Israel 2050
A Thriving Economy in a Sustainable Environment

Carbon Pricing in Israel

THE ISRAEL DEMOCRACY INSTITUTE

המשרד להגנת הסביבה
الوزارة لحماية البيئة
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ISBN: 978-965-519-288-9

Printed in Israel

Authors

Prof. Nathan Sussman (team leader), Israel Democracy Institute and Graduate Institute Geneva

Dr. Ruslana Rachel Palatnik, Israel Democracy Institute, University of Haifa, and Max Stern Yezreel Valley College

Dr. Ayelet Davidovitch, Israel Democracy Institute and IIASA

Yuval Laster, Ministry of Environmental Protection

Amir Zalzberg, Ministry of Environmental Protection

Avital Eshet, Ministry of Environmental Protection

Ron Kamara, Ecotraders, Ltd.

Sophia Igdalov, Ecotraders, Ltd.

Hila Shoef Kollwitz, Israel Democracy Institute and Tel Aviv University

Editors

Yuval Laster, Avital Eshet, Amir Zalzberg

Acknowledgments (in alphabetical order)

Dr. Shmuel Abramson, Daphna Aviram-Nitzan, Dr. David Assaf, Dr. Hanit Ben-Ari, Hagit Ben-Hamo, Dr. Adi Brander, Koby Buzo, Lior Gallo, Yogev Gross, Gai Harpaz, Sharon Hazor, Dr. Yitzhak Kedem, Hallel Khaeile, Prof. Doron Lavie, Dr. Yossi Margoninski, Shani Mendel Laufer, Natalia Mironichev, Ido Mor, Dr. Gil Proaktor, Dr. Arik Rivkin, Michael Ritov, Uri Ziskind

Translated to English by Naftali Greenwood

This document is a translated and shortened version of a policy document published by the Ministry of Environmental Protection.

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Abstract

● Carbon pricing is meant to solve the major market failure that occurs when a polluter does not pay for the damage caused by its greenhouse-gas emissions. Carbon pricing is considered a highly effective way of promoting reductions in greenhouse-gas emissions; it also creates market certainty. Thus, leading international economic organizations recommend its use. Many studies show that it encourages the reduction of greenhouse-gas emissions in practice.

● Carbon-pricing mechanisms are practiced in many countries that are signatories to the Paris Agreement, OECD member countries in particular. These mechanisms have been gaining momentum in recent years as countries extend carbon pricing to more and more sectors and establish increasing price trajectories in order to make sure they meet their international commitments under the United Nations Framework Convention on Climate Change. Israel is also committed to reducing its greenhouse-gas emissions as part of the global effort to curb global warming.

● Two carbon-pricing mechanisms are used around the world, either separately or combined: a carbon-tax mechanism, in which the price per ton of emission is predetermined commensurate with the carbon content of fuels; and an emissions-trading (cap-and-trade) mechanism, in which an emissions quota is predetermined and the price per ton emitted is determined in the market.

● A comparison of these two pricing mechanisms shows that in Israel's case, a carbon tax has many advantages over emissions trading, chiefly in terms of simplicity of collection (using the existing fuel-excise mechanism), a stable and foreknown price that allows the manufacturing sector to make long-term plans to reduce emissions, and the possibility of applying the tax to a broad range of sectors. For several years now, the OECD has been specifically urging the Government of Israel to consider carbon pricing by means of a carbon tax on fuel via the excise mechanism.

● An analysis of the external costs of fuel use in Israel vis-à-vis the excise mechanism indicates that the excise on fuel used for manufacturing and electricity production does not reflect the full external costs of air-pollutant and greenhouse-gas emissions. Furthermore, the transport fuel sector has additional external costs, including some that are unrelated to the environment—congestion and road accidents—and the excise falls far short of covering them in full. These disparities reflect a market failure that carbon pricing is meant to remedy.

● Carbon-emissions pricing by means of the fuel excise would cover some 80 percent of Israel's greenhouse-gas emissions. By combining it with internalization of the external cost of these emissions in the waste-treatment sector (8 percent of total emissions) and applying a Kigali amendment to reduce hydrofluorocarbon (HFC) consumption (7 percent of emissions), 95 percent coverage of greenhouse-gas emissions in Israel may be attained.

● A macroeconomic study that examined the implications of the transition to a low-carbon economy for economic growth found that carbon taxation alone would cause greenhouse-gas emissions to fall considerably—by 67 percent relative to 2015. An even higher rate is attained in a scenario that backs the tax with policy measures. Without taxation, in contrast, a 35 percent increase in emissions relative to 2015 is forecasted. It was also found in the study that a carbon tax would have a negligible effect on economic growth. Alongside the macroeconomic study, the expected savings to the economy as a result of cutting back on fossil-fuel use in order to reduce local air-pollutant emissions were calculated. This analysis shows that applying a carbon tax in Israel would save the economy some NIS 20 billion by reducing air pollution by 2050.

● A carbon tax, like other indirect taxes, has a regressive effect on household income and may aggravate economic inequality. A study on the impact of a carbon tax on households in Israel found that such a measure would increase inequality due to the high electricity consumption relative to income among households in low-income deciles. It was also found that households in peripheral localities are liable to be the most affected by a carbon tax. It is noteworthy in this context, however, that the authors of that study assumed that the carbon tax would raise the price of transport fuel, a step that Israel does not intend to take at the present time. To mitigate these adverse effects, many countries earmark the revenues from carbon pricing to policy measures and social projects that aim to ease the burden on low-income households.

● Carbon pricing may also affect the competitiveness of energy-intensive industries that are exposed to international trade. Therefore, many countries apply exemption mechanisms up to a certain emissions limit, create financial incentives to encourage industry to switch to clean energy sources, and promote border-adjustment tax mechanisms. In an analysis of the impact of a carbon tax on the competitiveness of Israeli industry, it was found that the competitiveness of several manufacturing sectors may indeed be negatively impacted: chemicals and chemical products, rubber and plastics, textiles and clothing, and nonferrous minerals (the cement industry). However, given that some destination countries of Israel's manufacturing exports are planning border-adjustment tax arrangements, it is reasonable to assume that certain sectors of Israeli industry will have to pay a tax to these countries. In the long term, carbon taxation incentivizes the development of green technologies and, for this reason, may improve the competitiveness of energy-intensive industries that are forced to adjust to the trend of transitioning to a sustainable and low-carbon economy.

- The carbon-pricing roadmap proposed in this study rests on several principles: The carbon tax will be applied by means of the existing excise mechanism. In the manufacturing and electricity sectors, the tax will be applied gradually in lieu of the excise until its level is equal to that of the external cost of carbon each year. In the transport sector, Israel's excise taxes are high by world standards; therefore, the carbon tax will be earmarked as a distinct component of the excise but will not be added to the excise—thus not making fuel more expensive.

- It is important to accompany the imposition of the tax with measures that compensate households, businesses, and industry, on the one hand, and that, on the other hand, incentivize energy efficiencies and technological transition to reduced-emission fuels in the long term. Examples of such measures are the support of efficiency-enhancing projects in the energy, manufacturing, and public trading sectors; electrifying the fleets of heavy vehicles (buses and trucks); subsidizing EV charging stations; subsidizing green construction of schools; and offering cash credits or vouchers to households in low-income deciles. Flexibility and protective mechanisms that would lighten the tax burden on industry and attenuate the potential adverse effects on competitiveness should also be considered.

Chapter 1 Background

1.1. Scope of the climate crisis, the wake-up call, and the response in international accords

According to the 2018 report from the Intergovernmental Panel on Climate Change (IPCC, 2018), the 1°C global average increase in temperature observed in recent decades is making the realization of climate risks more and more likely. Unless a further increase is forestalled during the narrow ten-year window of opportunity available to us, these threats will manifest much more widely and lead to radical change in our ways of life and those of coming generations. Added to this is the global effort to cope with the COVID-19 pandemic, which heightened the need for countries to gear up for crises and emphasized the importance of making bold decisions to avoid the heavy price of inaction.

At the UN climate conference held in December 2015 in Paris, a binding global agreement for fighting climate change was approved. The Paris Agreement is an important milestone in promoting the global transition to a low-carbon economy,[1] creating a systematic action plan for addressing climate change and detailing the obligations of the countries involved. However, according to a report issued in November 2019 by the

1 In this document, "carbon" denotes carbon dioxide, CO_2.

United Nations Environmental Programme,[2] even if the countries that signed the Paris Agreement meet the mitigation targets to which they pledged, average temperatures will still rise by 2.9°–3.4°C by 2100 relative to the preindustrial mean. The report warns that countries must triple their mitigation efforts in order to meet the target of holding the average increase to 2°, and must quintuple their mitigation efforts to attain the objective of limiting the average increase to 1.5°.

Global experience shows that setting targets does not assure their attainment; indeed, in various countries the target set and actual greenhouse-gas (GHG) emissions are far apart. Therefore, the policy tools that countries deploy to meet their targets are of decisive importance. **Experts on this issue agree that carbon pricing is the most efficient and effective way to promote long-term GHG emission abatement in large areas of the economy and to create market certainty.**[3] This consensus is reinforced by the "Economists' Statement"—a document signed by more than 3,500 economists worldwide that emphasizes the importance of carbon taxation for addressing the climate crisis.[4] Similarly, economic analyses conducted by leading international organizations such as the OECD, the International Monetary Fund (IMF), the World Bank, and the European Commission have shown that carbon pricing allows emission-mitigation objectives to be attained without meaningful deviation from

2 United Nations Environment Programme, *Emissions Gap Report 2019* (Nairobi: UNEP, 2019).

3 F. Flues and K. van Dender, "Carbon pricing design: Effectiveness, efficiency and feasibility: An investment perspective," *OECD Taxation Working Papers*, No. 48, (Paris: OECD Publishing, 2020); International Monetary Fund (IMF), *Fiscal Monitor: How to Mitigate Climate Change* (Washington DC: IMF, October 2019).

4 "Economists' Statement on Carbon Dividends Organized by the Climate Leadership Council," *Wall Street Journal*, January 16, 2019.

GDP growth targets. An examination of the potential effect of introducing carbon taxation in Israel found that Israel is no exception.[5]

Carbon pricing is meant to correct a serious market failure that occurs when the environmental and health costs of GHG emissions in production and consumption are not reflected in market prices. With carbon pricing, the external costs of GHG emissions can be internalized and factored into market prices, handing the burden of the tax to those responsible for the polluting activity (producers and consumers alike).

1.2. International organizations recommend carbon taxation as an effective tax-based mechanism for correcting the market failure

The IMF has found carbon taxation the most effective way to curb greenhouse-gas emissions and meet the global warming restraint targets to which the signatories of Paris Agreement committed. In the IMF's judgment, the carbon tax to be imposed should rise gradually to USD 75 per tonne in 2030. This level of taxation would increase the price of energy consumption from polluting sources (such as fossil fuels or electricity produced from them) and encourage investment in emission-mitigating technologies, energy efficiency enhancement, and energy consumption from renewable sources.[6]

5 Nathan Sussman et al. (2020). *Israel 2050–A Flourishing Economy in a Sustainable Environment: Effects of the Program on Macroeconomic Growth in Israel* (Jerusalem: Israel Democracy Institute, 2020) [Hebrew].

6 IMF, *Fiscal Monitor*.

The OECD also urges its member countries to introduce carbon taxes. According to its recommendation, in order to meet the Paris Agreement targets the carbon-tax rates should stand at €40–80 per tonne of carbon by 2020 and €50–100 per tonne by 2030.[7]

It is worth noting that carbon taxes may be an especially effective tool at this time, against the backdrop of the COVID-19 crisis and the economic slowdown. Countries may use the revenues generated by the tax to help their economies exit the crisis, while deploying green and sustainable growth generators, a matter that squares with both global trends and economic targets.

1.3. The price of carbon emissions and how it is set

Environmental economists offer two possible approaches toward estimating the external cost of carbon:[8]

(**1**) **The "social cost of carbon" (SCC) approach** estimates the external cost by calculating the damage caused by the emission of one tonne of carbon into the atmosphere. According to this approach, mitigating carbon emissions (e.g., by charging a carbon tax) is economically worthwhile as long as the requisite investment is lower than the cost of the emissions to society. Thus, this approach attempts to estimate the loss of social wellbeing as a result of environmental hazards. Considering damage to health, for example, it

7 Flues and van Dender, "Carbon pricing design"; OECD, *Accelerating Climate Action in Israel: Refocusing Mitigation Policies for the Electricity, Residential and Transport Sectors* (Paris: OECD Publishing, 2020).

8 Ministry of Environmental Protection, *The Green Book-External Costs of Air Pollutants and Greenhouse Gases* (updated) (Jerusalem: Ministry of Environmental Protection, 2020) [Hebrew].

is customary to estimate the economic damage associated with the cost of healthcare, loss of income, and premature mortality. The United States Environmental Protection Agency (EPA) uses this approach to calculate the externalities of GHG emissions. In February 2021, in accordance with an executive order signed by President Biden on the day he entered office,[9] the most up-to-date external costs were published, to be in effect for one year. During this year, expert teams in the United States were tasked with determining whether and how the models should be adjusted in view of the latest studies on the ravages of climate change.[10]

(**2**) **The cost-of-mitigation/prevention approach** estimates the cost of preventing/mitigating GHG concentration in accordance with a predetermined mitigation target. The assumption is that these targets reflect a collective preference. Therefore, the public's willingness to pay for mitigating or preventing carbon-emission damage needs to be estimated and a minimum marginal cost approach adopted (using the cost of mitigating an additional tonne of carbon, as distinct from the average cost per tonne of mitigation) in order to attain the GHG-emission mitigation targets set. The estimate is based on the use of various emission-mitigating technologies that will be available at different periods of time. For example, in a document produced for the European Union, the Delft consulting firm used the value of €100 per tonne of carbon to express the medium-term cost (up to 2030). For the long-term (2060), the cost calculated was €269 per tonne of carbon.[11]

9 The White House, *Executive Order on Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis*. January 20, 2021.

10 Interagency Working Group on Social Cost of Greenhouse Gases, United States Government, *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide-Interim Estimates under Executive Order 13990* (Washington DC: White House, 2021).

11 European Commission, Directorate-General for Mobility and Transport, Essen, H., Fiorello, D., El Beyrouty, K., et al., *Handbook on the external costs of transport*, Version 2019 – 1.1 (European Commission Publications Office, 2020).

1.4. Carbon-pricing mechanisms

Leading countries use two types of carbon-pricing mechanisms: carbon emission taxation (price intervention) and emissions trading (quantity intervention). Although each mechanism may operate on its own, the two are often integrated.

Carbon tax

A carbon tax is a mechanism for intervening in the prices of carbon-intensive inputs and products in order to internalize the external costs of the carbon and, by so doing, establish a new equilibrium at lower quantities of emissions. The higher the tax on carbon-intensive products, the more it will act as an incentive to reduce emissions. A carbon tax may be imposed on all sectors—energy-intensive or not—as well as on all greenhouse gases and not only carbon.[12]

On which sectors is carbon taxation applied?

Around the world, carbon taxation was applied initially only to the use of fuels for industry and electricity production. In recent years, however, several countries have extended it to additional sectors such as households and transport. Norway, for example, has expanded it in this manner, and Germany has introduced a new tax on fuels for transport and households (home heating). There is even a tendency to broaden the tax to all sectors of the economy, including waste management, agriculture, and others, in order to assure the taxation of all GHG emissions.[13]

12 Flues and van Dender, "Carbon pricing design."

13 World Bank, *State and Trends of Carbon Pricing 2020* (Washington, DC: World Bank, 2020), https://openknowledge.worldbank.org/handle/10986/33809.

As a rule, the larger the quantity of GHG emissions covered by carbon taxation, the more effective the tax is. Emissions not covered may impair the effectiveness of the tax in two main ways. First, once an emission is not covered, no incentive exists to mitigate it, resulting in emission-mitigation methods that exist but are not used. Second, non-coverage incentivizes the transfer of emissions from a taxed product to the alternative untaxed product. For example, taxing carbon emissions from the incineration of waste as a source of fuel but not taxing methane emissions from landfill may create an economic distortion that will encourage burial of waste instead of incineration, for energy reclamation purposes.[14]

How is a carbon tax charged and collected?

A carbon tax can be calculated and imposed in two ways:

- As a tax calculated on the basis of the carbon content of each fuel used, defining collection in units of currency per tonne of fuel.
- As tax on emissions calculated by measuring the quantity of carbon emitted from a smokestack or from some other source.

Around the world, it is common practice to tax fuels on the basis of their carbon quantity and to collect the tax at the stage of fuel importation or purchase. This method is used in Ireland, the UK, Denmark, Japan, Mexico, Norway, Finland, Sweden, Switzerland, and other countries.[15]

Taxation of fuel on the basis of carbon content is considered an accurate method of emission pricing due to the direct and one-to-one relation that exists between the carbon content of a fuel and the quantity of emissions that its combustion produces.

14 Flues and van Dender, "Carbon pricing design."

15 Ministry of Environmental Protection, *Examining the Potential for Reducing Greenhouse-Gas Emissions and Recommending a National Target in Israel* (Jerusalem: Ministry of Environmental Protection, 2015) [Hebrew].

Fuel-based taxation is also less costly than emissions-based taxation from an administrative standpoint because it does not require individual calculations of emissions quantities. Thus, it obviates the need for a complex system for monitoring, measurement, verification, and so on. This kind of taxation may be integrated into an existing excise mechanism, saving on the costs of setting up and operating a new tax system.

Emissions trading systems (ETS)

An emissions trading system (ETS) promotes the efficient allocation of emissions mitigation on the basis of the cap-and-trade principle. By setting a permissible emission cap and allowing players to trade in permits, an ETS steers the mitigation efforts toward those who can reduce emissions at the lowest cost.[16] This means that an enterprise that finds its emissions hard to cut may purchase an emissions allowance (in accordance with predetermined allocations) from enterprises that have greater ability to reduce emissions.

In an ETS, the quantity of permits is predetermined and permit price is set by the market (in contrast to a carbon-tax mechanism, in which the price is predetermined and the quantity of emissions is set by the players in the market). When demand for allowances rises, the allowance price goes up commensurably while the supply of allowances remains constant. Trading in emissions resembles trading on the stock exchange, with the price of emissions changing each day in accordance with demand. The initial allocation of permits may be distributed to companies at no charge or sold by auction. Concurrently, a trend of establishing a "floor price" has been identified in recent years; its purpose is to assure that the trading prices are high enough, less volatile, and conducive to lower emissions. Notably, setting a "floor price" is, in effect, the application of a carbon tax, the rate

16 OECD (2011). "Interactions between Emission Trading Systems and Other Overlapping Policy Instruments."

of which can only surpass the floor price, depending on market and trading conditions. Various countries, including Denmark, the UK, France, and the Netherlands, apply floor prices today.[17]

In Europe, the emissions-trading system (EU ETS) was considered insufficiently effective for many years because its carbon price was too low (around USD 4) to reflect the actual cost of mitigating emissions. In recent years, following several targeted reforms (along with the rebound of the economy from the 2008 crisis), the ETS carbon price has been rising and reached over €50 in the EU countries in 2021.[18] The EU ETS has succeeded in reducing emissions considerably, with the EU estimating a reduction of 21 percent in emissions quantity, in the sectors included in the ETS, over the period from the establishment of the system in 2005 to 2020.[19]

Advantages and drawbacks of the different pricing methods and the trend for integrating them

Generally speaking, the academic literature shows that carbon taxation is preferable to emissions-trading mechanisms under conditions of uncertainty, as the economic inefficiency of taxation methods (if the tax does not correctly reflect the external cost) is smaller than that of ETS mechanisms.[20] However, the choice of an ETS over a carbon tax is often a political decision influenced by motives unrelated to the economic efficiency of the alternatives alone. It is also worth noting that many countries combine the two mechanisms in order to cover a wider swath of emissions.

17 *Montel*, "9 EU states urge CO2 price floor to meet climate goals," December 13, 2018; World Bank, *State and Trends of Carbon Pricing 2020*.

18 *Ember*, "Carbon pricing."

19 "EU Emissions Trading System (EU ETS)," *European Commission* website.

20 Martin L. Weitzman, "Prices vs. Quantities," *Review of Economic Studies,* 41, no. 4 (1974): 477–491.

Advantages of a carbon tax over an ETS

● Carbon taxation, particularly when based on the quantity of carbon in fossil fuels, makes it possible to internalize the external costs of **a large share of GHG emissions**. (See Figure 3, which shows that 80 percent of GHG emissions in Israel originate in the combustion of fossil fuels.) By contrast, an ETS is complex and largely limited to large firms and enterprises that consume fuel within a certain cap; thus, it applies to a specific segment and covers a smaller share of GHG emissions. The coverage of an ETS may be broadened, but this is procedurally more complex and entails coordination with the large number of players involved.

● **Certainty about carbon price:** In a carbon-taxation mechanism, carbon price is predetermined by the government. In an ETS, on the other hand, the quantitative emission allowance prevails, and price is subject to changes commensurate with volatility of supply and demand for emission permits. Therefore, carbon price is less susceptible to frequent changes in a carbon-taxation framework than when set within the framework of an ETS.[21]

With a foreknown price in place, industry and private consumers are assured certainty and thus are encouraged to reduce emissions and invest in projects that attain this goal, knowing that these operations will be less costly to them than failing to reduce their emissions. In an ETS, the price of the permit is unstable because the cost of reducing emissions is not fully known before the initial allowance price is set, impairing the incentive to cut emissions.

In the long run, the price volatility of an ETS can threaten the system with collapse. If the price goes too high, the legislature will probably intervene; if it is too low, the system will be ineffective. In Europe, following the 2008 financial crisis and its dampening effect on economic activity and, in

21 Flues and van Dender, "Carbon pricing design."

turn, on emissions and demand for allowances, the carbon price fell from around €20 per tonne to €2.5 in April 2013.

● **Simplicity of collection:**[22] In most cases, carbon taxation is enforced by the tax authority and can be carried out within existing collection mechanisms. An ETS is more complex, involving high administrative, monitoring, and auditing costs. The complexity of auditing and supervision has even led to several cases of fraud in ETS mechanisms.[23] The simplicity of carbon taxation makes it easier for businesses, which already have to contend with the bureaucracy associated with Israeli regulation. It also facilitates the auditing of emission reductions, a challenge that grows when carbon pricing is carried out by means of an ETS. In a trading mechanism, it is hard to apply inspection and ascertain that emissions really have been reduced properly, particularly when not all sectors participate in the mechanism. In the past, for example, such systems were plagued by manipulations, with some enterprises even deliberately producing larger quantities of certain gases for the sole purpose of reducing the GHG emissions associated with their production and then selling the reduction.[24]

Contrastingly, the ETS has several conspicuous advantages

● In an ETS, the regulator determines the extent of emissions reduction. Thus, whereas a carbon tax creates price certainty for industry, an ETS creates **certainty on the quantity of emissions** in the affected sectors and the extent of attainment of the mitigation goals.

22 K. Kennedy, M. Obeiter, and N. Kaufman, "Putting a Price on Carbon: A Handbook for US Policymakers," *World Resources Institute Working Paper*, 2015.

23 Erez Romas, "Crime Organizations Hide Millions of Euros in Carbon Emission Trading," *Calcalist*, December 14, 2009 [Hebrew].

24 Nathanial Gronewold, "CDM Critics Demand Investigation of Suspect Offsets," *New York Times*, June 14, 2010.

- The ETS modus operandi makes it relatively easy to give **dispensations and exemptions** to sectors that are especially vulnerable to carbon pricing (see details in following chapters).

Finally, efficient implementation of an ETS with emissions allowances, unlike a carbon tax, requires the participation of many players whose size and influence on the market are limited. The smaller and more centralized the markets are—as in the case of Israel—the more the efficient application of an ETS is dependent on the ability to join the ETS mechanisms of other countries or economic regions. Such a process requires coordination and consent between the countries about market rules, especially in regard to the relevant sectors' mitigation targets. Therefore, it is typically flawed by severe complexity and major delays in putting the carbon pricing into effect.

Table 1
Summary: Carbon taxation vs. emissions-trading systems

Criterion	Carbon taxation	ETS
Tax base	Allows taxation of a large share of GHG emissions, particularly by taxing fuels	Covers only companies and enterprises (mainly large ones) that overrun the specified cap
Enforcement (degree of implementability)	Simple-through the state's tax system	Complex-entails enforcement and steep administrative costs (coping with breaches)
Certainty	Price certainty	Changes in supply and demand may cause price volatility, but this comes with predetermined emissions reduction that makes mitigation targets easier to attain

1.5. Summary

Carbon pricing is considered a highly effective way to mitigate GHG emissions. It allows external costs to be internalized and creates long-term emission abatement incentives. It is applied in two main ways: carbon taxation and emissions trading. With carbon taxation, a price for GHG emissions can be set in advance. It can be applied to all sectors—both energy-intensive ones (electricity, manufacturing, and transport) and others, such as waste management and agriculture, in a trend that has been gathering momentum in recent years. The tax is customarily charged on the basis of carbon quantity in fuel and is often collected by means of an existing tax mechanism, such as the fuel excise.

An ETS offers the possibility of creating an efficient market, in which the regulator sets the carbon quota that needs to be reduced and the market players can trade in emissions permits, with prices being set by the market. Accordingly, an enterprise that finds it difficult to reduce its emissions may purchase an emissions allowance (in accordance with predetermined allocations) from enterprises that are able to reduce their emissions. The most important ETS in operation today is the European Union's EU ETS, which includes the electricity and manufacturing sectors.

In a comparison of carbon taxation and ETS, the former is found to have several important advantages over the latter. The main ones are simplicity of collection, since the existing excise mechanism may be used; a foreknown price that allows industry to engage in long-term planning to reduce its emissions; and the possibility of applying the tax to a relatively wide range of sectors that include, for example, waste management. Contrastingly, the ETS gives policymakers certainty regarding the emissions mitigation that will be attained. Also, this mechanism makes it easier to grant dispensations and exemptions to various sectors, such as manufacturing.

The recommended way of applying the carbon-pricing mechanism in Israel is examined in Part C of this document.

Chapter 2

Carbon Pricing Around the World

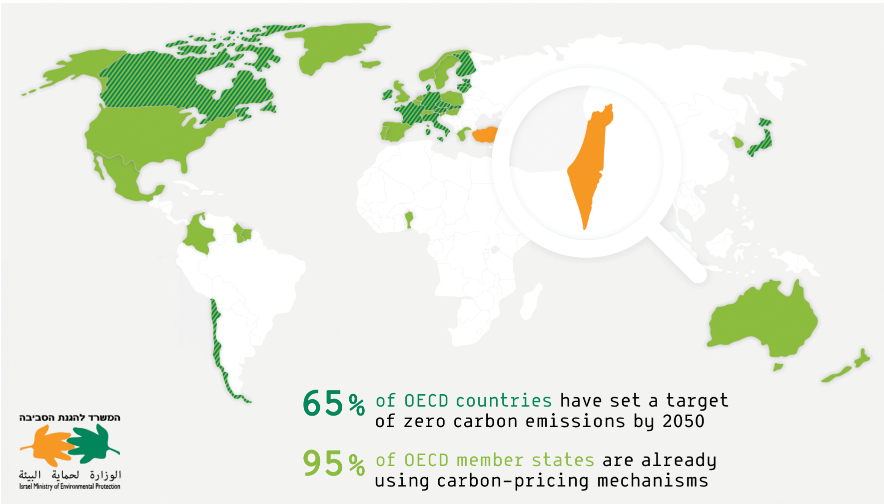
2.1. Carbon pricing as a widely used instrument globally

Carbon pricing is common around the world, particularly among OECD member countries. Of the 185 countries that signed the Paris Agreement, 96—accounting for 55 percent of global GHG emissions—affirmed that they use carbon pricing or intend to do so in order to meet their undertakings.[25] As of 2019, 34 OECD member countries applied some kind of carbon-pricing mechanism (carbon taxation, ETS, or a combination of both) to mitigate carbon emissions. Thus, **all member states[26] other than Turkey and Israel use some carbon-pricing mechanism.**

25 Celine Ramstein, Goran Dominioni, Sanaz Ettehad, Long Lam, Maurice Quant, Jialiang Zhang, Louis Mark et al. *State and trends of carbon pricing 2019* (World Bank, 2019).

26 As of 2019. Notably, in some cases the policies in question are in place at the state/province level but not at the federal level. In the United States and Canada, for example, carbon pricing is not applied at the federal level but does exist in some provinces/states.

Figure 1
Classification of OECD member states by emission-reduction programs and use of carbon pricing



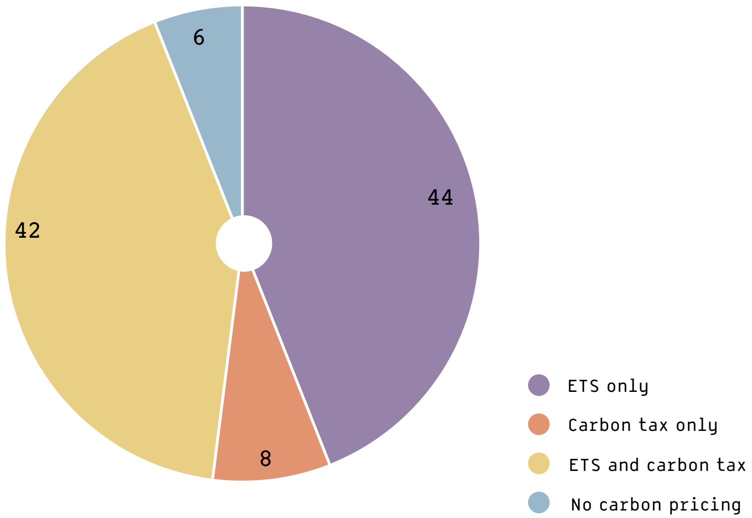
infographics: galiainfographics.co.il

- OECD countries with zero carbon-emission targets for 2050 that apply carbon-pricing mechanisms
- OECD countries that apply carbon-pricing mechanisms
- OECD countries with no emission-target legislation and no carbon-pricing mechanisms

As for carbon tax versus ETS, Figure 2 shows that 18 of the 36 OECD member countries tax carbon emissions at the national or regional level; the detailed distribution is shown in Figure 1.[27]

27 OECD, *Effective Carbon Rates 2018: Pricing Carbon Emissions Through Taxes and Emissions Trading* (Paris: OECD Publishing, 2018); OECD, *Taxing Energy Use 2019: Using Taxes for Climate Action* (Paris: OECD Publishing, 2019); Ramstein et al., *State and trends of carbon pricing 2019*.

Figure 2
Distribution of OECD member states by type of carbon-pricing mechanism (2019 data; %)



Importantly, recent developments in the climate policies of non-OECD countries that have a strong effect on global GHG emissions show that carbon-pricing policies are gaining speed there, too. For example, China decided to establish an ETS arrangement that was scheduled to begin operating in June 2021. It includes, at first, the electricity-production sector only (which accounts for 14 percent of global GHG emissions), and later is to include additional sectors, toward the target of a zero-carbon economy by 2060.[28]

28 "China Targets National Carbon Trading Online by End of June," *Bloomberg*, February 28, 2021.

2.2. Effects of carbon pricing on manufacturing

Effects on competitiveness due to regulation differences among countries[29]

The effects of carbon taxation on industrial competitiveness are mainly due to differences in carbon-pricing policies between countries that are trade partners, and not to the imposition of the tax per se. The literature discusses three circles of impact on competitiveness in international trade that stem from the lack of a standard carbon-pricing regime at the global level (Figure 6). The first-order effect manifests in an increase in industrial production costs in a country that uses carbon pricing, caused by the tax burden and the costs of investing in emission-abatement devices. The increase in production costs acts as an externality that brings on a second-order effect, which occurs when industry responds to this increase. The added costs may be passed on to consumers (or onto other industries that use these goods) by raising product prices—possibly affecting industrial competitiveness farther down the line. This response of industry may in turn induce third-order effects, including broader and longer-term economic implications for society (e.g., effects on profits, employment rates, and market mix), new trends in technological development (innovation and efficiency in resource use), and international economic effects (e.g., by means of relocation of production/investment, trade balance in goods, and so on). The third-order effects are harder to estimate because they may act in opposite directions. For example, unemployment rates may be affected by a price increase that dampens demand for a

29 Jane Ellis, Daniel Nachtigall, and Frank Venmans, "Carbon pricing and competitiveness: Are they at odds?" *OECD Environment Working Papers*, No. 152 (Paris: OECD Publications, 2019).

given product, causing employment to slump. Conversely, the need to install emission-treatment facilities requires human resources to run them—possibly increasing employment.

Importantly, too, technological developments, particularly innovative ones, may become key in preserving and even enhancing industrial competitiveness in the long run. The more effectively and rapidly a given industrial sector adapts to environment-related regulatory changes, the more it will gain an advantage over other sectors and become more competitive. Various studies in countries that apply a carbon tax find that these countries have a higher share of patents associated with emission mitigation than do similar countries that have no such tax.

The sectors that are most exposed to harm from carbon taxation are energy-intensive ones, in which a carbon tax will have the greatest impact. Below in this document is a mapping of sectors that are considered energy-efficient and their relative importance in terms of industrial turnover in Israel. This is followed by an analysis that seeks to determine which of these sectors are especially vulnerable in terms of competitiveness.

Industries considered energy-intensive around the world

Different sources define energy-intensive sectors differently. Several sectors are customarily regarded as energy-intensive; they include manufacturing of chemicals and petrochemicals, cement, iron and steel, aluminum, and paper.[30] Consequently, the criteria used to set threshold energy consumption levels for energy-intensive sectors, for the purpose of tax dispensations and benefits, vary among countries and entities. Sometimes consumption is calculated on the basis of energy expenditure

30 International Energy Agency (IEA), *Tracking Industry 2020* (Paris: IEA, 2020).

relative to total expenditure; at other times it is set relative to revenue. In draft legislation for the creation of an American ETS for carbon gases (not yet approved by the Senate), for example, energy-intensive sectors entitled to more lenient treatment are defined as those that spend more than 5 percent of their total revenue on energy.[31] Importantly, political considerations figure into these definitions because they determine the threshold for lenient treatment.

Research into the effects of carbon pricing on industry

Research on the impact of carbon pricing on imports or international trade has yielded mixed results, sometimes finding no effect and on other occasions reporting either positive or negative impacts. For example, German researchers found that carbon pricing would not impair competitiveness and that exports would actually grow.[32] Meanwhile, a study that looked into the impact of a hypothetical carbon tax in the United States found that carbon pricing at the level of USD 15 per tonne would induce a 0.8 percent increase in expenditure on imports in highly energy-intensive industries, mildly decreasing their competitiveness.[33] However, it should be noted that most studies on the effects on industrial

31 Joshua Schneck, Brian Murray, Jan Mazurek, and Gale Boyd, "Protecting Energy-Intensive Trade-Exposed Industry," *Nicholas Institute for Environmental Policy Solutions Primer* NI PR HR-3, (Durham NC: Duke University, 2009).

32 Sebastian Petrick and Ulrich J. Wagner, "The Impact of Carbon Trading on Industry: Evidence from German Manufacturing Firms," *Kiel Working Paper, No. 1912*, Kiel Institute for the World Economy, 2014.

33 J. Aldy and W. Pizer, "The Competitiveness Impacts of Climate Change Mitigation Policies," *Journal of the Association of Environmental and Resource Economists*, 2 no. 4 (2015): 565-595.

competitiveness were conducted on the basis of the EU ETS and, therefore, were predicated on low carbon prices.[34]

2.3. Tools for preventing loss of industrial competitiveness

Alleviating the direct burden of carbon pricing

From a global perspective, the main instrument of carbon pricing in industry is the ETS. To ease the burden on industry, it is the practice in these mechanisms to allocate allowances at no cost to certain sectors, namely, to exempt them from paying for their emissions up to the approved allowance. As a result, the sectors in question participate in the ETS but need to pay only for emissions that exceed their allotted emission allowances. Notably, the system allows a given sector to reduce emissions beyond its allowance and sell the surplus to a third party. This maintains the incentive to reduce marginal emissions without saddling the sector with the significant cost that would result from requiring payment for the entire emission. Notably, however, as a result, the sector's product prices do not fully reflect the cost of the carbon, thus creating only a partial incentive for consumers and customers of the sector to consume fewer goods that are intensive in GHG emissions.

In trading under the EU ETS, it is the practice to allocate no-charge allowances to sectors that are defined as being at "high risk" of being affected by the carbon pricing. The extent of the risk is determined in accordance with an index that reflects the intensity of production costs and the level of exposure to international trade. In recent years, however, there has been an attempt to revise this policy. First, the list of sectors

34 Ellis et al., "Carbon pricing and competitiveness."

considered exposed to risk will be reduced, even though the policy will continue to include much of European industry. Second, the no-cost allocation will be downsized by applying a new index. The number of allowances given in each sector will be determined on the basis of a benchmark that reflects the average emissions of the 10 percent of enterprises that have the lowest emission intensivity in the sector. Emissions that overshoot this limit will be liable to payment under the provisions of the ETS.[35] The plan is to gradually phase out the no-charge allocations, from 80 percent in 2013 to 43 percent in 2020 and 0 percent in 2030.

Similar mechanisms can be found in carbon-taxation systems around the world. Switzerland, for example, specifies a list of sectors entitled to no-charge allocations contingent on sector size (in terms of energy consumption).[36] In South Africa, the law includes a specific list of energy-intensive sectors that qualify for lenient treatment and, as such, are eligible for a 60–95 percent tax reduction.[37] The program in British Columbia allows industrial plants that emit below the specified threshold for their sector to receive grants equivalent to the carbon tax paid the previous year.[38]

35 European Court of Auditors, *Special Report 18/2020: The EU's Emissions Trading System: free allocation of allowances needed better targeting* (Luxembourg: European Court of Auditors, 2020).

36 Beat Hintermann and Maja Zarkovic, Carbon Pricing in Switzerland: A Fusion of Taxes, Command-and-Control, and Permit Markets, *ifo DICE Report* 18, no. 01 (2020): 35–41.

37 Republic of South Africa, *Carbon Tax Act* (Cape Town: Government Gazette, May 23, 2019).

38 British Columbia, *CleanBC Industrial Incentive Program*.

Direct or indirect support of industry[39]

Many countries offer meaningful financial incentives to encourage and enable industry to advance, develop, and implement energy-efficiency enhancement processes and innovative technologies for mitigating GHG emissions. The funding for these subsidies usually comes from the countries' carbon-pricing revenues.

In Canada, for example, governmental resources for emission mitigation include government investment in R&D that promotes innovative technologies for the abatement of industrial emissions. This investment is made via the Clean Growth Program, through which the government allocates C$155 million over a four-year period to co-fund R&D projects that promote clean technologies.[40] The program is meant for the energy sector, including transitioning to clean energy in industrial processes. Participating projects receive 75 percent support for implementation and 50 percent support for piloting. The Canadian government also advertises a program of loans and support for emission-mitigating projects. In 2020, for example, it issued C$750 million in loans to overland and marine fuel and gas companies in order to subvention their investments in emission mitigation.

In the Netherlands, the government has earmarked €100 million per year in funding for entrepreneurial and pilot projects that make use of new, economical, and efficient technologies in which the private sector provides a matching investment.[41] Another subsidy program is the Sustainable

39 This section was written with the assistance of Ruth Dagan and Maya Ra'am, "Policies and Means for Application of Greenhouse-Gas Mitigation in the Manufacturing Sectors of Selected Developed Countries," Herzog, Fox, and Neeman (April 2021) [Hebrew].

40 Government of Canada, *Clean Growth Program*.

41 Netherlands, *National Climate Agreement*, The Hague, June 28, 2019.

Energy Transition Subsidy Scheme—SDE++—which is designed for companies and organizations, including industry, and subsidizes them for the gap between the cost of a renewable-energy or carbon-mitigating technique and the market value of the product to which the technique is applied.[42]

Border-adjustment taxation[43]

Border-adjustment taxation is a measure designed to protect the competitiveness of energy-intensive sectors in a country that uses carbon pricing and to prevent these sectors from relocating to a country that has no such pricing (also known as "carbon leakage"). Various developed countries have considered adopting it in their discussions of establishing a carbon-pricing policy. When he took office, for example, President Biden announced that he would promote it in the United States.[44] Similarly, the European Union announced, as part of its "New Deal" program, its intention of adopting this mechanism, and its institutions published a draft proposal for it.[45] Notably, the intention in the EU is to create a border-adjustment mechanism that will fit into the existing EU ETS by requiring importers to purchase carbon allowances (and giving them an opportunity to trade in them), as opposed to a stand-alone tax (a customs duty).

42 Netherlands Enterprise Agency, "Features SDE++."

43 The information in this part of the document is based on a lecture by Dr. Michael Jacob at a workshop on carbon pricing (November 5, 2020).

44 Ari Natter, Jennifer A. Dlouhy, and David Westin, "Biden Exploring Border Adjustment Tax to Fight Climate Change," *BloombergQuint*, April 23, 2021.

45 European Commission, *EU Green Deal (carbon border-adjustment mechanism)*.

Border-adjustment taxation applies to the emissions that are "built into" imported goods. Its purpose is to strike a balance between products produced by industries within a country that has a carbon-pricing mechanism, and cheaper imports from countries that have no such mechanism and, accordingly, have lower production costs, with an emphasis on the products of energy-intensive industries.

Emissions built into products may be estimated in several ways. One approach is to assess them across the life cycle of the product, that is, to evaluate the total carbon emissions from the moment the resources needed to manufacture the product are mined, through the production stage, and up to end-of-life (including landfill, energy reclamation, or recycling). Although the results of this estimation method reflect reality well, they are very hard to calculate. A simpler option is the use of "Tier 1" emissions—estimating the direct in-plant emissions of the manufacturer of the product. One may augment this possibility by including "Tier 2" emissions—indirect emissions from energy consumption, such as those originating in the production of the electricity used in the plant's manufacturing processes. Yet another possibility is to consider average emissions from the use of identical technologies, obviating the need to calculate the emissions originating in the production of each and every product. This option incentivizes manufacturers of identical goods to use lower-emission technologies.

Several main considerations should be borne in mind when border-adjustment taxation is designed. First, the taxation should be applied only to products imported from countries that have no carbon-pricing mechanism; otherwise, imports would be double-taxed—carbon taxation on fuel in the origin country and border-adjustment taxation in the destination country. Second, the question of cross-border differences in regulation deserves thought: should regulation differences between countries other than those relating to carbon-pricing mechanisms, such as BAT (Best Available Technique) compliance, also be taken into account? A third consideration concerns the way the tax is to be applied in practice—via a customs duty, a fee, or an import license? In Europe, this matter has not yet been resolved. Finally, the mechanism should be constructed such that the level of border-adjustment taxation will be adjusted commensurate with adjustments in the relevant country's carbon pricing.

To protect the competitiveness of export industries, an adjustment mechanism in the opposite direction may be applied—a cash rebate for goods exported to countries that have no carbon tax in place. This would preclude impairment of the competitiveness of a producer in a country with carbon pricing that exports, among other things, to a country that has no carbon pricing and competes with it for local manufacture. From the environmental standpoint, the products are indeed manufactured in plants that are subject to carbon taxation; therefore, an incentive to switch to reduced-emission technologies exists. (This assumes that these sectors are not based mainly on exports to countries that do not use carbon pricing.) This mechanism, however, may be complex, particularly in the legal and bureaucratic senses.

The debate over the use of the proceeds of border-adjustment taxation resembles that of the use of revenue brought in by a carbon tax. The income may be invested in emission-reducing technologies—both in the country where the tax is imposed and in developing countries where polluting products are manufactured. Another possibility is the conclusion of an agreement with the exporting country, by which the exporting country collects the tax and uses the revenues for green investments there.

In sum, the measures presented above are immensely important in sparing local industry from harm and incentivizing it to switch to emission-free technologies via support and subsidy mechanisms. Lastly, a border-adjustment taxation mechanism is very important in fending off "carbon leakage" by eliminating the advantage of importing goods from countries that do not tax carbon.

2.4. Summary

Carbon pricing is a common mechanism around the world and has been gathering momentum in recent years as various countries expand the sectors that they include in it. In addition, to assure compliance with their climate undertakings, many countries have pre-defined set rises in the cost of taxation. Concurrently, carbon prices under the EU ETS are also trending upward, setting a record of more than €50 per tonne of carbon in the past year. Many studies show that the tax has indeed caused GHG emissions to fall.

Despite its effectiveness in reducing emissions, carbon pricing may impose a particular burden on households with low socioeconomic status and impair the competitiveness of energy-intensive sectors that are exposed to international trade. Therefore, many countries emphasize the importance of assuring a “just transition” that will moderate the harm caused to those exposed to it. By and large, this is conventionally done by using the tax receipts to fund energy-efficiency projects, transitions to renewable energy, and the like. Similarly, to mitigate damage to the competitiveness of domestic industry, use is made of exemption mechanisms up to a certain emission ceiling, industries are given subsidies to encourage them switch to clean energy, and new border-adjustment taxation mechanisms are promoted.

Chapter 3

The Israeli Case

3.1. Distribution of carbon emissions by source of emission in Israel

Some 80 percent of GHG emissions in Israel originate in combustion of fuel for the production of energy. Most fuel-combustion emissions come from the use of coal, natural gas, diesel fuel, and gasoline.

Figure 3
Distribution of GHG emissions in Israel, by emission source (Gg CO2eq) (as reported by Israel to the UN, 2017 data)

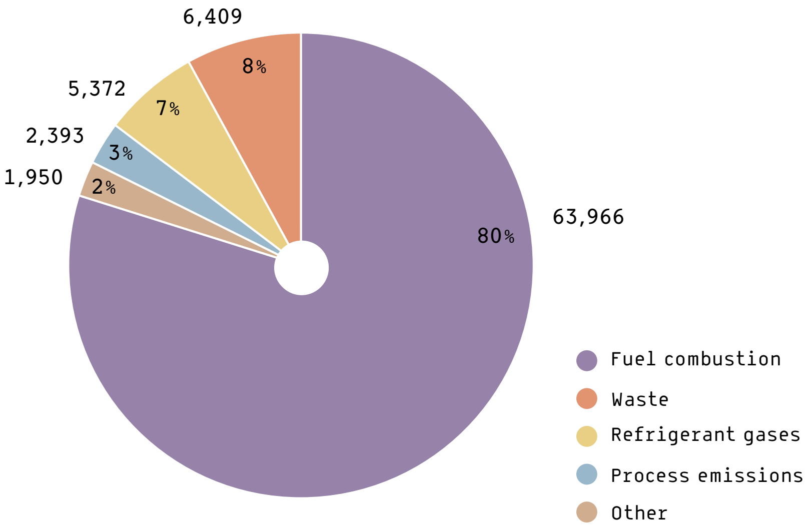
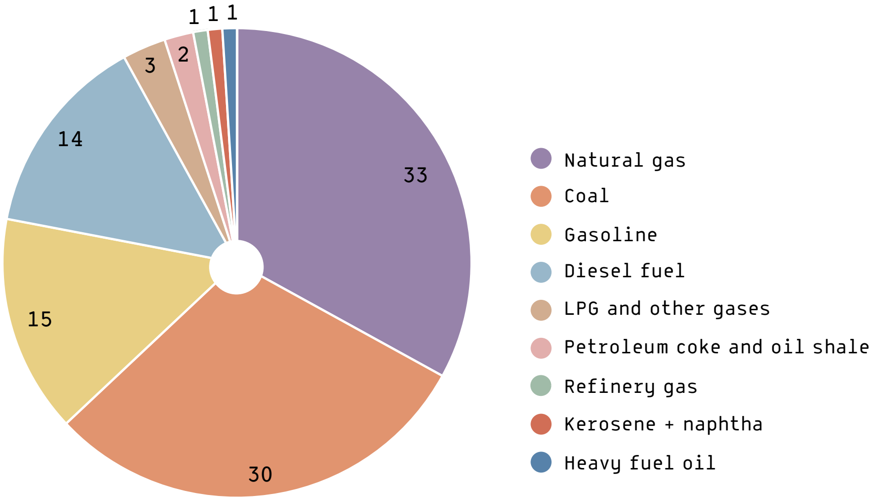


Figure 4
CO_2 emissions by fuel, 2019 (%)



Therefore, carbon-emission pricing by means of fuel taxation would cover around 80 percent of GHG emissions in Israel when emission-mitigating steps, such as switching to renewable energy, are taken concurrently.

Another source of GHG emission is the waste-management sector, which is responsible for 8 percent of emissions countrywide. These emissions are attributed to landfill and, accordingly, the strategic plan for the transition to a circular economy recommends adjusting the landfill duty to reflect the external cost of GHG emissions caused by landfill[46] and considering the introduction of a waste-incineration duty when thermal treatment facilities are used.

46 For elaboration, see Ministry of Environmental Protection, *Strategy for a Sustainable National Waste-Management System 2021-2030* (Jerusalem: Ministry of Environmental Protection, December 2020) [Hebrew].

Refrigerant gases account for 7 percent of GHG emissions in Israel. An amendment to the Montréal Protocol, adopted in October 2016 in reference to substances that deplete the ozone layer (the "Kigali Amendment"), requires countries around the world, including Israel, to gradually reduce their consumption of HFC-type refrigerant gases, which are powerful GHGs. Once applied, the amendment will enable GHG emissions Israel to fall by 7 percent, in addition to the 80 percent mitigation of emissions originating in fuel combustion and 8 percent of emissions from landfill.

Thus, if carbon pricing is implemented in the energy sector, pricing of GHG emissions applied in the waste-management sector, and the Kigali Amendment adopted, it will be possible to reach coverage of 95 percent of Israel's GHG emissions.

3.2. The external cost of carbon emissions in Israel

The external cost of GHG emission in Israel is calculated by the Ministry of Environmental Protection and is updated annually.[47] Based on a recommendation from the United States Environmental Protection Agency (EPA), it reflects the results of economic models that assume various scenarios of climate-change effects.[48]

As of 2020, the external cost of carbon emissions in Israel was NIS 167 per tonne. Following the American methodology, this value is adjusted by 2.1 percent annually for 2021–2030, 1.9 percent annually for 2030–2040, and 1.6 percent annually for 2040–2050.[49]

47 Ministry of Environmental Protection, *The Green Book*.

48 Interagency Working Group on Social Cost of Greenhouse Gases, *Technical Support Document*.

49 Ministry of Environmental Protection, *The Green Book.*

3.3. How fuel taxes are collected today

At the time of writing, fuels manufactured in Israel are taxed at a rate set under the Excise Tax on Fuel Order (Exemption and Rebate), 5665-2005, which operates by force of the Excise Tax on Fuel Law, 5718-1958. This statute establishes compulsory payment of the excise; the Order determines the excise sum. Imported fuel is taxed by means of a purchase tax, set under the Customs Duty Order. In practice, imported fuels and locally produced fuels are taxed at the same rate. In the case of petroleum distillates, the excise is paid by fuel companies that hold a “producer license” issued by the Fuel Authority and the Israel Tax Authority. These are the firms that purchase petroleum distillates from refineries and sell them to filling stations and industry. In the case of natural gas, the excise tax is paid by the producers.

Within the framework of the Excise Tax on Fuel Order, various mechanisms award exemptions or dispensations on the excise tax. The most conspicuous of them is the rebate, set at a percent of payment of the excise on diesel fuel only for selected sectors such as heavy haulage and professional vehicles, taxi owners, driving instructors, buses, engineering equipment, fishing vessels, and manufacturing (in cases where diesel fuel is used for combustion in the manufacturing process).[50] In accordance with a roadmap for its elimination, approved by the Knesset Finance Committee in March 2018, the rebate has fallen gradually over the years and should be totally phased out by 2026.[51]

50 The rebate is contingent on the year of vehicle manufacture and varies in accordance with adjustments applied by the Israel Tax Authority.

51 Israel Tax Authority.

Table 2
Current excise rates[52]

Fuel	Unit	Excise (Sept. 2020)
Heavy fuel oil	NIS/tonne	15
Natural gas	NIS/tonne	17
Coal	NIS/tonne	103
Petroleum coke	NIS/tonne	46
LPG	NIS/tonne	121
Diesel	NIS/kiloliter	2928*
Gasoline	ILS/kiloliter	3056

* Before rebate.

3.4. Why should Israel introduce carbon pricing?

The Israeli economy does not internalize the full external costs of GHG emissions caused by combustion of polluting fuels.

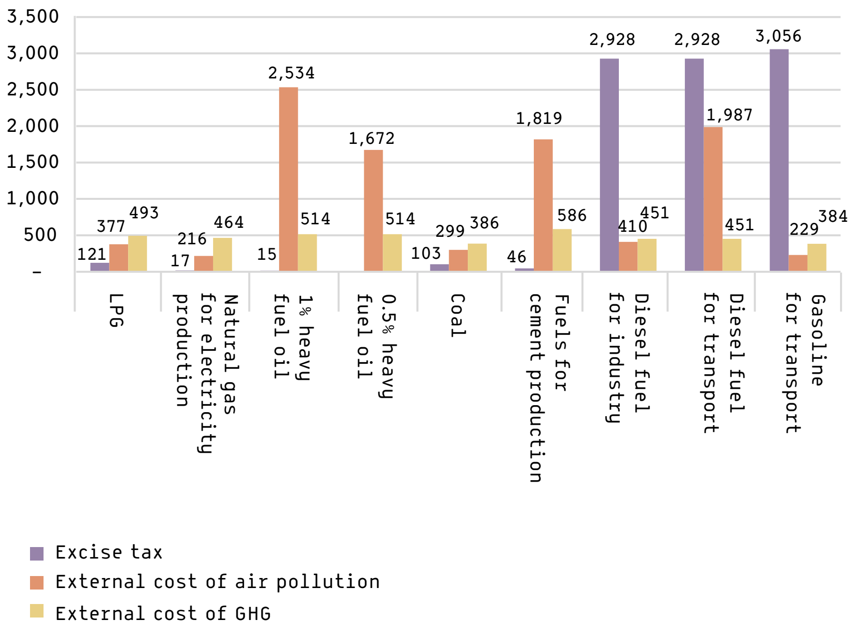
Today, the only taxation that Israel applies to the consumption of fuel products is the excise tax. The excise rates are set by the Israel Tax Authority, part of the Ministry of Finance. By comparing the level of the excise with the external costs associated with the use of fuels, due to emissions of both air pollutants and greenhouse gases,[53] the excise on fuels used for the electricity system and industry are found to be hundreds of percent lower than the external cost of the GHG emissions and air pollutants occasioned by these

52 Israel Tax Authority, January 2021 data.

53 For the values of these external costs, see Ministry of Environmental Protection, *The Green Book.*

sectors' activities. This state of affairs is a market failure that prevents the economy from optimally maximizing benefits. **Internalizing the cost of carbon via the fuel excise for industry and electricity production would do much to attenuate this market failure and encourage consumers to make efficiencies and switch to less polluting sources of energy.**[54]

Figure 5
Comparison of excise tax and external costs of air pollution and GHG emissions caused by fuel consumption (NIS per tonne/kiloliter)



54 In the exceptional case of heavy fuel oil, air pollution should also be internalized via the excise tax due to the immense damage that

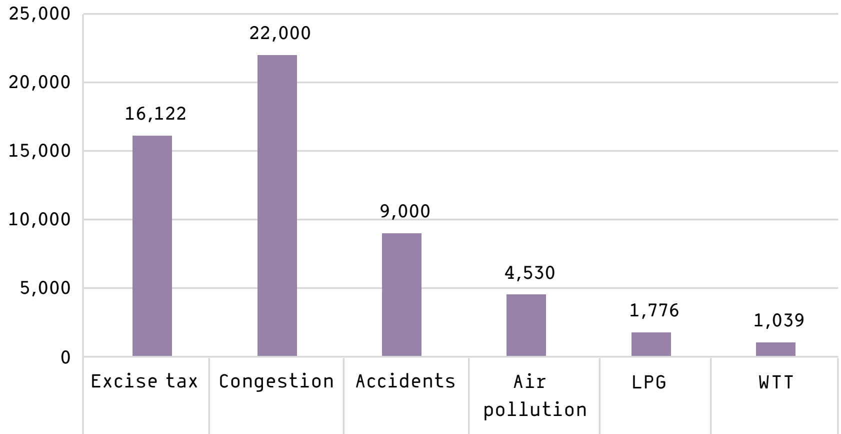
As for the excise tax on fuel for transport, it should be remembered that alongside environmental external costs, road transport also has non-environmental externalities resulting from congestion (loss of national product), traffic accidents, and infrastructure. A comparison of excise-tax incomes with total external costs (those that are quantifiable) shows that the excise tax falls far short of covering the total external cost of the use of motor vehicles. Congestion costs alone exceed the revenues brought in by the excise tax (see Figure 6).[55] The data also omit the total external costs of transport (e.g., noise and damage to habitats).[56]

its use causes relative to the other fuels and in order to minimize use of this polluting fuel.

55 Importantly, the excise tax relating to diesel fuel is an overestimate as presented because, in practice, there is an effective taxation mechanism that provides a rebate (tax refund on payment of excise for combustion of diesel fuel by consumers, set forth in the 2005 Excise Tax on Fuel Order).

56 At the time of writing, the Ministry of Environmental Protection is working on calculating the external costs of noise occasioned by road transport.

Figure 6
Comparison of total excise-tax revenue with external costs of transport, 2018 (NIS million)[57]



57 For more on how the external cost of road transport in Israel is calculated, see Ministry of Environmental Protection, *External Costs of Road Transport in Israel: Air Pollutants and Greenhouse Gases* (Jerusalem, 2021). State revenues from the excise tax were calculated on the basis of fuel-consumption coefficients that appear in Ministry of Environmental Protection, *Calculator of Air-Pollution Emissions from Road Transport,* and the excise rates as of September 2019. The annual cost of congestion is based on Manuel Trajtenberg and Hadar Zer Aviv, *To Unravel the 'Gordian Knot' 2.0: Tackling Congestion via Road Pricing and Ride Sharing* (Haifa: Samuel Neaman Institute for National Policy Research, 2020). In this work, congestion costs are estimated at 2% of GDP, as is assumed in Ministry of Environmental Protection and Ministry of Transport, National Infrastructures, and Road Safety, *Development of Public Transport in Israel: Strategic Plan-Ride Sharing Today and Tomorrow* (Jerusalem, 2012). The annual cost of traffic accidents is based on the Transport Project Assessment Procedure (Heb: *Nohal Perat*) estimate (adjusted up to 2015).

Consequently, an NIS 22.1 billion gap remains between the external costs and the taxation of transport fuels. This gap reflects yet another an uncorrected market failure.

Carbon pricing by means of excise taxes in Israel may do much to narrow the gap between the external costs of fuel use and the costs that the polluter (the fuel consumer in this case) actually pays. A direct and univalent association exists between fuel consumption and vehicle carbon emissions; therefore, the excise tax is an accurate instrument with which to internalize the external cost of carbon. It should be noted that there is no similar univalent association between fuel consumption and air-pollutant emissions because vehicle characteristics (the engine and the emissions-control system) have a major effect on the level of pollution. For the same reason, many countries price carbon emissions into the excise tax but do not do the same with other air pollutants.

The external costs of the waste-management sector and the internalization gap[58]

Waste management has various environmental effects, including GHG emissions. In particular, landfill is considered the worst way to deal with waste, at the very bottom of the “waste-treatment hierarchy” (the scale of preferences among waste-management methods), trailing other methods such as recycling and reclamation. Methane emissions from landfill sites in Israel account for 8 percent of total GHG emissions countrywide (Figure 3). Apart from GHG emissions, landfill also causes emission of local air pollutants, leaching of runoff that has high content of organic and inorganic compounds (including heavy metals) into soil and water sources, damage to open spaces, and so on.

58 This section is based on Ministry of Environmental Protection, *Strategy for a Sustainable National Waste-Management System*.

For this reason and to internalize the high environmental cost of landfill, countries around the world, including Israel, tax its use by imposing a landfill levy.

Landfill taxation on the basis of the weight of the waste is an efficient way to steer the market toward other kinds of waste management that rank higher on the hierarchy. A landfill levy should reflect the external costs to the economy of the damage caused by landfill. However, Israel's landfill levy for mixed urban-waste, currently set at NIS 109 per tonne,[59] does not reflect the full external cost of landfill. According to an economic analysis by the Ministry of Environmental Protection, the external cost of landfill per tonne of mixed waste is estimated at NIS 174 per tonne of buried waste as of 2019.[60] Most of this external cost reflects emissions of the greenhouse-gas methane (CH_4), at NIS 173 per tonne of buried waste. This leaves an NIS 64 gap (at the very least) per tonne of buried waste between landfill-levy revenues and the external cost of methane emissions.[61] **This**

59 The latest rate as of January 2021, as per the Ministry of Environmental Protection website.

60 See breakdown for the waste-managemente system in Chapter 7 of Ministry of Environmental Protection, *Strategy for a Sustainable National Waste-Management System*. Notably, the pricing of external landfill costs in this study pertains to air emissions only, making it something of an underestimate. The breadth and depth of environment-related economic research is spotty in reference to the full set of environmental components. Research on pricing of GHG and air-pollutant emissions is rich but there are major gaps in knowledge about the economic harm caused by additional environmental effects associated with landfill, such as pollution of water sources, soil pollution, olfactory pollution, and damage to landscape and biodiversity.

61 The gap is probably wider than NIS 64 per tonne of buried waste because the per-tonne external cost of this waste, as calculated, reflects only the damage that can be quantified by environmental-economics research today. See previous note.

gap reflects a market failure. In addition to the landfill waste levy, some European countries impose an incineration levy on waste transported to energy reclamation facilities for treatment. Its purpose is to reduce the quantity of waste that is taken to these facilities and divert it to forms of treatment that are higher than incineration on the waste hierarchy. The net cost of GHG emissions from waste-incineration facilities is estimated at NIS 28 per tonne of waste delivered to the facility for treatment.[62]

3.5. A carbon tax is the most appropriate carbon-pricing mechanism for Israel

Weighing the advantages and drawbacks of a carbon tax against those of an emissions-trading system reveals that a carbon tax is more appropriate in the Israeli case. First, it allows broader coverage of GHG emissions (because, unlike an ETS, which can mainly only be applied to large energy consumers, it relates to all fuel consumers irrespective of size). Second, the fact that a carbon tax can already be levied via the existing excise mechanism makes it relatively easy to implement and enforce, considerably lowering the administrative costs of the mechanism both to the entities to which it applies and to the regulator. And third, it can be applied effectively in Israel, with no need to join other countries' trade mechanisms in order to create a competitive market for emission allowances—and, in turn, obviating the need to make new international commitments. Therefore, carbon pricing in Israel is best accomplished by means of taxation and not by an ETS.

62 Calculation correct as of 2019. For elaboration, see Ministry of Environmental Protection, *Strategy for a Sustainable National Waste-Management System*.

3.6. Macroeconomic modeling of the effect of carbon pricing on carbon-emission mitigation by the energy sector and on growth in Israel

This section presents the main conclusions of a macroeconomic study that used the MESSAGEix-IL-MACRO tool to model Israel's energy system and to calculate the effect of imposing a carbon tax on the quantities and types of fuels consumed and the resulting GHG emissions at the sector level. The model also takes account of macroeconomic indicators such as changes in and effects on Gross Domestic Product (GDP).[63]

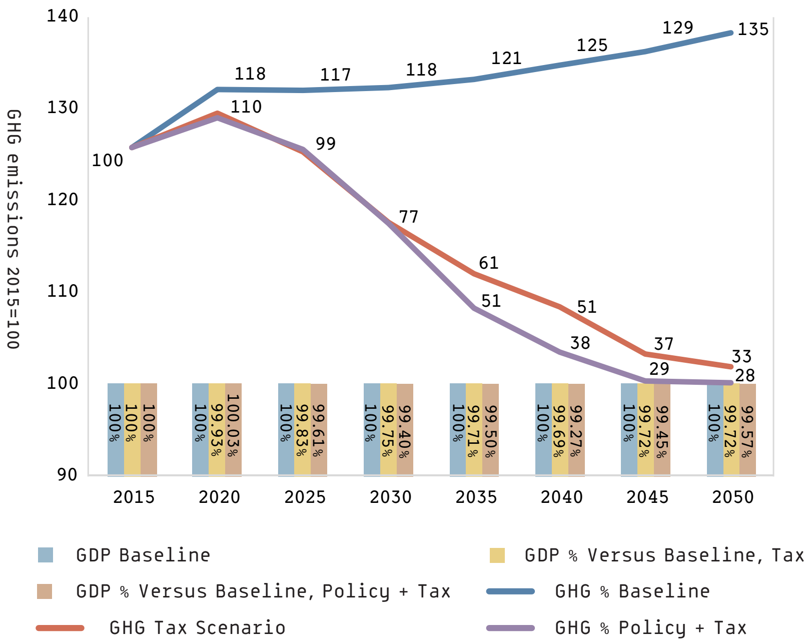
Main findings

Total change in GHG emissions in the "business as usual" (BAU) and tax scenarios

In a scenario that includes the introduction of a carbon tax, this measure alone causes countrywide GHG emissions to plunge (by 67 percent relative to 2015) and goes even farther when the tax is backed by policy measures (73 percent relative to 2015), as shown in Figure 7. In the baseline ("business as usual"—BAU) scenario, by contrast, emissions surge by 35 percent relative to 2015. In addition, the study found that each type of policy has a negligible impact on GDP, ranging from a few hundredths of a percent (0.06 percent of GDP, baseline scenario) to around four-tenths of a percent (0.43 percent of GDP, baseline scenario) in 2050. Notably, this impact does not include many country-level benefits such as lowering healthcare costs by reducing air pollution (as shown later in this chapter), and curtailing the loss in domestic product due to congestion.

63 For the full study, see Ruslana Rachel Palatnik, Ayelet Davidovitch, Volker Krey, Nathan Sussman, Keywan Riahi, & Matthew Gidden, "Is carbon pricing more efficient than policy standards? Insights

Figure 7
Projected carbon (GHG) emissions and Gross Domestic Product (GDP) according to baseline (BAU) scenario, tax scenario, and combined policy+tax scenario



To examine the paths of GHG emission mitigation under each scenario, below we segment the results of the study by sectors and fuels.

The electricity sector

In the BAU (baseline) scenario, the share of renewable energy (RE) rises to 17 percent of the mix of fuels by 2030 and remains there from that year

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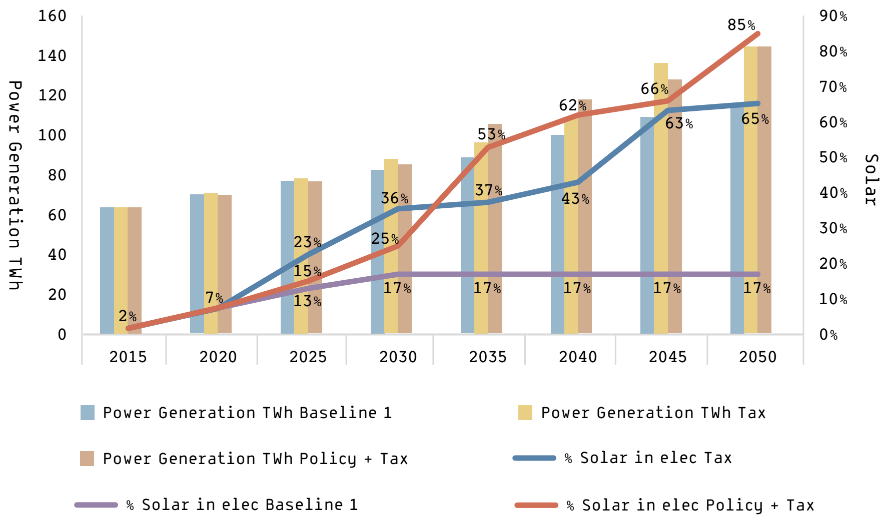
from a co-production of knowledge process in Israel," Energy Strategy Reviews, Elsevier (Forthcoming).

on. The “policy+tax” scenario set a target of 85 percent renewable energy; therefore, this is the rate that the model attains by 2050. The tax scenario, by contrast, has no external target for renewable energy in the mix of fuels. In this case, the model shows that introducing the tax induces a gentler increase in RE, to around 65 percent of total fuel (Figure 8).

Importantly, electricity production increases perceptibly in all scenarios relative to the baseline. The main reason, as we show below, has to do with the electrification of transport in both the policy target and tax scenarios. The differences between the policy-tool scenarios in electricity production stem from the rate of electrification of industry, which varies among the scenarios.

Figure 8
Electricity production and share of RE in it: Baseline, tax, and policy+tax scenarios



In both scenarios, the main transition is from natural gas to solar energy, it being assumed that the use of coal falls to zero by 2030 in accordance with the Ministry of Energy's undertaking. The policy+tax and tax scenarios both lead to a major increase in the share of solar energy in electricity production, at the expense of gas. It should be borne in mind that these increases take into account the costs of energy storage required for the reliable supply of solar-produced electricity, as reported by the Electricity Authority (2019). Therefore, gas should be seen as a bridging fuel in the transition of electricity production to RE.

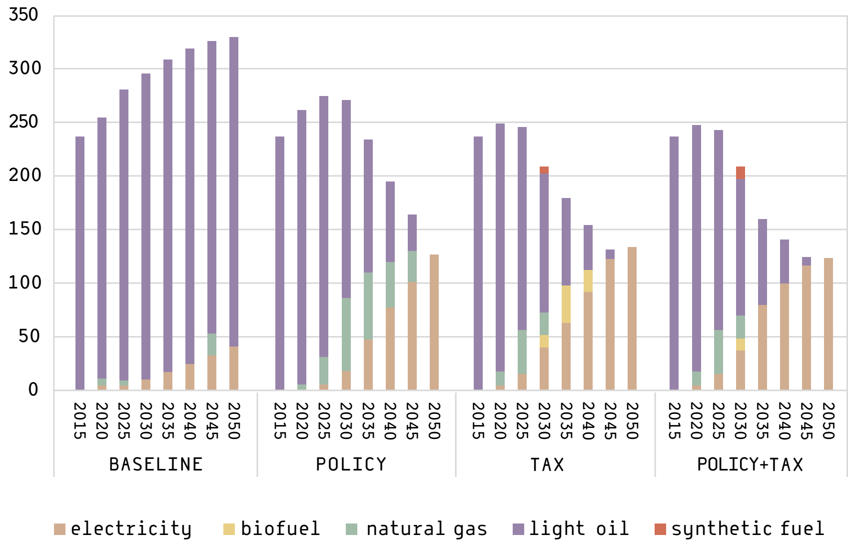
The transport sector

Transport is another sector that offers relative flexibility in transitioning to clean energy and energy-saving technologies. By combining these two processes, the forecasts of an increase in kilometers traveled can be met while also making major cutbacks in the sector's fuel consumption and energy-related emissions. This involves the sector totally disengaging from petroleum-based fuels in the near term, disengaging from natural gas in the medium term, and switching to full electrification in the long term, with the imposition of a carbon tax expediting the process (Figure 9).

The policy scenarios differ in the mix of fuels used en route to full electrification. In the policy-targets scenario, for example, in which taxation based on the level of pollution is not introduced, gas becomes an important fuel in the transition from petroleum distillates in an internal-combustion engine toward fully electric transport. In the tax scenario, by contrast, less natural gas is used for less time because natural gas also becomes more expensive, in line with its emission coefficient.

It should be noted that an internal-combustion engine operates at 20 percent efficiency while an electric motor attains 85 percent and even 98 percent efficiency. Accordingly, even though kilometers traveled are unchanged in both scenarios and rise as predicted, the transition to electric power facilitates a considerable decline in total energy used for transport. The decrease in transport emissions is directly contingent upon this saving in energy. Importantly, however, the electricity used for transport must be produced from clean fuels. Otherwise, the electrification of transport will merely shift emissions from the transport sector to the electricity-production sector and will have no meaningful effect on total GHG emissions in Israel.

Figure 9
Projected mix of fuels for transport, according to baseline, policy, tax, and policy+tax scenarios (PJ)



Total final consumption and energy ratio

The aggregate effect of these changes on total final consumption (TFC) of energy is presented in Figure 10, which shows that relative to the baseline scenario, TFC declines as use of petroleum distillates plummets and the transition to zero-emission fuels accelerates.

Another important indicator is national energy intensity, which reflects the ratio of TFC to GDP. As the intensity indicator drops, the country's energetic intensity falls and fewer energy inputs are needed to create one real unit of product.

Figure 11 shows that energy intensity declines by around 40 percent in both policy scenarios relative to baseline and that the tax scenario yields a more meaningful decline than does the scenario of policy without tax, because there is almost no difference in GDP between the scenarios (Figure 7) while TFC declines (Figure 10).

Figure 10
Total final consumption of fuel, according to baseline, policy, and tax scenarios (PJ)

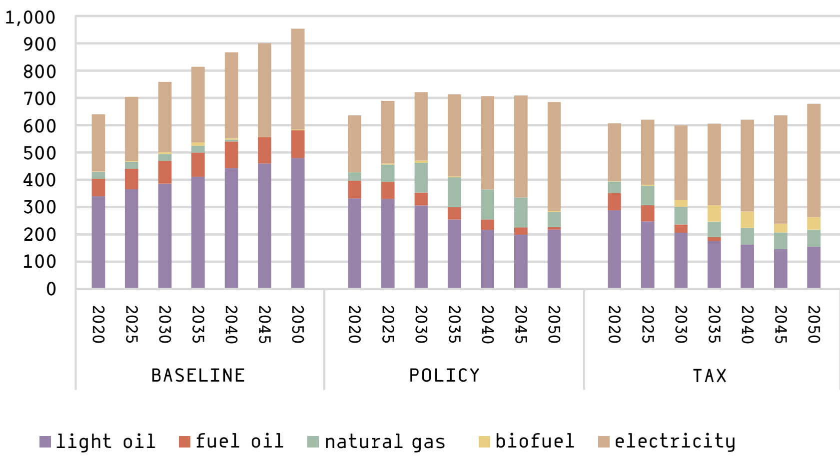
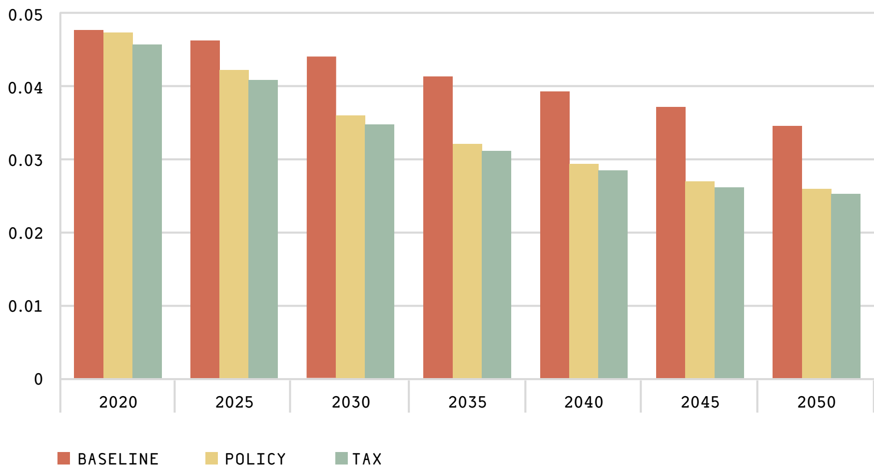


Figure 11
Energy intensity, according to baseline, policy, and tax scenarios (TFC in MTOE/GDP), 2015 prices (PPP)



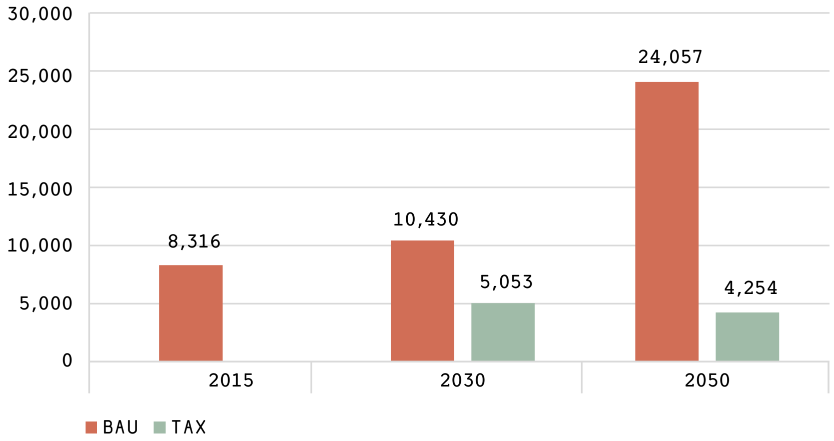
Reducing air pollution by imposing a carbon tax

On the basis of the fuel-consumption results of the MESSAGE model, we calculated the savings in the external costs of air-pollutant emissions due to the introduction of a carbon tax. These costs reflect the savings on expenditure for medical care, loss of working capacity, sick days, and other aspects stemming from health problems originating in air pollution. Also, as mentioned above, this saving does not manifest in an effect on GDP in the model.

For the purpose of the calculation, the following pollutants were examined: nitrous oxide (NOx), sulfur oxides (SOx), volatile organic compounds (VOCs), carbon monoxide (CO), and inhalable particulate matter ($PM_{2.5}$, PM_{10}). The external costs of each pollutant were calculated on the basis of the adjusted annual cost coefficients over the years taken from the Ministry of Environmental Protection's *Green Book*:[64] an annual increase of 3.39 percent by 2030 and of 3.14 percent afterwards, raising the external-cost coefficients to 2.7 times their level in 2050 relative to 2019. This increase should reflect the upturn in the standard of living standardized for income elasticity and the increase in population size in Israel.

The results of the calculation (Figure 12) show that in the scenario of carbon tax only, the external costs of air pollution fall by 40 percent by 2030 and 50 percent by 2050 relative to 2015. In the baseline (BAU) scenario, by contrast, the external cost rises considerably and manifests in a 190 percent increase by 2050 relative to 2015. Furthermore, a comparison between the tax scenario and the BAU scenario in 2050 shows an 82 percent reduction in the external cost of air pollution, largely due to the transition to RE-intensive electricity production and electrification of the transport sector. Consequently, applying a carbon tax in Israel would save the economy NIS 20 billion by mitigating air pollution in 2050 relative to carrying on as usual.

Figure 12
External cost of air pollution, by year and scenario (NIS million)



64 Ministry of Environmental Protection, *The Green Book*.

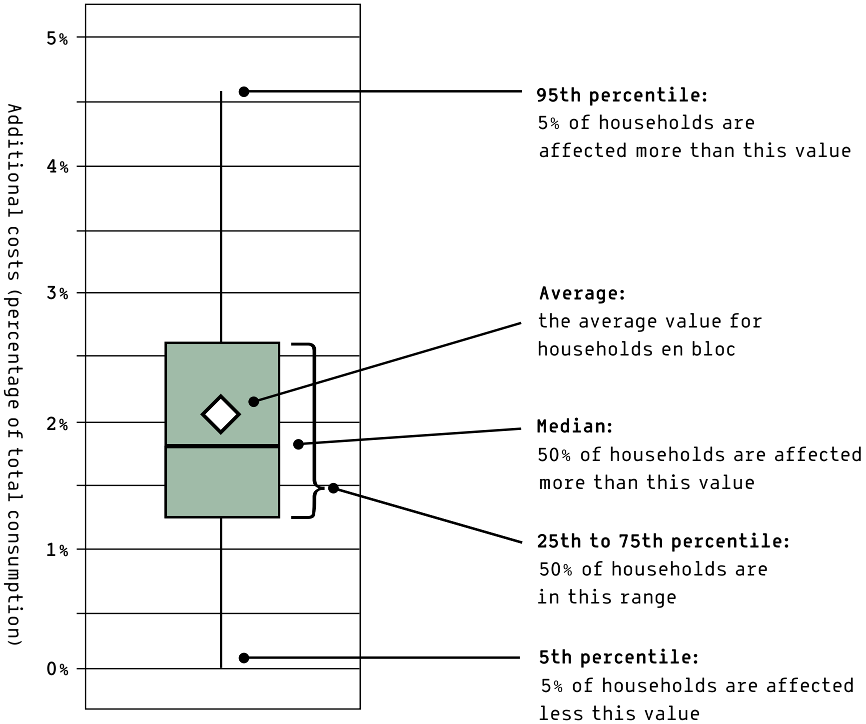
3.7. Distributive effects of carbon pricing on households in Israel

The Israel Public Policy Institute (IPPI), aided by a research team from the Mercator Research Institute on Global Commons and Climate Change (MCC), conducted a study on the effect of a carbon tax set at US$42 (NIS 140) per tonne of carbon emission (tCO_2) on households in Israel.[65] It should be emphasised that Israel does not intend to take the step examined in that study—imposing a carbon tax on transport fuels—at the present time. The researchers point to several characteristics of population groups that are vulnerable to the burden created by the carbon tax, which affects their consumption basket disproportionally.

The results are shown in box plots, which should be interpreted as follows:

65 Jan Steckel and Leonard Missbach, "Leaving No One Behind: Carbon Pricing in Israel: Distributional Consequences across Households," *Policy Paper Series Shaping the Transition to a Low-Carbon Economy: Perspectives from Israel and Germany* (Tel Aviv: Israel Public Policy Institute (IPPI) and Heinrich Böll Foundation, 2020).

Figure 13
Interpretation of box plots

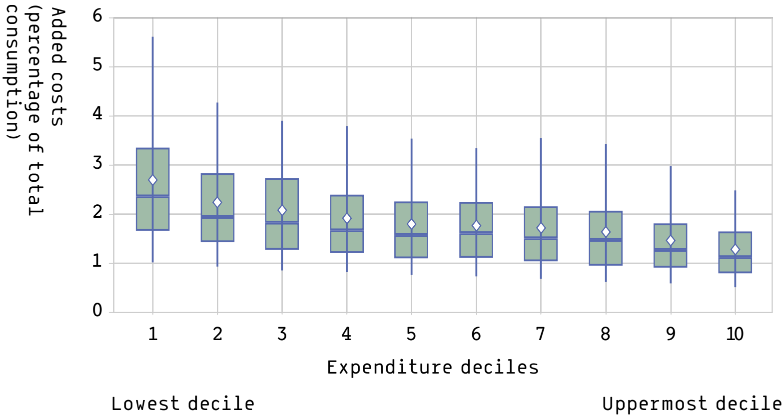


Distribution of the burden across socioeconomic-status groups

A carbon tax, like other indirect taxes, would have a regressive effect on household income in Israel. Namely, its burden—its share in total household expenditure—**would be higher in the lower expenditure deciles.**[66] **Thus, households in these deciles would spend on average 2.7 percent of their total expenditure on carbon tax, whereas those in the uppermost expenditure decile would spend an average of 1.3 percent.** According to the IPPI-MCC researchers, the lowest decile has the highest spending on electricity and gas as a share of its total expenditure but the lowest rate of expenditure on fuel for private vehicles. The share of total expenditure on private vehicle fuel is highest in the middle classes, deciles 3–7. With the imposition of a carbon tax, then, energy consumption in the home would increase the cost of the consumption basket of the lowest decile by 1.9 percent on average, as against an average upturn of only 0.4 percent in the uppermost decile. In this sense, the carbon-tax burden on electricity would have a regressive impact on household consumption. Transport and other consumer products, by contrast, would increase the cost of the household consumption basket, in percentage terms, to a similar degree across the expenditure deciles.

66 Even though Steckel and Missbach chose to relate to the distribution across expenditure deciles, presumably one could arrive at a similar distribution of the share of tax by using total household income and measuring across income deciles (which are more common criteria in sorting populations by socioeconomic background), because households in low income deciles spend most of their income on consumption whereas those in high income deciles devote much of their income to saving/investment and not to consumption. In this sense, the resulting distribution of the effect of the carbon tax on household income and across income deciles would probably be even more regressive.

Figure 14
Rate of increase in household expenditure in Israel due to introduction of an NIS 140/tCO2 carbon tax, by expenditure deciles



The relative share of added household expenditure due to carbon pricing at NIS 140/tCO_2 in total household expenditure (y-axis), distributed across expenditure levels (x-axis). The lowest decile comprises the 10% of households that spend the least per capita; the uppermost decile comprises the 10% of households that spend the most per capita. An additional 1% increase means that the household will need an additional 1% of its total expenditure budget to purchase the same products that it had purchased before the increase in prices. Source of data: Central Bureau of Statistics, Household Expenditure Survey 2018 (2019); GTAP 10 (GTAP 2019).

Source: Steckel and Missbach 2020

Distribution of the burden across geographic areas of residence

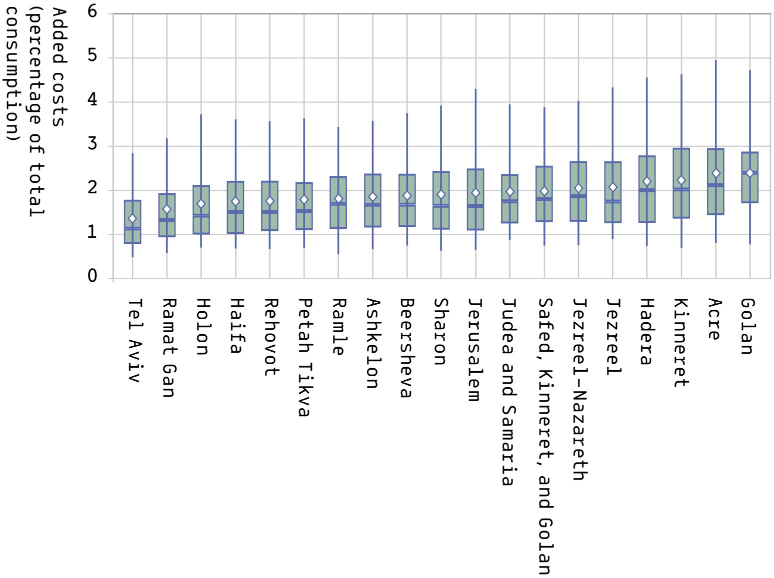
Residents of northern Israel other than those of Haifa would find the tax the most onerous, and the greatest price increase would hit those on the Golan Heights, at 2.5 percent of their total spending on average. Following them are residents of Judea and Samaria, the Jerusalem District, and the

Sharon District, and finally those in the south. Residents of Tel Aviv and its immediate environs (Ramat Gan, Holon, Petah Tikva) and of Haifa would face the lightest burden from the introduction of this tax. **Residents of Tel Aviv would absorb the smallest increase, at 1.5 percent of their spending on average. The introduction of a carbon tax would have the most significant impact on households in the rural periphery and/or in small localities insofar as they fall into the four lowest expenditure quintiles.** In the highest expenditure quintile, the burden is greatest among those living in metropolitan Tel Aviv but not in Tel Aviv city itself.

The detriment to the population in the north and to the rural population may stem from the colder climate in those areas, which requires energy consumption for home and water heating, and/or their considerable distance from areas of employment, commerce, and services. Lacking access to efficient public transport, households in these regions need to make more use of private vehicles, resulting in a higher level of fuel consumption.[67]

67 A distinction should be made between residents of the periphery with low socioeconomic status and those with a high status. The latter are presumed to have chosen to live far from areas of employment of their own free will; therefore, it is proper that they should shoulder the burden of the carbon tax on account of the extra consumption of polluting energy that stems from this decision.

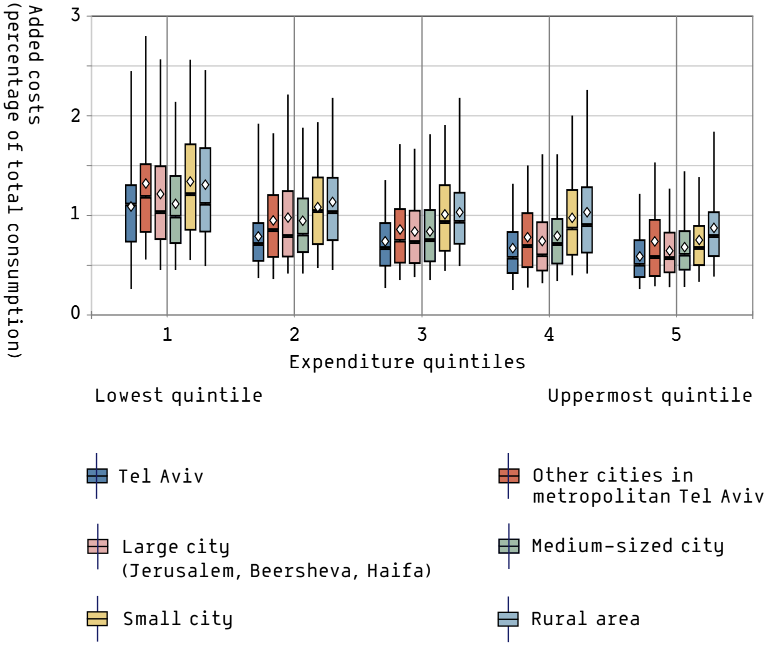
Figure 15
Rate of increase in household expenditure in Israel due to introduction of NIS 140/tCO2 carbon tax, by subdistricts



The relative share of added household expenditure due to carbon pricing at NIS 140/tCO2 in total household expenditure (y-axis), distributed across the country's 34 subdistricts. Each subdistrict presents all households included in it. The subdistricts are arrayed in the order of average spending. Source of data: Central Bureau of Statistics, Household Expenditure Survey 2018 (2019); GTAP 10 (GTAP 2019).

Source: Steckel and Missbach 2020

Figure 16
Rate of increase in household expenditure in Israel due to introduction of NIS 140/tCO2 carbon tax, by type of locality and expenditure quintiles



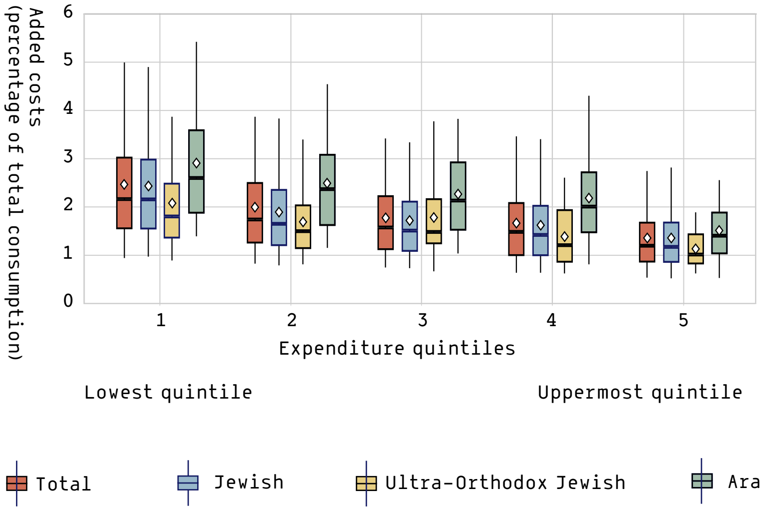
The relative share of added household expenditure due to carbon pricing at NIS 140/tCO2 in total household expenditure (y-axis), distributed across expenditure quintiles (x-axis). The lowest quintile comprises the 20% of households that spend the least per capita; the uppermost decile comprises the 20% of households that spend the most per capita. The countrywide quintiles are segmented afterwards on the basis of the geographical location of the household. The quintiles do not have identical numbers of households. "Other cities in metropolitan Tel Aviv" are Ashdod, Netanya, Rishon Lezion, and Petah Tikva. The expression "medium-sized city" denotes cities with populations of 50,000-200,000. "Small cities" are those with populations of 10,000-50,000. Households in subdistricts with fewer than 10,000 inhabitants are classified as "rural." Source of data: Central Bureau of Statistics, Household Expenditure Survey 2018 (2019); GTAP 10 (GTAP 2019).

Source: Steckel and Missbach 2020

Distribution of the burden across population groups

Segmenting the data by religious and sectoral characteristics (all Jews, ultra-Orthodox Jews, and Arabs), the researchers found that **the greatest increase in the cost of the household consumption basket, in all expenditure quintiles, would be borne by Arab households: 3 percent in the lowest quintile and 1.5 percent in the highest. Ultra-Orthodox households, by contrast, would incur the smallest increase among the three groups, at 2 percent in the lowest quintile and 1 percent in the highest**. A possible explanation is the lower use of private vehicles in ultra-Orthodox population centers and the relatively strong access of the population of these centers to public transport. Much of the Arab population, by contrast, is concentrated in the rural periphery, which has less access to public transport and must make intensive use of private vehicles due to the distance between Arab localities and centers of employment, commerce, and services. This explanation squares with another finding of the study: the Arab population is particularly sensitive to increases in fuel prices.

Figure 17
Rate of increase in household expenditure in Israel due to introduction of NIS 140/tCO2 carbon tax, by religion/sector and expenditure quintiles

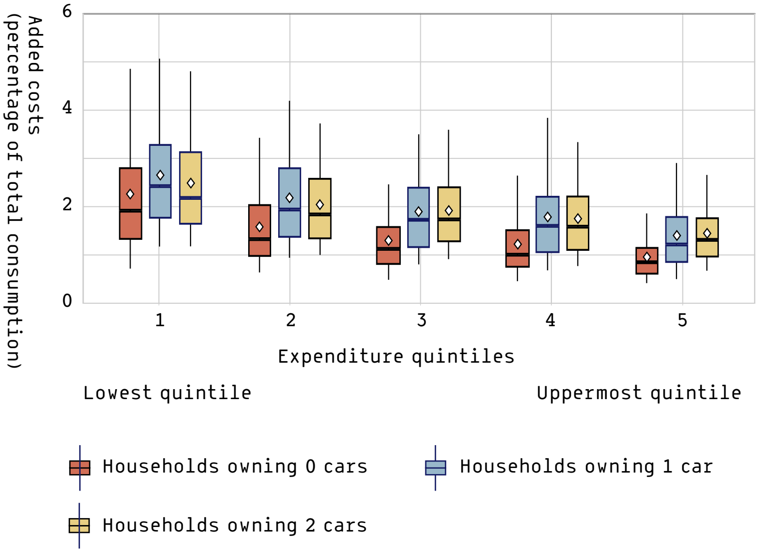


The relative share of added household expenditure due to carbon pricing at NIS 140/tCO2 in total household expenditure (y-axis), distributed across expenditure quintiles (x-axis). The lowest quintile comprises the 20% of households that spend the least per capita; the uppermost decile comprises the 20% of households that spend the most per capita. The countrywide quintiles are segmented afterwards on the basis of ethno-religious groups of households, parsed by religion as recorded in the Household Expenditure Survey. The segments do not have identical numbers of households. "Ultra-Orthodox Jewish" and "Jewish" are not coterminous; "Jewish" also includes households that reported maintaining a "traditional" way of life. "Arab" households are all households that defined themselves as such. Source of data: Central Bureau of Statistics, Household Expenditure Survey 2018 (2019); GTAP 10 (GTAP 2019).

Source: Steckel and Missbach 2020

Arab households in the lowest quintile spend 5 percent of their expenditure on fuel, as against slightly less than 2.5 percent in the Jewish sector and 1.25 percent among ultra-Orthodox households. In fact, fuel accounts for less than 2.5 percent of ultra-Orthodox households' expenditure, on average, in all quintiles other than the third (the middle class). In contrast to them and to the Jewish sector at large, Arab households spend 5–7.5 percent of their total expenditure on fuel. The picture is even graver when the extreme values of the sample are considered.

Figure 18
Rate of increase in household expenditure in Israel due to introduction of NIS 140/tCO2 carbon tax, by religion/sector and expenditure quintiles, 2018



The relative share of added household expenditure due to carbon pricing at NIS 140/tCO2 in total household expenditure (y-axis), distributed across expenditure quintiles (x-axis). The lowest quintile comprises the 20% of households that spend the least per capita; the uppermost decile comprises the 20% of households that spend the most per capita. The countrywide quintiles are segmented afterwards on the basis of number of cars owned by the household. The segments are not equal in number of households. The database has no information on households that own more than two cars. It should be noted that these added costs denote cross-sectoral carbon pricing and are not limited to transport. Source of data: Central Bureau of Statistics, Household Expenditure Survey 2018 (2019); GTAP 10 (GTAP 2019).

Source: Steckel and Missbach 2020

Effect of carbon pricing on annual expenditure on private vehicles

Pursuant to the analysis above, an evaluation was conducted of changes in annual expenditure on private vehicles, in two scenarios: business as usual (no tax) and tax. This assessment compared annual costs of upkeep for a gasoline-powered motor vehicle with those for an electric vehicle (EV).[68]

Table 3
Purchase and operating costs, by vehicle type (NIS)[69]

	Gasoline	EV
Purchase cost	108,000	130,000
Annualized purchase cost	12,661	15,240
Annual operating cost[70]	8,827	3,447
Total annual cost	21,488	18,687

Figure 19 shows that expenditure on a gasoline-powered vehicle in the scenario of introducing a carbon tax is 2 percent higher than the expenditure under BAU conditions. The increase for an EV, by contrast, is 8

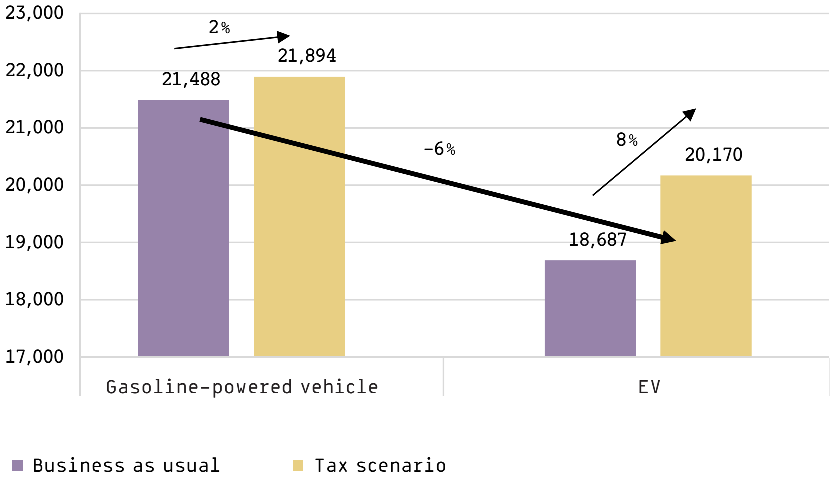
68 For the purposes of the analysis, it was assumed that a private vehicle travels 16,000 kilometers per year. Energy consumption is 0.2 kW/h per kilometer for an EV and 6.7 liters of gasoline per 100 kilometers for a gasoline-powered vehicle. It was also assumed that a car has a ten-year lifetime and a 3 percent amortization interest rate.

69 Based on analysis of costs of EV versus gasoline-powered vehicle. Source of data: Ministry of Energy.

70 Includes maintenance and fuel costs.

percent. Even after the tax is introduced, however, the EV probably remains less costly than a gasoline-powered vehicle; households that switch to one will save 6 percent on their car-ownership expenses relative to expenditure on a gasoline-powered vehicle today, without carbon pricing.

Figure 19
Annual costs (capital and operation), business-as-usual and carbon-tax scenarios (NIS per year)



Conclusions

The results of this study show that introducing a carbon tax increases inequality due to relatively large electricity consumption as share of total consumption among low-decile households. In contrast, because transport expenditure usually rises with income, imposing a carbon tax on this sector is progressive except for cases in which low-decile households live in distant areas where access to transport is limited. These households are prone to the most severe negative impact as a result of the carbon tax.

Also, the tax is unlikely to disincentivize the continued use of gasoline-powered vehicles as against EVs because the cost of owning an EV is likely to be lower than that of a gasoline-powered vehicle even after the tax is introduced.

Therefore, in making carbon-pricing policy, thought should be given to mitigating the adverse effects on low-income households, particularly the impact of an increase in electricity rates. Similarly, responses should be provided for disempowered households that live in distant rural areas, such as improving public transport.

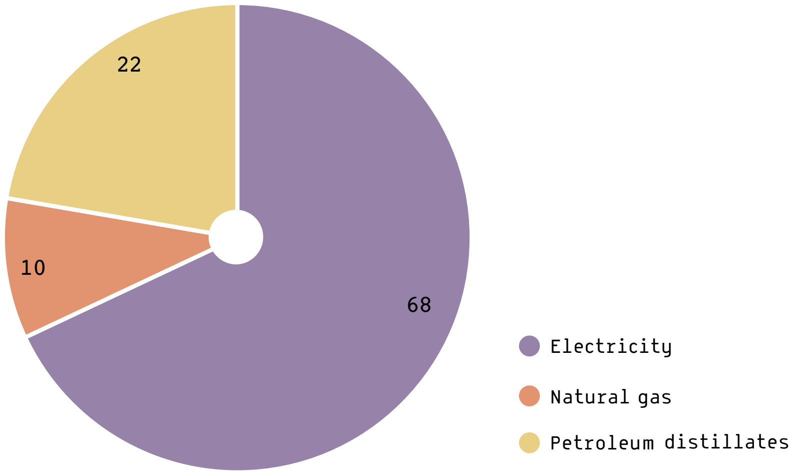
3.8. The effects of carbon pricing on the competitiveness of Israeli industry

Characteristics of energy expenditure by Israeli industry

Israeli industry spent an estimated NIS 8 billion on energy in 2017, 2 percent of its total revenue, with electricity as the most important component—68 percent of total energy spending.[71]

71 Energy consumption is based on data from the Central Bureau of Statistics (*Energy Balance*, 2017). Fuel prices are specified in Appendix 1 of this document.

Figure 20
Distribution of energy expenditure in Israeli industry, by component (%)[72]



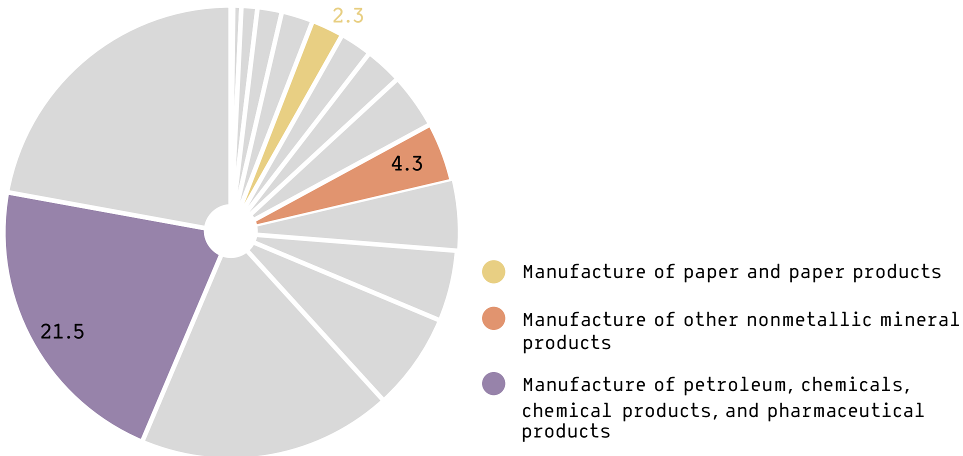
Most industry in Israel is not energy-intensive. Only a few sectors that are customarily considered energy-intensive around the world exist in Israel: manufacture of paper and paper products; manufacture of petroleum, chemicals, and chemical products; and manufacture of other nonmetallic mineral products (mainly cement).[73] These sectors account for only 28 percent of total industrial revenue, indicating that most industry in Israel does not belong to sectors defined globally as energy-intensive.[74]

72 Energy consumption is based on data from the Central Bureau of Statistics (*Energy Balance*, 2017). Fuel prices are specified in Appendix 1 of this document.

73 The petroleum-refining sector is not included in this analysis.

74 Source of revenue data: Central Bureau of Statistics, *Statistical Abstract of Israel* no. 70, Table 16.3.

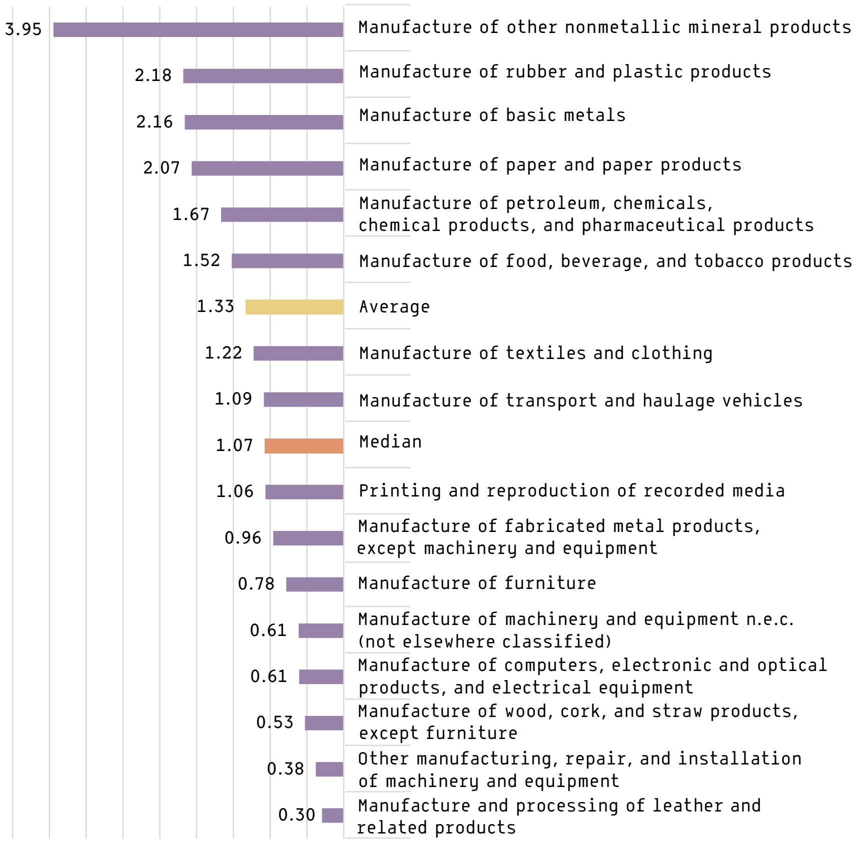
Figure 21
Share of total industrial output by sector, highlighting energy intensive sectors (2017 data; %)



Pursuant to this, Figure 22 below shows that when energy expenditure as a share of revenue is examined for each industrial sector, the highest rate obtained is for "manufacture of other nonmetallic mineral products," including cement. This share, 4 percent, is lower than the threshold of an energy-intensive industry as specified by American draft legislation (>5 percent)—reinforcing the conclusion that most industry in Israel is not energy-intensive.

Among Israel's "energy-intensive" sectors, a few may be susceptible to impaired competitiveness. In the literature and in governmental and legal documents, it is the practice to test the extent of exposure of energy-intensive sectors to international trade. This is done because insofar as this exposure is acute, cross-country differences in regulation may impair the competitiveness of the sector in question in a country that regulates carbon emissions stringently. To identify a trade exposure, the American bill, for example, measures trade intensity by calculating the share of imports and exports in sector revenue. For a sector to qualify for lenient treatment, the share must be at least 15 percent.[75]

Figure 22
Energy costs of industry as percentage of revenue (Israel, 2017)



75 US Environmental Protection Agency (EPA), *The Effects of H.R. 2454 on International Competitiveness and Emission Leakage in Energy-Intensive Trade-Exposed Industries*, December 2, 2009.

To map the industrial sectors that may be harmed by the introduction of a carbon tax, our analysis uses export data by sector[76] to estimate the exposure of each sector to the international market. Although import data may figure importantly in a sector's trade exposure, the analysis omits them because sector-level import data are lacking. The share of exports in total sector revenue is shown in Figure 23.

Figure 24 combines the shares of exports and energy expenditure in the revenue of each sector. The data shown are relative to the median, meaning that the axes represent the median share of exports in revenue (y-axis) and the median expenditure on energy as a share of revenue, i.e., energy intensity (x-axis). The data points shown represent the difference between the value obtained and the median. This approach makes it possible to separate sectors that are more energy-intensive and exposed to international trade from the others. The analysis reveals three main sectors that may face impaired competitiveness and are situated in the positive segment of both axes: chemicals and chemical products; rubber and plastic; and textiles and clothing. In addition, since the data do not include imports, and considering that the nonmetallic mineral sector (cement) is especially energy-intensive and acutely exposed to imports of cement from countries that have no carbon taxation (particularly Turkey), it, too, should be treated as a vulnerable sector.[77] These sectors account for 33 percent of total industrial revenue.

76 Central Bureau of Statistics, *Statistical Abstract of Israel* no. 70, Table 13.13.

77 The exposure to imports can be inferred from recent discussions on raising the duty on cement imports; see Navit Zomar, "'It's over': Katz signs on his opposition to raising the import tax on cement," *Calcalist*, June 22, 2020, https://www.calcalist.co.il/local/articles/0,7340,L-3835271,00.html [Hebrew].

Figure 23
Share of exports in revenue, by sector (Israel, 2017; %)

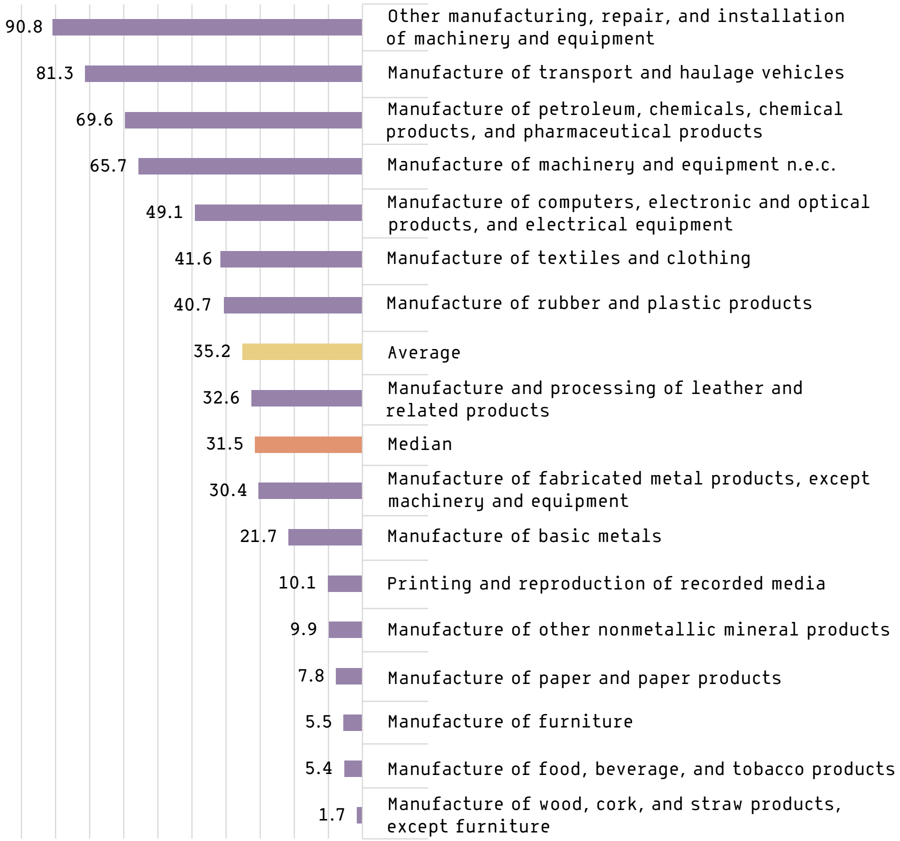
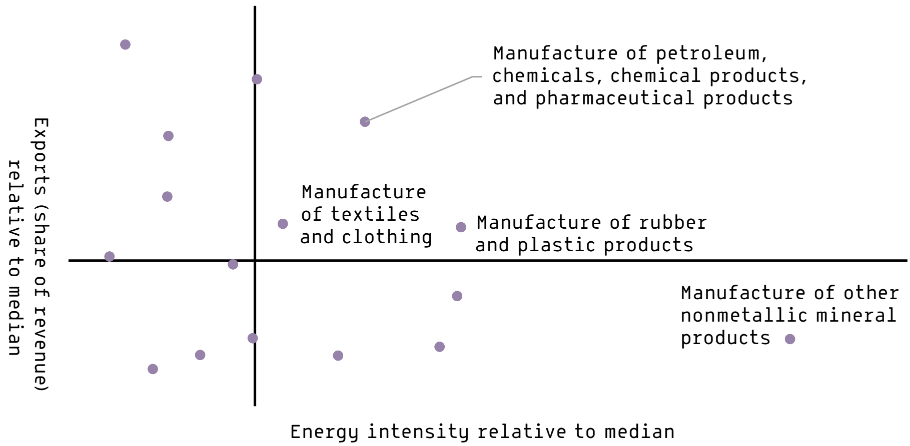


Figure 24
Energy intensity and exposure to exports, by sector (Israel, 2017)

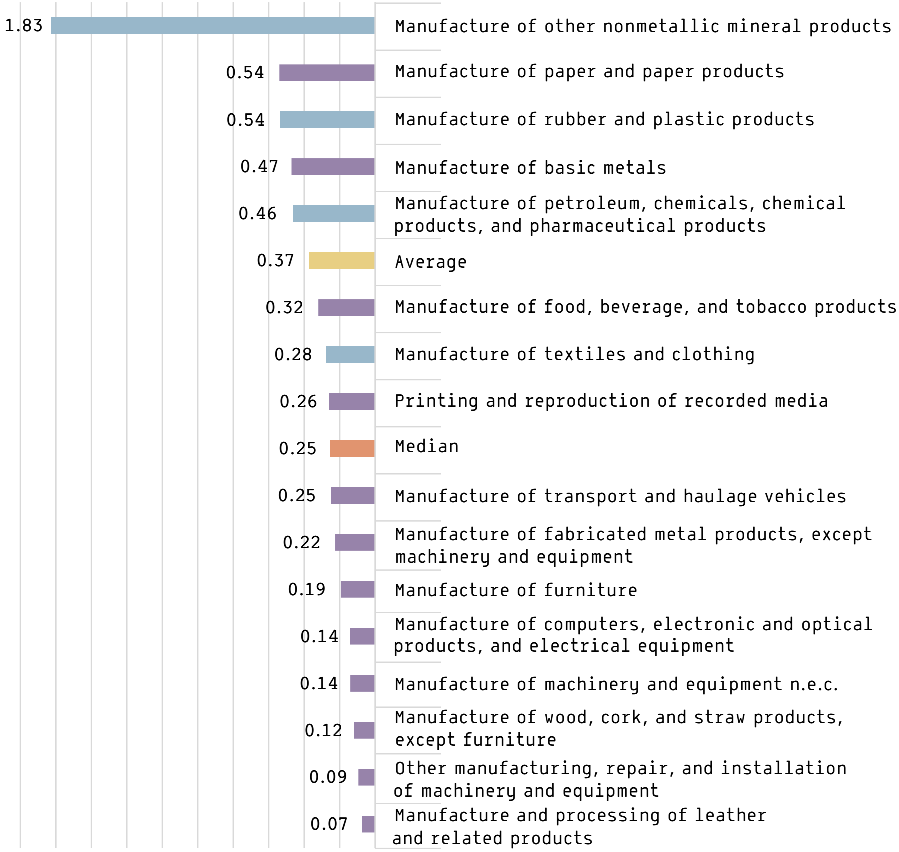


Burden of carbon tax on industry

The median tax burden on industry as a share of industrial revenue stands at 0.25 percent.

Figure 25 shows the share of the tax burden and revenue by industrial sector. The nonmetallic mineral products sector is the one most affected relative to revenue, at 1.83 percent. The burden in revenue terms is also high relative to the median in the sectors previously mapped as potentially vulnerable to impaired competitiveness.

Figure 25
Carbon-tax burden as share of revenue, by sectors (Israel, 2017)

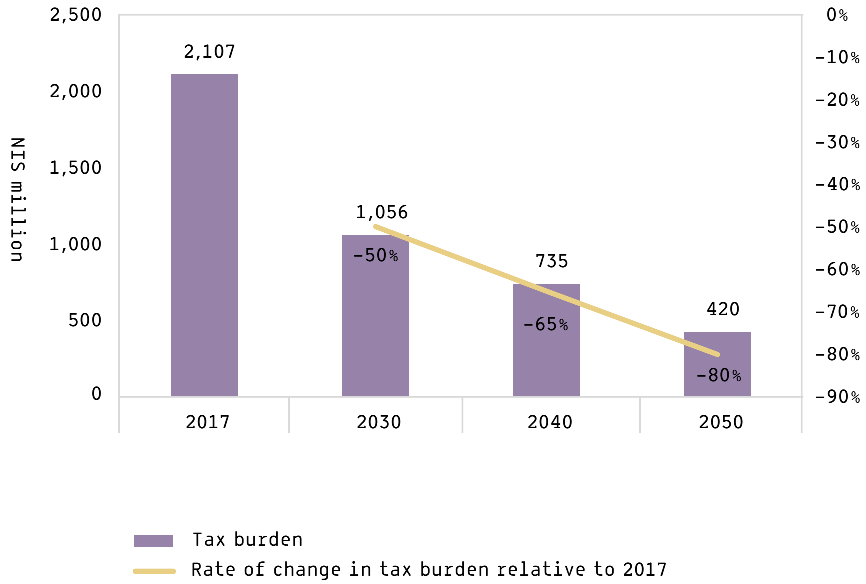


Meeting the targets of the roadmap for industry will probably make the tax burden less onerous. As part of the multi-sectoral “Israel 2050—A Flourishing Economy in a Sustainable Environment” process, a vision and roadmap for industry was formulated. The plan includes a target of 56 percent mitigation of GHG emissions by industry. (This includes emissions not originating in energy consumption—refrigerant gas consumption in the economy at large, and process emissions—but not indirect emissions from industrial consumption of electricity.)

The analysis performed for this document presumes an optimal downward path toward industry's attainment of the target set, by means of improved energy efficiency and reduced use of petroleum distillates, in particularly heavy fuel oil, including via electrification of industry and more intensive use of alternative fuels (RDF) in the cement industry in the near term. In the longer term, the model emphasizes a transition to low-carbon fuels, including hydrogen produced by means of RE. It should be noted that the downward path presumed in the model is not necessarily driven by industry's response to a carbon tax (which is also applied in a target-setting policy scenario). The introduction of such a tax, however, may create an important incentive toward meeting the target of reducing emissions and may encourage the transition to this course.

Figure 26 shows that by staying on this course, the burden of the carbon tax on industry will decline steadily over the years, such that by 2030, it will already be 50 percent below what industry would be shouldering today (on the basis of 2017 data) if the tax were introduced.

Figure 26
Tax burden on industry if emission-mitigation targets are met



Conclusions

- Most of Israeli industry is not energy-intensive. Its sectors that are considered energy-intensive (by the conventional global criterion) generate only 28 percent of total industrial revenue.
- Only four industrial sectors in Israel, accounting for 33 percent of industrial revenue, are prone to damage if a carbon tax is introduced; they will need to be taken into account when the taxation policty is designed.
- Since the European Union is promoting a border-adjustment tax that will be charged on products manufactured in countries that do not use carbon pricing, energy-intensive sectors in Israel that export to Europe

will have to pay a carbon tax whether Israel imposes one or not. The only difference would be that the revenues generated by the tax would accrue to the European Union and not to Israel.

- Meeting the emission-mitigation target set for industry in the "Israel 2050—A Flourishing Economy in a Sustainable Environment" process would already allow the burden of the carbon tax and its share in industry's energy expenditure to fall substantially in the coming decade.

Finally, a carbon tax is an instrument that helps to create certainty in the economy and facilitates and incentivizes the development of green technologies. In the long run, it may also enhance competitiveness in the country's energy-intensive sectors, which will successfully adjust to the trend of transitioning to a sustainable and low-carbon economy—a goal toward which the world's countries, including Israel, are progressing.

3.9. The effect of carbon pricing on commercial transport in Israel

To complete the picture of the effects of carbon taxation on various industrial sectors in Israel, we tested the impact of the tax on the heavy-vehicle and commercial-transport fleet in a scenario in which a carbon tax is added to the existing excise tax on fuel for transport. Regarding private transport, the effect of the tax was examined as one of the impacts of the tax on households, discussed above. Therefore, we first mapped the sectors that would be most heavily affected by the tax: trucks (haulage and distribution), buses, minibuses, taxis, and service trucks (e.g., garbage trucks).

On the basis of the existing data on kilometers traveled,[78] an analysis was performed for the following sectors: trucks, buses, minibuses, and taxis, as shown in Table 4 below. The analysis of each sector was based on different energy-consumption scenarios with the addition of capital and vehicle-operation costs (constituting total ownership cost—TOC). In the analysis, a future taxation environment, in which a carbon tax is introduced but the excise rebate is abolished, was taken as given in order to reflect the future effects of the tax more reliably.[79]

Table 4
Kilometers traveled, by type of vehicle[80]

Type of vehicle	Annual kilometers traveled
Trucks	3,465,408,108
Public transport (buses)	734,717,990
Minibuses	1,174,571,584
Taxis	1,735,475,642

Public transport

To test the effect of the tax on the public-transport sector, the following scenarios were examined:

78 Central Bureau of Statistics (2019), "Kilometers Travelled, by Type of Vehicle," Table 19:4.

79 The analysis takes account of the change in fuel prices only, omitting the cost of converting vehicles to the use of different kinds of energy.

80 Source of data: Central Bureau of Statistics (2019), "Kilometers Travelled, by Type of Vehicle," Table 19:4.

Table 5
Energy-consumption scenarios for public transport

Scenario	Description of scenario
Pre-tax	Expenditure in 2019 without carbon tax and without rebate
Business as usual	100% consumption of diesel fuel
Electrification	Urban buses: 50% electricity, 50% diesel Interurban buses: 100% diesel
CNG (compressed natural gas)	Urban buses: 100% diesel Interurban buses: 50% CNG, 50% diesel

Expenditure on energy in each of the scenarios was calculated by combining the data on kilometers traveled (Table 4), utilization (Appendix 4), and fuel prices (Appendix 2). Data on costs of vehicle capital and operation, spread multi-annually, were added.[81]

81 A 3 percent discount rate, ten-year vehicle life, and a €4/NIS 1 exchange rate are assumed.

Table 6
Capital and operating costs, buses

Type of propulsion	Cost	Unit
Diesel[82]	87,923	NIS per year
CNG[83]	120,175	NIS per year
Electricity[84]	160,291	NIS per year

According to the results of this calculation, in the business-as-usual scenario (diesel fuel), an NIS 167/tonne carbon tax increases expenditure by 6 percent relative to the scenario of diesel fuel and no carbon tax. In the pro-CNG scenario, expenditure falls by 2 percent, and in the pro-electrification scenario it increases by 4 percent relative to the diesel-and-no-carbon-tax scenario but falls relative to potential expenditure in a business-as-usual situation. Thus, switching to alternative propulsion will reduce costs relative to business as usual in both cases and, in the case of CNG, expenditure will fall even relative to diesel consumption without a carbon tax.

82 Source of data: Ministry of Environmental Protection.

83 Orhan Topal and Ismail Nakir, "Total Cost of Ownership Based Economic Analysis of Diesel, CNG and Electric Bus Concepts for the Public Transport in Istanbul City," *Energies* 11, no. 9 (2018): 2369.

84 Source of data: Ministry of Environmental Protection.

Figure 27
Rate of expenditure increase in each scenario relative to pre-tax scenario (TOC, NIS thousand)

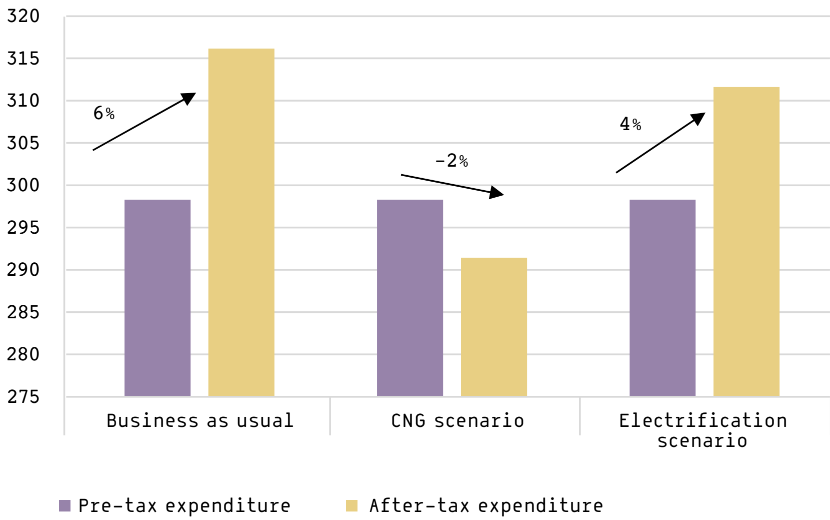


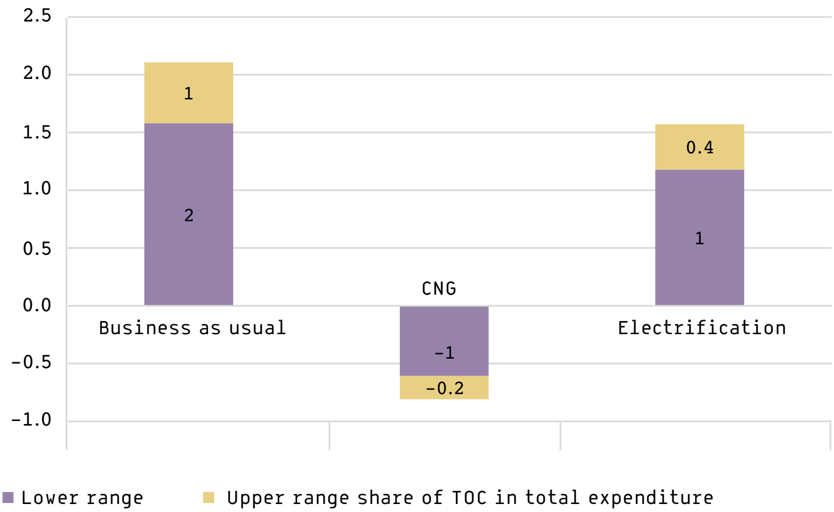
Figure 27 above shows the rate of change in TOC as a result of taxing carbon as against not taxing it[85] in an analysis for two values of the share of TOC in total expenditure: low—26 percent, and high—35 percent.[86] Thus, the expected effect of a carbon tax on buses, with no mitigation actions taken, is low (a 1–2 percent increase in TOC). If public-transport

85 As stated, it is assumed in this scenario that no diesel rebate is given.

86 Source of data: Public-transport operators. According to the original data, energy expenditure is 15 percent of total expenditure in the low scenario and 20 percent in the high scenario. A 43 percent average rebate rate is assumed (Israel Tax Authority, December 2020).

operators switch to alternative propulsion technologies, even if only in part, expenditure may fall by 1 percent of TOC in the CNG scenario or increase by 1 percent in the electrification scenario.

Figure 28
Change in public-transport operators' business TOC expenditure after introduction of NIS 167/tonne carbon tax, various scenarios (% of increase in TOC)



Trucks

To test the effect of the carbon tax on trucking fleets (trucks weighing greater than 3.5 tonnes), the following scenarios were examined:

Table 7
Energy consumption scenarios for trucks

Scenario	Description of scenario
Pre-tax	100% consumption of diesel fuel, no carbon tax and no excise rebate
Business as usual	100% consumption of diesel fuel
Electrification	Trucks 3.5-10 tonnes: 50% electricity, 50% diesel Trucks >10 tonnes: 100% diesel
CNG (compressed natural gas)	Trucks 3.5-10 tonnes: 50% CNG, 50% diesel Trucks >10 tonnes: 100% diesel

By combining data on kilometers traveled, utilization (Appendix 4), and fuel prices (Appendix 2), expenditure on energy and annual capital and operating costs[87] were calculated in each scenario.

87 A 3 percent discount rate and a ten-year vehicle life are assumed.

Table 8
Capital and operating costs, light trucks (3.5-16 tonnes)

Type of propulsion	Cost	Unit
Diesel[88]	38,728	NIS/year
Electricity[89]	47,914-72,539	NIS/year
CNG[90]	40,615	NIS/year

The results, comparing the change in costs (TOC) in each of the scenarios relative to the pre-tax expenditure scenario, show a 5 percent increase in expenditure in the business-as-usual scenario and a 2 percent decline in the CNG scenario. The electrification scenario demonstrates the acute sensitivity of change in expenditure to the extent of EV penetration, ranging from 2 percent with high-level penetration to 17 percent if penetration is weak.

88 Ministry of Energy, *Alternative Propulsion for the Heavy-Vehicle Fleet* (Jerusalem, 2020) [Hebrew].

89 California Energy Commission, *Forecast of Medium- and Heavy-Duty Vehicle Attributes to 2030*, 2018.

90 Data for BEV class 4/5 trucks were taken into account. The range of costs represents a sensitivity test for a scenario of high-level penetration of EV; therefore, the price is the lower than that in a lower-penetration scenario, making the price higher-the most common scenario abroad.

Figure 29
Increase in expenditure in each scenario relative to pre-tax scenario (TOC, NIS thousand)

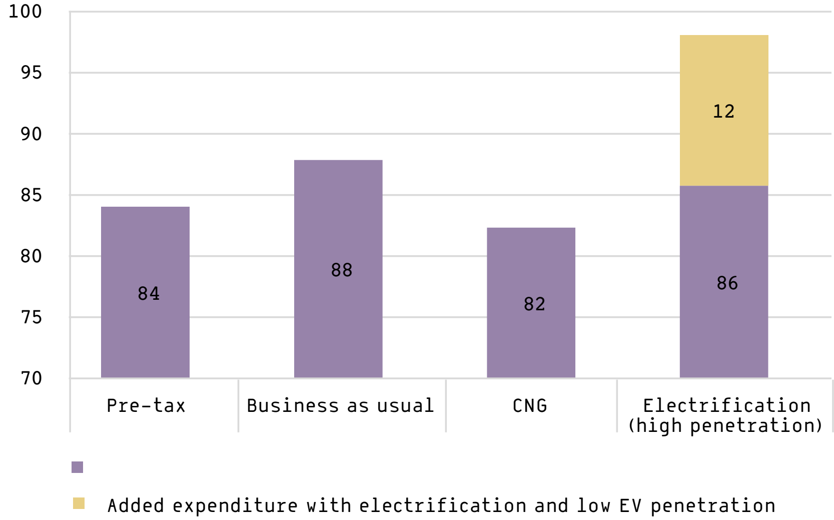


Figure 29 above shows the change in total expenditure as a result of introducing a carbon tax, in each scenario. The analysis is based on the share of TOC in total business expenditure: 35 percent on average before rebate of excise-tax payments.[91]

91 Source of data: Public-transport operators. According to the original data, energy expenditure is 15 percent of total expenditure in the low scenario and 20 percent in the high scenario. A 45 percent average rebate rate is assumed (Israel Tax Authority, December 2020).

Figure 30
Percentage change in truck operators' TOC business expenditure after introduction of NIS 167/tonne carbon tax in various scenarios (%)

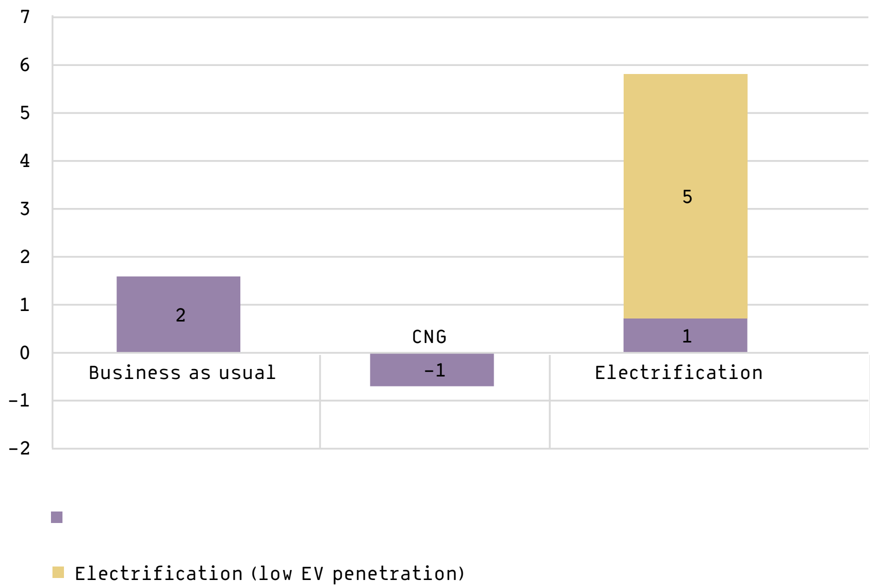


Figure 30 above shows that the expected effect of introducing a carbon tax on truck-fleet operators in a business-as-usual scenario stands at 2 percent of TOC. If mitigation measures are taken, TOC may fall by 1 percent in the CNG scenario and rise by 5 percent in the event of electrification with low penetration. If electric trucks make strong inroads and purchase costs fall, however, the increase would be only 1 percent.

Taxis

The effect of a carbon tax on energy expenditure for taxis is estimated on the basis of the following scenarios.

Table 9
Energy-consumption scenarios, taxis

Scenario	Description of scenario
Business as usual	100% diesel consumption
EV	100% EV taxis
Hybrid	100% hybrid taxis

By combining data on kilometers traveled, utilization (Appendix 4), and fuel prices (Appendix 2), expenditure on energy and annual capital and operating costs[92] were calculated in each scenario. Switching to 100 percent use of EV taxis would reduce energy expenditure by 70 percent even when electricity is liable to the carbon tax. A transition to hybrid taxis would reduce energy expenditure by 2 percent.

Capital and operating costs, along with additional annual expenses, [93] were added to the calculation.

92 A 3 percent discount rate and a ten-year vehicle life are assumed.

93 In the calculation of annual cost, a 3 percent discount rate and a five-year vehicle life are assumed.

Table 10
Annual taxi purchase and operating costs

Type of propulsion	Diesel	Electricity	Hybrid	
Purchase cost	100,000[94]	140,000[95]	110,000[96]	NIS
Annualized purchase cost	21,835	30,570	24,019	NIS per year
Annual operating cost[97]	2,400	1,680	2,400	NIS per year
Other annual costs[98]	18,119	18,119	18,119	NIS per year
Total	42,354	50,368	44,538	NIS per year

94 Skoda taxi.

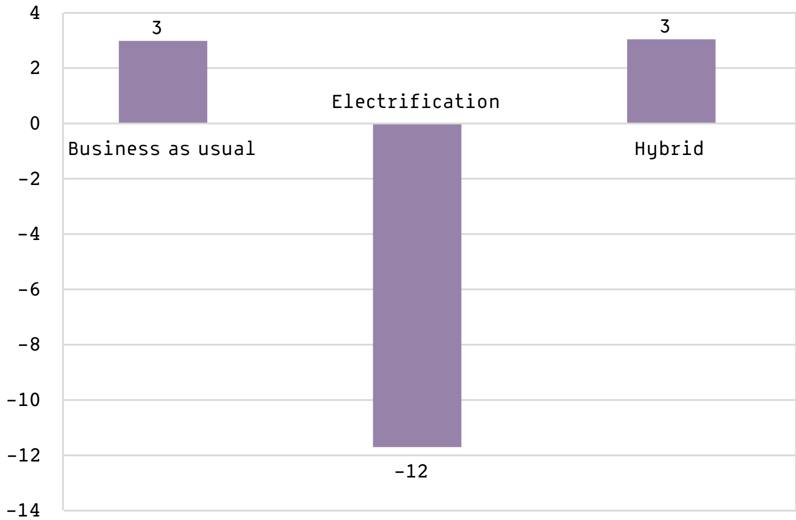
95 Medium-sized MG ZS EV taxi.

96 Toyota taxi.

97 Based on a Ministry of Transport analysis of the costs of vehicles of different kinds of propulsion.

98 Obtained from conversations with taxi drivers. The costs include annual license fee, annual inspection, vehicle insurance, passenger insurance, meter insurance, and meter purchase cost. The cost of a taxi badge is not included because presumably it will be sold at its purchase price. (Today, a badge goes for more than the sum charged by the state when it was purchased; therefore, the analysis is based on an overestimate.)

Figure 31
Percentage change in expenditure on taxi fleet relative to baseline year, with introduction of NIS 167/tonne carbon tax, various scenarios
(Increase in energy expenditure as share of total expenditure; %)



Thus, total expenditure rises by 3 percent in two scenarios: business as usual and transitioning to hybrid taxis. (Importantly, the analysis deals with consumer costs only and does not take into account the benefit of the savings on emissions in the latter scenario.) In the EV scenario, by contrast, expenditure on taxis decreases by a hefty 12 percent due to a steep decline in the price of the propulsion energy.

Conclusions

The results indicate that introducing an NIS 167/tonne carbon tax induces a 3–6 percent increase in total expenditure on heavy vehicles, public transport, and taxis, with no change in the extent or mix of energy consumption in these sectors.

As for the impact of the change in fuel consumption in the various scenarios, expenditure in the CNG scenario declines relative to that preceding the introduction of the carbon tax. This is due to the low CO_2 content of natural gas and the slow rate of change in capital and operating costs relative to that of diesel-powered vehicles. For buses and trucks, by contrast, expenditure in the EV scenario is lower than in the business-as-usual scenario but higher than in the pre-tax situation (contingent upon the extent of EV penetration in the market). This is because, in this case, even though EVs emit little carbon, their capital and operating costs are higher. Switching to electric taxis, by contrast, brings on a sizable 12 percent decrease in expenses.

3.10. Summary

In Israel, taxation of fuel combustion (excise) is not aligned with the level of external costs. The disparity is evident in both the energy and industry sectors and recurs in transport (to which the external costs of congestion and traffic accidents are added to those of air pollution and GHG). A carbon tax is an efficient way of correcting this market failure; it may also help Israel comply with the international accords on reducing emissions that it has signed.

Imposing a carbon tax on emissions from energy consumption, together with introducing an incineration levy and a landfill levy in the waste-management sector and applying the Kigali Amendment, may raise the coverage rate of GHG emissions in Israel to 95 percent.

In macroeconomic research that used hybrid models to test the impact of a carbon tax on the Israeli economy, it was found that a carbon tax is unlikely to impair economic growth. Consequently, introducing a carbon tax probably would incentivize greater use of RE and encourage changeover to reduced-emission vehicles.

However, a carbon tax may have major adverse effects on specific sectors—to which thought should be given when establishing the mechanism generally, and particularly the part relating to the use of the tax proceeds. First, a carbon tax would have especially regressive effects through electricity prices, and an increase in electricity prices would be particularly harmful to the lower deciles in Israeli society. In the transport sector, by contrast, a carbon tax would actually be more progressive, except in cases of low-socioeconomic-status localities in peripheral areas that lack convenient access to public transport.

Second, testing the effect of a carbon tax on industry shows that, overall, the impairment of industrial competitiveness in Israel is likely to be small, but thought should be given to four specific sectors that are more vulnerable because they are energy-intensive and exposed to international trade. However, since many countries to which Israeli industry exports are now working to introduce a border-adjustment-tax mechanism, Israeli industry probably will have to pay a carbon tax in any case, the only question being whether the revenues generated by the tax will accrue to Israel or to a foreign country.

Finally, the effect of a carbon tax on operators of public transport, heavy transport (trucks), and taxis was examined. Here it was found that these operators' expenses are likely to increase by 3–6 percent in a business-as-usual scenario. A change in type of vehicle propulsion, however, may attenuate the upturn (for example, in the case of electric buses), and may even reduce expenses in some cases, as in natural-gas-powered buses and trucks.

Chapter 4

Recommendations

4.1. Important principles for introducing a carbon tax in Israel

Roadmap for introducing a carbon tax in Israel's energy sector

Principle 1: Use the existing excise-tax mechanism to collect the carbon tax

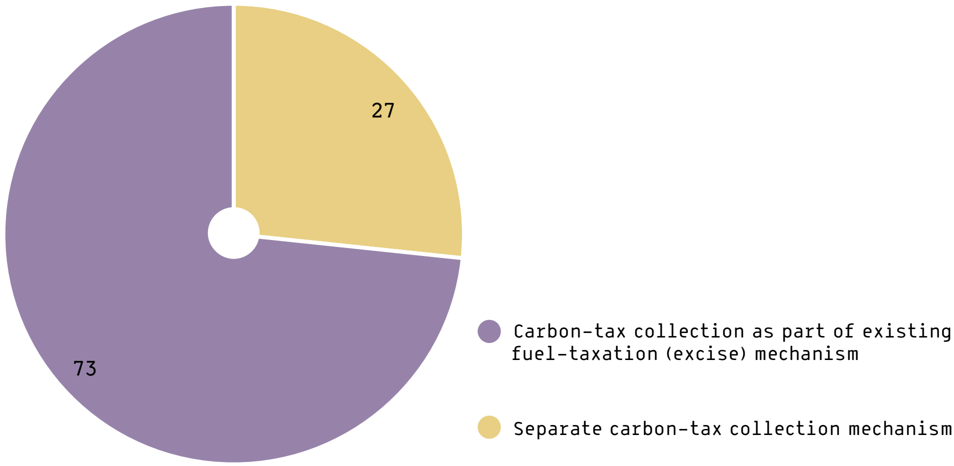
In most OECD countries (73 percent), carbon taxation is applied within the framework of existing fuel taxation and constitutes an increase in the fuel excise.[99]

In Israel, too, we propose building the carbon tax into the excise-tax framework (or the purchase tax for imported fuels). As explained above, the use of the existing fuel-taxation system allows simplicity of collection and major savings relative to the cost of creating a new tax mechanism.

We would also propose that the rate of carbon taxation on fuels should be presented as a distinct component in calculating fuel taxation. Thus it could be recognized for deduction from exporters' payments on account of another country's border-adjustment taxation.

99 OECD, *Taxing Energy Use 2019.*

Figure 32
Distribution of OECD countries by carbon-tax mechanism (%)



Principle 2: (industry and electricity): Gradually introduce the tax in the industry and electricity sectors instead of the excise and raise it until it reaches the level of the external cost of carbon each year

We would propose phasing in the internalization of the external environmental costs of carbon emission (as published and updated from time to time by the Ministry of Environmental Protection[100]) gradually from 2023 to 2028 in order to give the economy time to prepare and adjust. A faster or slower path may be specified for certain fuels, such as completing full internalization of the external cost in taxation of heavy fuel oil before 2028.

100 Ministry of Environmental Protection, *The Green Book*.

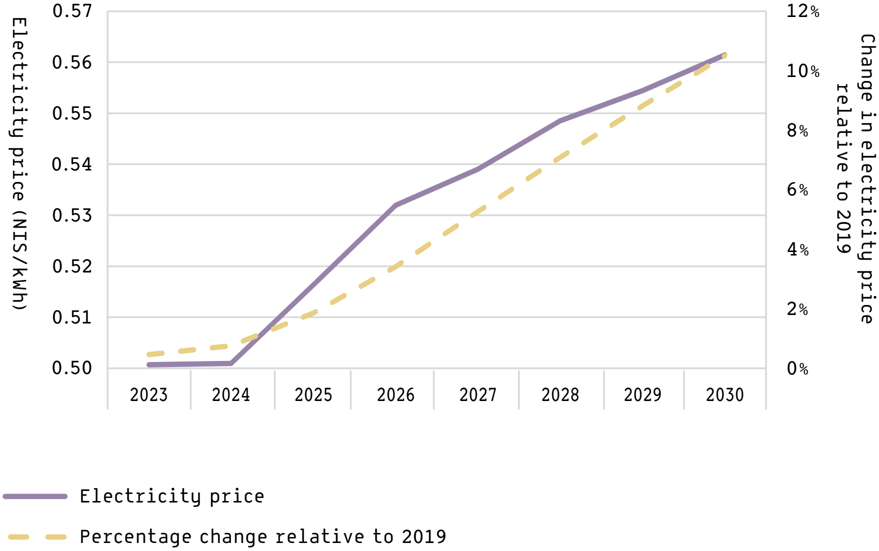
Principle 3. (the transport sector): Present carbon taxation as a distinct component in the rate of excise on diesel and gasoline for transport

In the transport sector, Israel's rate of excise taxation is high by world standards. Therefore, at the present time we would propose that the taxation of carbon in diesel fuel and gasoline for transport should not be added to the excise tax, and instead should be presented as a distinct component of the tax applying to fuel. Thus it would not raise fuel prices immediately.

The effect of a carbon tax on electricity prices

Figure 33 presents the projected electricity prices and the annual percentage change relative to 2019. The figure shows that by 2030, electricity rate prices will have risen by 10 percent relative to 2019, to NIS 0.55 per kW/h, while natural-gas taxation is expected to stand at 71 percent of the full price of carbon that year according to the roadmap presented above.

Figure 33
Change in electricity prices due to introduction of carbon taxation



Internalizing the external cost of carbon emission in the waste-management sector

As explained in Section C4, the external cost of landfill-related GHG emissions is misaligned with the level of the landfill levy. Therefore, the landfill levy should be adjusted to reflect the external cost of GHG emission. As of 2019, this cost was estimated at NIS 174/tonne of buried waste, NIS 64/tonne more than the current landfill levy. It is also recommended to consider a mechanism for pricing the GHG emissions of energy-reclamation facilities. As of 2019, the net external cost of waste hauled to such a facility was estimated at NIS 28/tonne.[101]

4.2. Recommendations for main supplemental policy tools to address the effects of carbon pricing

As noted, the introduction of a carbon tax may be harmful to households in low-income deciles and to industrial sectors that are both energy-intensive and exposed to international trade. Even though the tax incentivizes more efficient energy use and promotes the transition to zero-emission fuels, energy consumers are limited in their short-term ability to react to the tax burden by adjusting their energy consumption. Therefore, it is important to accompany the introduction of the tax with measures that will ease the burden on households, businesses, and industry, on the one hand, and on other, will incentivize greater energy efficiency and conversion to reduced-emission fuel technologies in the long term. To ease the burden of the tax on industry and mitigate the potential impairment of competitiveness, consideration should be given to flexibility and protection mechanisms. Below is a menu of measures for this purpose, including the annual budget cost and the benefit to the economy from lowering the external costs of GHG and air-pollutant emissions.[102]

101 For an itemized calculation of external costs per tonne of treated waste, see Ministry of Environmental Protection, *Strategy for a Sustainable National Waste-Management System*, Chapter 7.

102 The measures that reflect the enhancement of energy efficiency in 2030 are based on Ministry of Energy targets for the electricity mix, of 70 percent natural gas and 30 percent RE.

Supporting energy-efficiency projects in industry and in the commercial-public sector

Pursuant to Government Resolution 1403, a joint committee of the Ministries of the Economy, Energy, the Environment, and Finance introduced a program of grants for energy-efficiency enhancements and mitigation of GHG emission. The scheme facilitates support from the regulator for projects that may create major efficiencies. Experience shows that government support may put into practice effective projects that would not be implemented by market forces alone. The grants provided make it possible to reduce payback of the entrepreneur's investment, and thus may be a decisive factor in carrying out the project. This is a way to incentivize the implementation of environmental projects as an alternative to projects that are unlikely to have a favorable effect on the environment.

On the basis of the National Plan for Energy Efficiency,[103] a NIS 700 million five-year budget is needed for continued support of energy-efficiency projects in industry and the commercial-public sector. This budget would probably save 2 TWh and reduce external costs by NIS 2 billion through savings on electricity consumption.[104]

Electrifying heavy-vehicle fleets (buses and trucks)

Today, Israel's fleets of heavy vehicles—buses and trucks—run almost exclusively on diesel fuel.

103 Ministry of Energy, *National Plan for Energy Efficiency* (Jerusalem, 2020) [Hebrew].

104 The benefit is calculated for a ten-year period, corresponding with the lifetime of the proposed project.

The most available and familiar technology for zero-emission buses is electricity, meaning fully electric propulsion. Electric buses have many advantages over diesel-powered vehicles, including reducing and preventing air pollution in city centers, mitigating GHG emissions, attenuating or preventing noise, and providing a better passenger experience, among others. According to the roadmap for the transition to zero-air-pollution city buses,[105] the target of full electrification of the fleet of urban public buses in Israel by 2034 will require a budget investment of NIS 310 million, yielding an estimated benefit of NIS 1.35 billion.

Unlike buses, truck electrification technology remains far from mature—particularly for heavy trucks, due to their lengthy travel distances and heavy weight. However, incentivizing the transition to electric propulsion may be considered for light trucks and vehicles that operate in urban areas, such as garbage trucks.[106]

Subsidizing EV charging points

Electric propulsion for cars has been developing rapidly in recent years for reasons that include environmental advantages, technological developments, and falling battery prices. Although EVs do not emit pollutants as they travel, they do so indirectly when they use electricity produced at power plants that are usually far from population centers.

As part of the multisectoral "Israel 2050—A Flourishing Economy in a Sustainable Environment" process, a target of 20 percent private EVs by 2030 has been set. One of the conditions for such a massive transition to EVs is the availability of an appropriate charging infrastructure. As long as

105 Ministry of Environmental Protection, *Roadmap for Transition to the Use of Zero-Air-Pollution City Buses* (Jerusalem, 2021) [Hebrew].

106 Ministry of Energy, *Alternative Propulsion for the Heavy-Vehicle Fleet*.

such an infrastructure is lacking, people will not buy EVs, and as long as people do not buy EVs, private enterprises will find it unviable to create a public charging infrastructure. Therefore, government investment in EV charging infrastructure is needed. Subsidizing 70 percent of the cost of installing public and rapid charging points will require budgetary investment of NIS 830 million.[107] The benefit of attaining a 20 percent rate of EVs by 2030 is set at NIS 8 billion in savings on external costs.[108]

Subsidizing green building of schools

Green building has a massive effect on the electricity consumption of the structures in question. With this in mind, the Ministry of Construction and Housing, in conjunction with the Ministries of Energy and the Environment, is acting to update the planning and building regulations in order to formulate a compulsory sustainable building standard (green building) in applications for new building permits countrywide. Government support, particularly in low-socioeconomic-status localities, may be helpful not only in constructing schools that meet the green-building standard but also in directly increasing the schools' budget as a result of savings on the electricity bill—in addition to the economic benefit of the reduction of emissions, of course. NIS 250 million in government support over five years for green building of schools in disadvantaged localities would create

107 It is assumed that annual kilometers traveled will remain unchanged at today's level of 16,000 km per year. It is also assumed that one public charging point will serve 20 EVs at a cost of NIS 20,000 and a rapid charging point will serve 600 EVs at a cost of NIS 350,000.

108 Ministry of Energy, *Energy System Targets for 2030* (Jerusalem, 2019) [Hebrew].

a saving of NIS 100 million in external costs,[109] while simultaneously narrowing social disparities and improving education in these locations.

Cash rebates for low-income households

As stated in this document, introducing a carbon tax on energy consumption by households is likely to cause particular harm to low-income households and exacerbate social inequality. To reduce this harm, we would propose giving households in the two lowest income deciles a rebate on the increase in their electric bills due to the carbon tax. Applying permanently to all relevant households, it would represent the added payment made by the average household, which, in view of today's consumption, would come to around NIS 500 per year by 2030. The total credit is projected at NIS 260 million annually. It could be implemented in cash or by means of vouchers for the purchase or installation of products that save on electricity expenses. Thus, the detriment to low-income households may be eased without impairing the incentive to make efficiencies in electricity consumption.

4.3. Summary

A carbon tax is the most efficient economic way to incentivize the mitigation of greenhouse-gas emissions. Recommended by large international economic institutions worldwide, it is implemented in many countries that are signatories to the Paris Agreement, particularly OECD countries. Estimates using a dynamic macroeconomic model for the Israeli economy show that introducing a carbon tax would mitigate GHG emissions by incentivizing the transition to renewable energy, expediting

109 Over a fifty-year lifetime.

the changeover to EVs, and reducing energy intensivity in GDP (enhancing energy efficiency). The reduction would be attained with a minimal direct downward effect on domestic product—this, without taking into account the expected gains from cutting pollution-related morbidity due to better air quality, reducing congestion, and developing new export industries.

Therefore, a gradually increasing carbon tax in Israel would create a long-term commitment to the attainment of the emission-mitigation goals. On the one hand, it would encourage private enterprise; on the other, it would nudge energy-planning policymakers to internalize the external costs of pollution and the pressures generated by energy consumers. The more fully the planning targets and actual performance anticipate market forces, the lower the burden of the carbon tax will be in practice.

Imposing a carbon tax also poses an issue in political economy. At the local level, this tax, like any tax, imposes a cost on energy consumers—households and firms. Therefore, it is important to move toward a carbon tax in partnership with industry and the public at large. The tax must be socially just and not merely a way to increase Israel's tax burden. Its introduction should be accompanied by fiscal measures that will attenuate its burden on weak population groups and the productive sector, provided they do not offset the effect of the tax on energy consumption.

References

Abadie, Alberto, and Javier Gardeazabal. "The Economic Costs of Conflict: A Case Study of the Basque Country." *American Economic Review* 93, no. 1 (2003): 113–132.

Acemoglu, Daron, Philippe Aghion, Leonardo Bursztyn, and David Hemous. "The Environment and Directed Technical Change." *American Economic Review* 102, no. 1 (2012): 131–166.

Acemoglu, Daron, Ufuk Akcigit, Douglas Hanley, and William Kerr. "Transition to Clean Technology." *Journal of Political Economy* 124, no. 1 (2016): 52–104.

Aldy, Joseph, and William Pizer. "The Competitiveness Impacts of Climate Change Mitigation Policies." *Journal of the Association of Environmental and Resource Economists*, 2, no. 4 (2015): 565–595.

Anbumozhi, Venkatachalam, Masahiro Kawai, and Bindu N. Lohani, eds. *Managing the Transition to a Low-Carbon Economy Perspectives, Policies, and Practices from Asia*. Asian Development Bank Institute, 2015.

Argov, Eyal, and Shai Tzur. *A Long-Term Growth Model for the Israeli Economy*. Jerusalem: Bank of Israel, 2019. [Hebrew].

Arndt, Channing, Rob Davies, Sherwin Gabriel, Konstantin Makrelov, Bruno Merven, and Faaiqa Hartley. "A Sequential Approach to Integrated Energy Modeling in South Africa." *Applied Energy* 161 (2016): 591–599.

Aviram-Nitzan, Daphna, and Erez Summer. *Israel 2050-A Flourishing Economy in a Sustainable Environment: Effects of the Program on the Quality of Life of the Israeli Public*. Jerusalem: Israel Democracy Institute, 2019. [Hebrew].

Bank of Israel. *A Special Report by the Research Department: Raising the Standard of Living in Israel by Bosting Labor Productivity*. Bank of Israel, 2019. [Hebrew].

Baum, Zvi, Ruslana Rachel Palatnik, Iddo Kan, and Mickey Rapaport-Rom. "Economic Impacts of Water Scarcity under Diverse Water Salinities." *Water Economics and Policy* 2, no. 1 (2016).

Binswanger, Mathias. "Technological Progress and Sustainable Development: What About the Rebound Effect?" *Ecological Economics* 36, no. 1 (2001): 119-132.

Bloomberg. "China Targets National Carbon Trading Online by End of June." February 28, 2021.

Bohringer, Christoph, and Thomas F. Rutherford. "Combining Bottom-up and Top-down." *Energy Economics* 30, no. 2 (2008): 574-596.

Buffie, Edward E., Andrew Berg, Catherine Pattillo, Rafael Portillo, and Luis-Felipe Zanna. *Public Investment, Growth, and Debt Sustainability: Putting Together the Pieces*. Washington DC: International Monetary Fund, 2012.

Burke, Marshall, W. Mathew Davis, and Noah S. Diffenbaugh. "Large Potential Reduction in Economic Damages under UN Mitigation Targets." *Nature* 557 (2018): 549-553.

Calderon, Cesar, and Luis Serven. *Infrastructure, Growth and Inequality: An Overview*. Washington DC: World Bank, 2014.

Centre for Sustainable Energy (CSE). *Report to the Committee on Climate Change (CCC): Research on Fuel Poverty: The Implications of Meeting the Fourth Carbon Budget*. CSE, 2014.

Climact, the Belgian Federal Planning Bureau, and Oxford Economics. *Macroeconomic Impacts of the Low Carbon Transition in Belgium*. Brussels: Federal Climate Change Service, 2016.

Committee on Climate Change (CCC). *Energy Prices and Bills: Impacts of Meeting Carbon Budgets*. London: CCC, 2017.

Committee on Climate Change (CCC). *Net Zero: The UK's Contribution to Stopping Global Warming*. London: CCC, 2019.

Davidovitch, Ayelet, Ruslana Rachel Palatnik, Mordechai Shechter, and Ofira Eilon. "How Will Climate Change Affect the Global and Israeli Insurance Industry?" *Ecology and Environment* 10, no. 4 (2019): 58–59. [Hebrew].

Ellis, Jane, Daniel Nachtigall, and Frank Venmans. "Carbon pricing and competitiveness: Are they at odds?" *OECD Environment Working Papers*, No. 152. Paris: OECD Publications, 2019.

European Automobile Manufacturers Association (ACEA). *ACEA Tax Guide*. ACEA, 2019.

European Commission. *A Clean Planet for All: A European Long-Term Strategic Vision for a Prosperous, Modern, Competitive and Climate Neutral Economy*. Brussels: European Commission, 2018.

European Commission. *Communication from the Commission: The European Green Deal*. Brussels: European Commission, December 11, 2019.

European Commission. *EU Green Deal (carbon border-adjustment mechanism)*.

European Commission. "Financing the Green Transition: The European Green Deal Investment Plan and Just Transition Mechanism." *European Commission* website, January 14, 2020.

European Commission. "Just Transition Platform." *European Commission* website, 2020.

European Commission, Directorate-General for Mobility and Transport, Essen, H., Fiorello, D., El Beyrouty, K., et al. *Handbook on the external costs of transport*, Version 2019 – 1.1. European Commission Publications Office, 2020.

European Court of Auditors. *Special Report 18/2020: The EU's Emissions Trading System: free allocation of allowances needed better targeting*. Luxembourg: European Court of Auditors, 2020.

Feitelson, Eran, and Amit Tubi. "A Main Driver or an Intermediate Variable? Climate Change, Water and Security in the Middle East." *Global Environmental Change* 44 (2017): 39–48.

Flues, F., and K. van Dender. "Carbon pricing design: Effectiveness, efficiency and feasibility: An investment perspective." *OECD Taxation Working Papers*, No. 48. Paris: OECD Publishing, 2020.

Fricko, Oliver, Petr Havlik, Joeri Rogelj, Zbignew Klimont, Mykola Gusti, Nils Johnson, and Peter Kolp. "The Marker Quantification of the Shared Socioeconomic Pathway 2: A Middle-of-the-Road Scenario for the 21st Century." *Global Environmental Change* 42 (2017): 251–267.

Gabay, Hadas, Isaac A. Meir, Moshe Schwartz, and Elia Werzberger. "Cost-Benefit Analysis of Green Buildings: An Israeli Officebuildings Case Study." *Energy and Buildings* 76 (2014): 558-564.

Governo de Portugal. *Roterio Nacional De Baixo Carbono 2050*. Governo de Portugal, 2012.

Gronewold, Nathanial. "CDM Critics Demand Investigation of Suspect Offsets." *New York Times*, June 14, 2010.

Guilluy, Christophe. *Twilight of the Elites: Prosperity, the Periphery, and the Future of France*. Yale University Press, 2020.

Helgesen, Per Ivar, and Asgeir Tomasgard. "From Linking to Integration of Energy System Models and Computational General Equilibrium models-Effects on Equilibria and Convergence." *Energy* 159 (2018): 1218-1233.

Hintermann, Beat, and Maja Zarkovic. "Carbon Pricing in Switzerland: A Fusion of Taxes, Command-and-Control, and Permit Markets." *ifo DICE Report* 18, no. 01 (2020): 35-41.

Hourcade, Jean Charles, Mark Jaccard, Chris Bataille, and Frederic Ghersi. "Hybrid Modeling: New Answers to Old Challenges-Introduction to the Special Issue of the Energy Journal." *The Energy Journal* 27 (2006): 1-11.

Huppmann, Daniel, Mathew Gidden, Oliver Fricko, Peter Kolp, Clara Orthofer, Michael Pimmer, Nikolay Kushin, Adriano Vinca, Alessio Mastrucci, Keywan Riahi, and Volker Krey. "The MESSAGEix Integrated Assessment Model and the ix Modeling Platform (ixmp): An Open Framework for Integrated and Cross-cutting Analysis of Energy, Climate, the Environment, and Sustainable Development." *Environmental Modelling and Software* 112 (2019): 143-156.

Interagency Working Group on Social Cost of Greenhouse Gases, United States Government. *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide-Interim Estimates under Executive Order 13990*. Washington DC: White House, 2021.

International Energy Agency (IEA). *Sustainable Recovery: World Energy Outlook Special Report*. Paris: IEA, 2020.

International Energy Agency (IEA). *Tracking Industry 2020*. Paris: IEA, 2020. www.iea.org/reports/tracking-industry-2020

International Labour Organisation (ILO). *A Just Transition toward Sustainable Economies and Societies for All*. Geneva: International Labour Organization, 2019.

International Labour Organisation (ILO) and International Institute for Labour Studies (IILS). *A Review of Global Fiscal Stimulus*. EC-IILS Joint Discussion Paper Series, No. 5. Geneva: International Labour Organization, 2011.

International Labour Organisation (ILO). 2015. *Guidelines for a Just Transition towards Environmentally Sustainable Economies and Societies for All*. Geneva: International Labour Organization.

International Labor Organization (ILO) and United Nations Framework Convention on Climate Change. *Global Forum on Just Transition: Climate Change, Decent Work, and Sustainable Development. Final Report*. Geneva: International Labor Organization, 2017.

International Monetary Fund (IMF). *Fiscal Monitor: How to Mitigate Climate Change*. Washington DC: IMF, October 2019.

International Monetary Fund (IMF). "Is it Time for an Infrastructure Push? The Macroeconomic Effects of Public Investment." In *World Economic Outlook 2014: Legacies, Clouds, Uncertainties*. Washington DC: IMF, 2014.

Israel Information Centre for Assessments of Climate Change Information Center (ICCIC). *Report no. 1: Review of Existing Literature, Identification of Knowledge Gaps, and Priorities in Filling Them*. Jerusalem: ICCIC, 2020. [Hebrew].

Israel Innovation Authority. *Sectoral Review: Clean Technologies in Israel*. Jerusalem: Israel Innovation Authority, 2018. [Hebrew].

Jewell, J., A. Cherp, and K. Riahi. "Energy Security under De-Carbonization Scenarios: An Assessment Framework and Evaluation under Different Technology and Policy Choices." *Energy Policy* 65 (2014): 743–760.

Khan, Matthew E., Kamiar Mohaddes, Ryan N.C. Ng, M. Hashem Pesaran, Mehdi Raissi, and Jui-Chung Yang. *Long Term Macroeconomic Effects of Climate Change: A Cross-Country Analysis* (Working Paper No. 26167). Cambridge MA: National Bureau of Economic Research, 2019.

Kitous, Alban, Kimon Keramidas, Toon Vandyck, Bert Saveyn, Rita Van Dingenen, Joe Spadaro, and Mike Holland. *Global Energy and Climate Outlook 2017: How Climate Policies Improve Air Quality-Global Energy Trends and Ancillary Benefits of the Paris Agreement*. Luxembourg: Publications Office of the European Union, 2017.

Kiuila, Olga. "Decarbonisation Perspectives for the Polish Economy." *Energy Policy* 118 (2018): 69–76.

Lebelle, Aurélie. "Yellow vests: 'The resentment is gigantic,' warns Christophe Guilluy." *La Parisien*, November 17, 2018.

Luckmann, Junas, Harald Grethe, Scott McDonald, Anton Orlov, and Khalid Siddig. "An Integrated Economic Model of Multiple Types and Uses of Water." *Water Resources Research* 50 (2014): 3875–3892.

Manne, Alan Sussmann, and Clas-Otto Wene. *MARKAL-Macro: A Linked Model for Energy-Economy Analysis*. No. BNL-47161. Upton NY: Brookhaven National Laboratory, 1992.

Maor, Dafna. "Fuel Tax Climbs to 60%: France is Burning–and This Isn't the Only Reason." *The Marker*, November 25, 2018. [Hebrew].

Messner, Sabine, and Leo Schrattenholzer. "MESSAGE-MACRO: Linking an Energy Supply Model with a Macroeconomic Module and Solving it Iteratively." *Energy* 25, no. 3 (2000): 267–282.

Montel. "9 EU states urge CO2 price floor to meet climate goals." December 13, 2018.

Ministry of Energy. *Alternative Propulsion for the Heavy-Vehicle Fleet*. Jerusalem: Ministry of Energy, 2020. [Hebrew].

Ministry of Energy. *Energy System Targets for 2030*. Jerusalem: Ministry of Energy, 2019. [Hebrew].

Ministry of Energy. *National Plan for Energy Efficiency*. Jerusalem: Ministry of Energy, 2020. [Hebrew].

Ministry of Energy, Ministry of Transport, Ministry of Finance, and Ministry of the Economy. *Israel 250: A Thriving Economy in a Sustainable Environment: Measures, Targets, and Vision by Field*. Jerusalem: Israel Democracy Institute, 2019. [Hebrew].

Ministry of Environmental Protection. *Examining the Potential for Reducing Greenhouse-Gas Emissions and Recommending a National Target in Israel*. Jerusalem: Ministry of Environmental Protection, 2015. [Hebrew].

Ministry of Environmental Protection. *External Costs of Road Transport in Israel: Air Pollutants and Greenhouse Gases*. Jerusalem: Ministry of Environmental Protection, 2021. [Hebrew].

Ministry of Environmental Protection. *National Program for the Implementation of the Paris Agreement*. Jerusalem: Ministry of Environmental Protection, 2016. [Hebrew].

Ministry of Environmental Protection. *Reducing Greenhouse-Gas Emissions in Israel: Annual Followup Report on Implementation of the National Program and Objectives for Reducing Greenhouse-Gas Emissions*. Jerusalem: Ministry of Environmental Protection, 2018. [Hebrew].

Ministry of Environmental Protection. *Strategy for a Sustainable National Waste-Management System 2021-2030*. Jerusalem: Ministry of Environmental Protection, December 2020. [Hebrew].

Ministry of Environmental Protection. *The Green Book-External Costs of Air Pollutants and Greenhouse Gases* (updated). Jerusalem: Ministry of Environmental Protection, 2020. [Hebrew].

Ministry of Environmental Protection and Ministry of Transport, National Infrastructures, and Road Safety. *Development of Public Transport in Israel: Strategic Plan-Ride Sharing Today and Tomorrow*. Jerusalem, 2012. [Hebrew].

Nordhaus, William D. "A Review of the Stern Review on the Economics of Climate Change." *Journal of Economic Literature* 45 (2007): 686-702.

Natter, Ari, Jennifer A. Dlouhy, and David Westin. "Biden Exploring Border Adjustment Tax to Fight Climate Change." *BloombergQuint*, April 23, 2021.

OECD. *Accelerating Climate Action: Refocusing Policies through a Well-Being Lens*. Paris: OECD Publishing, 2019.

OECD. *Accelerating Climate Change in Israel: Refocusing Mitigation Policies for the Electricity, Residential and Transport Sectors*. Paris: OECD Publishing, 2020.

OECD. *Effective Carbon Rates 2018: Pricing Carbon Emissions Through Taxes and Emissions Trading*. Paris: OECD Publishing, 2018.

OECD. *From Containment to Recovery: Environmental Responses to the COVID-19 Pandemic*. Paris: OECD Publishing, 2020.

OECD. "Greener Skills and Jobs for a Low-Carbon Future." *OECD Green Growth Papers*, No. 2013/10. Paris: OECD Publishing, 2013.

OECD. *Investing in Climate, Investing in Growth*. Paris: OECD Publishing, 2017.

OECD. *Taxing Energy Use 2019: Using Taxes for Climate Action*. Paris: OECD Publishing, 2019.

OECD. *The Cost of Air Pollution: Health Impacts of Road Transport*. Paris: OECD Publishing, 2014.

Office of the Prime Minister. *National Program for the Attainment of Objectives in Reducing Greenhouse-Gas Emissions and Energy Efficiency* (Updated 2017). Jerusalem: Office of the Prime Minister, 2016. [Hebrew].

Office of the Prime Minister. *Reducing Greenhouse-Gas Emissions and Streamlining Energy Consumption in Israel* (Updated 2017). Jerusalem: Office of the Prime Minister, 2015. [Hebrew].

Orimoloye, Israel Ropo, Sonwabo Perez Mazinyo, Ahmed Mukalazi Kalumba, Olapeju Yewande Ekundayo, and Werner Nel. "Implications of Climate Variability and Change on Urban and Human Health: A Review." *Cities* 91 (2019): 213–223.

Orthofer, Clara Luisa, Daniel Huppmann, and Volker Krey. "South Africa after Paris: Fracking Its Way to the NDCs?" *Frontiers in Energy Research* 7 (Article 20, 2019).

Palatnik, Ruslana Rachel. "The Economic Value of Seawater Desalination–The Case of Israel." In *Economy-Wide Modeling of Water at Regional and Global Scales: Advances in Applied General Equilibrium Modeling*, edited by Glynn Wittwer, 193–208. Singapore: Springer, 2019.

Palatnik, Ruslana Rachel, Ayelet Davidovitch, Tamar Trop, and Ofira Eilon. "Is Green Worth It? A Cost-Benefit Analysis of Green Schools in Israel." *Ecology and Environment* 9, no. 1 (2018): 50–57. [Hebrew].

Palatnik, Ruslana Rachel, Helena Faitelson, and Mordechai Shechter. "Israeli Policy towards Reaching Cancun Pledge: A Comparison of Actions in Plan and Economically Efficient Measures." *Finance and Business* 1 (2012): 149–155.

Palatnik, Ruslana Rachel, and Mordechai Shechter. "Assessing the Impact of Greenhouse Gas Emission Controls within the Framework of a General Equilibrium Model of the Israeli Economy." *Economic Quarterly* 55, no. 4 (2008): 545-573.

Petrick, Sebastian, and Ulrich J. Wagner. "The Impact of Carbon Trading on Industry: Evidence from German Manufacturing Firms." *Kiel Working Paper, No. 1912*. Kiel Institute for the World Economy, 2014.

Pindyck, Robert S. "The Social Cost of Carbon Revisited." *Journal of Environmental Economics and Management* 94 (2019): 140-160.

Ramstein, Celine, Goran Dominioni, Sanaz Ettehad, Long Lam, Maurice Quant, Jialiang Zhang, Louis Mark et al. *State and trends of carbon pricing 2019*. The World Bank, 2019.

Republic of South Africa. *Carbon Tax Act*. Cape Town: Government Gazette, May 23, 2019.

Rozenberg, Julie, Adrien Vogt-Schilb, and Stephane Hallegatte. *Transition to Clean Capital, Irreversible Investment and Stranded Assets. Policy Research Working Paper No. 6859*. Washington DC: World Bank, 2014.

Schneck, Joshua, Brian Murray, Jan Mazurek, and Gale Boyd. "Protecting Energy-Intensive Trade-Exposed Industry." *Nicholas Institute for Environmental Policy Solutions Primer* NI PR HR-3. Durham NC: Duke University, 2009.

Seixas, J., P. Fortes, J. P. Gouveia, S. G. Simoes, A. Pereira, and R. Pereira. *The Role of Electricity in the Decarbonization of the Decarbonization of the Portuguese Economy*. Universidade Nova De Lisboa and College of William and Mary, 2017.

Siddig, Khalid, and Harald Grethe. "No More Gas from Egypt? Modeling Offshore Discoveries and Import Uncertainty of Natural Gas in Israel." *Applied Energy* 136 (2014): 312-324.

Solomon, A. A., Dmitrii Bogdanov, and Christian Breyer. "Solar Driven Net Zero Emission Electricity Supply with Negligible Carbon Cost: Israel as a Case Study for Sun Belt Countries." *Energy* 155 (2018): 87-104.

Steckel, Jan, and Leonard Missbach. "Leaving No One Behind: Carbon Pricing in Israel: Distributional Consequences across Households." *Policy Paper Series Shaping the Transition to a Low-Carbon Economy: Perspectives from Israel and Germany*. Israel Public Policy Institute (IPPI) and Heinrich Böll Foundation Tel Aviv, 2020.

Stern, Nicholas. *The Economics of Climate Change: The Stern Review*. Cambridge and New York: Cambridge University Press, 2007.

SueWing, Ian. "The Synthesis of Bottom-up and Top-down Approaches to Climate Policy Modeling: Electric Power Technologies and the Cost of Limiting US CO2 Emissions." *Energy Policy* 34, no. 18 (2006): 3847-3869.

Sussman, Nathan, Daphna Aviram-Nitzan, and Hila Shoef Kollwitz. *A Just Transition to a Low-Carbon Economy*. Jerusalem: Israel Democracy Institute, 2020. [Hebrew].

Sussman, Nathan, Ruslana Rachel Palatnik, Ayelet Davidovitch, and Hila Shoef Kollwitz. *Israel 2050-A Flourishing Economy in a Sustainable Environment: Effects of the Program on Macroeconomic Growth in Israel*. Jerusalem: Israel Democracy Institute, 2020. [Hebrew].

Sussman, Nathan, Uri Sharon, and Hila Shoef Kollwitz. *Green Extrication Plan 2020: Measures for the Advancement of the State Budget*. Jerusalem: Israel Democracy Institute and the Coalition of Environmental Organizations, 2020. [Hebrew].

The White House. *Executive Order on Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis*. January 20, 2021.

Tishler, Asher, J. Newman, I. Spekterman, and C. Woo. "Assessing the Options for a Competitive Electricity Market in Israel." *Utilities Policy* 16 (2008): 21–29.

Trajtenberg, Manuel, and Hadar Zer Aviv. *To Unravel the "Gordian Knot" 2.0: Tackling Congestion via Road Pricing and Ride Sharing*. Haifa: Samuel Neaman Institute for National Policy Research, 2020.

Tzafrir, Rinat. "Researchers: Air Pollution Is Making the Body More Vulnerable to the Coronavirus." *Ha'aretz*, March 18, 2020. [Hebrew].

UK Government. *The Clean Growth Strategy: Leading the Way to a Low Carbon Future*. 2017.

United Nations. *Solidarity and Just Transition Silesia Declaration*. New York: United Nations, 2018.

United Nations. *The Sustainable Development Goals Report 2016*. New York: United Nations, 2016.

United Nations. *The Sustainable Development Goals Report 2020*. New York: United Nations, 2020.

United Nations Environment Programme. *Emissions Gap Report 2019*. Nairobi: UNEP, 2019.

US Environmental Protection Agency (EPA). *The Effects of H.R. 2454 on International Competitiveness and Emission Leakage in Energy-Intensive Trade-Exposed Industries*. December 2, 2009.

Weitzman, Martin L. "Prices vs. Quantities." *Review of Economic Studies*, 41, no. 4 (1974): 477-491.

World Bank. *State and Trends of Carbon Pricing 2020*. Washington, DC: World Bank, 2020.

World Bank. *Transformative Climate Finance: A New Approach for Climate Finance to Achieve Low-Carbon Resilient Development in Developing Countries*. Washington DC: World Bank, 2020.

ISBN:
978-965-519-288-9

November 2022
www.en.idi.org.il