israeli water experts had pointed out that cheap water, combined with border protection, encouraged production of water-dependent crops, thereby contributing to the water crisis. The price increase forced growers of crops such as cotton to use only treated effluent for irrigation, while the area of crops for which the Ministry of Health did not allow irrigation with effluents (e.g. fruit and vegetables) was reduced.

The government approved a series of investments to improve reservoirs. Studies on meeting the needs of Israel and neighbouring countries over the following 20 years estimated that annual water consumption in Israel in 2025 could reach 2.5 billion cubic metres (compared with 1.8 billion today), with 700 million cubic metres a year coming from desalination. Tenders were issued for desalination and wastewater treatment plants. Plans on preventing pollution of water sources were drawn up. In addition, it was decided to spend ISL 20 million (USD 4.5 million) per year on water-conservation projects for five years.

Some of these projects are to be financed out of government budgets and some are being undertaken by the private sector as BOT projects. Approximately 45% of a total ILS 18 billion investment in the national water system planned for the next decade will come from the private sector. The first tender for a desalination plant yielded a price of USD 0.52 per cubic metre — lower than even the most optimistic forecast. The tender was won by a group of Israeli and foreign companies. For major infrastructure, the practice of integrating Israeli and foreign management and technologies, together with strong financial backing from a foreign group, seems likely to continue. Tenders have also been issued for wastewater treatment plants to increase the amount of effluent recycled for irrigation (Figure 1).

Figure 1. Numbers of sewage treatment plants and quantity of treated effluent



Source: MoE.

Another means of increasing the amount of water available in Israel is to import water by sea from Turkey. In February 2004, following two years of negotiations, the governments of Turkey and Israel signed an agreement by which Turkey would sell Israel 50 million cubic metres of water annually over 20 years, meeting some 3% of Israel's requirements. The water, from Turkey's Manavgat River, is to be transported by tanker. Critics have noted that desalination plants could provide water more cheaply. The deal was nevertheless concluded, in part to cement strategic and economic ties between the two nations.

The influence of water management policies on demand for EG&S

Israel is a world leader in water resource management and water-related technologies. In the past, the need for water led Israel to develop and adopt new technologies. Today, new technologies are needed again to overcome the freshwater shortage. The current consensus is that the way to improve the water system is through activities to protect natural water reservoirs, use existing water more efficiently and increase the potential quantity of water available for consumption. Demand for the following technologies and environmental services is expected to increase as a consequence:

- **Desalination technologies.** Plans call for increasing sea-water desalination capacity to about 400 million cubic metres by 2010 and to build plants in southern Israel to produce drinking water from brackish groundwater.

- **Technologies to improve effluent quality.** The quality of treated wastewater needs to be improved so that it can be used for irrigation without harming the soil and aquifers. Most existing sewage treatment plants perform only secondary treatment. By 2005 plants have to meet new standards (Table 5) and carry out additional treatment for nutrients.

- **Repair services for water-conveying systems.** Fines for irregular water use, combined with incentives for water economy, are expected to encourage the replacement of old water pipelines and pumping systems with more sophisticated control systems.

- **Air-conditioning systems based on air-cooled condensers.** The MoE is trying to spearhead a move to get industrial buildings and large commercial centres to switch to air-conditioning technologies using air instead of water as the cooling medium, since water-based systems not only consume water but also increase the salinity of effluents reaching groundwater.

- **Low-salt industrial water softeners**. Sodium ion-exchange water softeners, commonly used in industry, are big contributors to the saltiness of wastewater. After a 1995 regulation limited the amount of salt that could be discharged to the sewage system, factories started searching for ways to reduce the concentrations of salt their water softeners discharged. One technology softens water through an electro-chemical process. Some companies involved in developing this process now market the technology not only in Israel but also abroad.

- **Small industrial effluent treatment systems.** To avoid overloading municipal treatment systems with pollution, industries are required to treat their effluent before it leaves the factory. Recent remarkable improvements in membrane quality, enabling membranes to function longer and with higher pollutant concentrations, have led more factories to install small treatment systems combining media filters, biological treatment and membrane filtration. Most of the membranes are imported from Germany, the Netherlands and the United States.

River restoration

Background

Israel has about 16 principal rivers flowing to the Mediterranean Sea and some 25 others flowing to the Jordan River and the Sea of Galilee. In the past, water flowed abundantly in most of these rivers, and rich ecosystems and scenery thrived on their banks. Today, Israel's rivers are in a parlous state as a result of decades of neglect. They have gradually dried up, tapped to supply drinking and irrigation water for large development projects and at the same time becoming conduits for household, industrial and agricultural effluents.

Despite environmental laws protecting rivers against water pollution, and protests by environmental activists and academics, no real action was taken against major polluters until the mid-1980s. One large factory discharging to the Kishon River ignored court orders to clean up its effluent for 20 years. With the rise in public environmental awareness and the establishment of the MoE, the situation changed. Environmental decision makers realised that preventing river pollution was a public obligation and that there was strong demand to return green areas to the public and repair damaged ecosystems. In 1980, when Israel signed the Barcelona Convention Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources (which it ratified in 1991), preventing sea pollution caused by polluted rivers became an international obligation as well.

River restoration in Israel began in 1989 when the Ministries of Agriculture and the Interior and the EPS established the Yarkon River Authority, which became an agency of the MoE after that ministry was formed. In 1993 the MoE and the Jewish National Fund (JNF) set up the National River Administration to co-ordinate responsibilities, budgets, professional expertise and operations. A year later the Kishon River Authority was established.

The River Administration co-operates with the MoE, the Water Commission, various river-related central government offices, the Nature and Parks Authority and the local authorities adjacent to rivers

scheduled for restoration. It has a national control team composed of experts from the MoE, the JNF, the Water Commission and the Ministry of Tourism, working with professionals involved in river restoration. Recently the River Administration established 12 regional administrations, which work under the leadership of local authorities adjacent to rivers, and two independent administrations for the Yarkon and Kishon rivers. All these administrations have prepared or nearly finished a master plan, and some have prepared statutory plans for the preservation of open space. Physical restoration and landscaping of the Kishon, Taninim, Hadera, Alexander, Yarkon, Lachish, Be'er Sheva and Herud rivers has commenced.

The influence of river restoration on demand for EG&S

River restoration requires major investments in environmental services and technologies. In 1999, at the invitation of the MoE and the JNF, a year-round work plan for the restoration of Israel's rivers was prepared. It recommends priorities for planning and implementation and the amount of funding needed. The funds required are estimated at ILS 1.8 billion (USD 410 million) over 12 years, of which ILS 1.1 billion (USD 250 million) is for cleaning up pollution (mainly by building wastewater treatment plants) and ILS 700 million (USD 158 million) is for engineering and construction.

From 1993 to 2003, the public sector directly invested more than ILS 150 million in the restoration of river environs. This money funded environmental services such as planning, supervision and security, as well as drainage infrastructure, cleaning, park development and the like. In addition, stricter water-quality standards and increased levels of enforcement meant the private sector had to invest heavily in improving effluent treatment systems and acquiring non-polluting technologies (Box 3).

Sewage treatment plants have had to upgrade their effluent quality to discharge treated sewage into rivers without harming the ecosystem, and the standard was further raised to require that discharges also not pollute groundwater. Technologies used at the latest sewage treatment plants can meet the new standard, which was to be raised again in 2005 (Table 5). At present, 37 sewage treatment plants are being planned or built at a cost of ILS 400 million (USD 90 million), some under BOT arrangements.

Until recently, the standard for treating municipal effluent was determined by the levels of biological oxygen demand and total suspended solids. Nutrients like nitrogen and phosphorus were not defined as problems since much of the treated effluent ended up irrigating crops, which need nutrients. In 2002, a stricter standard was defined for non-restricted irrigation and for effluents discharged to rivers (Table 5). It will necessitate considerable investment in enlarging existing treatment plants or retrofitting them with new technologies, or in building new plants. As of early 2005, the new standard had not been formalised because no decision had yet been taken on how to allocate the money, but the MoE is giving permits to discharge effluents to rivers only if the effluents meet the new quality standard. Many plants for which discharge into a river is the least-cost option will have to invest in new technologies to meet the standard.

A number of funding possibilities are being examined for river rehabilitation projects. A survey estimating the rise in land values near new parks forecasts increases of 15-20%. Since the land adjacent to the rivers is public land, it has been suggested that it would be in the interest of the Israel Land Administration (the government agency that manages public lands in Israel) to help finance the projects. Other ideas include asking corporations to sponsor streams or sections of streams as a form of corporate image enhancement, and raising funds or obtaining in-kind maintenance services in parks and hiking areas by selling franchises for commercial activity in these areas. Such approaches would help rivers become environmental and commercial assets rather than a burden on the public budget.

Table 5. 1992 sewage treatment standard and new standards for irrigation and river discharge

	EC dS/m	BOD mg/l	TSS mg/l	COD mg/l	N_{total} mg/l	P_{total} mg/l	Cl mg/l	Na mg/l	pH

1992 standard for sewage treatment plants	—	20	30	—	—	—	—	—	—
New standard for agricultural use without restrictions	1.4	10	10	100	20	5	250	150	6.5-8.5
Standard for discharge into rivers	—	10	10	70	10	0.2	400	200	7.0-8.5

Notes:

EC = electrical conductivity
dS/m = deci-Siemens per metre
BOD = biological oxygen demand
mg/l = miligrammes per litre
TSS = total suspended solids
COD = chemical oxygen demand

Source: MoE.

Experience in river restoration in developed countries has mainly been with temperate-zone rivers. Israel's rivers have the characteristics of Mediterranean rivers, which require other restoration methods. River restoration is important not only for those living near rivers but also regionally, as Israel has pledged in international agreements to prevent pollution of the Mediterranean. Israel already has recorded successes, such as the Alexander River restoration project (executed by the in co-operation with local Palestinian authorities), which won the Theiss International Riverprize at the 2003 Riverfestival contest in Brisbane, Australia. Israeli experience and research in this field could prove useful to those planning restoration in other parts of the world with similar conditions.

Box 3. The Kishon River restoration project

The 70-km Kishon River is one of Israel's largest coastal rivers. The final 7 km to the Mediterranean Sea at Haifa Bay are heavily polluted by industrial and municipal effluents. Some fishers and navy personnel who have worked in these waters have become seriously ill as a result. The Kishon stands out as one of Israel's most serious cases of pollution and ecosystem damage.

The pollution began in the 1930s, and as early as the 1940s the final section of the river was classified as "dead". In the 1970s and 1980s, Israeli professionals and environmental organisations began to demand that those then responsible for the environment take action to halt further pollution of the river. International organisations also protested the discharge of sewage into the river, because it contributed to pollution of the Mediterranean Sea.

In 1994, the Kishon River Authority was formed to prepare a master plan for pollution clean-up and prevention. The long-term goal was to make the river an environmental resource for the public and a green area for the Haifa municipal area and its environs. The plan required the large polluting factories and the Haifa sewage treatment plant to adopt the best available technology and mandatory schedules to significantly minimise discharges through the beginning of 2002. These pollution sources invested USD 125 million in new sewage treatment technologies. As a result, pollutant discharges fell by more than 90%. Improvement at the sewage treatment plant allowed the treated wastewater to be used for irrigation, thereby decreasing the volume of effluents discharged into the river. The schedules set out in the master plan also require the factories and sewage treatment plant to add storage reservoirs in the future (as a contingency measure in the event of an accident) and to upgrade their monitoring systems.

Much work remains to be done, such as removing the toxic sludge that has built up on the riverbed, cleaning up the river banks and establishing an automated monitoring system. Life has started to return to the river but the ecosystem is not yet fully restored. Because sewage treatment does not remove salts, the salinity of effluents has not declined. A plan recently adopted by the MoE suggests constructing a pipeline to carry treated effluents directly to the Mediterranean Sea, on the theory that brine, which harms the freshwater river ecology, would not pollute the Mediterranean. The plan was recommended by an international consulting company hired by the MoE, and was endorsed by independent Israeli experts. But international environmental organisations, including the Mediterranean branch of Greenpeace, claim that the amount of effluent would still be too great, and the pollution and salt loads too heavy, for discharge into the sea and that such a pipeline would make it difficult to monitor pollutants discharged by the factories.

The capital costs of the Kishon River project were estimated in 2001 at ILS 206 million (USD 45.2 million) over 12 years. Funding will also have to be found for maintenance costs. As in all river restoration projects, the investment funds will eventually reach companies that provide environmental services (e.g. planning and consulting, supervision, cleaning, management) and that are involved in building infrastructure and supplying environmental technologies.

Summary

The rise in public environmental awareness and recognition by public institutions that environmental problems could no longer be ignored brought about a fundamental change in Israel's environmental policies during the 1990s. The main thrust of the new policies was that Israel should achieve environmental quality standards equivalent to those of developed countries.

Implementation of these policies led to an increase in the size of Israel's EG&S market. The new emphasis on environmental protection spurred a rise in demand for types of technology not previously found in the Israeli market. Free-trade agreements between Israel and the countries where most of the technologies concerned are manufactured facilitated Israeli import of EG&S. Technology-oriented Israeli manufacturers found new opportunities in this area and soon started developing technologies for use in Israel, often adapting imported technologies to the local market's needs.

Joint ventures between foreign and local companies were beneficial for both sides. The Israeli companies benefited from the foreign companies' experience when participating in government procurement tenders, and the foreign companies benefited from local knowledge and contacts. The major barriers for the foreign companies in Israel were (and still are) the political situation and the relatively small size of the market.

In the future, the MoE's activities will continue to determine the areas of EG&S market development by prioritising enforcement and investing public funds. Substantial investment will be necessary in coming years to address problems related to water supply, sewage treatment, river restoration and management of municipal and hazardous waste.

The Israeli economy has been in recession, obliging the government to cut expenses, creating a difficult finance situation for local authorities and making it difficult to complete planned infrastructure projects. Therefore, ways to increase private-sector financing for such projects (e.g. BOT projects and privatising parts of the central water supply and sewage treatment systems) should be examined.

Encouragement of R&D in environmental technology will spur development of the EG&S industry and provide a sounder basis for addressing environmental problems specific to Israel. Relaxing the requirement of proven technology in government procurement would encourage private investment in R&D.

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Annex 1
Major multilateral environmental agreements (MEAs) signed or ratified by Israel

***MEAs and related agreements to which Israel is a party*[1]**

- International Plant Protection Convention, 6 December 1951 [1961]
- Antarctic Treaty, 1959 [1975]
- International Convention for the Protection of New Varieties of Plants (UPOV), 1961, as revised at Geneva, 1972, 1978 and 1991 [in 1999 ratified 1978 Act]
- International Convention for the Conservation of Atlantic Tunas, 14 May 1966 [1969]
- International Convention on Civil Liability for Oil Pollution Damage London (as amended 19 November 1976 and 25 May 1984), 29 November 1969 [1977]
- Convention for the Conservation of Antarctic Seals, 1 June 1972 [1991]
- Convention for the Protection of the World Cultural and Natural Heritage, 23 November 1972 [1977]
- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 29 December 1972 [1982]
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington), 1973 [1975]

  Amendment to Article XI of the Convention (Bonn), 22 June 1979 [1987]

- Convention on the Prohibition of Military or any Other Hostile Use of Environmental Modification Techniques, 18 May 1977 [1984]
- Treaty for Amazonian Cooperation, 3 July 1978 [1980]
- Convention on the Physical Protection of Nuclear Material, 3 March 1980 [1987]
- Convention on the Conservation of Antarctic Marine Living Resources, 20 May 1980 [1986]
- United Nations Convention on the Law of the Sea, 10 December 1982 [ratified 1988; in force in 1994]
- Convention for the Protection of the Ozone Layer (Vienna), 1985 [1990]

  Protocol on Substances that Deplete the Ozone Layer (Montreal), [1990]

  London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (London), 1990 [1992]

  Copenhagen Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (Copenhagen), 1992 [1997]

- Convention on Early Notification of a Nuclear Accident, 26 September 1986 [1991]
- Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel), 1989 [1992]

1. The figure in brackets is the year the MEA entered into force in Israel.

- International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC) (London), 1990 [1998]
- United Nations Framework Convention on Climate Change (New York), 1992 [1994]
- Convention on Biological Diversity (Rio de Janeiro), 1992 [1994]
- United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (Paris), 1994 (1996).
- International Tropical Timber Agreement (Geneva), 1994 [1997]

MEAS signed or ratified but not yet in force[2]

- Convention on the Regulation of Antarctic Mineral Resource Activities, 2 June 1988 [signed 1988]
- Protocol to the Antarctic Treaty on Environmental Protection, 4 October 1991 [signed 1992]
- The Kyoto Protocol to the United Nations Framework Convention on Climate Change (Kyoto), 1997 [ratified 2002]
- Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (Rotterdam Convention on PIC), 1998 [signed 1999]
- Stockholm Convention on Persistent Organic Pollutants (POPs), 2001 [signed 2001]

2. The figure in brackets is the year Israel signed or ratified the MEA.

Annex 2.
Israel's environmental indicators in relation to indicators of wealthy nations

Indicator	Country data	Group data (high income)
Population (millions)	6.40	957.00
Urban population (% of total)	91.80	77.50
GDP (USD billions)	108.00	24 887.00
GNI per capita, Atlas method (USD)	16 750.00	26 510.00
Agriculture		
Land area (1 000 km^2)	21.00	31 018.00
Agricultural land (% of land area)	28.00	36.00
Irrigated land (% of crop land)	46.40	12.00
Fertiliser consumption (100 grams/ha arable land)	3 213.00	1 196.00
Food production index (1989-91 = 100)	115.00	115.00
Population density, rural (people/km^2 arable land)	156.00	193.00
Forests		
Forest area (1 000 km^2)	1.00	8 034.00
Forest area (% of total land area)	6.40	26.10
Annual deforestation (% change, 1990-2000)	-4.90	-0.10
Biodiversity		
Mammal species, total known	92.00	..
Mammal species, threatened	14.00	..
Bird species, total known	180.00	..
Bird species, threatened	12.00	..
Nationally protected area (% of land area)	15.80	19.50
Energy		
GDP per unit of energy use (PPP$/kg oil equiv)	6.50	4.90
Commercial energy use per capita (kg oil equiv)	3 241.00	5 430.00
Energy imports net (% commercial energy use)	97.00	26.00
Electric power consumption per capita (kWh)	6 188.00	8 617.00
Share of electricity generated by coal (%)	69.00	38.40
Emissions and pollution		
CO_2 emissions per unit of GDP (kg/PPP$ GDP)	0.50	0.50
CO_2 emissions per capita (Mt)	10.00	12.30
Particulate matter (pop.-weighted average—µg/m3)	52.00	..
Passenger cars (per 1 000 people)	228.00	443.00
Water and sanitation		
Freshwater resources per capita (m3)	273.00	9 672.00
total (% total water resources)	94.00	..
agriculture (% total freshwater withdrawal)	54.00	42.00
Under-5 mortality rate (per 1 000 live births)	6.00	7.00
National accounting aggregates - 2001		
Gross national savings (% GNI)	14.90	23.30
Consumption of fixed capital (% GNI)	13.20	13.20
Education expenditure (% GNI)	6.60	5.00
Energy depletion (% GNI)	0.00	0.80
Mineral depletion (% GNI)	0.00	0.00
Net forest depletion (% GNI)	0.00	..
CO_2 damage (% GNI)	0.40	0.30
Particulate emission damage (% GNI)	0.00	0.30
Adjusted net savings (% GNI)	..	13.70

Source: World Bank