MA in Social and Policy Aspects of Climate Change

תוכנית המ.א. בהיבטי חברה ומדיניות של שינוי אקלים

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בית הספר ללימודי חברה ומדיניות
הפקולטה למדעי החברה ע"ש גרשון גורדון
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Is Israel Meeting its International Climate Obligations?

Evaluating National Performance in the Electricity, Waste, Transport and Industrial Sectors

Reducing Emissions from Israel's Electricity Sector

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Reducing Emissions from Israel's Solid Waste Sector Sapir Arama, Yael Vardi

Reducing Emissions from Israel's Transportation Sector

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Executive Summary:

For twenty-three years, the 1992 United Nations Framework Convention on Climate Change (UNFCCC) proved to be an ineffective international basis for galvanizing global efforts to reduce greenhouse gas emissions. The Paris Agreement, signed in 2015 at the UNFCCC's 21st "Conference of the Parties," constituted a turning point in global climate politics. Rather than impose "top-down" emissions reduction targets, the agreement adopted a "bottom-up" approach: countries submitted action programs—called Nationally Determined Contributions (NDCs)—in which they established their own objectives and plans to reduce carbon emissions. The State of Israel signed and ratified the Paris Agreement without delay. On November 14, 2016, the Israeli government ratified the Paris Agreement on Climate Change, becoming the 113th country to approve the new global strategy for addressing the climate crisis.

According to the Paris Agreement, every five years, countries are required to submit a new NDC, continuously ratcheting down their own emission targets as they seek to meet increasingly stringent climate-driven performance expectations. At the November 2021 COP26 in Glasgow, 151 of the 193 signatories to the Paris Agreement, including Israel, submitted a revised NDC. It was in this context that Israel's government adopted Decision 171, entitled "Transition to a Low Carbon Economy," on July 25, 2021. The decision was made in the lead-up to the Glasgow meeting.

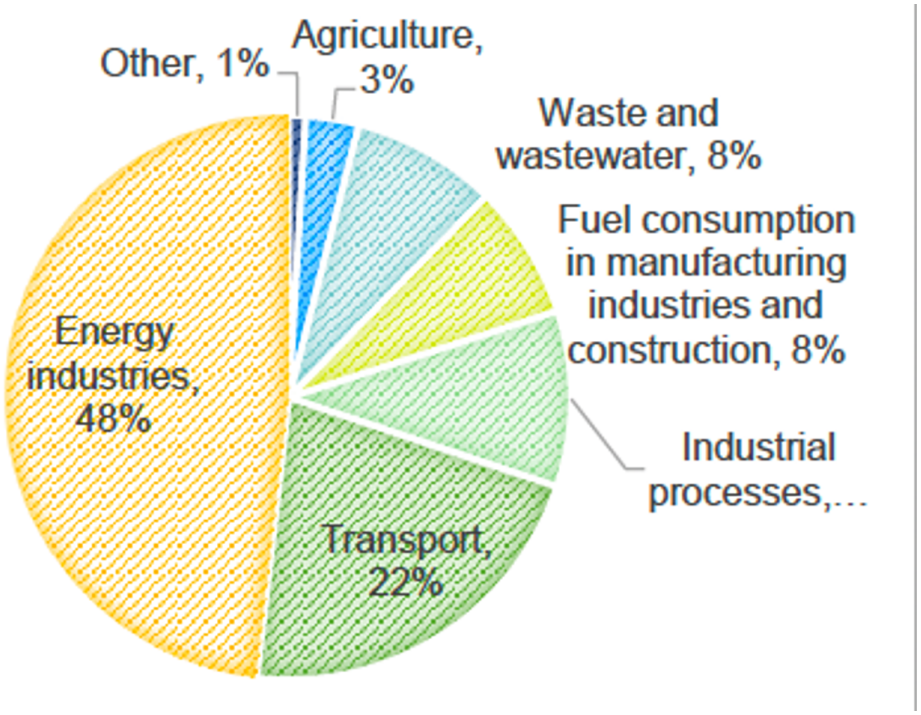
Unlike Israel's original NDC, this new government decision included an absolute greenhouse gas (GHG) emissions reduction target for 2030 of 27% (relative to 2015), along with an unconditional absolute GHG emissions reduction goal for 2050 of 85% (relative to emissions in 2015). These objectives reflected a significantly more ambitious commitment to improving the country's climate performance: Israel's initial NDC submitted in 2015 projected 2030 greenhouse emissions would be 81.65 MtCO2e, but under the new plan, Israel promised to cut them to 58 MtCO2e by 2030— a reduction of almost 30%.

Figure 1 reflects the breakdown of Israeli greenhouse gas emissions as of 2020. The four major categories of emissions are:

- The energy/electricity sector;
- The transportation sector;
- The waste sector; and
- The industrial sector.

Together, they combine for a total of 86% of the country's total greenhouse gas emissions.

Figure 1: Percentage Greenhouse Gas Emissions by Category in Israel



Source: Israel Ministry of Environmental Protection, 2024

As mentioned, Israeli Government Decision 171 set forth sector-specific targets for reducing greenhouse gas emissions for these four primary target areas. These are summarized in Figure 2. Electricity and energy industries produce almost half of Israel's greenhouse gas emissions. By 2030, the government pledged that these would be reduced by 30% compared to emissions measured in 2015, and by 85% by 2050. A new energy intensity target was set so that by 2030 the energy intensity of GDP will be 122 MWh per NIS 1 million.

Overall, the emissions target for the transport sector was underwhelming: rather than promising a decrease, the government decision stated that the total increase in emissions would be limited to 3.3% by 2030 compared to 2015. The decision also pledged that by 2026, all new municipal buses purchased would be "clean vehicles," and that reductions in GHG emissions from new vehicles would be reassessed in 2025.

Commitments regarding Israel's waste sector were more ambitious: GHG emissions from solid waste were to be cut by 47% by 2030 and 92% by 2050 compared to emissions measured in 2015. Moreover, by 2030, Israel pledged to reduce landfill disposal from 80% to 20%, and to eliminate untreated organic waste landfill by 2030. Finally, by 2030, GHG emissions from industry were to be reduced by at least 30% relative to emissions in 2015 (12 MtCO2e), with a 56% cut by 2050.

Figure 2: Official and Declared GHG Emissions Reduction Targets of Israel

		official targets				Declared targets
GHG Emissions Source	Baseline - 2015 (MtCO2e)	2030 Target (% reduction)	2030 Target (emissions, MtCO2e)	2050 Target (% reduction)	2050 Target (emissions, MtCO2e)	2050 Target
Economy Wide	80.7	27%	58	85%	12	Net-Zero GHG Emissions
Electricity Generation	37.6	30%	26.3	85%	5.6	-
Transport	17.6	3.3% increase	18.2	96%	0.7	-
Industry	11.4	30%	8.0	56%	5.0	-
Waste	7.4	47%	3.9	92%	0.6	-

Source: Israel Ministry of Environmental Protection, 2025, First Biennial Transparency Report

Israel is presently considering its third NDC strategy, which is to be prepared and submitted before the COP31 gathering in 2026. Before moving on to the next phase, it is important to consider how well the country is meeting its existing 2021 commitments. Graduate students in Climate Policy at Tel Aviv University evaluated Israel's implementation of the government-mandated climate goals for the four categories of emissions listed above. The findings are presented in their 109-page report. They suggest that present efforts are inadequate.

Israel's Electricity and Energy Sector:

Among the positive developments that reduced emissions from electricity and energy production in recent years, the report identified:

1. **Coal Phase-Out and Increased Natural Gas Use**

   Israel has rapidly decreased its reliance on coal for electricity generation—from over 60% in 2012 to less than 22% in 2020. A complete coal phase-out is planned by 2025, aligning with global climate targets and significantly reducing emissions. Natural gas now generates about 70% of the country's electricity. This transition contributes to reduced emissions and aligns with the government's original goal of eliminating coal entirely by 2025.

2. **Growth in Solar Energy and Structural Reform**

   Solar power now generates roughly 13–14% of Israel's electricity, with significant PV installation growth. Additionally, a major energy market reform (2018–2026) has opened the sector to competition, decentralizing the Israel Electric Corporation and laying the groundwork for further renewable integration.

At the same time, four areas of failure in the sector were identified in the evaluation:

1. **Slow Progress Toward Renewable Energy Targets**

   Israel's 2021 NDC aims for 30% renewable electricity by 2030. Current levels of electricity coming from renewables (13–14%) suggest that the country is off track. Bureaucratic bottlenecks, underdeveloped grid infrastructure, and overreliance on solar were identified as central factors limiting progress.

2. **Regulatory and Institutional Fragmentation**

   Poor coordination between ministries (e.g., Energy, Environmental Protection), unclear statutory responsibilities, and a cumbersome permitting system also hinder implementation. The absence of a unified, integrated, and empowered regulatory body is conspicuous, leading to slow project approvals.

3. **Overreliance on Solar Energy Alone**

Israel's renewable portfolio is overly concentrated on solar, limiting energy security and grid flexibility. In contrast to countries with diversified mixes (wind, hydro, geothermal), Israel lacks backup options for cloudy days or emergencies—compromising energy reliability during the decarbonization transition.

4. **Lack of High-Level Political Priority**

Environmental policy often takes a backseat to security and legal reform. Experts suggest that climate issues are seen as a luxury, not a priority—hindering consistent funding, long-term planning, and public engagement.

Recommendations:

The report makes specific recommendations, based on the positive experiences found in other country's climate policies:

Diversify Renewable Energy Sources

Like Kenya (geothermal) and Norway (wind and hydro), Israel should explore offshore wind, geothermal, and possibly biomass, supported by feasibility studies and pilot projects to build energy resilience.

Create a "One-Stop-Shop" for Project Permits

Drawing from U.S. and EU models, Israel should establish a single, centralized regulatory portal to simplify and expedite renewable energy project approvals, integrating environmental, land-use, and energy evaluations.

Establish a National Energy Council

The report calls for an inter-ministerial authority to align energy policies, manage NDC implementation, and coordinate funding, public outreach, and enforcement—reducing fragmentation and improving accountability.

Adopt Energy Storage and Grid Modernization Strategies

Investment must be expanded in diverse energy storage technologies (batteries, pumped hydro) and smart grid infrastructure to accommodate solar intermittency and decentralized energy production.

Strengthen Public Engagement and Incentives

The Israeli government should utilize policy nudges and adopt financial tools (e.g., feed-in tariffs, subsidies, tax breaks) to engage households and businesses. Statutory mandates requiring solar installations on all new buildings, as well as support for renters or smaller properties through tailored programs is also recommended.

Conclusion:

Israel's electricity sector has made clear progress—especially in phasing out coal and expanding solar—but it still faces significant barriers to achieving its 2030 and 2050 climate goals. Stronger political will, a diversified energy mix, streamlined regulation, and coordinated governance are essential to accelerate the clean energy transition and fulfill Israel's NDCs under the Paris Agreement.

Israel's Transportation Sector

Among the positive developments in Israel's transport sector in recent years cited by the report are:

1. **Growth of Electric Vehicle Adoption**

   Israel has seen a rapid increase in EV sales, rising from ~0% in 2015 to 18.6% of new vehicle sales in 2023. EVs are projected to make up 95% of new vehicle sales by 2030, especially if supported by green tax incentives and an expanding charging infrastructure.

2. **Electrification of Public Transport**

   The share of electric municipal buses increased from 1.1% in 2021 to 17.7% in 2022, with a target of 100% by 2026. While this target is unlikely to be met, recent years have demonstrated the potential of such efforts when supported by government incentives and the falling costs of electric buses, particularly from China.

There are, however, numerous failures identified in Israel's transport sector decarbonization efforts. Four central ones are:

1. **Weak Short-Term Targets and Policy Delays**

The 2021 NDC does not even require an immediate reduction in GHG emissions from transportation, allowing emissions to grow by 3.3% by 2030—a near "business-as-usual" trajectory. More ambitious reductions (96% by 2050) are deferred, with no medium-term targets to guide consistent progress. This exemplifies intergenerational lassitude—leaving the burden of emission reduction to future generations.

2. **Slow Modal Shift from Private to Public Transport**

   Despite investments in public transport (light rail, buses), private car use remains dominant. Key projects like electrification of the national railway and the Tel Aviv light rail have been delayed until 2030, minimizing near-term impact. Based on Israel's track record, it is uncertain whether these targets will be met.

3. **Insufficient Focus on Non-Metropolitan Areas**

   Transport policy efforts are concentrated in major cities, neglecting smaller towns and rural areas. Without regional planning, car dependency will persist and likely increase with population growth.

4. **Uncertain Electricity Sector Readiness**

   Transport electrification may simply shift greenhouse gas emissions to the power sector if renewable energy targets are unmet. Israel would need over 99% renewable electricity to support full EV deployment without increasing total emissions—yet it struggles to meet its 30% by 2030 goal.

Among the recommendations for improvement advised by the report are:

Increase Incentives and Public Confidence in EVs

Norway offered generous tax breaks, free public parking, and toll exemptions for EVs, allowing it to achieve90% EV sales by 2024. Israel should restore and expand EV incentives—particularly for low-income and commercial users.

Combine Long-Term Infrastructure with Short-Term Emissions Cuts

Like Spain, Israel should pair major projects with near-term policies like low-emission zones, speed limits, and public transport subsidies to reduce emissions immediately.

Integrated Urban and Transport Planning

Inspired by Singapore, Israel should embed sustainable mobility in national planning, linking compact cities with efficient public transport and congestion pricing.

Set Legally Binding, Short- and Medium-Term Targets

Following Spain's model, Israel should set enforceable milestones for 2030 and 2040, ensuring accountability toward 2050 climate goals.

Conclusion:

Israel has laid a strong foundation through EV expansion and public transport investment. However, short-term commitments remain weak, and long-term goals are at risk due to delays in implementation, and insufficient renewable energy progress. Integrated and regionally inclusive transport policies are essential for meeting national and global climate objectives.

Israel's Waste Sector:

There are few positive developments in reducing greenhouse gas emissions from Israel's waste management system. These should be continued and expanded. Chief among them is implementing a new Strategic Plan for a Circular Economy. In 2021, Israel's Ministry of Environmental Protection introduced a roadmap to transform Israel's linear waste economy into a circular economy by 2050—promoting zero waste, resource recovery, and sustainability. However, its implementation by the present government (elected in 2022) remains in doubt.

At the same time, the report highlights four areas of inadequate performance in the country's waste sector:

1. **Overreliance on Landfills**

   Despite NDC goals, approximately 80% of Israel's waste is still landfilled (compared to 42% in OECD countries). This contributes to about 10% of national GHG emissions, primarily from untreated organic waste.

2. **Policy Instability and Contradictions**

Frequent political changes have led to inconsistent policies and program reversals (e.g., the cancellation of a billion-shekel waste separation initiative). Policies promoting both waste incineration and source separation conflict and slow systemic progress.

3. **Failure in Organic Waste Management**

   Organic waste forms 43% of municipal waste, yet only a fraction is treated properly. Barriers include public opposition to facilities, low compost quality that reduces demand, and persistent delays in facility construction. The result: higher GHG emissions from untreated waste.

4. **Lack of Enforcement and Regulatory Framework**

   There is no comprehensive framework law governing waste. Regulatory bodies lack resources, leading to poor enforcement, widespread illegal dumping and burning, and weak data collection. This fragmentation undermines the transition to sustainable practices.

Recommendations for Improvement:

1. **Implement a "Pay As You Throw" (PAYT) Model**

   Inspired by countries like South Korea and Germany, PAYT schemes encourage waste reduction and recycling by charging households based on waste output. South Korea, for example, achieved over 60% recycling rates using PAYT.

2. **Legislate a National Waste Framework Law**

   Similar to the EU Waste Framework Directive, Israel needs a unified law to define treatment hierarchies, responsibilities, and enforcement mechanisms. This would improve coordination and accountability.

3. **Focus on Source Separation and Organic Waste**

   Expand separation into three waste streams: recyclables, organic, and residual. Organic separation should start in institutional sectors (e.g., schools, hotels) where collection is more manageable.

4. **Enhance Public Incentives and Infrastructure Investment**

   Offer long-term financial support for local authorities to build sorting and recycling infrastructure. After increasing landfill fees to encourage recycling, funds from Israel's *National Cleanliness*

Fund should be used more effectively—including expanded support public education campaigns tailored to Israel's diverse society.

Conclusion:

By adopting consistent policies, aligning with international best practices, and strengthening enforcement, Israel can reduce emissions, fulfill its climate promises, and emerge as a regional leader in sustainable waste management.

Israel's Industrial Sector:

The report identified a few positive developments contributing to reduced greenhouse gas emissions from Israel's industrial sector in recent years. Israel's 2021 NDC introduced explicit targets for industry: a 30% emissions reduction by 2030 and 56% cut by 2050 -- relative to 2015 levels. This marked a significant shift from the more general and less measurable 2015 INDC and was cited in the report as a major improvement.

Additionally, emission reductions by key companies are worth noting. A few major polluters like *Israel Chemicals Ltd*. (ICL) and the Israel Oil Refineries (Bazan) have begun internal sustainability initiatives that may in time produce decarbonized outcomes. ICL, for instance, generates over 80% of its electricity internally by relying heavily on recovered heat and has set a net-zero target for 2050. Some companies are also shifting to alternative fuels such as waste and used tires.

Despite this, the report pointed out four key failures which stand in the way of meeting the country's climate commitment in Israel's industrial sector:

1. **Weak Regulatory Framework and Ineffective Carbon Pricing**

   Israel's carbon tax is weak and does not fund reinvestment in green technologies. The enforcement system is undermined by light penalties, bureaucratic delays, and limited oversight—especially concerning major polluters like Bazan, which has resisted inspections and withheld emissions data.

2. **Technological and Industrial Constraints**

   Heavy industries such as cement, oil refining, and phosphate production are difficult to decarbonize due to their inherent energy intensity. Progress is slow due to limited use of

renewables and alternative fuels, and inconsistent emissions tracking further complicates enforcement.

3. **Lack of Political Prioritization and Investment**

   Climate policy often takes a backseat to national security. Investment in clean technologies remains low, and climate-related spending has declined since 2015. Inter-ministerial coordination is also weak, slowing industrial decarbonization efforts.

4. **Sector-Specific Oversight Failures**

   While generalizations are difficult across diverse industries, there are clear examples of noncompliance and resistance to change. Bazan, Israel's largest oil refinery, is a prime case of enforcement failure: real-time sensors often max out during pollution events, suggesting underreporting. Yet penalties remain too minor to deter continued violations.

Recommendations for Improvement - Based on International Experience:

1. **Robust Carbon Pricing Mechanism**
   Like the EU Emissions Trading System, Israel should implement a meaningful carbon tax or cap-and-trade program. If Israel was serious about its climate policy, it could pursue the route taken by several non-EU countries like Norway, Iceland, and Liechtenstein, and join EU Emmission Trading System. Revenues from carbon taxes or cap and trade programs should fund clean tech investment, support vulnerable populations, and assist low-carbon industrial transitions.
2. **Adopt Global Best Practices in Industrial Decarbonization**

   Israel can learn from:

   - **Holcim (Switzerland)**: use of low-carbon cement alternatives and waste-derived fuels.
   - **UltraTech (India)**: blended cement, waste heat recovery, and over 600 MW of installed renewables.
   - **CEMEX and Heidelberg (Europe)**: deployment of carbon capture and utilization (CCU) in high-emission sectors.
3. **Promote Circular Economy and Efficiency**
   Israel should incentivize reuse of industrial byproducts and recycled materials in cement, and

implement waste heat recovery systems. Tax incentives and grants should support renewable integration and energy efficiency upgrades.

4. **Strengthen Oversight and Public Transparency**

   The government needs to expand funding for and upgrade authority at the Ministry of Environmental Protection and its inspectors. It also needs to establish a transparent, public emissions database, improve monitoring technology, and require real-time reporting by major emitters.

5. **Enact Comprehensive Industrial Climate Policy**

   It is important to adopt legally binding greenhouse gas emissions targets, enforce stricter permits under the integrated licensing law and develop sector-specific decarbonization plans, particularly for cement and petrochemicals.

Conclusion:

Despite the new targets adopted in the 2021 NDC and some sporadic corporate progress, Israel's emissions trajectory from industry is not aligned with its declared 2030 and 2050 goals. Meeting Paris Agreement obligations will require meaningful policy reform, technological innovation, stronger regulation, and a unified national strategy. The tools and models for emissions reduction exist and are already being utilized by companies around the world. The challenge lies in execution and political will.

Final Conclusions:

This report concludes that before Israel makes additional international commitments, it must take concrete measures to implement its existing emissions reduction strategies. At present it appears that Israel will fail to meet most of its specific international commitments associated wit implementing its climate mitigation strategy. Israel's commitments under the Israel has carefully chosen 2015 to be its baseline for climate reporting. Since that time, Israel's total greenhouse gas emissions have dropped by 4.5% from approximately 81.1 million metric tons of CO_2 equivalent to 77.415 $MtCO_2e$. But if the year 2000 was used as a baseline, overall emissions will have increased by 15%. But even its more recent improvement is only a fifth of that achieved by most European countries such as Spain, Italy, Germany and Denmark. Israel's decline can be attributed to several factors, including a gradual shift from coal to natural gas in electricity generation, slow but steady adoption of renewable energy sources, and enhnaced energy efficiency measures. The present pace of decarbonization is much slower than anticipated, indicating that Israel needs to implement far more aggressive policies if it is to meet its climate targets and global commitments..

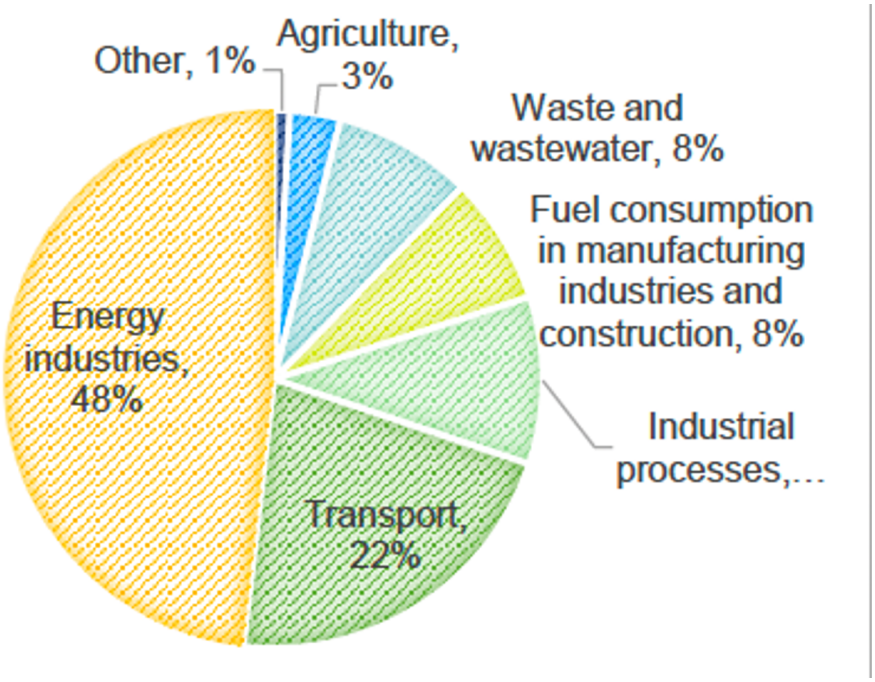
תקציר מנהלים

במשך עשרים ושלוש שנים, אמנת המסגרת של האומות המאוחדות לשינוי האקלים משנת 1992 (UNFCCC) הוכיחה את עצמה כבסיס בינלאומי לא יעיל לגיוס מאמצים גלובליים להפחתת פליטת גזי חממה. הסכם פריז, שנחתם בשנת 2015 בוועידת הצדדים ה-21 של ה-UNFCCC, היווה נקודת מפנה בפוליטיקת האקלים העולמית. במקום להטיל יעדי הפחתת פליטות "מלמעלה למטה", ההסכם אימץ גישה "מלמטה למעלה": מדינות הגישו תוכניות פעולה – הנקראות תרומות לאומיות שנקבעו (NDCs) – שבהן קבעו את יעדיהן ותוכניותיהן להפחתת פליטת הפחמן. מדינת ישראל חתמה ואשררה את הסכם פריז ללא דיחוי. ב-14 בנובמבר 2016, ממשלת ישראל אשררה את הסכם פריז לשינוי האקלים, והפכה למדינה ה-113 שאישרה את האסטרטגיה הגלובלית החדשה להתמודדות עם משבר האקלים.

על פי הסכם פריז, כל חמש שנים נדרשות המדינות להגיש NDC חדש, תוך הפחתה מתמשכת של יעדי הפליטה שלהן במטרה לעמוד בציפיות ביצועים מחמירות יותר המונעות על ידי האקלים. בוועידת COP26 בנובמבר 2021 בגלזגו, 151 מתוך 193 המדינות החתומות על הסכם פריז, כולל ישראל, הגישו NDC מעודכן. בהקשר זה אימצה ממשלת ישראל את החלטה 171, שכותרתה "מעבר לכלכלה דלת פחמן", ב-25 ביולי 2021. ההחלטה התקבלה כהכנה לפגישה בגלזגו.

בניגוד ל-NDC המקורי של ישראל, החלטת הממשלה החדשה כללה יעד הפחתה מוחלט של פליטת גזי חממה (GHG) לשנת 2030 בשיעור של 27% (יחסית לשנת 2015), יחד עם יעד הפחתה מוחלט בלתי מותנה לשנת 2050 בשיעור של 85% (יחסית לפליטות בשנת 2015). יעדים אלה שיקפו התחייבות שאפתנית יותר לשיפור ביצועי האקלים של המדינה: ה-NDC הראשוני של ישראל שהוגש בשנת 2015 חזה כי פליטות גזי החממה בשנת 2030 יעמדו על 81.65 מיליון טון שווה ערך לפחמן דו-חמצני (MtCO2e), אך תחת התוכנית החדשה, ישראל התחייבה להפחיתם ל-58 MtCO2e עד שנת 2030 – הפחתה של כמעט 30%.

איור 1: אחוז פליטת גזי חממה לפי קטגוריה בישראל



מקור: משרד להגנת הסביבה, 2024

כפי שצוין, החלטת ממשלת ישראל 171 קבעה יעדים ספציפיים להפחתת פליטת גזי חממה בארבעת התחומים המרכזיים הללו. הם מסוכמים ב-**Figure 2**. תעשיות החשמל והאנרגיה מייצרות כמעט מחצית מפליטת גזי החממה של ישראל. עד שנת 2030, התחייבה הממשלה להפחית פליטות אלה ב-30% בהשוואה לפליטות שנמדדו בשנת 2015, וב-85% עד שנת 2050. נקבע יעד חדש לעוצמת האנרגיה כך שעד שנת 2030 עוצמת האנרגיה של התוצר המקומי הגולמי (GDP) תעמוד על 122 מגה-ואט שעה (MWh) לכל מיליון ש"ח.

בסך הכל, יעד הפליטה לסקטור התחבורה היה מאכזב: במקום להבטיח הפחתה, קבעה החלטת הממשלה כי העלייה הכוללת בפליטות תוגבל ל-3.3% עד שנת 2030 בהשוואה לשנת 2015. ההחלטה גם התחייבה כי עד שנת 2026, כל האוטובוסים העירוניים החדשים שיירכשו יהיו "רכבים נקיים", וכי הפחתות בפליטת גזי חממה מרכבים חדשים ייבחנו מחדש בשנת 2025.

התחייבויות הנוגעות למערך ניהול הפסולת של ישראל היו שאפתניות יותר: פליטת גזי חממה מפסולת מוצקה הייתה אמורה להיחתך ב-47% עד שנת 2030 וב-92% עד שנת 2050 בהשוואה לפליטות שנמדדו בשנת 2015. יתרה מכך, עד שנת 2030, התחייבה ישראל להפחית את ההטמנה של פסולת מ-80% ל-20%, ולבטל את ההטמנה של פסולת אורגנית לא מטופלת עד שנת 2030. לבסוף, עד שנת 2030, הייתה אמורה פליטת גזי חממה מהתעשייה להצטמצם בלפחות 30% ביחס לפליטות בשנת 2015 (12 MtCO2e), עם הפחתה של 56% עד שנת 2050.

איור 2: יעדי הפחתת פליטת גזי חממה רשמיים ומוצהרים של ישראל

		official targets				Declared targets
GHG Emissions Source	Baseline - 2015 (MtCO2e)	2030 Target (% reduction)	2030 Target (emissions, MtCO2e)	2050 Target (% reduction)	2050 Target (emissions, MtCO2e)	2050 Target
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Waste	7.4	47%	3.9	92%	0.6	-

מקור: משרד להגנת הסביבה, 2025, דו"ח השקיפות הדו-שנתי הראשון

ישראל שוקלת כעת את אסטרטגיית ה-NDC השלישית שלה, שאמורה להיות מוכנה ומוגשת לפני כינוס COP31 בשנת 2026. לפני המעבר לשלב הבא, חשוב לשקול עד כמה המדינה עומדת בהתחייבויותיה הקיימות משנת 2021. סטודנטים לתואר שני במדיניות אקלים באוניברסיטת תל אביב העריכו את יישום מטרות האקלים שהוגדרו על ידי

הממשלה בארבעת תחומי הפליטה המפורטים לעיל. הדו״ח הוא בן 109 עמודים. מן הממצאים שלו עולה שהמאמצים הקיימים אינם מספקים.

סקטור החשמל והאנרגיה של ישראל:

מבין ההתפתחויות החיוביות שתרמו להפחתת פליטות מסקטור החשמל והאנרגיה בשנים האחרונות, זיהה הדו״ח את הדברים הבאים:

1. **הפסקת השימוש בפחם והרחבת השימוש בגז טבעי**

ישראל צמצמה במהירות את תלותה בפחם לייצור חשמל – מיותר מ-60% בשנת 2012 לפחות מ-22% בשנת 2020. מתוכננת הפסקה מוחלטת של השימוש בפחם עד שנת 2025, בהתאם ליעדים גלובליים ועם השפעה משמעותית על הפחתת פליטות. כיום גז טבעי מהווה כ-70% מייצור החשמל בישראל. המעבר הזה תורם להפחתת פליטות ותואם את היעד המקורי של הממשלה להפסיק את השימוש בפחם לחלוטין עד 2025.

2. **גידול באנרגיה סולארית ורפורמה מבנית**

האנרגיה הסולארית מהווה כיום כ-13–14% מייצור החשמל בישראל, תוך גידול ניכר בהתקנת פאנלים סולאריים (PV). בנוסף, רפורמה מקיפה במבנה שוק האנרגיה (2018–2026) פתחה את השוק לתחרות, ביזרה את חברת החשמל, והניחה תשתית להרחבת השימוש באנרגיות מתחדשות.

יחד עם זאת, ההערכה הצביעה על ארבעה כשלי מפתח בסקטור החשמל:

1. **התקדמות איטית לעבר יעדי אנרגיה מתחדשת**

ה-NDC של ישראל לשנת 2021 שואף ל-30% אנרגיה מתחדשת עד 2030. אך רמות הייצור הנוכחיות (13–14%) מצביעות על סטייה מהיעד. צוינו חסמים בירוקרטיים, תשתיות רשת לא מפותחות, ותלות יתר באנרגיה סולארית כגורמים מעכבים עיקריים.

2. **פיצול רגולטורי ומוסדי**

תיאום לקוי בין משרדי ממשלה (למשל האנרגיה והגנת הסביבה), סמכויות לא ברורות, ומערך רישוי מסורבל – כולם מקשים על יישום מדיניות. היעדר גוף רגולטורי מאוחד, חזק ומשולב בולט לעין וגורם לעיכובים באישור פרויקטים.

3. **תלות יתר באנרגיה סולארית בלבד**

הפורמולה הישראלית לאנרגיות מתחדשות מבוססת בעיקר על שמש, דבר שמגביל את גמישות הרשת וביטחון האנרגיה. בניגוד למדינות עם שילוב מגוון של מקורות (רוח, הידרו, גיאותרמי), בישראל חסרים פתרונות גיבוי לימים מעוננים או מצבי חירום.

4. **היעדר עדיפות פוליטית ברמה הגבוהה**

מדיניות סביבתית לרוב נדחקת לשוליים מול ביטחון ועניינים משפטיים. מומחים מציינים כי נושאי אקלים נתפסים כ"לוקסוס", ולא כעדיפות לאומית – דבר שמעכב תקצוב, תכנון ארוך טווח והירתמות הציבור.

המלצות:

הדו"ח מציג שורת המלצות המבוססות על הצלחות במדינות אחרות:

1. **גיוון מקורות האנרגיה המתחדשת**

בדומה לקניה (גיאותרמי) ונורווגיה (רוח והידרו), על ישראל לבחון פיתוח רוח ימית, גיאותרמיה, ואולי גם ביומסה – בתמיכת מחקרים ופיילוטים להגברת חוסן אנרגטי.

2. **הקמת "חלון רגולציה אחד" לאישורי פרויקטים**

בהשראת מודלים מארה"ב והאיחוד האירופי, יש להקים רגולטור מרכזי אחד שירכז את כל ההיתרים הסביבתיים, התכנוניים והאנרגטיים – ויקצר תהליכים משמעותית.

3. **הקמת מועצה לאומית לאנרגיה**

יש להקים גוף בין-משרדי שיתאם בין משרדי האנרגיה, האוצר, והגנת הסביבה – ויוביל את יישום ה-NDC, ינהל תקציבים, הסברה ואכיפה.

4. **השקעה באגירת אנרגיה ותשתיות רשת חכמות**

ישראל צריכה להרחיב השקעות בטכנולוגיות אגירה (סוללות, הידרו שאיבה) ולהתאים את רשת החשמל לעבודה עם אנרגיה סולארית מתחלפת וייצור מבוזר.

5. **חיזוק השתתפות הציבור ותמריצים**

הממשלה צריכה להפעיל כלים כמו תעריפי הזנה, סובסידיות והטבות מס, לחייב התקנת סולארי בבנייה חדשה, ולספק תמיכה מותאמת גם לשוכרים ובעלי דירות קטנות.

סיכום סקטור החמשל והאנרגיה:

סקטור החשמל בישראל אכן רשם הישגים – במיוחד בהפחתת הפחם והרחבת הסולאר – אך עדיין עומד בפני אתגרים משמעותיים. עמידה ביעדי האקלים לשנים 2030 ו-2050 תחייב רצון פוליטי נחוש, גיוון אנרגטי, רגולציה יעילה וממשל מתואם.

סקטור התחבורה של ישראל:

מבין ההתפתחויות החיוביות בסקטור התחבורה בישראל בשנים האחרונות שצוינו בדו"ח:

1. **עלייה חדה באימוץ רכבים חשמליים (EVs)**

נרשמה עלייה מהירה במכירת רכבים חשמליים – מ-0% בשנת 2015 ל-18.6% ממכירות הרכב החדשות בשנת 2023. התחזיות מצביעות על כך שעד שנת 2030, רכבים חשמליים יהוו 95% מכלל הרכישות בשוק הרכב, במיוחד אם יימשך התמיכה במיסוי ירוק והרחבת התשתית לטעינה.

2. **חשמול התחבורה הציבורית**

שיעור האוטובוסים העירוניים החשמליים עלה מ-1.1% בשנת 2021 ל-17.7% ב-2022, עם יעד של 100% עד שנת 2026. למרות שסביר שיעד זה לא יושג במלואו, השנים האחרונות הוכיחו כי תמריצים ממשלתיים וירידת מחירי אוטובוסים חשמליים (במיוחד מסין) מביאים לתוצאות חיוביות.

עם זאת, זוהו בדו"ח ארבעה כשלים מרכזיים במאמצי הדה-קרבוניזציה של סקטור התחבורה:

1. **יעדים קצרי טווח חלשים ודחיות במדיניות**

ה-NDC לשנת 2021 לא דורש הפחתה מיידית בפליטות התחבורה, אלא מתיר להן לעלות ב-3.3% עד שנת 2030 – כמעט תרחיש של "עסקים כרגיל". הפחתות משמעותיות (96% עד 2050) נדחות, ואין יעדים ביניים שיכוונו את המאמצים לאורך הדרך. זהו ביטוי לרשלנות בין-דורית – כלומר, העברת הנטל לדורות הבאים.

2. **מעבר איטי מרכב פרטי לתחבורה ציבורית**

למרות השקעות ברכבות קלות ואוטובוסים, השימוש ברכב פרטי עדיין שולט. פרויקטים מרכזיים כמו חישמול הרכבת הארצית והרכבת הקלה בת"א נדחו ל-2030 – עם השפעה שולית עד אז. לאור ניסיון העבר, אין ודאות שעמידה ביעדים תתממש.

3. **הזנחת הפריפריה**

מרבית המאמצים מתמקדים בערים הגדולות, תוך הזנחת יישובים קטנים ואזורים כפריים. בהיעדר תכנון אזורי, התלות ברכב פרטי צפויה להימשך ואף לגדול.

4. **אי-ודאות לגבי מוכנות סקטור החשמל**

החשמול ההולך וגובר של התחבורה עלול רק להעביר את פליטות גזי החממה מסקטור התחבורה לסקטור החשמל אם לא יושגו יעדי הפחתת פליטות ומעבר לאנרגיה המתחדשת במערכת החשמל. נדרש מעל 99% ייצור חשמל מאנרגיה מתחדשת כדי לאזן את ההשפעה של מעבר לרכבים חשמליים – בזמן שישראל מתקשה להגיע אפילו ל-30% עד 2030.

המלצות לשיפור:

1. **הגדלת תמריצים ואמון הציבור ברכבים חשמליים**

בנורווגיה הוצעו פטורי מס, חניה חינם, והנחות באגרות – והביאו ל-90% מכירות רכבים חשמליים עד 2024. ישראל צריכה לשמר ולהרחיב תמריצים, במיוחד לאוכלוסיות מוחלשות ולעסקים.

2. **שילוב תשתיות ארוכות טווח עם הפחתות מיידיות**

בדומה לספרד, יש להשקיע בתשתיות רכבת תוך החלת אזורים מופחתי פליטות, הגבלת מהירות וסובסידיות לתחבורה ציבורית – לצורך השגת השפעה מיידית.

3. **תכנון משולב של תחבורה ועירוניות**

בהשראת סינגפור, ישראל צריכה לשלב תחבורה בת קיימא באסטרטגיית הפיתוח הלאומית – עם ערים קומפקטיות, תחבורה ציבורית יעילה ותמחור גודש.

4. **קביעת יעדים מחייבים בטווח קצר ובינוני**

יש לאמץ אבני דרך ברורות ומחייבות לשנים 2030 ו-2040, ולוודא אחריות אמיתית לעמידה ביעדים עד 2050.

סיכום סקטור התחבורה:

ישראל הניחה תשתית חיובית – במיוחד דרך הרחבת EVs והשקעה בתחבורה ציבורית – אך היעדים קצרי הטווח חלשים והיישום מתעכב. ללא מדיניות אינטגרטיבית וכוללת לפריפריה, לא תוכל לעמוד ביעדים הלאומיים והבינלאומיים.

סקטור הפסולת של ישראל:

קיימות מעט התפתחויות חיוביות מעטות בהפחתת פליטות מסקטור הפסולת, שראוי להרחיבן:

תוכנית אסטרטגית לכלכלה מעגלית

למשל, בשנת 2021 פרסם המשרד להגנת הסביבה מפת דרכים להפיכת כלכלת הפסולת הלינארית של ישראל לכלכלה מעגלית עד 2050 – עם דגש על אפס פסולת, מיחזור ומשאבים. עם זאת, מימושה תחת הממשלה הנבחרת ב-2022 מוטל בספק.

הדו"ח מזהה ארבעה כשלים עיקריים:

1. **תלות גבוהה בהטמנה**

כ-80% מהפסולת מוטמנת – לעומת 42% בממוצע מדינות ה-OECD – וגורמת לכ-10% מפליטות המדינה, בעיקר מפסולת אורגנית לא מטופלת.

2. **חוסר יציבות במדיניות וסותרים פנימיים**

שינויים פוליטיים הביאו לשינויים במדיניות – כולל ביטול יוזמות כמו הפרדת פסולת במיליארד ש"ח. קידום מקביל של מיחזור ושריפה סותר זה את זה.

3. **כישלון בטיפול בפסולת אורגנית**

הפסולת האורגנית מהווה 43% מהפסולת הביתית, אך רובם לא מטופלים כהלכה. התנגדות ציבורית למתקני קומפטציה, איכות קומפוסט ירודה ועיכובים בבנייה גורמים לפליטות מוגברות מהווים גורמים שתורמים לכשל בטיפול הפסולת הארגונית.

4. **חוסר ברגולציה ואכיפה**

אין חוק מסגרת כולל לפסולת. לרגולטורים אפוא, אין משאבים לאכיפה, נתונים לוקים, והשלכה לא חוקית רחבה פוגעת במעבר בר קיימא.

המלצות לשיפור:

1. **יישום PAYT (Pay As You Throw "שלם לפי כמות הנזרקת"**

מודלים מקוריאה וגרמניה מוכיחים כי תמחור לפי משקל הפסולת מקדם צמצום ומיחזור. כך קוריאה הצליחה להגיע ליותר מ-60% מיחזור פסולת.

2. **חקיקת חוק פסולת לאומי**

בדומה לדירקטיבה האירופית, יש לחוקק חוק שיגדיר היררכיות טיפול, תחומי אחריות ואכיפה – ומערכת תיאום.

3. **התמקדות בהפרדת מקורות ובאורגני**

ראוי להרחיב הפרדה לשלושה זרמים: אורגני, מיחזורי, ושאריות. רצוי שאסטרטגיה כזו תתחיל במוסדות כמו בתי ספר ומלונות שבהם האיסוף פשוט יחסית.

4. **חיזוק תמריצים ציבוריים ותשתיות**

חיוני להעניק תמיכה ארוכת טווח לרשויות לבניית מתקני מיון ומיחזור. בהקשר זה, חובה להשתמש בכספי קרן הניקיון לקמפיינים חינוכיים והסברה המכוונים לחברה הישראלית המגוונת

סיכום סקטור הפסולת:

מדיניות יציבה, חקיקה אחידה, תמריצים ואכיפה – יכולים לאפשר לישראל לעמוד בהתחייבויותיה, להפחית פליטות ולהיות מובילה אזורית.

סקטור התעשייה של ישראל:

הדו"ח מצביע על כמה הישגים חיוביים שהוגשו בתחום צמצום פליטות גזי חממה בסקטור התעשייתי בישראל בשנים האחרונות:

1. **יעדים מדודים ב-NDC לשנת 2021**

לראשונה נקבעו יעדי הפחתה לסקטור התעשייתי – 30% עד 2030, ו-56% עד 2050 לעומת 2015. שינוי מהותי לעומת NDC 2015 הכללי והמעורפל.

2. **יוזמות מצד חברות מזהמות**

חברות כמו ICL ובזן החלו ביוזמות פנימיות להפחתת פליטות. ICL מפיקה מעל 80% מהחשמל בעצמה, תוך שימוש בחום עודף, ומכוונת לנטו-אפס עד 2050. יש מגמה לצרוך דלקים חלופיים (כמו פסולת וצמיגים).

אך במקביל, נרשמו גם כשלים בולטים רבים:

1. **רגולציה חלשה ומיסוי פחמן לא אפקטיבי**

מס הפחמן שמוצע בישראל הנו חלש וההכנסות ממנו אינומושקעות בטכנולוגיות ירוקות. האכיפה סמלית בלבד, איטית וחסרת שיניים – במיוחד מול בזן שלעתים חוסמת פיקוח מקומי מלא על ידי "איגוד ערים לאיכות הסביבה" במפרץ חיפה.

2. **מגבלות טכנולוגיות במפעלי תשתית**

תעשיות כמו מלט, זיקוק פוספטים ודלק קשות מאוד לדה-קרבוניזציה בשל עוצמת האנרגיה האינהרנטית שלהן. כמו כן, חסרה השקעה באנרגיה מתחדשת ובמעקב אחר פליטות במפעלים רבים.

3. **חוסר עדיפות פוליטית וחוסר השקעה**

באופן כללי, נושאי אקלים נדחקים לעומת ביטחון. ההשקעה בטכנולוגיות ירוקות נמוכה, והתקצוב לצמצום פליטות ירד מאז 2015.

4. **כשלי אכיפה בענפים מסוימים**

הדוגמה של בזן – סירוב לחשוף מידע, חיישנים שמגיעים לתקרת המדידה בזמן אירועים מזהמים, וקנסות שאינם מהווים הרתעה – מדגישה חוסר רצינות.

המלצות לשיפור:

1. **מנגנון תמחור פחמן אמיתי**

להצטרף למערכת הסחר בפיטות של הקהילה האירופית (EU ETS), כפי שעשו מדינות כגון: נורווגיה, איסלנד וליכטנשטיין. כמו כן, יש להשתמש בהכנסות להשקעה בטכנולוגיה ירוקה ותמיכה באוכלוסיות פגיעות.

2. **למידה מהשוק הבינלאומי והצלחות במפעלים בחו"ל**

- Holcim: חליפי מלט, דלק מפסולת.
- UltraTech (הודו) מלט מעורב, אגירת חום, מתקני PV.
- CEMEX/Heidelberg: לכידת ואחסון פחמן (CCU).

3. **קידום כלכלה מעגלית ויעילות אנרגטית**

לתמרץ שימוש בתוצרי לוואי תעשייתיים ומיחזור במלט, ולהשקיע בטכנולוגיות לניצול חום.

4. **חיזוק אכיפה ושקיפות ציבורית**

להרחיב את סמכויות מפקחי המשרד להגנת הסביבה, איגוד הערים ורשויות מקומיות ובמקביל להקים מאגר פליטות פתוח לציבור, החייב דיווח בזמן אמת מהמפעלים.

5. **חקיקת מדיניות אקלימית תעשייתית מחייבת**

לקבוע יעדים מחייבים, להחמיר ברישוי סביבתי, ולהכין תוכניות סקטוריאליות לתעשיות מזהמות כמו מלט ונפט.

סיכום ,תעשייה:

למרות היעדים המוצהרים ושיפור קל ביוזמות פרטיות, המגמה הנוכחית היא ברורה: התעשייה במדינת ישראל איננה עומדת ביעדים המדינה קבעה לעצמה לשנות 2030 ו-2050. יש צורך דחוף בהגברת המחויבות הפוליטית לביצועיים תעשייתיים טובים יותר, רגולציה יותר משמעותית וקידום טכנולוגית ירוקות בתעשייה כדי שישראל תעמוד בהתחייבויות שקבעה לצמצום פליטות בקרב התעשיה המקומית.

סיכום כללי

הדו"ח מסכם כי לפני שישראל תתחייב להתחייבויות בינלאומיות נוספות, עליה לנקוט צעדים ממשיים ליישום אסטרטגיות הפחתת הפליטות שכבר קיבלה על עצמה. נכון לעכשיו, נראה כי ישראל תיכשל בעמידה ברוב ההתחייבויות הבינלאומיות הספציפיות שלה הקשורות ליישום אסטרטגיית ההפחתה שלה. היה נח לישראל לבחור את שנת 2015 כשנת הבסיס לדיווחי האקלים שלה. מאז, פליטות גזי החממה הכוללת של ישראל אכן ירדו ב-4.5% – מכ-81.1 מיליון טון שווה ערך לפחמן דו-חמצני ל-77.415 מיליון טון. אולם אם הייתה נבחרת שנת 2000 כקו בסיס, הפליטות הכוללות היו מצביעות על עלייה של כ-15%.

גם ההתקדמות שנרשמה לאחרונה היא רק כחמישית מזו שהושגה ברוב מדינות אירופה, לרבות ספרד, איטליה, גרמניה ודנמרק. הירידה בפליטות גזי חממה בישראל נובעת ממספר גורמים, ביניהם מעבר הדרגתי מפחם לגז טבעי בייצור חשמל, אימוץ איטי אך עקבי של מקורות אנרגיה מתחדשת, ושיפור ביעילות האנרגטית. קצב הדה-קרבוניזציה הנוכחי איטי בהרבה מהצפוי, דבר המצביע על כך שישראל צריכה ליישם מדיניות אגרסיבית הרבה יותר אם ברצונה לעמוד ביעדי האקלים וההתחייבויות הבינלאומיות שלה.

Chapter 1- Israel's Electricity Sector

Nir Mor, Mor Asudon, Keren Weinberg, Gideon Kirui

History & Background

The 2015 Paris Agreement (CoP21) aims to limit global warming below 2°C, ideally 1.5°C, requiring global emissions to peak before 2025 and decrease by 43% by 2030.[1] Nationally Determined Contributions (NDCs) are essential, requiring domestic emission reduction measures**.** The UNFCCC, established in 1992, aims to stabilize greenhouse gas concentrations and its principles include CBDR-RC.[2] INDCs became legally binding NDCs upon ratification of the Paris Agreement. While targets are not legally enforceable, submitting, updating, and reporting NDCs is mandatory.

Key features of the NDC system include: 1) National Determinations, allowing countries flexibility; 2) Differentiated Responsibilities, with developed countries taking the lead; and 3) Financing and Equity, including the $100 billion Climate Fund. Challenges include varying ambition, data quality, and financial commitments.

Israel has submitted two NDCs thus far.[3,4] Initially, in 2015 Israel submitted an "Intended Nationally Determined Contribution" (INDC) indicating its commitment to begin mitigating greenhouse gases and reducing 27% of emissions by 2030 (from 2015 levels), focusing on 17% renewable energy by 2030, energy efficiency, and climate adaptation. Five years later, Israel submitted its first update to the UNFCCC Secretariat**.** The 2021 NDC is data-driven, integrating adaptation and mitigation. Specifically, it targets a 30% reduction in electricity generation emissions by 2030 and at least 85% by 2050 (from 2015 levels) due to population growth Sector-specific commitments include 30% renewable energy by 2030, phasing out coal by 2025, and improved waste management.

Israel's energy transition approach evolved significantly between 2015 and 2021. The 2015 INDC broadly focused on energy efficiency. The 2021 NDC sets concrete targets, including phasing out coal by 2025 and emphasizing solar energy, supported by Government Decision No. 465. The 2015 INDC lacked such specific plans. Both acknowledge the challenges that Israel faces in meeting its emissions reduction targets: the 2021 NDC cites limited land and energy security concerns, while the 2015 INDC broadly addressed energy efficiency without specific metrics. As would be expected, the 2021 NDC is more concrete and ambitious, aligning with global mitigation goals. It reflects increased specificity, measurable targets, and integration of climate strategies, demonstrating Israel's strengthened commitment.

Table 1: A Comparison of Israel's 2015 INDC and 2021 NDC, by Sector:

Aspect	2015 INDC	2021 NDC
Target Basis	Per capita emissions reduction.	Absolute GHG emissions reduction.
GHG Reduction Goal	7.7 tCO_2e per capita by 2030.	27% below 2015 by 2030; 85% by 2050.
Renewable Energy	17% of electricity by 2030.	30% of electricity by 2030.
Coal Phase-Out	Not explicitly stated.	Complete coal phase-out by 2025.
Net-Zero Target	Not mentioned.	Net-zero by 2050.
Adaptation Focus	Limited.	Integrated with mitigation.
Sectoral Details	General strategies.	Quantified and time-bound commitments.
Monitoring	Limited specifics on tracking.	Clear mechanisms and transparency.

Progress and Potential to Meet Goals

What works:

Israel's electricity generation has shifted significantly, with natural gas dominating the fuel mix generating electrical power (approximately 70% in 2022). Coal's contribution has declined sharply. Renewable energy integration has progressed slowly, reaching approximately 13% by the end of 2023. Energy intensity has also improved, decreasing by an average of 3.7% annually since 2010. Installed electricity capacity totaled 21.5 GW in 2021 and is projected to reach 27.9 GW by 2025. A structural reform (2018-2026) has been adopted by the government that aims to decentralize the Israel Electric Corporation (IEC) and increase market competition. Recent developments include the development of internal "energy islands" to enhance resilience.[5]

While Israel has made progress in solar energy installation, increasing PV production significantly, it faces challenges in meeting its 2030 NDC target of 30% renewable energy. Current renewable energy

usage is only 10-15%, averaging 14% in 2024.[6] Achieving the 30% target requires increasing installed capacity and storage capacity substantially. Challenges include bureaucratic bottlenecks, limited land resources (potentially addressed through dual-use solutions and offshore wind projects), underdeveloped transmission infrastructure (addressed through energy storage and grid upgrades), and competition from natural gas.

Interviews with Israeli experts reveal additional barriers. These include dependence on non-renewable fuels, infrastructure limitations, regulatory hurdles, lack of coordination between official bodies involved in energy supply, insufficient public awareness, and technological gaps. These necessitate systemic changes, including reducing fossil fuel dependence, improving infrastructure, streamlining regulations, fostering public support, and promoting technological innovation. Distributed energy production, while theoretically beneficial, is limited by the existing grid structure.

As Eliraz Shifman Berman, Head of Renewable Energy at Israel's Ministry of Energy explains, the energy sector operates on multiple levels, such as production, transmission, distribution, and supply[7]**.** In 2018, Israel undertook a major electricity reform and broke the monopoly of the Israel Electric Company, opening the market. It had already opened the market in the production and supply stages. The transmission and distribution are now handled by the electricity company, meaning it's illegal under the law to have another distribution company. Thus, municipalities are required to be part of Israel's main electricity grid because, in the country, it is not possible to build more major networks. Each area is supplied by another network, and it is a kind of specific monopoly because there is a network for each area and no possibility of dividing the networks."[8]

Funding is not a major barrier at the state level. According to Dr. Naama Teschner, Senior Lecturer, Department of Environmental, Geoinformatics and Urban Planning Sciences from Ben Gurion University, Member, School of Sustainability and Climate Change "The economic aspect is very marginal. Within five years, we are expected to recover all the investment (the costs of switching to solar energy - building infrastructure, installing panels, a network, etc). There are cases worldwide that can be implemented regardless of the country's profile, such as a developer, cooperative investments, and the like. The initial investment (in the adoption of renewable energies - building infrastructure, installation, etc) is very worthwhile. The problem with implementing examples is neither economic nor related to the resources of these municipalities but to other factors."[9]

Funding, however, may be a barrier at local and private levels:[10] "When we get to the private sector, there are other barriers, and in this case, they may also be economic because it takes them longer to recover the

investment, and the roofs may be too small for solar systems. There are also houses that residents are renting who lack the motivation to promote it." says Dr. Teschner.[11]

Israel's reliance on solar energy as the primary renewable source raises concerns about energy security and independence. Dr. Teschner notes, "There is a conversation about it and exists in the conversation the idea that there is a possibility that a variety of energy sources support extreme situations and could create an energy production solution in extreme situations. However renewable energies do not necessarily strengthen energy independence. For example, a solar field is affected as much as a residential building when a missile falls - if not more. And yet it is not preferable or better to divide power production? I am very much against the assertion, without empirical research, that renewable energies and distributed energy necessarily strengthen energy security, increase energy justice, etc., -- all kinds of statements not supported by research. There is an unquestioned contribution associated with creating renewable energies: it will contribute to reducing greenhouse gas emissions. But transferring all energy production to renewable energies will reduce energy security."[12]

Dr. Teschner argues that "Israel has the possibility only for solar energy and not for any other forms of energy, like in Europe where they have wind, hydro and electricity networks that connect countries in a single grid. In Israel, there is no ability to do so, if something happens to a local source of production, we do not have the possibility to purchase electricity from other countries."[13]

The interviews suggest that Israel's Ministry of Energy prioritizes renewable energy. The Ministry's commitment can be seen, both in terms of the number of people working on it and the emphasis and central place it receives on the policy agenda. However, from a governmental perspective, unlike European countries, renewable energy cannot be seen as a top priority.[14]

An interview with a senior government official at Israel's Ministry of Environmental Protection suggests that the government has not prioritized renewable energy. If clean energy production was at the top of the government's agenda, Israel would be meeting the goals, arguing that "for Israel's government, promoting legal reform and addressing security risks push environmental issues aside. In Israel, environmental issues are considered a privilege at best and, at worst, seen as vanity. If it were at the top of the government's agenda, it would look different," The government official concludes. This lack of overall governmental prioritization hinders progress towards NDC targets making it unlikely that Israel will meet its international commitments by the stipulated dates.[15]

<u>What does not work</u>:

Obstacles preventing progress toward Israel's climate goals are multifaceted. Galit Cohen, former Director General of the Israel Ministry of Environmental Protection, highlighted the complexities of transitioning from fossil fuels, noting that while natural gas provides short-term stability and revenue, its environmental impact and tax revenue allocation pose challenges. She emphasized the need for decentralized renewable energy sources like solar-generated power but acknowledged the need for grid modernization and energy storage solutions to address intermittency and increased electricity demand. Cohen stressed the importance of the 2015 baseline year for Israel's NDCs, reflecting Israel's unique challenges, and the shift to a decentralized NDC development process, which, while potentially effective, can create conflicts between ministries- posing a budgetary issue. She also noted the influence of municipal power, in which local municipalities hold power over energy provision, and importantly, energy decentralization – offering multiple sources of energy production. By decentralizing both political power and electric power, decision making processes can be made through top-down as well as bottom-up initiatives, and solutions can be applied to problems within specific contexts. However, this approach can hinder national objectives, and thus Cohen expressed concern that Israel will miss its 2030 targets due to continued fossil fuel reliance, insufficient renewable capacity, and grid modernization delays[16].

Israel's electricity sector is crucial for achieving the Paris Agreement goals, but current climate policy reveals several areas needing improvement. Israel's goals are less ambitious than other Global North countries, yet it struggles to meet them, making it part of the environmental problem rather than the solution.[17] Expanding renewable energy integration is critical, but bureaucratic, administrative, economic, and social barriers hinder progress.[18] Streamlining regulations,[19] implementing a Feed-in Tariff (FIT) policy that reflects real economic costs, and regulating solar panel installation on new buildings[20] are potential solutions. Improved environmental regulation is needed to promote technological innovation and reduce emissions.[21]

International cooperation on technology development and emissions trading,[22] along with domestic cross-sectoral collaboration,[23] is also essential. Energy efficiency improvements across all sectors[24], research and development of new technologies, and investment in smart electricity infrastructure are also necessary.[25] Carbon pricing policies, such as emissions trading systems[26] and financial incentives for renewable energy investments, should be considered. Finally, public awareness and support are crucial.[27] As Prof. Tal suggests, the core issue lies in legislation and policymaking. Despite coalition agreements for climate law, the government has not acted coherently, even expanding natural gas exploration. Israel needs comprehensive climate legislation with clear targets and strong enforcement while shifting resources away from fossil fuel exploration and towards renewable energy development.[28]

Case Study: Comparing Israel's Nationally Determined Contribution (NDC) with those of Norway, the Republic of the Marshall Islands (RMI), and Kenya

To understand how other nations are tackling the fulfilment of NDCs, we put together examples of Norway, the Republic of the Marshall Islands (RMI), and Kenya to offer valuable lessons and potential models for emulation for Israel, though with important caveats. No single country's approach can be perfectly replicated due to differing contexts, but the core principles and specific strategies can be adapted.

Norway's Model (Partial Emulation):

Norway has significantly reduced GHG emissions in its electricity sector, with 98.9% of its electricity from low-carbon sources by late 2024, primarily hydropower (89%) and wind power (9%). This has resulted in a low carbon intensity of 28.60 gCO2eq/kWh. [29] The government's policies aim to further reduce emissions by 25 million tons of CO_2 equivalents, focusing on security of supply, renewable energy development, energy efficiency, and value creation from renewable resources.[30]

Norway is also historically a net exporter of electricity to neighboring countries, reaching a record 20.5 TWh of net exports in 2020, making it one of the largest exporters in Europe. Moreover, as electrification forms a central part of any country's energy transition, Norway finds itself in an enviable starting position. Its energy demand is already highly electrified: in 2019, electricity covered almost half of the country's TFC[31], the highest share among IEA[32] member countries. The wind sector has grown significantly, despite local opposition to onshore projects, and the government resumed licensing for new projects in 2022. Offshore wind development is also a priority, with the Hywind Tampen[33] floating wind farm under construction. [34]

For Israel, adopting Norway's approach could reduce GHG emissions, even with less hydropower but abundant solar resources. By investing in renewable energy, especially solar, and supporting electrification in transport and industry, Israel could make significant strides. Israel has multilateral agreements with Egypt and Jordan on the exportation of natural gas. Hence, the regulatory foundation is in place as well as the motivation. Now, Israel needs to do the same with renewables.

While Norway's specific strategies may not be directly applicable, its focus on renewable energy, electrification, and supportive policies offers useful lessons for Israel. [35]

RMI's Model (Strategic Emulation):

When looking at nations' progress to achieve their NDCs, it is vital to also examine nations who are particularly susceptible to climate change. Hence, we chose to include the Republic of Marshall Islands (RMI) as a country that is highly vulnerable to climate change and is highly motivated to act on it[36]. After signing the 2015 Paris Agreement and creating an initial INDC, RMI was the first nation to submit a second, updated NDC already in 2018 with updated motivations and plan actions at CoP24[37].

On 22 November 2018, the Marshall Islands distinguished itself as the first nation to submit its second NDC, thereby establishing a more ambitious emissions reduction target. This revised commitment pledges to decrease GHG emissions by a minimum of 32% below 2010 levels by 2025, and by at least 45% below 2010 levels by 2030. Submitted in advance of the UN Climate Change Conference in Katowice, Poland, the second NDC further commits the Marshall Islands to developing a National Adaptation Plan (NAP) by the end of 2019, outlining adaptation milestones, implementation measures, and a financing plan. Additionally, the nation's pledges to submit an adaptation communication to the UNFCCC by 2020, adopt a gender-responsive and human rights-based approach in NDC-related activities, and adhere to the latest IPCC guidelines. Beyond the binding targets, the NDC also presents an indicative target of at least a 58% reduction in emissions below 2010 levels by 2035 and reiterates the Marshall Islands' aspiration for net zero emissions by 2050[38].

The Electricity Roadmap

RMI has created an Electricity Roadmap to help the nation achieve its goals using measurable and realistic steps[39]. The roadmap is split into gradual goals for 2018-2022; 2025; 2030; and 2050. Then, the RMI defined specific goals for its electricity sector: affordability; improved energy efficiency and reduced losses; increased energy security; reliable power supply; improving the quality of life on other islands; and finally, a technical threshold called "diesel-off" capabilities by 2025.

While Israel and the RMI share similar ambitions, the difference in execution is significant. What the RMI has done better than Israel is create incremental goals that are measurable and timed. Each with its own sub-goals not just by market category, but also by socioeconomic sectors. Another important thing that the RMI considers are surrounding Islands, hence highlighting the need for decentralization and multi-stakeholder involvement. Israel is not in the same position due to its geo-political situation, however, recent agreements with Egypt and Jordan for natural gas show that this is possible. nonetheless, what Israel can do is increase its level of inter-ministry cooperation within the Knesset. Different

ministries must work together to achieve the 2030 goals quicker and wholly. This can be done through budget (re)allocation and collaborative policy proposals.

Kenya's Model (Specific Strategy Emulation):

Kenya's diversified renewable energy mix, particularly its success with geothermal energy and PV, offers a valuable lesson. Firstly, Israel can, and should, diversify its renewables portfolio. The focus on PV is logical, due to the nation's impressive quantities of incoming solar radiation. However, considering Israel's geopolitical state, energy security becomes an increasingly important factor. For example, Israel has potential for geothermal energy in certain regions[40]. Investing in research and development and creating a supportive regulatory framework could unlock this valuable resource. Kenya highlights the importance of tailoring renewable energy strategies to specific geographical and resource contexts.

Overall, these examples offer several options. Israel can strategically pick and choose elements from each model, adapting them to its specific circumstances. The most important takeaways are the need for a strong policy push for renewables, strategic planning with clear targets, grid modernization, multi-stakeholder collaboration, and a diversified approach to renewable energy development. By learning from these examples and tailoring the best practices to its context, Israel can accelerate its progress toward its NDC targets.

Policy Recommendations:

Based on academic sources, peer-reviewed reports, and interviews with Israel's leading professionals (both in the public and the private sector), the following is a list of concrete policy recommendations for Israel to meet the NDC goals:

1. *Diversify Renewable Energy Portfolio*: While solar is essential, Israel should actively explore and invest in other renewable energy sources like wind (onshore and offshore – including floating turbines), geothermal, and potentially biomass to enhance energy security and resilience. Conduct feasibility studies and develop targeted incentive programs for these technologies.

2. *Strengthen Energy Efficiency Targets and Incentives*: Set more ambitious energy efficiency targets across all sectors (industry, buildings, transport) and require homeowners to publish energy audits and report on energy efficiency before selling homes. For example, the EU Energy Efficiency Directive (EED) does not specifically require energy audits before selling homes, but rather, Energy Performance Certificates (EPCs) under the Energy Performance of Buildings Directive (EPBD). An EPC should be presented when a building is constructed, sold or rented to create transparency about energy efficiency.

Increase grant funding and technical assistance schemes to support businesses and households in implementing energy-efficient technologies and practices.[41]

3. *Streamline Regulatory Processes*: Simplify and expedite permitting processes for renewable energy projects and green infrastructure development. Establish a "one-stop shop" for approvals to reduce bureaucratic hurdles and delays. A prime example is found in the United States. In many states across the country, a wide range of approvals from multiple agencies are required to implement and launch renewable energy projects. Offshore wind renewable energy projects require approval from the Bureau of Ocean Energy Management (BOEM), state energy departments, environmental review agencies, and local authorities, with lengthy approval processes.[42, 43] Another example is when projects undergo at state-level, but get delayed at the municipal level due to zoning and community opposition. Wind farm projects often face this type of problem, as local municipalities have planning veto power even after receiving the required approvals from federal agencies.[44] The use of a "One-stop-shop" approach solves these problems as it effectively creates a body that centralizes a unified application portal (such as a digital platform where all required documents are submitted at once, to one body), a team that brings together all relevant representatives (from the world of energy, environment, land use, municipal authorities, etc.), a unified EIA that meets all regulatory requirements, can establish rapid processing mechanisms and can clarify and determine maximum response times for agencies to approve or deny permits and provide an expedited process according to defined criteria, and in addition, can create guidance for public engagement by creating a transparent process in which stakeholders are consulted early to prevent last-minute opposition and legal battles.

4. *Promote Regional Energy Cooperation:* Expand existing collaborations to leverage regional resources and expertise. Explore joint projects and cross-border energy trading mechanisms with neighboring countries.[45] Dual-use solutions inbuilt and agricultural spaces, along with regional cooperation (e.g., the "water for electricity" agreement or “Project Prosperity” with Jordan), can address land constraints. Israel's transition from a natural gas importer to a net exporter, coupled with declining coal use (21.8% in 2020 vs. 61% in 2012), demonstrates progress. The national goal is 70% natural gas and 30% renewable energy, with complete coal phase-out (except for emergency generation). The 2021 NDC reinforces this commitment with more specific targets and broader climate strategies. Here, we recommend that the focus will be on multi-lateral agreements for the sake of energy security.

5. *Develop Comprehensive Energy Storage Solutions:* Invest in research, development, and deployment of diverse energy storage technologies (e.g., batteries, pumped hydro, thermal storage) to address the intermittency of solar and other renewable sources.[46, 47]

6. *Incentivize Private Sector Investment*: Offer attractive financial incentives (tax breaks, subsidies, feed-in tariffs) to encourage private sector investment in renewable energy projects, energy efficiency upgrades, and green technology innovation.[48] Nevertheless, the main effort should still come from the public sector in the form of governmental regulations without relying to heavily on Israel's private sector.

7. *Enhance Public Awareness and Engagement*: Launch public awareness campaigns to educate citizens about the importance of energy efficiency and renewable energy, promoting behavioral changes and fostering public support for the energy transition,[49,50] This can be done through "policy nudges".

8. *Establish a National Energy Council*: Create a high-level, inter-ministerial council to coordinate energy policy, streamline decision-making, and ensure alignment between different government agencies. This council should be responsible for overseeing the implementation of the NDC and related policies.

Chapter 2: Israel's Transport Sector

Marie Frieling, Hui Ling Chuah, Tali Klagsbrun

Introduction into Israel's Transport targets in the 2021 NDC

Israel's National Determined Contribution (NDC) under the Paris Agreement, submitted in July 2021, outlines four targets for the transport sector, presented in order of their intended achievement. Table 1 are the summaries.

Table X: Israel's NDC 2021 targets and their intended achievement for Transport.

NDC 2021 Targets on Transport	**Year of intended achievement**	**Content of Target**
Goals for development of transport GHG Emissions		
Target 2	2030	Limit increase of GHG emissions to 3.3% relative to 2015 (17.6 $MtCO_2e$) i.e. 18.18 $MtCO_2e$
Target 4	2050	Reduce GHG emissions by at least 96% relative to 2015 i.e. 0.7 $MtCO_2e$
Measures aimed at reducing emissions ("Supporting Targets")		
Target 1 Electrification of Public Transport	2026	Purchase all new municipal buses as clean vehicles as defined in section 77A of the Transport Ordinance [New Version]
Target 3 Electrification of Private Transport	From 2030 onwards	Limit to an amount equal to 5% of the average GHG emissions for a new vehicle, weighing up to 3.5 tons registered in 2020

Source: Authors' compilation based on Israel's 2021 NDC

Targets 2 and 4 set goals for the development of emissions for the transport sector for 2030

and 2050, respectively.

By 2030 (Target 2), the growth in Greenhouse Gas (GHG) emissions from transportation is to be capped at 3.3% above 2015 levels. Transportation emissions in 2015 were 17.6 $MtCO_2e$, which means transport emissions in 2030 should not exceed 18.18 $MtCO_2e$ to meet this target.

By 2050 (Target 4), GHG emissions from transport are to be reduced by at least 96% compared to 2015 levels, which is a target of 0.7 $MtCO_2e$.

These targets must be understood in the context of the broader GHG emission reduction goals set in the NDC. Israel aims to reduce absolute GHG emissions by 27% and 85% by 2030 and 2050 respectively, both relative to 2015 levels. Consequently, while the NDC permits transport emissions to increase until 2030, overall emissions must decrease. By 2050, however, the reduction in the transport sector is projected to outpace the overall reduction, with an ambitious 96% decrease i.e. 0.7 $MtCO_2e$, reflecting the perception that, although transportation emissions are challenging to curb in the short term, they are not considered unattainable in the long term.

In this context, the emission reduction targets for the transport sector must be classified as extremely modest. In particular, the short-term commitments, which allow a further increase up to 2030, hardly differ from a "business-as-usual" approach. Most of the emission reductions in this sector are postponed to the distant future, and the lack of medium-term reduction targets until 2040 leaves no clear pathway for the 96% reduction by 2050.

Targets 1 and 3 relate to measures aimed at reducing emissions from transportation, whereby the former refers to public transport, the latter to private cars.

Target 1 mandates that, by 2026, all newly procured municipal buses must be clean vehicles, as defined in section 77A of the Transport Ordinance. This 100% public procurement quota applies only to municipal buses; intercity buses are not mentioned. Additionally, the NDC does not include provisions for the replacement of existing combustion engine buses within the fleet.

Target 3 focuses on reducing emissions from new private vehicles. From 2030, emissions from a new vehicle must not exceed 5% of the average emissions of new vehicles in 2020. However, this target applies solely to vehicles weighing up to 3.5 tons. Notably, the NDC lacks targets for the electrification of vehicles above 3.5 tonnes (i.e. trucks and vans etc). The target includes a clause allowing revision in 2025, contingent on four factors: (1) technological developments, (2) the extent of the penetration of electric vehicles in Israel and globally, (3) electricity infrastructure and (4) the deployment of charging stations in Israel. This clause potentially

enables decision-makers to lower the ambition of this goal due to the broad range of possible challenges in electrification or emission reduction through electrification it encompasses.

Analyzing the sectoral targets for transportation in Israel's NDC also requires a comparison with its intended NDC (INDC) submitted to the UNFCCC in 2015. While the overall ambition of the 2021-NDC has increased, shifting from a per capita GHG reduction in the 2015 INDC to an absolute reduction, it is noteworthy that a key target related to transportation from the 2015 INDC is absent in the 2021 NDC. Specifically, the earlier target of a 20% shift from private to public transportation, which can be considered ambitious, is no longer included. Furthermore, the 2015 INDC emphasized the development of public transport systems, including the Tel Aviv metropolitan light rail, the expansion of the intercity rail system, and the Jerusalem light rail. The removal of these elements in the 2021-NDC suggests a strategic shift from enhancing public transportation to focusing on the electrification of private (and public) vehicles. Indeed, the 2021 NDC addresses public transport only in the context of municipal bus electrification, without referencing further development of public transport infrastructure.

This shift highlights another critical factor: achieving the transport sector targets in Israel's NDC is heavily dependent on meeting the targets for electricity generation. Actual reduction in CO_2 emission for transportation can only be truly achieved through electrification of vehicles if the sources of electricity generation are from renewable energy. Therefore, there is also a need to have a look at the NDC targets committed for the electricity generation from renewable sources. As there will be another group doing this topic, a brief discussion will be given due to the correlation between the electrification of transportation and electricity generation via renewable sources.

The 2021 NDC for the electricity generation by renewable sources are as follows:

Reduction of greenhouse gas emissions from electricity generation by 2030 by 30% to 26.3 $MtCO_2e$ as compared to emissions measured in 2015, which were 37.6 $MtCO_2e$, taking into account the renewable energy targets set in Government Decision No. 465 (approved on October 25, 2020). No. 465 formalized the decision undertaken by the Minister of Energy and Infrastructure to phase-out coal-fired power generation no later than 2026 and determined targets for a renewable power generation share of 20% in 2025 and 30% in 2030. This is a more ambitious target when compared to the 2015-INDC whereby renewable energy is to make up 17% of the total electricity generated in 2030.

Interviews/email correspondences

During our evaluation processes, we have engaged stakeholders from various government ministries, experts in the field of transportation and Non-profit organisation (NGO).

The interviewees are:

1. **Reiz, Ran.** 2025. *Director of the Transportation Department, Ministry of Environmental Protection.* Interview, 27 January 2025.
2. **Yehoshua, Nahum.** 2025. *Head of Sustainable and Electric Transportation Department, Sustainable Energy Division, Ministry of* Energy and Infrastructure. Interview, 16 February 2025.
3. **Dolev, Shahar.** 2025. *Charged of Models Development and Long-Term Planning, Israel Ministry of Energy and Infrastructure.* Written correspondence, received 20 January 2025.
4. **Yanai, Moshe.** 2024. *Head of Agriculture, Environment, and Energy Statistics Sector, Israel Central Bureau of Statistics.* Written responses, received 18 December 2024.
5. **Smuelovich, Sivan.** 2025. *Director of 15 Dakot ("15 Minutes"), NGO.* Written responses, received 26 January 2025.
6. **Avineri, Erel.** 2025. *Head, M.Sc. Program in Energy and Power Systems Engineering, Afeka Tel Aviv Academic College of Engineering.* Interview, 4 February 2025.
7. **Cohen, Galit.** 2024. *Ex-Director of the Ministry of Environmental Protection.* Interview, 30 December 2024.
8. **Proaktor, Gil.** 2025. *Senior Manager of Climate Mitigation Division, Ministry of Environmental Protection.* Written responses, received 26 February 2025.

Israel, like all the Parties to the Paris Agreement is requested to submit its new NDC to the UNFCCC in 2025. Like 90% of the countries, Israel failed to submit the new NDC by the deadline set at February 10 2025.[51] However, our research and interviews show that discussions on possible updates on targets for the new NDCs are ongoing between ministries, therefore being part of the report.

Progress and potential to meet international commitments

Overview about measures in process

The following paragraphs will provide an assessment of the variety of measures in progress in the Israeli transportation sector designated to reduce GHG emissions, including the NDC targets 1 and 3 (supporting targets). The chapter is structured around four main fields of action: (1) Electrification of public transport, (2) Electrification of private transport, (3) Expansion of public transport, cycling and walking infrastructure and (4) Efforts to reduce private car attractiveness.

1.1 Electrification of public transport

1.1.1 Electrification of the urban bus fleet / NDC Target 1: Purchase of Clean Municipal Buses by 2026

In 2022, the Ministry of Environmental Protection issued a call for proposals with a budget of NIS 40 million to encourage the purchase of electric buses for urban and intercity transportation.[52] NIS 20 million were spent in the purchase in 2022 and that another round of purchase is planned for 2025. Ministry of Environmental Protection transportation expert, Ran Reiz emphasized that as the prices of Chinese electric buses decreased significantly (to NIS 250,000 per bus) over the years, reaching the same level as conventional diesel buses, the country will not need to put in money into the incentive program.

China's new energy vehicle market has ranked first in the world since 2015. This was due China’s more than 20 years of technology development to address the key problems of battery electric vehicles (BEVs) such as “driving range anxiety, long battery charging time, and driving safety hazards”. Currently, China's BEV technologies are leading the global development, and complete sets of technologies are exported to the European Union.[53] However, there are concerns with the battery safety of EVs. In 2020, a total of 124 fire accidents (including spontaneous combustion and smoke) related to electric cars, buses and trucks occurred in China, involving 25 brand automotive enterprises and 38 BEV models.[54]

There is a significant increase in the share of electric bus purchases, with electric buses comprising 17.7% of municipal bus purchases in 2022, compared to 1.1% in 2021.[55] According to governmental projections, in 2025 electric buses are supposed to reach 50% of the total

purchases of municipal buses and jump to 100% in one year in 2026.

Even though this would constitute a sharp increase, the NDC Target 1 of 100% of newly purchased buses being electric should be achievable due to government assistance in terms of funding and technological improvements reducing the production cost of electric buses from other countries.

In addition to this little ambitious target, the government has also set itself the goal of having 60% of the urban bus fleet electrified by 2026 (3,000 buses) and 100% by 2035 (5,000 buses).[56] It seems rather doubtful that these will also be achieved as well, as according to Ran Reiz, currently only about a quarter of urban buses are electric.

1.1.2 Electrification of the interurban bus fleet

Current electrification efforts focus primarily on municipal buses due to significant technological and infrastructural barriers in interurban transport. Battery capacity remains insufficient for long-distance travel without frequent charging, and increasing traffic congestion further complicates travel time predictability.[57] While no strategic plan currently exists for interurban bus electrification, the issue may be addressed in Israel's next NDC.[58]

1.1.3 Electrification of passenger train network

Official government documents list the full electrification of the passenger train network as an implemented measure, initially targeted for completion by 2022.[59] However, media reports indicate that the project has been delayed until at least June 2027, with a more realistic completion date projected for 2030.[60]

1.2 Electrification of Private Transport

1.2.1 NDC Target 3: 95% Reduction in average GHG emissions from new private vehicles by 2030

In 2020, the baseline year for target 3, average GHG emissions from new private vehicles were 149 gCO2/km 145.9 gCO2/km. A 95% reduction would bring down average GHG emissions to 7.45 gCO2/km.

Until 2023, the average has been reduced to 115.5 gCO2/km, constituting a reduction of ca. 22.5 % in the first 8 years and leaving a further 77.5% reduction for the remaining 7 years until 2030.[61]

The reduction from 2022 to 2023 was notably fast, with emissions dropping by 10% in just one year (from 128.3 gCO2/km to 115.5 gCO2/km). If this trend continues, the goal of reaching 7.45 gCO2/km by 2030 could be achievable, but the pace of reduction would need to be maintained or even accelerated in the coming years to stay on track.

The Green Taxation framework is the primary policy tool for reducing GHG emissions from private vehicles. Under this system, the standard purchase tax on new cars is 83%, with deductions applied based on a vehicle's environmental performance.[62] Cleaner cars benefit from lower tax rates, and until recently, discounts on registration fees also provided additional incentives. These measures significantly contributed to electric vehicles (EVs) reaching an 18.6% share of new vehicle sales in Israel in 2023, up from 3.9% in 2021 and 0% in 2015.

However, tax benefits for EVs have been gradually reduced. In May 2024, the government increased the purchase tax on electric cars from 20% to 35%, while lowering the maximum tax discount from NIS 60,000 to NIS 50,000. This change raised the cost of popular EV models by approximately NIS 12,000.

Further reductions in incentives followed in January 2025, when the purchase tax was increased from 35% to 45%, and the maximum tax benefit was reduced to NIS 35,000. These measures significantly increased the effective tax rate, particularly for higher-priced EVs. Despite these reductions, fully electric vehicles continue to receive a green taxation benefit of NIS 18,400 until the end of 2027. Additionally, the discount on registration fees for EVs was eliminated, leading to a rise in registration costs. For instance, the registration fee for an EV priced between NIS 179,000 and NIS 230,000 increased from NIS 600 to NIS 2,500, while higher-end EVs, such as the Tesla Model Y or XPeng P6, now face a registration fee of NIS 3,600.[63]

At the same time, the purchase of highly polluting vehicles in emission categories 14 and 15 became more expensive due to the introduction of pollution-based fines. These fines, ranging from NIS 1,700 to over NIS 7,000, apply to popular gasoline and diesel-powered SUVs, minivans, and most light commercial vehicles.[64]

Looking ahead, the government plans to continue gradually increasing the purchase tax on EVs. According to Ministry of Energy and Infrastructure documents, the tax rate is expected to rise to 52% in 2026 and 60% in 2027, although these figures are not yet finalized.[65]

Table 2: Share of EVs in Israel's private cars from 2015 to 2023 and Government projections for 2030 and 2050.

Year	**2015**	**2021**	**2023**	**2030 (Government predictions)**	**2050 (Government predictions)**
Share of new EVs (sales) (%)	0	3.9	18.6	95	100
EVs in fleet (nos.)	1,088	13,939	90,273	1,290,000	6,000,000
All cars in fleet (nos.)	2,583,175	3,312,273	3,556,116	4,300,000	6,000,000
Share in fleet (%)	0.04	0.42	2.54	30	100
Average GHG emissions from new private vehicles (% reduction in average gCO2e/km)	145.9	n/d	128.30 (2022) 12.1 % reduction	38.3 in WEM (73.7 % reduction) 0 in WAM (100% reduction)	n/d

Source: Data from Israel's Central Bureau of Statistics (CBS) for the share of EVS 2015-2023[66], Data from Israel's first Biennial Transparency Report for government predictions[67], Data from the Ministry of Energy and Infrastructure for Average GHG emissions[68].

1.2.2 Expansions of charging infrastructure

To accommodate the expected rise in EV use, the Ministry of Energy and Infrastructure

allocated a budget of NIS 70 million to promote the installation of electric vehicle charging stations across the country including an initiative to co-fund the cost of installations from 2018 to 2022[69]. So far 7,000 public charging points have been completed. According to the Ministry of Energy's calculations approximately 20,000 Alternative Current (AV) charging points and 6,000 Direct Current (DC) charging points need to be installed from 2030 to 2035 in order to meet the target of the Government Decision 171 passed on the 25th of July 2021entitled "Transition to a Low Carbon Economy". Funding is also given to companies managing petrol stations to convert to charging stations if they meet certain requirements specified by the government.

Israel is also promoting charging infrastructure in new residential and commercial buildings, with NIS 39 million invested in electrification efforts.

1.2.3 Plans to reduce Heavy-Duty Vehicles Emissions

According to Ran Reiz, targets to decrease emissions from heavy duty vehicles (weighing more than 3.5 tons) will be included in the next NDC. Israel has signed a Global Memorandum of Understanding (MOU) at the COP28 in Dubai in 2024[70], committing to the goal of 100% electric buses and truck sales by 2040[71]. Israel's first Biennial Transparency Report foresees 50% of imported vehicles over 3.5 tons to have zero tailpipe emissions by 2035, this target currently undergoing regulatory impact assessment as part of updates to the Clean Air Act.

1.3 Expansion of public transport and cycling infrastructure

1.3.1 Expansion of public transport infrastructure in metropolitan areas

Israel has allocated NIS 250 billion for public transport expansion by 2035. Key projects include:

- Light rail in the Tel Aviv Metropolitan Area: Construction began in 2015, with full operation expected by 2028, connecting 13 cities.
- Light rail planning in Be'er Sheva: Primary planning began in 2018.
- Jerusalem Light Rail expansion: Ongoing since 2021.
- Planned Tel Aviv Metro system: Currently under development.

1.3.2 Increase in Bus Service and Attractiveness

Bus service expansion includes a 30% increase in travel distance from 2010 to 2022. The "Fast Lanes" project in the Tel Aviv Metropolitan Area, launched in 2021, adds 120 km of dedicated lanes for high-occupancy vehicles and public transport, supported by Park & Ride facilities. An additional NIS 2.2 billion (~USD 594 million) has been allocated to further expand public bus services until 2026.

1.3.3 Development of intercity public transport

New rail lines are under construction, such as the Eastern Railway, which connects northern and southern Israel without passing through Tel Aviv, expected to be completed by 2026. Intercity highway lanes dedicated to public transport have been expanded.

Recent intercity public transport development resulted in a Rail ridership increased by 92% from 2010 (ca. 36 million passengers) to 2019 (69 million passengers) but experienced a temporary decline due to the COVID-19 pandemic, rebounding to 55 million passengers in 2022[72] and to over 62 million in 2023 .It is noteworthy that rail passenger transport reached an all-time high in August 2023 and fell sharply in October 2023 with the start of the war. It is therefore not clear whether rail passenger numbers would have returned to the higher pre-war levels of 2019 without the impact of the war. Complete data for 2024 is not yet available.[73]

1.3.4 Cycling Infrastructure Development

Tel Aviv District Planning and Building Committee calls for the paving of 758 km of cycling paths as part of a general national plan in April 2022. The planned 758 kilometers of cycling paths are in addition to the existing 251 kilometers, and mostly in Tel Aviv. According to the plan, Tel Aviv will gain 283 kilometers, Ramat Gan 69 kilometers, Herzliya 90 kilometers, Holon 75 kilometers, with the rest spread over the remaining local authorities. The plan was drawn up by the Ministry of Transport with budget estimate for the whole network at NIS 8 billion, divided into five-year portions, NIS 2 billion for each five-year period[74]. The Ministry of Transportation contributes the money and the cities contract with companies to operate and create the infrastructure for bicycles, walking and public transport lanes[75]. Each contract is for five years. Three companies with capabilities were awarded. The plan is for the cities to manage and allow them to create the lanes and they are coming with capabilities and abilities to work

with the cities to implement the lanes.

The plan is to develop a 2,000km bicycle infrastructure by 2030.[76] Part of the infrastructure to be funded includes installing ramps on public stairs to facilitate walking up or down the stairs with a bicycle; adding new innovative bicycle parking methods, such as docking stations in the courtyards of private buildings; continue promoting shared electric vehicles while improving regulations to maintain the safety of both riders and pedestrians; and adding 11 new pedestrian streets which will be closed to cars.[77]

1.3.5 Efforts to improve data availability about modal split

According to Ran Reiz, four government offices (namely the ministries of environment protection, transport, energy and the bureaus of statistics) are using technology in the form of models for transport to gather statistics to better be able to set the future targets for NDCs accurately. They are currently in discussions to determine the sets of criteria to run the model. With the information, the ministries will be in a better position to set out measures for the transport sector. This includes the "ye'adey pitzul"(Target Division), a system to effectively observe the evolution of the transport modal split, i.e. the percentage of daily travels done by private vehicles vs. by public transport, cycling and walking.

The Ministry of Transport has set a goal to reduce annual private vehicle travel to 5,000 km per capita by 2030.[78] While this target is not formally included in the NDC, setting measurable targets to reduce private vehicle use must be acknowledged as a step in the right direction. However, this target must be considered relatively modest given that this figure was 5342 km per capita in 2023 and that it is only a per capita target, while the population is growing.

1.4 Efforts to reduce private car attractiveness

1.4.1 Planned taxation on car usages.

According to Ran Reiz, two types of taxation frameworks are considered for implementation: Firstly, a congestion tax to be paid by all private cars (electric and gasoline fueled) entering the metropolis cities. Second, a "travelling" tax, charged by distance travelled, for electric cars (fuel tax already imposed on gasoline fueled cars). These proposed taxes already appear in the public proposals but not yet approved due to political reasons.

1.4.2 Discussions about reform of vehicle reimburse mechanism

Ran Reiz also mentioned that Israeli government ministries are working on modifying the

existing vehicle reimbursement scheme in Israel which is a major contributing factor to extensive usages of private cars. In many countries, employers provide salary benefits such as the provision of cars for their employees, including covering the cost of gasoline, parking fees and taxes for the cars. In Israel, the government is implementing measures to reimburse public sector employees for the cost of owning a private car. This was originally introduced to circumvent salary caps. Subsequently, this has become a significant income supplement for more than half of the country's public sector employees, i.e. 10% of all Israeli employees. [79]

The goal now is to change the prevailing public sector financial incentives in salary to have a car. This will involve the need to change the agreements between workers unions (employees) and government. The change is moving slowly but according to ministry representatives, there is work going on. By 2030, they plan to have other kinds of incentives for the public employees of the government and municipalities in place as well as better ways to promote public transport over private cars.

1.4.3 Implementation of Low Emission Zones (LEZs) in cities

Two LEZs were implemented in Haifa's lower city and in Jerusalem in 2018 and 2020 respectively.[80] The zones ban all polluting vehicles from entering these cities. This is part of a joint initiative between the Ministry of Environmental Protection and the Haifa / Jerusalem municipalities to reduce air pollution and reduce environmental risks in these cities. With the ban in place, people living or working in these cities will need to have to replace their old cars with low emission vehicles.

2. Emission development and Remaining challenges

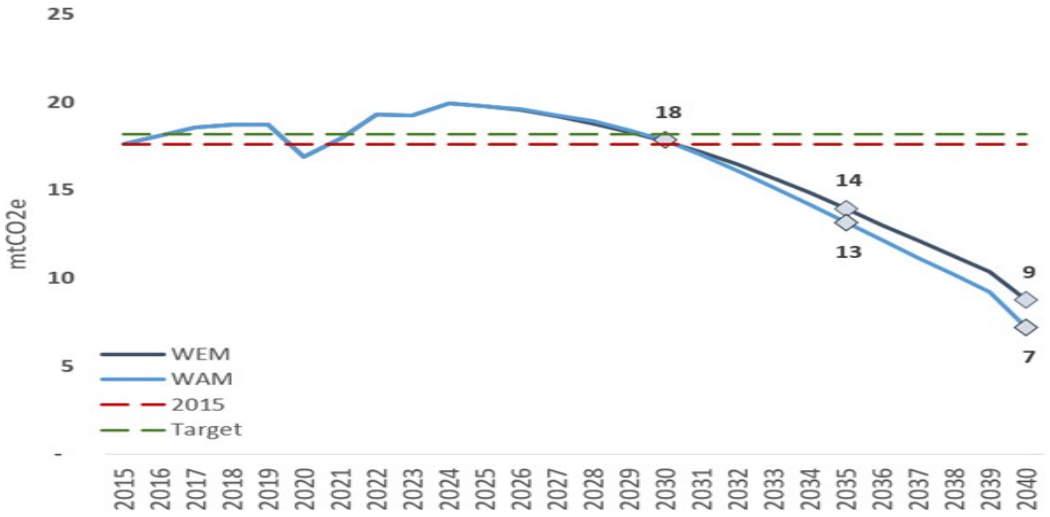
As outlined in Section 2, several measures have already been adopted or are in the process of being planned to address Israel’s transport sector emissions. To meet the supporting targets for 2026 and 2030, a rapid increase in the share of electric municipal buses and private electric vehicles (EVs) in new purchases is essential. However, with recent reductions in tax incentives for EVs, achieving a 95% share of purchases by 2030 hinges on significant further reductions in EV market prices. Nonetheless, this goal is still within reach.

The critical question is “whether the combined effects of these supportive measures, along with other planned actions, will be sufficient to achieve the necessary reductions in greenhouse gas (GHG) emissions?”

Projected Transport-Related Emission Developments

Israel's First Biennial Transparency Report offers two emission projections under two distinct scenarios: the *With Existing Measures* (WEM) Scenario and the *With Additional Measures* (WAM) Scenario. Both projections suggest that transportation reduction targets will be met. The WEM Scenario forecasts a 0.8% increase in transport-related emissions relative to 2015 levels, exceeding the target to limit emissions growth to 3.3% by 2.5%. The WAM Scenario, by contrast, anticipates only a 0.2% increase in emissions by 2030.[81]

Figure 1: Government projections under the *With Existing Measures* (WEM) and *With Additional Measures* (WAM) Scenarios



Source: Israel's First Biennial Transparency Report, 2025 [82]

Looking further ahead, government projections extend to 2040, a decade before the 2050 target of a 96% reduction in emissions. By 2040, the WEM Scenario predicts transport-related emissions of 7.4 million metric tons of CO2 equivalent (mt CO2e), while the WAM Scenario estimates 7.0 mt CO2e. This leaves a reduction requirement of an additional 6.7 mt CO2e and 6.3 mt CO2e respectively by 2050.

A key distinction between the two scenarios is the rate of electrification: the WAM Scenario envisions that all new private vehicle purchases under 3.5 tons will be electric by 2030, with 50% of heavy-duty vehicles (above 3.5 tons) following suit by 2035.

Our assessment, however, suggests that these projections are based on overly optimistic assumptions. The existing measures and the additional strategies currently under consideration may not be sufficient to achieve the anticipated reductions in emissions. The following issues need further consideration and are explored in more detail in the subsequent sections:

1. Challenges in achieving a Modal Shift from Private to Public Transportation
2. Development of Private Vehicle Transport Volume
3. Renewable Electricity Supply to Meet Increased Demand for Electrified Transport
4. Challenges in Implementing Measures to Reduce Car Attractiveness
5. Lack in Focus on non-metropolitan areas and holistic urban planning approach

2.1.1 Challenges in achieving a Modal Shift from *Private* to *Public Transportation*

While the electrification of public transport infrastructure is a crucial element of Israel's strategy, the predominant source of emissions remains private transportation. As shown in Figure 2, emissions from private vehicles constitute the largest share of total transport-related GHG emissions.

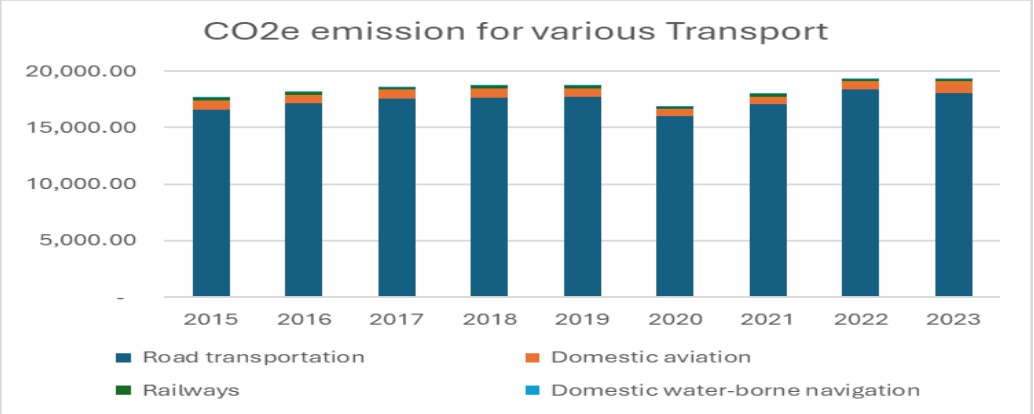


Figure 2: Breakdown of CO_2 emission for various transport modes in 2023
Source: Figure by authors based on data from Israel's CBS [83]

In terms of emissions per person per kilometer, public transportation is significantly more efficient than private vehicles. Thus, a shift from private to public transport is pivotal to achieving the 2030 target of 18.18 Mt CO2e (target 2) and the 2050 target of 0.7 Mt CO2e (target 4).

Despite ongoing investments in Israeli public transportation infrastructure, experts have emphasized that the benefits of these measures will likely be realized only after 2030. According to Ran Reiz, substantial changes in the shift from private to public transport will not occur until the electrification of the national rail system and the construction of light rail networks are completed. Unfortunately, project timelines have been delayed, in part due to political challenges such as the scheduling limitations during Shabbat, which have significantly reduced the window for contractor work.[84] Additionally, there is concern that the electrification of the rail system was awarded to a single company with limited experience working in Israel, further complicating the expected timeline. Consequently, the anticipated increase in public transport ridership and reduction in private vehicle use will likely not materialize until after 2030.

2.2 Development of Private Vehicle Transport Volume

As mentioned earlier, the government's projections rely on several assumptions that warrant scrutiny, particularly the expected reduction in vehicle kilometers traveled (VKT). Recent data indicates an increase in the average kilometers traveled per citizen (from 4,975 km in 2015 to 5,462 km in 2022). Yet, the projections predict a reduction in VKT, forecasting 5,099 km per capita by 2025, 4,982 km by 2030, and 4,785 km by 2040.

Additionally, the number of private vehicles has grown significantly in recent years. In a recent analysis of future transportation trends, Professor Erel Avineri's projections suggest that the number of vehicles in Israel could rise to 10 million by 2050 under an intermediate scenario, or as high as 11 million in a high-growth scenario.[85] This contrasts sharply with the government's estimate of just 6 million vehicles by 2050, suggesting that the official projections may be overly optimistic.

Moreover, while the government anticipates a reduction in the average mileage per vehicle, Avineri predicts a continued increase in total transportation volume, with annual vehicle kilometers rising from 95,000 km in the low scenario to 120,000 km in the high scenario by 2050.

Though it is reasonable to expect public transportation infrastructure projects to contribute to a reduction in VKT, we question the extent to which this will occur. Research indicates that "pull measures"—such as expanding public transport options—are ineffective unless paired with

"push measures" that reduce the attractiveness of private car use.[86] Our analysis of existing policies shows that while push measures like congestion taxes, “travel” taxes, and reforms to vehicle reimbursement schemes are being discussed, their actual implementation appears to be far from imminent.

2.3 Renewable Electricity supply to meet increased demand for electrified transport

A critical concern is whether Israel’s electricity sector can meet the growing demand for electrified transportation with renewable energy sources, and whether this transition will truly lead to a reduction in transport-related GHG emissions, or simply shift emissions from the transport sector to the electricity sector.

Israel’s Ministry of Environmental Protection has suggested that the gradual transition to electric vehicles will give the energy sector time to adjust. Ran Reiz noted that it will take Israel another 15 years to switch or replace 4 million gasoline fueled cars from the moment that the energy sector switches. In the meantime, continuous efforts will be made to move to EVs while leaving the energy sector to come up with the solution for the electricity supply. Israel’s Ministry of Energy and Infrastructure conducted assessments on the capability of the energy system to meet the additional demand for electrified transport in addition to the other demands of residents/industries. According to ministry scientist, Dr. Shahar Dolev, these assessments show that the electricity system will be able to cope under the condition that charging is managed, i.e. spread out over the night and not taking place during peak hours. On the other hand, if there is no management, and people return home from work between 5:00 PM and 7:00 PM and plug their cars into a charging socket then, peak charging will coincide with the peak domestic energy demand in the evening, causing a huge load on the grid and the electricity production system.[87]

The Ministry of Energy and Infrastructure's estimates suggest that by 2050, the transportation sector will require 24.85 TWh of electricity, with the majority of demand coming from private vehicles (13.71 TWh)[88]. However, these estimates are based on the assumption that the total number of private cars will be limited to 6 million by 2050, a figure that appears optimistic given official projections of population growth.[89]

Based on CBS data on the average distance travelled per vehicle in 2023 and the average electricity consumption of each type of vehicle if it's electrified, we conducted our own calculations to estimate the electricity consumption of future electrified road transport. Table 3 shows that, under the assumption that Israel's road transport volume remains constant, a fully electrified transport sector would require an estimated 24.64 TWh of electricity per year.

Therefore, our results show a very similar result for the electricity needs of an electrified transport sector. Significant differences, however, are that we calculate with a hypothetically fully electrified road transport volume for 2023, not encompassing electricity consumption of railways. The figure 24.64 TWh represents approximately 35.4% of Israel's total electricity consumption in 2023 (69.659 TWh, accounting for 76.59 TWh production minus 6.931 TWh exports, 2023 data[90]). However, transport demand is expected to increase significantly. Assuming constant average mileage and keeping the number of other vehicle types unchanged, electrification under these conditions would require 43.59 TWh per year for road transport alone—an increase of 62.6% compared to Israel's total electricity consumption in 2023.

Table 3: Estimation of electricity consumption of future electrified road transport

Type of vehicle	**Average distance travelled per vehicle in 2023 in 1000[91] (km)**	**Number of type of vehicle[92]**	**Average electricity consumption of electrified vehicle type[93] (kWh/km)**	**Electricity consumption per vehicle type in case of electrification (constant 2023 transport volume) (kWh)**
Private cars	14.7	3,556,166	0.20	10,457,501.040

Trucks	26.9	307,355	1.1	9,097,934,450
Minibuses	45.1	15,442	1.24	863,516,408
Buses	54	25,320	2.48	3,386,366,400
taxis	63.6	22,447	0.2	285,723,840
motorcycles	75	167,585	0.044	552,029,500
Total				**~24.64 TWh**

Source: Authors' calculations based on data from Israel's CBS

Government forecasts, on the other hand, present a more conservative scenario, projecting 6 million private cars by 2050. Replicating our calculations for this optimistic case, we still predict electrification would add 31.83 TWh to annual electricity demand, equivalent to 45.7% of Israel's 2023 electricity consumption.

We also assessed the potential GHG emissions from the additional electricity demand under various renewable energy penetration scenarios. Our calculations show that with the 2023 level of renewable penetration (12 %), a full road transport electrification would still result in substantial indirect emissions of 11 874 Mt CO2e. This would contribute to only a 35.4% emission reduction, compared to the 18 383 Mt CO2e currently generated by road transportation. Even with an ambitious 70% renewable energy share, electrified transport would lead to additional emissions varying from 405 Mt CO2e for the current transport volume to 716 Mt CO2e taking into account the predictions for the increase in private vehicles.

Table 4: Estimation of GHG Emissions for additional electricity demand for road transport electrification under different renewable energy penetration levels

Renewable Share	**Scenario A** (3.556M cars, 24.64 TWh)	**Scenario B** (10M cars, 43.59 TWh)	**Scenario C** (6M cars, 31.83 TWh)
12 % (2022 level)	11 874 Mt	21 006 Mt	15 339 Mt

30 %	9 445 Mt	16 709 Mt	12 201 Mt
50 %	6 746 Mt	11 935 Mt	8 715 Mt
70 %	4 048 Mt	7 161 Mt	5 229 Mt
90 %	1 349 Mt	2 387 Mt	1 743 Mt

Source: Authors' calculations based on data from Israel's CBS, government predictions and Erel Avineris projections

To achieve the reduction of transport related GHG emissions to 0.7 Mt CO_2e by 2050 (target 4), the energy sector would need a 99.9%–99.97% renewable electricity share—a near-total decarbonization of electricity generation. These figures do not even take into account other transport related emissions such as aviation and railway. Given that Israel is already struggling to meet its 30% renewable energy goal by 2030, such a drastic increase in electricity demand from only one sector (transport) poses an immense challenge, given limited space for electricity infrastructure and considering that population growth will also lead to demand increases from other sectors.

The above calculations are simplified estimates, intended to illustrate the scale of the challenge rather than provide precise energy modelling. The figures were derived by multiplying projected vehicle numbers and average mileage with electricity consumption per km, and then estimating total emissions based on different renewable energy shares. There are several limitations to this approach worth acknowledging. Efficiency improvements in electrified cars might reduce the increase in electricity demand and electricity grid dynamics were not modelled in detail, meaning assumptions about renewables directly replacing fossil fuels are simplified. The transport volume evolution might be underestimated on the other hand side, as only the increase in private vehicle numbers was factored in rather than travel distances.

Nonetheless, the results clearly show that transport policies can't rely on electrification alone, as this would require an unrealistically rapid expansion of renewable electricity. Therefore, holistic strategies to reduce dependency on private cars remain absolutely crucial.

2.4 Challenges in Implementing Measures to Reduce Car Attractiveness

The implementation of "push measures" aimed at reducing car dependency is fraught with political and practical challenges. Ran Reiz noted that changes to public sector car-related financial incentives are slow due to the need to negotiate with workers' unions. In his view, the real shift in car usage will not occur until after 2030, when political and public resistance to policies that discourage car ownership or use can be addressed. Similarly, the "travel" tax, which would use GPS tracking to charge drivers based on their usage, remains difficult to implement due to technical and political challenges.

The potential effectiveness of taxes like the congestion tax also remains uncertain, as employers often cover the costs of vehicle-related expenses, meaning that drivers may not feel the financial burden directly. This can be seen already in Tel Aviv's "for pay" "Fast Lane" experience on crowded Highway 1, where many employers cover the cost for drivers who utilize this lane during hours of high congestion. Ultimately, reducing private car usage will require a combination of regulatory measures and infrastructure changes.

2.5 Lack in Focus on non-metropolitan areas and holistic urban planning approach

Reducing GHG emissions is not the main concern in Israel's policies in the area of transport. When asked about measures required to reduce car dependence outside of metropolitan areas, Ran Reiz stated that transportation is the main cause of air pollution in the cities. With limited financial means, policies should focus on the cities to address GHG emissions and air pollution at the same time. As the population increases and the absolute numbers of private vehicles are projected to skyrocket by 178%, reaching approximately 10 million by 2050, Israel risks facing a "transportation crisis without precedent in the Western world". [94]

Developing public transportation infrastructure in metropolitan areas is necessary to prevent dramatic future traffic jams. The electrification of public and private transport effectively helps to fight air pollution and improve public health. The fact that there is a harmony of objectives between these critical public interest concerns and measures to reduce GHG emissions in the transport sector is arguably beneficial for the achievement of the country's NDC targets. At the same time, this leads to a focus on metropolitan areas in transport policies, leaving important gaps that need to be addressed in order to achieve the country's long-term sustainability goals.

Public transportation infrastructure needs to be developed not only in metropolitan areas but also in smaller and middle-sized cities. Urban planning must be carried out with the aim of creating jobs, leisure activities and residential areas in close proximity in order to connect them with public transport.

The challenge to provide enough renewable energy to provide for a growing car fleet, with general electricity consumption increasing at the same time, seems to be irresolvable.

Ultimately, addressing GHG emissions from transportation will require a multifaceted strategy that reduces reliance on private vehicles across both urban and rural areas.

2.5.1 Urban Success Stories

Role of Cities and Local Governments

Spain's cities and local governments play a leading role in advancing transport decarbonization. Local governments have used their regulatory power to implement ambitious sustainability policies, such as low-emission zones, pedestrianization projects, and investment in public transport. One of the key success factors has been the ability of municipal authorities to resist political and social objections to restrictive transportation measures and make them a long-term component of urban planning.[95] Cities like Barcelona, Madrid, and Pontevedra have demonstrated how proactive local policymaking can yield rapid results in reducing car dependency and improving urban sustainability.

Low-Emission Zones (LEZs)

Many Spanish cities, including Madrid and Barcelona, have established low-emission zones, restricting access to parts of the city for high-emission vehicles. Madrid's "Madrid Central" program, for example, bans most polluting vehicles from entering the city center, significantly reducing air pollution and traffic congestion. While a few cities pioneered on those measures, the national government followed with a comprehensive climate change law in 2021, which requires all Spanish cities with more than 50,000 inhabitants from 2023 on to establish low-emission zones.[96]

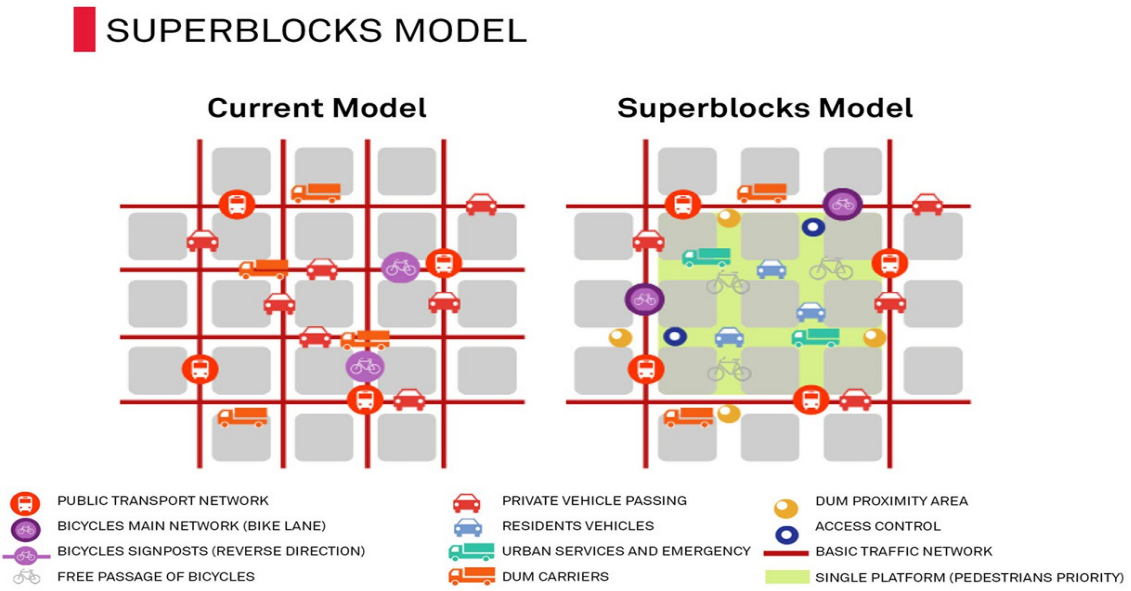
Speed Limits and Traffic Calming Measures

This is another area where several cities have pioneered sustainable transport policies, introducing speed limits to increase safety and reduce emissions. This was followed in 2020 by national legislation introducing a national speed limit of 30 km/h on most urban roads. Studies show that lower speeds contribute to reduced emissions, noise pollution, and traffic-related fatalities.[97]

Superblocks Initiative in Barcelona

Barcelona's "Superblocks" initiative is one of the most renowned urban planning strategies worldwide. By restricting traffic in designated areas, and transforming parking lots, the program creates pedestrian-friendly spaces where walking and cycling take priority. This initiative has led to significant improvements in air quality, noise reduction, and overall quality of life for residents.[98]

Figure 3: Previous model compared to superblock model, providing an area within the block that prioritizes pedestrians and bicycles and allows certain vehicles to enter



Source: Mobility Urban Plan, Ajuntament de Barcelona [99]

Pontevedra: A Car-Free Success Story

The city of Pontevedra stands out as a leading example of car-free urban transformation. Over a 20-year period, the city reduced vehicles in the downtown area by 90%, leading to a two-third reduction in transport emissions and eliminating traffic-related fatalities. By prioritizing pedestrians and cyclists, Pontevedra has become a model for sustainable urban mobility.[100]

Figure 4: Pontevedra's "metrominuto" - Plan, showcasing walking distances and estimated time in the city to encourage walking

Source: Pontevedra City Council [101]

2.5.2 Participatory Strategy Development

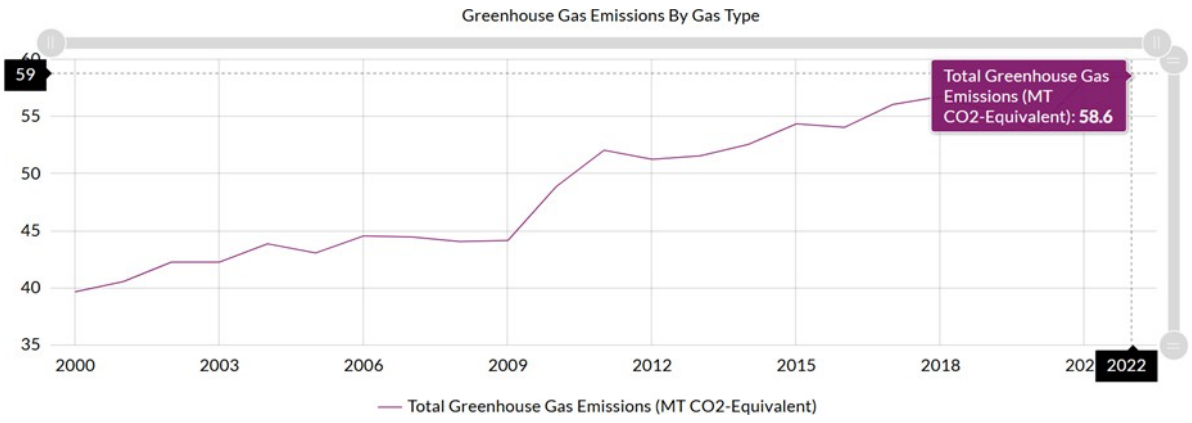
A final significant aspect of Spain's approach to decarbonizing transport is the extensive stakeholder participation that ensures that the perspectives of local governments, industry and civil society are included in policy design. The "Diálogo Abierto de Movilidad" initiative involved various stakeholders in the design of the mobility strategy, making the process transparent and inclusive and revealing co-benefits for health and safety.[102]

Spain's policies for reducing GHG emissions from transport present a structured, socially inclusive, and effective model for Israel to consider. By integrating ambitious intermediate targets, prioritizing modal shifts, engaging local governments, and ensuring public participation, Spain has created a comprehensive and actionable strategy. While Israel can learn from this approach to enhance the seriousness and effectiveness of its own decarbonization efforts in the transport sector, there is also at least one aspect where Spa[103]in can learn from Israel: Spain still lacks targets for the electrification of heavy road transport.[104]

2.6 Singapore

For 2021 NDC, Singapore intends to reduce emissions to around 60 MtCO2e in 2030 after peaking its emissions earlier with a period for implementation from 2021 to 2030. Singapore's total emission had been increasing from 39.7MtCO_2e (2000) to 58.6 7MtCO_2e (2022) (refer to Figure 3).

Figure 5: Total GHG emissions from 2000-2022[105].



Source: Department of Statistic Singapore

This commitment may not be sufficient in attaining the requisite GHG emissions reductions. However, given the small country's dimensions, with no natural resources, Singapore is putting in place many dramatic measures which will certainly contribute

to future emission reductions.

Singapore is a small country with some commonalities with Israel in terms of the scarcity of land and difficulties (or no access) in pursuing alternative energy options such as nuclear, hydro-electric or geothermal power. Both countries are heavily dependent on fossil fuel and are now switching to natural gas for their electricity generation.

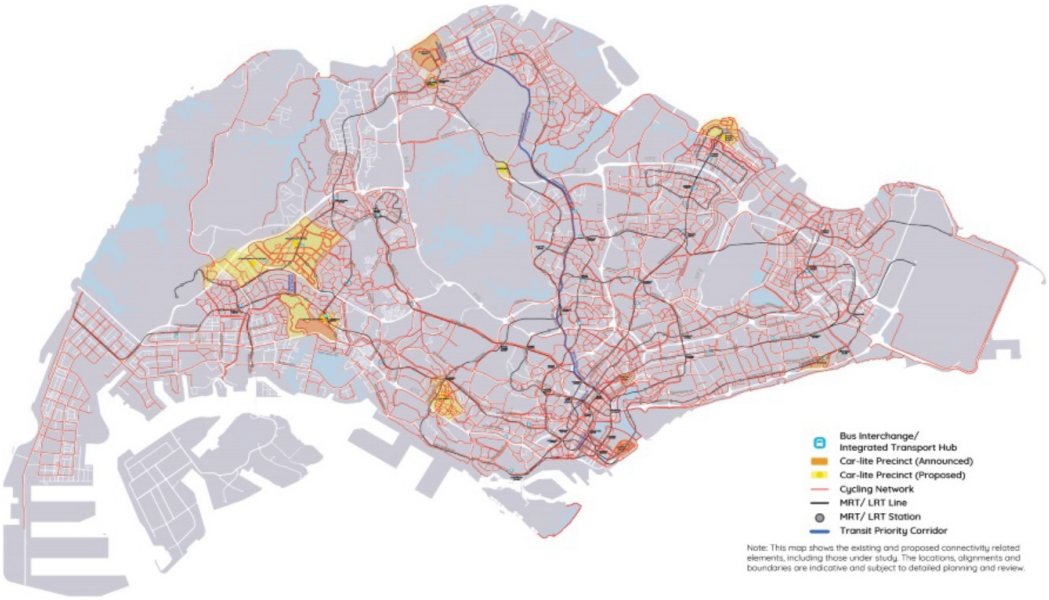
2.6.1 Public sector take the lead

The Singapore Government launched many initiatives like the GreenGov.SG which is the public sector's sustainability movement, which includes targets like peaking the public sector's carbon emissions around 2025 and achieving net zero emissions around 2045. This includes procurements of new vehicles registered by the public sector to be clean energy vehicles with zero tailpipe emissions from 2023 onwards. In addition, all public sector cars will run on cleaner energy by 2035 and the public sector to procure more electricity from clean energy sources.

2.6.2 Urban planning

Singapore has a statutory land use plan called the Master Plan (MP) which guides Singapore's development in the medium term over the next 10 to 15 years. It is reviewed every five years. In the latest Master plan 2019[106], one of the themes is "Better Connectivity for All". This means connectivity across Singapore will be further enhanced with expanded public transport and active mobility networks.

Figure 6: Expanded public transport and active mobility networks in Singapore



Source: Urban Redevelopment Authority (URA)

The Master plan 2019 includes:

1. Building of more rail lines and stations and better bus connectivity with more integrated transport hubs (ITHs) and new bus services.
2. Well-connected networks for “WALK” & “CYCLE" with long term planning and implementation of dedicated footpaths and cycling paths. An example is the Transit Priority Corridor (TPC) that runs at a length of 21.5km from the town Woodlands to the city. This North-South Corridor has continuous bus lanes and cycling routes. It will also be Singapore’s first integrated transport corridor with expected completion date around 2026. This active mobility is part of Singapore initiative for sustainable transportation in Singapore.
3. In new towns, car-lite precincts are planned to prioritise pedestrians, cyclists and public transport users. Developments in these precincts will include less parking

and road spaces for general vehicular traffic and new car-parking concepts such as hub parking will be built.

4. Some roads are also redesigned for more community spaces with wider walking and cycling paths. There will also be roadside greenery to enhance the environments for residents. Safety features like the 50 Silver zones for seniors are also implemented.[107]

Figure 7: Example of TPC (North-South Corridor) from Urban Redevelopment Authority (URA) and Land Transport Authority (LTA)

Source: Urban Redevelopment Authority (URA) and Land Transport Authority (LTA)

Another highlight of the master plan is to have "Easier Access to work & amenities". Amenities such as schools, shops/shopping malls and parks will be readily accessible via walk, cycle or ride. By 2040, residents should be able to reach the nearest neighbourhood centre within 20 minutes; and 9 in 10 of all peak-period journeys can be completed within 45 minutes via walk, cycle or ride (public transport). The aim is to make Walk-Cycle-Ride modes of transport so convenient, fast and comfortable that commuters will choose such modes over private transport for their daily commutes.

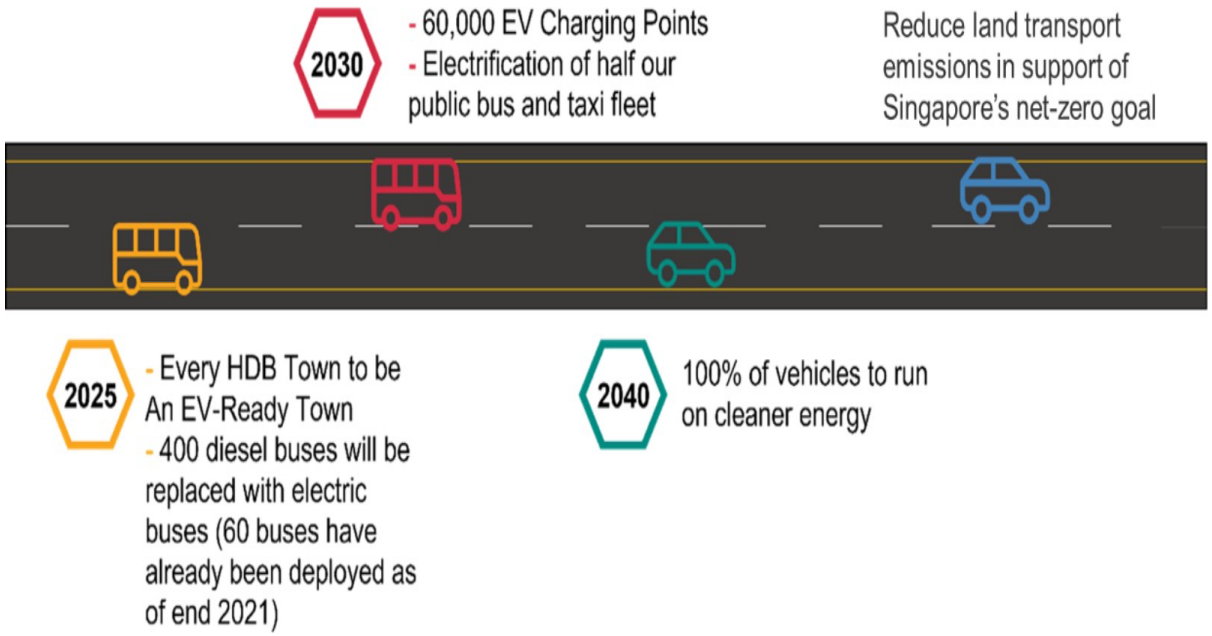
More jobs are also being planned in the various business nodes closer to homes. An example is the Punggol Digital District.

2.6.3 Transportation Public transport

In order to better manage the public system, improvements were made using the public transport industry financing frameworks after assessments were done on previous model whereby the operators own and maintain the rail/buses and related assets. LTA now owns all bus and train operating assets through the Bus Contracting Model in September 2016 and the New Rail Financing Framework for the train operators, SMRT and SBS Transit, in October 2016 and April 2018 respectively.[108] In this way, the public transport operators will be more focused on providing reliable and well-maintained services for the public while the government will ensure more timely investments in capacity expansion, replacement and upgrading the assets. LTA also set up the Singapore Bus Academy and Singapore Rail Academy to deepen local capabilities, raise professionalism and support skills upgrading in our bus and rail industries respectively.

This ensures that the trains and buses are run and maintained by capable and well trained skilled personnels. Provision of reliable public transport is an essential factor that gives commuters the confidence to use the public transport.Under the Singapore Green Plan 2030[109], the overall Green Transport roadmap of Singapore is shown below.

Figure 8: Overall Green Transport roadmap of Singapore (from LTA)



Source: LTA

- The goal is to electrify half of the bus fleet by 2030 and 100% cleaner energy bus fleet by 2040.

- Singapore taxi operators have also committed to ensuring that at least half of taxis in the country will be electric by 2030. To support this, the LTA is extending the statutory lifespan of all electric taxis from eight years to 10 years to give operators more time to optimize their investments[110].

Private transport

- Incentives were given for the adoption of cleaner energy vehicles from 1 January 2025 to 31 December 2025. Owners who register electric cars and taxis in 2025 will continue to enjoy the existing EV Early Adoption Incentive (EEAI) quantum (rebate of 45% off the Additional Registration Fee (ARF), capped at SGD$15,000) by LTA. The National Environment Agency (NEA) will continue to give the Vehicular Emissions Scheme (VES) Band rebate (ranging from SGD$25,000 to SGD$2,500 for electric and hybrid cars respectively. These 2 rebates will allow buyers to enjoy a combined cost savings of up to SGD$40,000 for electric cars during the said period[111].

- Under the Singapore Green Plan 2030, in order to encourage EV, a target of 60,000 EV charging points by 2030 was set. This includes working with the private sector to achieve 40,000 charging points in public carparks and 20,000 charging points in private premises. All carparks in the HDB towns (around 2,000) will be installed with charging points by 2025[112].

- The Electric Vehicles Charging Act (EVCA) was passed by Parliament in November 2022 to regulate the safe charging of EVs, ensure the provision of reliable EV charging services, and expand the network of accessible charging infrastructure in Singapore. Under the Act, 1. New developments must install charging points that draw a total power of one-fifth of the required minimum power capacity. 2. EV chargers must be certified as fit for charging EVs according to requirements. During its use, EV chargers must also be periodically inspected and maintained to ensure that they are kept in good condition.

- Singapore was also the first country to impose a vehicle quota system to cap vehicle growth, and the only country to set a zero-growth rate for cars and motorcycles according to their 2021-NDC[113]. The Singapore's Electronic Road Pricing (ERP) system is designed to reduce congestion by charging drivers when they pass through ERP gantries during operational hours. This system will be replaced by ERP 2.0 which uses

a Global Navigation Satellite System (GNSS)-based system to manage traffic flows without the need for physical gantries. It also provides the option to implement distance-based charging in the future.

2.6.4 Electricity from renewable sources

In 2021-NDC, Singapore aims to 1. achieve solar target of at least 2 gigawatt-peak (GWp) by 2030 (solar target of 350 megawatt-peak (MWp) in 2020) and 2. deploying Energy Storage System (ESS) with 200MWh of energy storage capacity and 200MW of discharge capacity, to enhance the resilience of its energy supply and power grid.

- SolarRoof and SolarNova programmes are part of the "Whole-of-Government" efforts to aggregate demand for solar PV systems across government agencies. This includes installing the systems on the rooftops of HDB flats and public sector buildings. Reservoirs and offshore spaces were used with Sembcorp Tengeh Floating Solar Farm being one of the world's largest inland floating solar PV systems with 122,000 solar panels spanning across a land area of around 45 football fields providing 60 MWp[114]. Temporary vacant lands were also used for solar PV systems. Building Integrated Solar Photovoltaic (BIPV) were also deployed. It refers to the seamless integration of solar PV systems into the design of buildings such as roofs, facades, and windows. They offer a sustainable and visually appealing solution for clean energy generation in buildings.

- Singapore is also involved in a renewable energy import project known as the Lao PDR-Thailand-Malaysia-Singapore Power Integration Project (LTMS-PIP) whereby 100 megawatts (MW) of renewable hydropower will be imported from Laos to Singapore via Thailand and Malaysia using existing interconnections.[115]

The largest Energy Storage System (ESS) in Southeast Asia was opened in Singapore's Jurong island in 2023 with a maximum storage capacity of 285 megawatt-hours (MWh).[116]

Policy Recommendations for Achieving Israel's NDC Targets in the Transportation Sector

As Israel considers its third NDC, it has an opportunity to upgrade national efforts to reduce GHG emissions from the transport sector. Our assessment shows that there is a need to intensify Israel's efforts in order to achieve the emission reduction goals set for 2030 and 2050. Following the Spanish example, Israel should improve its long and medium-term planning by setting ambitious interim targets for reducing emissions by 2035 and 2040.

Enhancing Policy Measures to Reduce Vehicle Kilometres Travelled

A critical challenge is reducing vehicle kilometres travelled by simultaneously placing constraints on private car use, phasing out incentives for private vehicle use and strengthening public transportation. Several policy measures should be implemented to achieve these goals:

1. Implementing Demand Management Strategies

   The planned congestion taxes for metropolitan areas need to be adopted and combined with additional policies such as road pricing and reductions in parking availability. Systems like Singapore's Electronic Road Pricing (ERP) system can be applied by charging drivers when they pass through ERP gantries during peak hours. Additionally, measures to repurpose public road space to prioritize public transit should be expanded, such as reducing available parking in cities and expanding dedicated bus lanes and high-occupancy vehicle (HOV) lanes, with consistent penalties enforced for non-compliance. National legislation setting the default speed limit in cities at 30 km/h is also a successful approach, as the case of Spain shows.

2. Reforming the Vehicle Reimbursement Scheme

The existing vehicle reimbursement system, which incentivizes government employees' private car ownership and usage, should be phased out or significantly restructured. A gradual, multi-stage reform should include engaging in serious negotiations with labour unions and offering alternative benefits. Initially, substitute payments should be provided for new employees and those willing to transition. Early-stage reforms could include replacing free workplace parking with monetary compensation, with the medium-term goal of replacing the vehicle reimbursement scheme entirely. This will help employees who have planned their car ownership and commuting routine on the basis of the existing system to adjust. At the same time, a framework for sustainability reporting by organizations should be created that places greater responsibility on employers with regard to the mobility of their employees. They should consider measures to encourage their employees to use public transportation or to come to work by bike or on foot. In addition, companies should be encouraged to establish or relocate to locations that are easily accessible by public transport.[117] Strengthening Public Transportation Infrastructure and Services

3. **Enhancing Reliability and Accessibility of Public Transport**

Findings from the CBS survey for the Ministry of Transportation indicate that improving station proximity (40%), ensuring fixed schedules (28%), and reducing travel time (27%) are key to increasing public transport usage. To address these concerns, efforts should focus on improving service frequency, particularly during peak hours, and expanding coverage during weekends and holidays. The “Naim BeSofash” weekend transport initiative provides a partial solution. While this is not a solution for all municipalities, further expansion and standardization of such services would be an important step.

4. **Developing Infrastructure for Electric Buses**

With the increasing adoption of electric buses, adequate infrastructure must be established, including parking facilities and charging stations. Large-scale bus terminals with extensive charging capabilities should be prioritized, requiring strategic investment and coordination between the government and local authorities.

Incentivizing the Transition to Electric Vehicles While Managing Grid Demand

5. **Introducing Incentives for Electric Vehicle Adoption**

Financial incentives should be introduced to accelerate the transition from internal combustion engine (ICE) vehicles to electric vehicles (EVs). This policy does not necessarily have to lead to a significant reduction in revenue from import duties on vehicles or fuel taxes, which are essential for the Israeli state budget. What is important is that the steering effect of the taxes significantly increases the purchase price of conventional vehicles compared to that of electric vehicles.

6. Expanding EV charging infrastructure and implementing Smart Charging Policies

To prevent excessive strain on the electricity grid, public awareness campaigns should encourage EV charging during off-peak hours. The government should mandate the integration of smart charging technologies that delay charging until off-peak periods, even if vehicles are plugged in earlier. These measures will help balance electricity demand and optimize grid utilization. In order to increase people's confidence and safety, regulations such as Singapore's Electric Vehicles Charging Act (EVCA) should also be implemented to regulate the safe charging of EVs and the provision of reliable EV charging services.

7. Encouraging the Retirement of High-Emission Vehicles

7.1 Financial incentives

Due to Israel's high import tariffs on vehicles, the proportion of very old cars remains high. Replacing these older, high-emission vehicles will yield the most immediate emissions reductions. Specific policies should include trade-in bonuses, direct financial incentives, and scrappage programs for vehicles exceeding a certain age threshold. By prioritizing the removal of the most polluting cars, Israel can achieve faster and more significant reductions in greenhouse gas emissions.

7.2 Expansion of LEZs into other cities

With the experience gained from the two cities, measures can be taken to introduce LEZs to other cities. The example in Spain shows that national legislation requiring all cities above a certain size (e.g. more than 50,000 inhabitants) to set up LEZs is a successful approach. Owners of old cars, especially the polluting ones, will be forced to have to replace or scrap their old cars. These measures will force them to find other alternatives in terms of buying low emission vehicles or taking public transport. Using health reasons as a strong supporting reason, people will be less resistant to the implementation of LEZs.

While measures to promote the replacement of internal combustion engines with electric vehicles are an essential part of any strategy to reduce transport emissions, our calculations based on projections of traffic growth and future demand for electricity from renewable energy sources show that an exclusive focus on electrification will only result in a shift of emissions to the electricity sector. The

combination of these measures with measures 1-4 is therefore crucial.

Urban Planning for Sustainable Mobility

8. **Developing New Urban Centers to Reduce Commuting Needs**

   Israel's central districts, which comprise only 7% of the land mass yet house over 40% of the population, are experiencing unsustainable population density and travel demands. Given the expected population increase, proactive decentralization efforts are necessary. New cities should be strategically developed outside of Tel Aviv and central districts, incorporating transit-oriented design principles to minimize car dependency.

9. **Integrating Sustainable Transport Infrastructure in New Developments**

   Future urban planning should mandate the inclusion of public transport infrastructure such as dedicated "fast lanes", light rail networks, and metro systems. Planners should systematically examine which urban areas are suitable for limited car traffic and pedestrian-friendly spaces following the example of the Spanish "Superblock" initiative. Additionally, all new housing projects should be required to install EV charging infrastructure that also includes structures for generating and storing solar energy in order to prevent future challenges related to retrofitting old buildings for electrification. Learning from Singapore's approach, companies are encouraged to establish offices nested together with the residential houses in the new towns (out of city center), thereby reducing long-distance commuting.

End of the Service Period for EVs

1. Plans for Recycling Electric Vehicle Batteries

There will need to be plans for future disposal of the tens of thousands of EVs and hybrid cars' batteries when they reach the end of their service period. This will pose a considerable challenge as usually such batteries will require special handling during the disposals. Nevertheless, from our research and interviews, so far there was no mention of the aftermath. Israel's Ministry of Energy and Infrastructure along with the Environmental Protection Ministry has not regulated electric vehicle battery handling in Israel. The absence of such regulation will potentially affect the waste disposal sector in future and the government will need to look into this seriously and have a long-term plan ready.

Achieving Israel's NDC goals for the transportation sector requires a multi-faceted approach combining regulatory reforms, infrastructure investments, financial incentives, and urban planning initiatives. By implementing these recommendations, Israel can reduce its reliance on private vehicles, enhance public transportation, and transition toward a more sustainable, low-carbon transportation system.

3. Introduction into Israel's Transport targets in the 2021 NDC

Israel's National Determined Contribution (NDC) under the Paris Agreement, submitted in July 2021, outlines four targets for the transport sector, presented in order of their intended achievement. Table 1 are the summaries.

Table 1: Israel's NDC 2021 targets and their intended achievement for Transport.

NDC 2021 Targets on Transport	Year of intended achievement	Content of Target
Goals for development of transport GHG Emissions		
Target 2	2030	Limit increase of GHG emissions to 3.3% relative to 2015 (17.6 $MtCO_2e$) i.e. 18.18 $MtCO_2e$
Target 4	2050	Reduce GHG emissions by at least 96% relative to 2015 i.e. 0.7 $MtCO_2e$
Measures aimed at reducing emissions ("Supporting Targets")		
Target 1 Electrification of Public Transport	2026	Purchase all new municipal buses as clean vehicles as defined in section 77A of the Transport Ordinance [New Version]
Target 3 Electrification of Private Transport	From 2030 onwards	Limit to an amount equal to 5% of the average GHG emissions for a new vehicle, weighing up to 3.5 tons registered in 2020

Source: Authors' compilation based on Israel's 2021 NDC

Targets 2 and 4 set goals for the development of emissions for the transport sector for 2030 and 2050, respectively.

By 2030 (Target 2), the growth in Greenhouse Gas (GHG) emissions from transportation

is to be capped at 3.3% above 2015 levels. Transportation emissions in 2015 were 17.6 $MtCO_2e$, which means transport emissions in 2030 should not exceed 18.18 $MtCO_2e$ to meet this target.

By 2050 (Target 4), GHG emissions from transport are to be reduced by at least 96% compared to 2015 levels, which is a target of 0.7 $MtCO_2e$.

These targets must be understood in the context of the broader GHG emission reduction goals set in the NDC. Israel aims to reduce absolute GHG emissions by 27% and 85% by 2030 and 2050 respectively, both relative to 2015 levels. Consequently, while the NDC permits transport emissions to increase until 2030, overall emissions must decrease. By 2050, however, the reduction in the transport sector is projected to outpace the overall reduction, with an ambitious 96% decrease i.e. 0.7 $MtCO_2e$, reflecting the perception that, although transportation emissions are challenging to curb in the short term, they are not considered unattainable in the long term.

Chapter 3: The Waste Sector in Israel

A. The Waste Management Chain in Israel

The waste management system in Israel is divided into two main stages: intra-urban, in which local authorities are responsible for the collection and initial separation of waste, and extra-urban, in which waste is transferred to end-treatment facilities for sorting, recycling, recovery, or landfill. There are transfer stations that help streamline the transportation to end-treatment facilities, with some including partial or full sorting facilities. The materials separated, and the proportion of waste separated at the source vary between authorities and between geographical regions, with some authorities using designated bins for different waste streams, while in others no separation is performed, or only certain streams are separated[118].

The separation in the later stages of the treatment chain is also only partially implemented, and despite investments in sorting technologies, as of 2021, only about 35% of the waste designated for sorting undergoes this process (This takes place in mixed waste sorting facilities – Dirty MRF). Thus, a significant portion of the waste (about 3 million tons per year) is sent directly to landfill, due to limited capacity and a lack of available sorting facilities[119].

In total, 4.5 million tons, which account for 78% of the waste in Israel, are landfilled, 14% (806 thousand tons) is recycled, 6% (348 thousand tons) is organic waste that is treated mainly through composting and anaerobic digestion, and 2% (126 thousand tons) is used to produce RDF fuel, mainly for the cement industry.[120]

B. Waste Streams in Israel

Dividing the waste into various streams reveals that organic waste constitutes about 40% of Israel's generated waste, depending on estimates[121]. Of this, about one-third is landfilled, another third undergoes composting or biological stabilization, and the rest is evaporated[122].

Facilities for treating organic waste include composting sites (such as Dudaim and Compost 2000), which produce fertilizer products, and anaerobic digestion facilities (such as Emek Hefer and South Golan), which generate renewable energy. Plastic waste accounts for approximately 19% of Israel's total waste (about 1 million tons per year), with only 7% of it recycled and 11% utilized for energy recovery due to limited economic viability and insufficient recycling facilities[123].

Regarding paper and cardboard, which account for about 20% of total waste, approximately 260,000 tons are recycled, while 12% is still landfilled. About 50% of beverage containers and glass packaging are collected for recycling, with approximately 40% of the processed glass recycled domestically and the remainder exported[124].

Below is the data in a graphical display:

C. The Carbon Footprint of Waste Treatment Methods in Israel and Worldwide

In terms of greenhouse gas emissions, landfilling is considered a polluting method associated with significant greenhouse gas emissions. According to inventory data, landfilling is responsible for approximately 90% of all waste-related emissions in Israel, with most emissions resulting specifically from the landfill disposal of biodegradable waste[125].

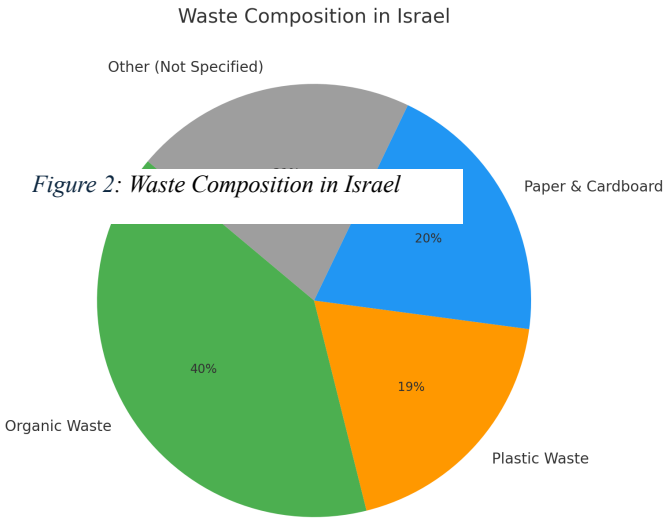


Figure 2: Waste Composition in Israel

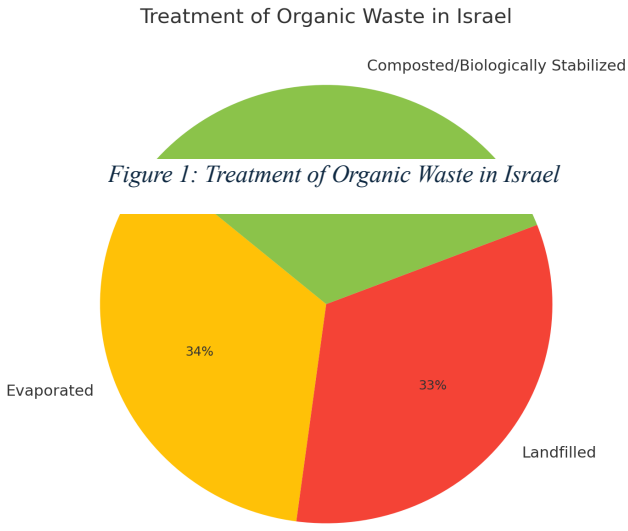


Figure 1: Treatment of Organic Waste in Israel

However, by sealing landfills and capturing emitted greenhouse gases, emissions from existing landfills can be reduced by at least 50%[126]. Additionally, according to inventory data, other sources of waste-related emissions include composting and treatment of domestic and industrial wastewater.

In recent years, compared to landfilling, recovery is increasingly considered a preferred alternative in many countries. These countries promote solutions that include end-treatment facilities for waste incineration and energy production in major cities. Recovery enables energy generation during waste incineration, saving on transportation and land use, and is therefore regarded as a preferable option over landfill.

From a greenhouse gas emissions perspective, however, the CO_2 emissions expected from plastic waste incineration in energy recovery facilities conflict with global efforts to reduce greenhouse gas emissions. Currently, no full recovery facilities are operational in Israel, but two facilities utilize RDF technology. These RDF facilities are located in Nesher Cement Plant in Ramla, and in the Southern Region near Ashkelon. Together, they process approximately 350,000 tons of waste annually, converting it into refuse-derived fuel (RDF) for industrial energy use.

RDF (Refuse-Derived Fuel) is considered an intermediate waste treatment method because it does not produce electricity or heat directly on-site like traditional recovery facilities but rather creates solid fuel. In the 2022 inventory, emissions resulting from controlled waste incineration had not yet been calculated.

Full recovery technologies such as WTE[127]. Nevertheless, recovery technologies still generate considerable emissions, and their widespread adoption continues to pose environmental concerns.

Another method for addressing waste is anaerobic digestion in biogas facilities. Israel has two anaerobic digestion sites that process 9% of its organic waste. Emissions from these existing facilities had not yet been calculated in the 2022 inventory. Anaerobic digestion is considered

significantly more efficient in reducing greenhouse gas emissions compared to landfilling and recovery, potentially reducing emissions by about 83% relative to landfill[128]. This method applies only to organic waste and requires its separation from other waste streams. As a result, comparing these treatment methods is challenging since each requires different preparatory steps before reaching end-treatment facilities.

D. Regulation in the Israeli Waste Sector

Legislation

Israeli waste legislation has gradually developed without framework legislation and consistent guiding principles. This has led to a dispersion of powers and unorganized regulation. Present policies can be divided into two main types: legislation that establishes basic behavioral norms regarding the prevention of hazards and mechanisms for waste management, such as the Cleanliness Maintenance Law (1984) and the Business Licensing Law (1968); and legislation that focuses on specific waste streams, primarily under the principle of Extended Producer Responsibility (EPR), which imposes responsibility on manufacturers for managing their product waste.

Key legislation in this field includes the Deposit Law on Beverage Containers (1999), the Packaging Law (2011), the Tire Recycling Law (2007), and the Electrical and Electronic Equipment and Batteries Treatment Law (2012). Additionally, there are laws aimed at reducing plastic waste, such as the Single-Use Plastic Bag Reduction Law (2016).

Despite the diverse legislation, there is still no uniform and coordinated framework law in the waste sector. Thus, no law establishes general principles for waste management, a hierarchy of

waste treatment, the division of responsibility for waste collection and treatment by type, or the licensing and registration mechanisms for regulating the waste sector.

Supervision and Enforcement

Supervision and enforcement in Israel's waste sector are carried out by the Ministry of Environmental Protection's regional offices and local authorities through environmental units and municipal environmental quality associations. Enforcement in this field is mainly criminal, while in-laws establishing producer responsibility for waste reduction, and administrative enforcement through financial penalties is applied.

The licensing of waste operators is regulated under the Business Licensing Law, which requires all entities operating solid waste disposal facilities to obtain a license from the local authority. Regulation in this sector suffers from issues resulting from the absence of a uniform and coordinated framework law. As a result the system contains loopholes that hinder the implementation of existing laws and impair consistency in the regulation of various waste streams[129].

Licensing of waste operators is also not fully regulated, and there is a need for a clear licensing framework for this sector, including treatment and landfill facilities, alongside updating business licensing conditions in this field. Supervision and enforcement are also inadequate, with significant gaps in law enforcement and handling environmental crime, including illegal waste dumping and unregulated burning[130].

In addition, waste market data collection and monitoring in Israel are inconsistent, and the data collected by local authorities are not detailed or transparent enough, which undermines the ability to implement effective policies. These regulatory barriers delay the transition to efficient and sustainable waste management and emphasize the need to formulate a structured and binding policy in the field.

4. Failures and Barriers on the Path to Achieving Waste Emission Reduction Targets

Israel faces significant challenges in managing its waste sector, which threaten its ability to meet emission reduction targets. Key barriers in this field include political instability (which leads to unclear and contradictory policies), lack of economic incentives to recycle or reduce, failure of source separation programs, ineffective organic waste treatment, lack of comprehensive framework legislation, and weak enforcement. Each barrier will be briefly considered.

Political Instability

Frequent policy changes resulting from government transitions and changes of ministers in the Ministry of Environmental Protection undermine the ability to implement long-term emission reduction plans. Waste policy changes with each new minister, leading to project freezes and wasted resources. For example, the waste separation at source program, which received an investment of approximately one billion shekels, was canceled after a new minister declared it inefficient[131]. These changes create uncertainty for local authorities and private investors, making it difficult to plan long-term investments in recycling and energy recovery infrastructure. This results in inconsistencies that hamper the ability to expedite effective waste solutions, and delays Israel's progress in meeting emission reduction targets.

Unclear and Contradictory Policies

Israel's policy simultaneously promotes waste separation and sorting facilities alongside waste incineration and energy recovery facilities, which are inefficient without source separation[132]. The contradiction between these two approaches creates regulatory and economic confusion, delaying the development of a stable waste treatment market and hindering the promotion of long-term solutions.

Lack of Economic Feasibility

One of the significant failures in Israel's waste sector is the absence of effective economic incentives for authorities and the public to reduce and recycle waste. Although a landfill levy was introduced to reduce landfilling rates, it has not been updated sufficiently to become a meaningful incentive to minimize landfill disposal. Local authorities struggle to allocate adequate resources for source separation and recycling infrastructure development due to the lack of grants and long-term support. Similarly, economic incentive mechanisms to develop alternative treatment facilities are insufficient, causing continued reliance on landfills as the cheapest and most accessible solution.

Additionally, private companies are hesitant to invest in advanced treatment facilities due to regulatory uncertainty and frequent policy changes. In the absence of long-term governmental commitments, investments in recycling and energy recovery are minimal, delaying the expansion of recycling infrastructure in Israel[133].

Failure of Source Separation Programs

National waste separation programs have mostly failed due to a lack of sufficient financial support for local authorities and inadequate incentives for the public. The wet and dry waste separation program, which operated between 2009–2015, failed due to insufficient funding and professional

guidance for local authorities. Moreover, the public received inadequate incentives for active participation in the separation system, reducing public trust and cooperation with local authorities[134].

Failure in Organic Waste Treatment

Organic waste constitutes about 43% of municipal waste in Israel and is a major source of greenhouse gas emissions. Despite state efforts to reduce organic waste landfilling, its disposal in garbage dumps rates remains very common. Due to a shortage of efficient end-treatment facilities, even organic waste sent for sorting is not properly separated, preventing its acceptance at existing end-treatment sites[135]. The compost produced from this waste is of low quality and thus is not in demand for agricultural and fertilization purposes. As a result, a large portion of organic waste continues to be landfilled, impairing Israel's ability to meet its emission reduction targets.

The establishment of advanced organic waste treatment facilities has also faced delays due to opposition of local communities (the NIMBY phenomenon), stemming from concerns about negative environmental impacts such as odor, soil pollution, and declining property values. Additionally, local authorities are reluctant to approve the construction of these facilities due to resource shortages and concerns about public backlash.

Lack of Framework Legislation

Despite numerous laws regulating various aspects of Israel's waste sector, there is no clear framework law for waste management. This gap leads to inconsistencies in defining basic waste-related concepts, setting waste treatment hierarchies, and assigning responsibilities among authorities[136]. The involvement of the Ministries of Interior, Environmental Protection – and local authorities themselves, are never clearly delineated. These gaps hinder the enforcement of existing laws, allowing for illegal activity in the field.

Insufficient Enforcement and Waste-Related Crime

The lack of adequate supervision in the waste sector encourages illegal activities, including dumping waste in unregulated sites, avoiding landfill fees, and illegal waste burning. Criminal elements exploit the high cost of waste treatment (and the privatization of waste disposal) to operate illegally, frequently intimidating local officials from enforcing solid waste laws[137]. This can lead to severe environmental damage – for example, widespread burning of trash in open spaces rather than proper disposal[138]. Additionally, the Ministry of Environmental Protection faces a severe shortage of personnel and resources, which hampers its ability to enforce existing laws and prevent illegal activities.

Centralization in the Waste Market

The waste market in Israel is characterized by a high level of centralization, especially in the northern and southern regions[139], which leads to collusion, increased prices and greater incentives for illegal activity. The limited number of transfer stations and landfill sites results in local authorities being "captive" to certain companies, forcing them to pay high service fees, which in turn encourages the illegal dumping of waste in open areas.

5. Comparative Review of Waste Treatment Worldwide Versus Israel

A. Review of Waste Treatment Models in Various Countries

A comprehensive review of existing waste treatment models in different countries worldwide, conducted as part of the strategic plan of the Ministry of Environmental Protection mentioned above, reveals several key trends and insights[140]:

- By utilizing appropriate policy tools and significantly increasing the use of alternative treatment methods such as recycling and recovery, landfill rates can be substantially reduced within a few

years. For example, landfill rates in Slovenia, Lithuania, and Latvia decreased by more than 60% between 2006 and 2017. In Sweden, Denmark, Germany, Belgium, and Finland, landfill rates were reduced to near-zero levels by 2017.

- There is no observable difference in achieving targets between countries that have developed national-level waste management programs and those with only local-level programs.
- Overall, there is a noticeable trend indicating a shift from waste management systems based on waste disposal toward systems focused on prevention at the source and recycling. For example, in France, there is a law that prohibits manufacturers from designing products with planned obsolescence, and in EU countries, the sale of certain single-use plastic products has been banned. Those types of efforts allow a cycle of waste reduction to start.
- Countries that simultaneously implement numerous policy tools (establishing legally binding regulations that direct producer and/or consumer behavior) alongside economic tools (market-based incentives that encourage behavioral change among waste sector stakeholders) tend to achieve better waste management outcomes.
- Economic incentives for households based on the amount of waste disposed of ("Save as you throw") significantly increase recycling rates: in all countries with particularly high recycling rates, some version of this model is applied. Accordingly, all countries with recycling rates below 20% do not implement this model.
- Analyzing recycling and landfill rates in relation to landfill levies in various countries indicates the high effectiveness of such levies. For example, in Germany, the Netherlands, and Sweden, municipal waste landfill rates are near zero, and these countries impose very high tipping fees or landfill levies compared to the European average. Conversely, in countries without landfill levies, the percentage of the solid waste stream disposed in landfills averages 60% of total waste, with correspondingly low recycling rates. In contrast, countries with a landfill levy have an average landfill rate of only 33%[141]. An important caveat is that the existence of a high landfill levy is correlated with additional policy tools within that country's waste management policy; thus, this is a correlation rather than necessarily a causal relationship.

B. Adapting International Case Studies to Israel

When adopting different policies based on international case studies, it is important to consider Israel's unique characteristics, which may affect the effectiveness of implementing various policy changes and their ability to function effectively in Israel:

- **Cultural Differences:** Cultural differences within Israeli society raise questions about the effectiveness of "public education" programs and information-based behavior change initiatives. Therefore, in light of past experiences, such programs will require significant investment over time to rebuild trust and effectively drive behavioral change. Culturally specific campaigns may be important to make progress across Israel's diverse communities.
- **Waste Composition:** The composition of waste in Israel differs significantly from that in other regions. Solid waste composition is characterized by a relatively high percentage of wet organic waste, owing to the historically high consumption of fruits and vegetables. Therefore, according to an industry expert, the efficiency of recovery solutions is lower due to the relatively low calorific value of such organic waste[142]. Consequently, these solutions are less effective, highlighting the increased importance of source separation for organic waste).
- **Limited Effectiveness of Landfill Levy in Israel:** Although there is a correlation between high landfill levies and low landfill rates in many countries, this correlation has shown limited effectiveness in Israel thus far — landfill rates remain relatively high compared to the landfill levy cost. The landfill rate in Israel is almost double the rate predicted by this correlation[143].

6. Recommendations for Policy Change to Meet NDC Targets and Commitments

Our general recommendation is to ensure that waste is treated in accordance with the waste treatment hierarchy, with an emphasis on treating the organic waste stream, which constitutes a significant percentage of the waste produced in Israel, as noted above and is a major contributor to greenhouse gas emissions. These steps can significantly reduce emissions in the waste sector.

A waste treatment hierarchy was established in the European Union's Framework Waste Directive 2008/98/EC concerning waste management and treatment, which determines the priority order for waste treatment from first to last: First, prevention and reduction at the source (Prevention); second, preparation for reuse (Preparing for re-use); third, recycling (Recycling); fourth, recovery (Recovery) - waste incineration through controlled thermal treatment while generating energy; fifth, disposal (Disposal)[144].

Accordingly, we believe that prevention and reduction at the source of waste is the first step that should be taken with the existing policy tools, including an emphasis on reducing organic waste at the source through food waste reduction:

Reducing Organic Waste – Due to the high volume of emissions resulting from the landfilling of organic waste, maximum efforts should be invested in its treatment, and in accordance with the waste treatment hierarchy, efforts should begin with reducing organic waste at the source through minimizing food waste.

It is proposed, therefore, to adopt the recommendations of the National Report on Food Loss and Food Rescue in Israel for 2022, the proposed policy steps by each ministry, and the legislative amendments included there. For example: The Ministry of Health will formulate policies to remove barriers for food banks and organizations, with an emphasis on rescuing fresh and healthy food; The Ministry of Agriculture will enhance production planning and coordination while developing incentives for farmers to donate food surpluses instead of destroying them; The Ministry of Economy will provide incentives for producers to donate healthy food and promote dynamic pricing in retail chains to reduce food loss due to approaching expiration dates; The Ministry of Welfare will support initiatives to rescue and distribute healthy food to disadvantaged populations; The Procurement Administration will require private entities participating in government tenders, as well as publicly funded institutions managing large-scale kitchens, to

engage with recognized food rescue organizations as a condition for receiving government funding or contract approval etc[145].

In addition, a "Pay as You Throw" (PAYT) mechanism should be adopted, which has been proven to be an effective tool in other countries for reducing municipal waste. For example, in South Korea and in Germany, those kinds of schemes led to increased recycling[146]. Implementing effective PAYT schemes should particularly focus on organic waste, as this is a significant portion of household waste, as discussed above.

Separation of Waste at Source into Three Streams - A recyclables bin, an organic waste bin, and a residual waste bin — Both in the waste strategy of the Ministry of Environmental Protection and in interviews, there was consensus on the implementation of waste separation at source for organic waste in a **brown bin**, expanding the use of the **orange bin** (currently a bin for packaging) to collect dry recyclable materials, and using the **green bin** for collecting remaining waste[147,148,149] . Such separation has the potential to significantly reduce emissions from waste and could constitute a meaningful change that would bring Israel closer to achieving its self-imposed targets.

Separation of Organic Waste at Source with an emphasis on the institutional sector – It is proposed to focus on the institutional sector, which generates large quantities of organic waste per day and can be more easily recruited for waste separation, which is of higher quality and enables the production of fertilizer for various uses.

Improving Organic Waste Treatment – Turning organic waste into a resource by separating it at the source and ensuring quality treatment to convert it into fertilizer; one of the tools that can be utilized is promoting the Clean Air Regulations (Prevention of Hazards from Organic Waste), 2022, drafted by the Ministry of Environmental Protection and published in September 2022 for public comments. These regulations aim to impose an obligation to treat the organic component of the material before landfill disposal or transfer for use, a step that will lead to the prevention or reduction of greenhouse gas emissions and optimal waste treatment[150].

Legislating a Framework Law for Waste Management and Adding Standards for Waste Enforcement - We believe that, in accordance with the waste strategy established by the Ministry of Environmental Protection, a **framework law for waste** must be enacted. The absence of such legislation constitutes a major failure and a barrier to implementing the waste policy set forth. Therefore, this law is an indispensable condition for pursuing emission reduction targets.

Strengthening Regulation - As mentioned above, a major failure in Israeli solid waste policy is the lack of supervision and enforcement, which leads to extensive illegal activities in the waste sector. To address this failure, it is necessary to address the shortage of manpower in this field by increasing staffing levels and investing resources to ensure the waste policy is implemented. Without deterrence, enforcement will fail, and emission reduction targets will not be achieved.

Addressing Market Concentration - In this regard, we can only support the Ministry of Environmental Protection's efforts to ensure competition in the waste treatment and transportation market[151], which will lead to improved efficiency, lower prices, and serve as an incentive to operate lawfully.

7. Summary and Conclusion

Israel's waste sector plays a significant role in the country's greenhouse gas emissions, posing a major challenge to its climate policy commitments under the NDC framework. Despite ambitious targets for emission reduction, Israel's reliance on landfilling, weak enforcement, and inadequate investment in sustainable waste management have hindered progress.

To meet its NDC goals, Israel must prioritize waste prevention, improve organic waste management, and expand recycling infrastructure. Aligning with the waste hierarchy model and addressing regulatory gaps are crucial steps. To ensure the success of any program, it must be implemented consistently and over the long term, independent of political or governmental changes. The key lies in maintaining the continuity of one comprehensive program that addresses

every stage of the system. The necessary knowledge already exists – the main challenge is to carry it through in a systematic and committed manner. By committing to comprehensive reforms, Israel can reduce emissions, fulfill its climate commitments, and become a leader in sustainable waste management.

Chapter 4: Israel's Industrial Sector

David Bloch, Dalia Raphael, Hadar Sharabani, Dan Eliyahu

1. Introduction

Israel's commitment to reducing greenhouse gas (GHG) emissions under the United Nations Framework Convention on Climate Change (UNFCCC) has evolved significantly since its initial submission of Intended Nationally Determined Contributions (INDC) in 2015. The 2021 Nationally Determined Contribution (NDC) establishes more specific and ambitious targets for the industrial sector, reflecting the growing urgency of climate action. This paper examines the objectives outlined in Israel's 2021 NDC, evaluates progress in emission reduction efforts, identifies key obstacles, and proposes concrete policy recommendations for ensuring compliance with international climate commitments.

2. Comparative Analysis of Israel's Climate Commitments: 2015 INDC and 2021 NDC

Israel's 2021 NDC, established under the Paris Agreement, sets explicit targets for the industrial sector, aiming for a **30% reduction in GHG emissions by 2030** and a **56% reduction by 2050**, both measured against the 2015 emission levels, which were quantified at 12 $MtCO_2e$. Conversely, the 2015 INDC presented at the Paris Climate Conference (COP21), outlined a commitment to reduce **per capita GHG emissions by 26% by 2030**, based on a business-as-usual scenario. This target was formulated relative to anticipated economic growth and energy demand rather than as an absolute decrease in emissions, with the formal reason being Israel's high rate of population growth[152].

2.1 Evolution of Commitments

The 2021 NDC represents a more ambitious and sector-specific approach to emission reduction in the industrial sector compared to the broader aims of the 2015 INDC. Key distinctions include the

baseline year selection, with the 2015 INDC employing a business-as-usual projection and the 2021 NDC utilizing 2015 emission levels as a definitive benchmark for industrial emissions. Furthermore, the 2021 NDC establishes a sector-specific reduction goal of 30% by 2030, exceeding the general 26% reduction target of the 2015 INDC. Notably, the 2015 baseline of 12 $MtCO_2e$ for industrial emissions in the 2021 NDC encompasses both process and energy-related emissions, leading to inconsistencies with other data sources that focus solely on industrial processes. For example, Israel's Second Biennial Update Report[153] indicated a 25.9% increase in industrial process emissions relative to 2015, reaching 7.826 MtCO2e in 2020, while the Central Bureau of Statistics reported 6.064 MtCO2e from industrial processes and product use in 2015. The 12 MtCO2e figure likely includes energy emissions (heat and electricity), whereas the other figures refer to emissions from industrial processes alone.

2.2 Contextual Considerations

The selection of 2015 as the baseline year was influenced by the enhanced availability of precise data following the Paris Agreement and the stabilization of natural gas usage by 2015. In contrast, many EU countries used 1990 as a baseline, which included emissions from old, inefficient industries in the Soviet Union that were already slated for closure[154]. The substantial GDP growth experienced by the Israeli economy between 2005 and 2015[155] also made 2015 a convenient reference point. The scope of Israel's industrial sector is comparable to that of Western countries[156], and while the proportion of manufacturing in Israel's GDP has decreased, the manufacturing industry itself has expanded[157](Fig. 1). Industrial emissions include both direct emissions from processes and indirect emissions from energy consumption.

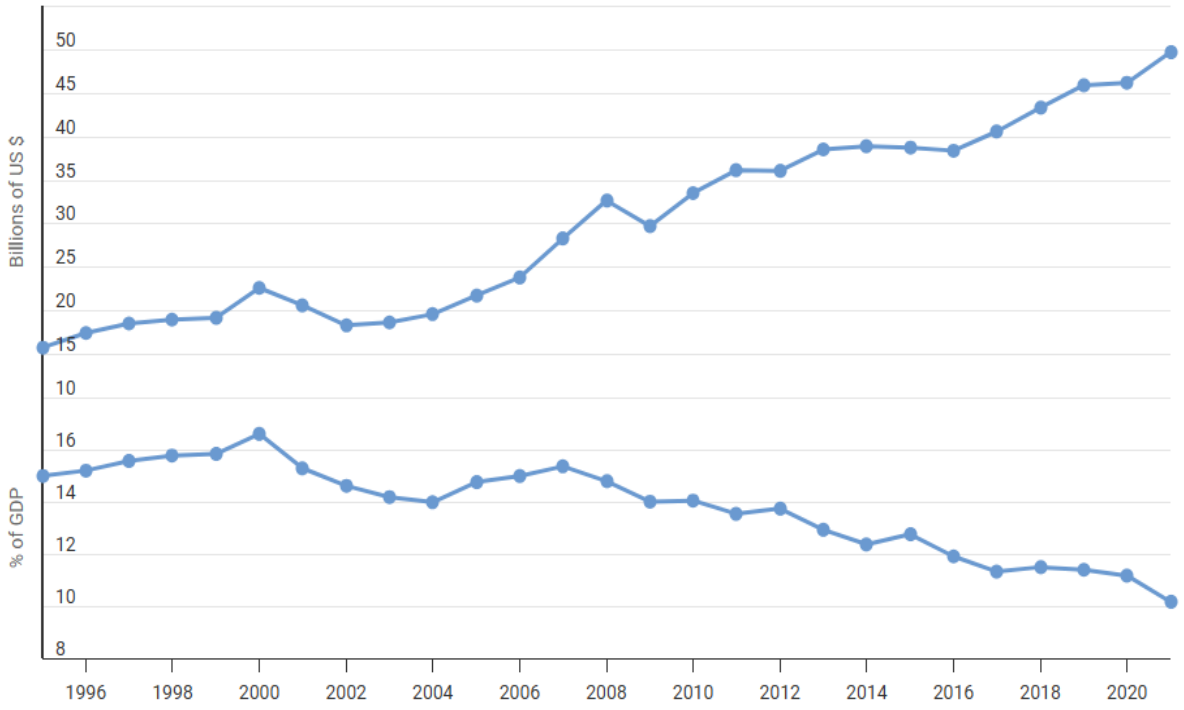


Fig. 1 | Israel Manufacturing Output 1995-2021. While the share of manufacturing in Israel's GDP has decreased, the manufacturing industry itself has grown.[157]

In summary, the 2021 NDC sets clear, specific and more ambitious targets for the industrial sector compared to the 2015 INDC. The 2021 NDC's goals require a well-defined action plan. There are some discrepancies in emissions data and methodology that require clarification. Regardless, the industry sector has an important share in Israel's emissions and economy, therefore it must be taken into account in a serious manner when attempting to comply with international commitments.

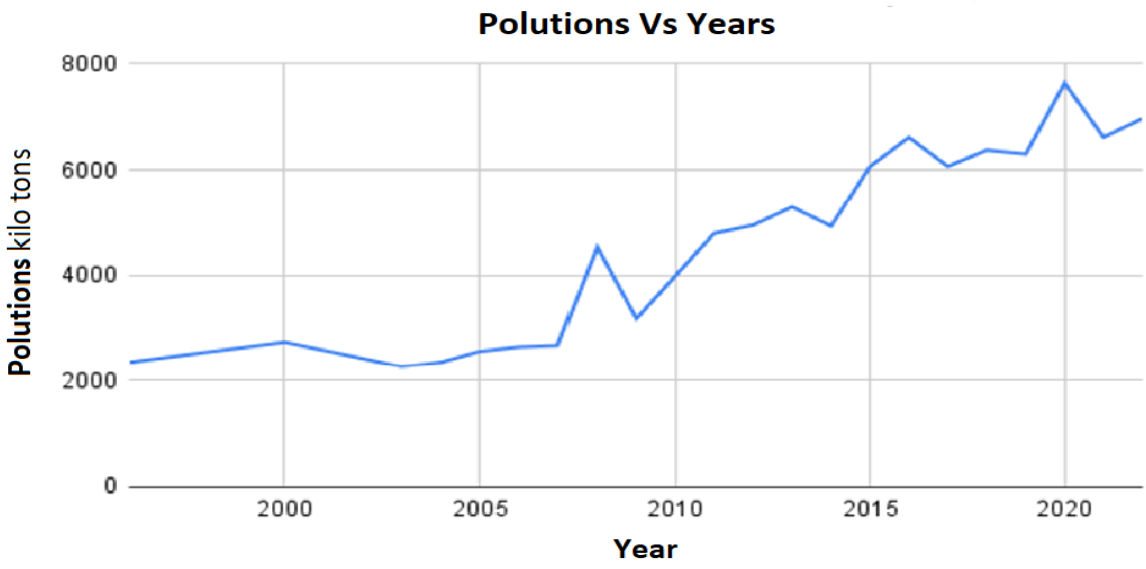
3. Progress Towards Industrial Emission Reduction Goals in Israel

3.1 Key Industrial Emitters and Emission Trends

Industrial emissions in Israel originate from both direct processes and energy consumption. Major industrial emitters include Bazan (Oil Refinery, Haifa) with 7.8 million tons CO_2e, Nesher Cement Enterprises at 6.5 million tons CO_2e, ICL Rotem (Phosphate Production) with 2.1 million tons CO_2e, Carmel Olefins (Polymers & Plastics) at 1.7 million tons CO_2e, and Gadiv Petrochemical Industries at 1.6 million tons CO_2e. Other significant contributors include Dor Chemicals (1.3 million tons CO_2e), Adama Agan (1.1 million tons CO_2e), Paz Industries (1 million tons CO_2e), and Hanson Israel (950,000 tons CO_2e). While a national-level increase in CO_2 emissions from industry has been observed over the past two decades, the implementation of the "Clean Air Law" has led to a significant decrease in emissions, primarily due to the shift to natural gas and the adoption of pollution reduction technologies[158]. In 2023, Israel experienced a 4% decrease in overall GHG emissions, mainly in electricity production and the reduction of F-gases following the Kigali Amendment[159]. However, a debate persists regarding the trend of industrial emissions since 2015, with some sources indicating an increase and others a decrease. This discrepancy may arise from variations in data collection and categorization, particularly the inclusion of energy-related emissions in the 12 MtCO2e baseline figure from 2015.

This total emissions include also energy (heat and electricity) emissions, if we look only on the CO2 processes without energy consumptions, we get this graph over the

years:



3.2 Potential for Progress

Industrial companies are taking steps to lessen their environmental impact. Bazan and ICL are aiming for a 30% reduction in emissions by 2030, with ICL additionally targeting net-zero emissions by 2050. Nesher has set goals of 27% by 2030 and 54% by 2050. Furthermore, Israel is making progress in implementing stricter regulations around greenhouse gas emissions, aligning with European standards. The adoption of alternative fuels like waste and used tires and a shift towards renewable energy sources are also contributing to a reduction in emissions. For instance, ICL now generates over 80% of its electricity internally using heat from its production processes. Building on these domestic initiatives, international case studies offer additional insight into effective decarbonization strategies that Israel could adapt to its local context.

In Switzerland, the cement manufacturer Holcim[160] has achieved a 7.63% decrease in CO_2 intensity between 2018 and 2023 by substituting clinker with calcined clay, fly ash, slag, and recycled construction materials, all of which emit less CO_2 and require less energy. Holcim has

also transitioned to alternative fuels, including biomass and non-recyclable plastics, which accounted for 30.1% of its energy mix in 2023. Additionally, it has developed low-emission products such as ECOPlanet cement and ECOPact concrete, with up to 50% less CO_2 emissions than traditional equivalents, and invested heavily in carbon capture, renewable energy, and energy-efficient kilns—demonstrating that environmental and financial performance can go hand in hand.

India's UltraTech Cement[161] has followed a similar trajectory, achieving a 12% reduction in Scope 1 CO_2 emissions compared to its 2017 baseline and a 28% reduction in Scope 2 emissions since 2020. These outcomes were driven by a transition to blended cement with reduced clinker content (as low as 35%), the installation of waste heat recovery systems across 18 facilities, the expansion of renewable energy capacity to 612 MW, and the recycling of over 16 million tons of industrial byproducts and construction demolition waste. UltraTech's experience shows that emission reduction strategies can be compatible with business growth, as evidenced by a 22% increase in revenue.

In Germany, BASF[162] has contributed to cement sector decarbonization by developing CO_2 capture technologies in collaboration with Linde and Heidelberg Materials and providing chemical additives that support clinker reduction and improve concrete durability, while promoting circularity through the use of recycled materials.

Further examples include CEMEX[163], which reduced its CO_2 emissions per ton of cement by 9% between 2020 and 2022 and targets a 47% reduction by 2030 through alternative fuels, energy efficiency, and CCUS; Heidelberg Materials[164], which plans to operate a CCS facility in Belgium by 2029 capable of capturing 97% of CO_2 emissions; Material Evolution[165], which has introduced an innovative low-carbon cement using industrial byproducts and an alkali fusion process that cuts emissions by up to 85%; and CarbonCure[166], a technology that injects captured CO_2 into fresh concrete to both sequester carbon and improve material strength.

These case studies highlight a range of strategies - clinker reduction, circular economy integration, renewable energy, waste heat recovery, and carbon capture technologies - that can inform and support Israel's pathway toward industrial decarbonization.

3.3 Will Israel meet its Commitments?

The current trajectory suggests that
Israel will likely not meet its international commitments without substantial policy changes and a renewed focus on climate action. While there has been some progress in reducing industrial emissions due to the "Clean Air Law"[158] and the transition to natural gas, the lack of progress in renewable energy adoption[153] and the preference for end-of-pipe solutions prevent meaningful mitigation. Israel can and should further look into the range of strategies highlighted by international progress to seriously move towards industrial decarbonization.

4. Obstacles Hindering Industrial Emission Reduction

4.1 Policy and Regulatory Deficiencies

Israel's current carbon tax is less effective than its European counterparts, as it lacks mechanisms for reinvestment in sustainable infrastructure or support for vulnerable populations, thereby diminishing the incentive for industries to adopt cleaner technologies. Notably, Israel attended COP21 without an approved climate action plan, and the proposed plan in 2015 allocated significantly fewer resources compared to previous strategies, dropping from 2.2 billion NIS to only 700 million NIS[152]. While efforts are underway to implement European-style regulations, the process is slow, and gaps persist in the existing framework. Furthermore, a tendency to prioritize end-of-pipe solutions over addressing the fundamental causes of emissions is evident, an approach that is reaching its limitations.

4.2 Industrial and Technological Limitations

Israel's heavy industries, including cement production (Nesher), oil refining (Bazan), and phosphate mining (ICL Rotem), present particular challenges for decarbonization due to their energy-intensive operations and the necessity for specialized technological solutions. The transition to renewable energy sources is proceeding slowly, and the adoption of alternative fuels like biomass and waste-based fuels remains limited, hindering potential emission reductions. Moreover, inconsistencies in emission tracking methods complicate the accurate assessment of progress.

4.3 Economic and Political Constraints

Insufficient investment in renewable energy, energy efficiency, and other essential technologies for emissions reduction is a significant constraint. The existing financial incentives for adopting cleaner technologies are inadequate to drive substantial change, and the high costs associated with transitioning to cleaner production processes, particularly for heavy industries, pose a barrier to investment. Ongoing conflicts and geopolitical instability divert governmental attention and financial resources away from climate initiatives. The prevailing narrative emphasizing reliance on local production also makes the closure of polluting factories a difficult proposition. Shifts in government priorities have led to a reduced focus on climate action[158], and a lack of sufficient cooperation and coordination among government ministries impedes the effective implementation of climate policy. Enforcement agencies encounter considerable obstacles in penalizing industrial polluters due to factors such as Bazan's non-cooperative behavior during inspections, protracted bureaucratic procedures, and the imposition of low financial penalties.

4.4 Specific Industrial Sector Challenges

The cement industry, primarily represented by Nesher, faces unique challenges due to the energy-intensive nature of cement production and issues related to emissions monitoring and regulation. Bazan, a major oil refinery, represents a significant source of emissions and encounters difficulties in diminishing its carbon footprint. Concerns have been raised regarding the accuracy and transparency of its emissions reporting[167]. Monitoring limitations and Bazan's apparent lack of prioritization of GHG emission reductions further compound this issue.

5. Oversight and Challenges in Industrial Emission Monitoring: Deep Dive Into The Case of Bazan Refinery

5.1 Concerns Over Industrial Emission Reporting

According to Lihi Shahar[167], CEO of the Haifa Municipal Association, there are significant concerns regarding the accuracy and transparency of emissions reporting by Bazan (Oil Refineries Ltd.). Based on her experience, Bazan’s self-reported data may not reflect the full extent of their emissions. When analyzing general pollutant emissions, the Haifa Municipal Association operates air monitoring sensors that provide real-time data to the public. However, in pollution events, these sensors often reach their maximum measurable levels, making it impossible to quantify emissions beyond the upper limit. While Bazan reports these incidents as "maximum levels," there is no acknowledgment that emissions may have exceeded these thresholds. Additionally, certain pollutants lack effective monitoring technologies, making it difficult to measure their concentrations below regulatory thresholds. The Haifa Municipal Association has raised doubts about the reliability of Bazan’s monitoring data in some cases.

5.2 Regulatory Oversight and Enforcement Limitations

The Haifa Municipal Association is responsible for ensuring that Bazan complies with environmental regulations, working alongside the Society for the Protection of Nature in Israel[167].

The association manages 20 mobile monitoring units stationed around the refinery to measure emissions externally. In the event of pollution incidents at Bazan, emergency response teams are required to investigate the source of emissions. For instance, benzene, a known carcinogen, is a major concern. However, in approximately 94% of reported pollution events, emergency teams return without identifying a definitive pollution source. Despite this, the law mandates that Bazan report such incidents. On average, significant pollution events occur once every two weeks.

5.3 Greenhouse Gas Emissions: A Low Priority

According to Shahar[167], Bazan has not prioritized greenhouse gas (GHG) emission reductions. The refinery has shown little willingness to allocate resources or funding to monitoring GHG emissions, which presents a major obstacle to meeting national climate targets.

5.4 Bureaucratic and Legal Challenges in Enforcement

The Haifa Municipal Association faces significant challenges in enforcing environmental regulations. One of the key issues is Bazan's non-cooperative behavior during unannounced inspections. According to Shahar[167], while most businesses comply with the Business Licensing Law (Sections 28 and 29), which grants inspectors the right to conduct inspections at any time, Bazan often initially denies entry to inspectors. This delay raises concerns that the refinery may be addressing violations before allowing inspectors access. However, during routine scheduled inspections, access is granted without issue. Furthermore, lengthy bureaucratic processes and low financial penalties reduce the effectiveness of regulatory enforcement. The current enforcement framework does not create a strong deterrent against pollution, allowing businesses to operate with minimal financial consequences for environmental violations.

5.5 Recommendations for Strengthening Regulation and Enforcement

Shahar provided several key recommendations for improving environmental regulation and enforcement in the industrial sector[167]:

- **Strengthening Regulatory Oversight**
  - Granting more authority and enforcement powers to environmental inspectors.
  - Implementing stricter environmental standards and more intensive regulation of industrial emissions.
- **Financial Penalties to Discourage Pollution**
  - Imposing significant financial penalties to ensure that pollution is not economically viable.
  - In 2023, the financial valuation of emissions from Bazan was estimated at **166 million NIS**, yet over a decade, the total fines imposed amounted to just **20 million NIS**, often after years of investigations and bureaucratic delays.
- **Judicial Reforms for Environmental Accountability**
  - Strengthening the role of prosecutors and judges in recognizing the long-term environmental consequences of industrial pollution.
  - Filing criminal indictments against executives who fail to prevent pollution events that harm the public.
- **Transitioning to Sustainable Industries**
  - Encouraging a shift away from polluting industries towards sustainable industrial practices.
  - Addressing bureaucratic inefficiencies that slow down environmental policy implementation.
- **Establishing Effective Deterrence Mechanisms**
  - Developing enforcement tools that create a real deterrent against industrial pollution.
  - Removing unnecessary bureaucratic hurdles that delay enforcement actions.

In summary, the obstacles preventing progress in reducing industrial GHG emissions in Israel are multifaceted, including ineffective policies, technological challenges, insufficient financial incentives, political factors, and specific issues within major polluting industries. Overcoming these obstacles requires a comprehensive, well-funded, and coordinated approach that includes both policy changes and technological advancements. **The most significant barriers include a lack of a proper carbon tax, insufficient renewable energy targets, the failure to implement circular economy practices and the ongoing war.**

6. Policy Recommendations for Enhanced Emission Reduction

6.1 Strengthening Emission Reduction Targets

To align with global efforts to limit warming to 1.5°C, Israel should adopt a more ambitious emissions reduction target for 2030. Furthermore, the implementation of legally binding net-zero targets by 2050 across all sectors, including a specific and aggressive target for the industrial sector, is crucial.

6.2 Implementing an Effective Carbon Pricing Mechanism

A robust carbon tax or emissions trading system (ETS) should be implemented, encompassing all major industrial sources of GHG emissions. This system should establish a sufficiently high carbon price, incorporate a mechanism for regular increases over time, and include border carbon adjustments to ensure a level playing field for domestic industries. Revenues generated from this system should be strategically directed towards incentivizing investments in clean technologies, supporting the transition of industries to low-carbon practices, and providing assistance to vulnerable populations potentially affected by carbon taxes.

6.3 Promoting Industrial Decarbonization Strategies

To mitigate emissions from cement production, incentivizing the use of supplementary cementitious materials (SCMs) such as fly ash, slag, and calcined clay to replace clinker is recommended. Funding should be allocated for research and development of low-clinker cement alternatives, and tax breaks or subsidies should be offered to companies utilizing blended cement. Policies should also encourage the transition from heavy fuels to cleaner alternatives like natural gas, biomass, and waste. Incentives should be provided for the use of non-recyclable plastics and waste oils as alternative fuels in industrial processes. Investments in energy efficiency upgrades and the adoption of renewable energy sources such as solar, wind, and hydropower in industrial plants should be supported through grants and subsidies. The implementation of Waste Heat Recovery Systems (WHRS) to generate renewable electricity from industrial processes should also be promoted. Supporting Carbon Capture and Utilization (CCU) technologies through funding, incentives, and partnerships (e.g., with companies like BASF[162]) is also advisable.

6.4 Encouraging Circular Economy Practices

Financial incentives should be established to promote the recycling and reuse of industrial byproducts and construction demolition waste as raw materials. The use of recycled materials in cement and concrete production should be encouraged, and programs aimed at minimizing waste generation and enhancing resource efficiency should be implemented.

6.5 Enhancing Climate Governance

The effective enforcement of the integrated licensing law, ensuring that industrial permits align with environmental standards and include requirements for reducing GHG emissions, is essential. Adopting advanced regulations similar to those in Europe, focusing on emissions reduction at the source, is recommended. Environmental standards must be effectively enforced

and monitored, with significant penalties imposed for violations. Strengthening the authority and enforcement powers of environmental inspectors and implementing stricter environmental standards are crucial[167]. Inter-ministerial collaboration should be prioritized to ensure climate policy is a priority across all government ministries, with clear lines of responsibility and mechanisms for coordination[158]. Sector-specific policies tailored to the unique challenges of hard-to-abate industries should be developed, encouraging the adoption of best available technologies and facilitating technology transfer. Reconsidering the baseline for emissions reductions to align with international standards, such as using 2005 or 1990, should be considered. Finally, promoting transparency and data accessibility through the establishment of a public database of industrial emissions, similar to the PRTR[159], and ensuring regular and transparent reporting by companies, with data accessible to researchers, policymakers, and the public, is vital.

7. Conclusion

While Israel has demonstrated progress in reducing industrial emissions, particularly through the implementation of the "Clean Air Law"[158] and the transition to natural gas, significant challenges remain in meeting its 2030 and 2050 climate commitments. The current trajectory suggests that **Israel will likely not meet its international commitments without substantial policy changes and a renewed focus on climate action**. By implementing a robust carbon pricing mechanism, increasing the adoption of renewable energy sources[153], promoting circular economy practices, and strengthening regulatory oversight, Israel can establish a more effective pathway towards achieving climate resilience and industrial sustainability.

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