

The future of the petrochemical industry in Haifa Bay: Assessment of McKinsey's report

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Review of the McKinsey report on the future of the petrochemical industry in Haifa Bay

Executive Summary

In June 2018, the National Economic Council procured a report authored by McKinsey¹, a consultancy firm, to serve as a key source of economic analysis to help guide the government in its decision about the future of the petrochemical industry in Haifa Bay. The purpose of this current report is to assess the McKinsey report's assumptions, data, and methodology in order to determine whether there are significant deficiencies in its analysis and outputs that cast doubt about its conclusions.

We believe that there are. In doing so, we only agree with the McKinsey report itself, which lists significant gaps in its analysis and concludes “(a) decision on shutdown is a complex policy decision which should balance a variety of considerations, not all of which were addressed within the scope of this economic analysis” (pg. 54).

Insofar as these gaps exist, along with, in our view, a fundamental problem with the methodology the report employs to calculate the Bazan complex's economic value, we suggest that the government remedy these issues before it makes a final decision. In chapter 3 of our report, we have proposed a set of recommendations to this end.

The following is a summary of the analytic deficiencies we identified in our review of the McKinsey report:

- 1. Pre-COVID oil market analysis is not relevant for today's market.** The COVID pandemic dramatically changed the world from the time when the McKinsey report was written, causing severe shocks that reverberated worldwide across oil and chemical demand, oil prices, and refinery margins. Any economic analysis of the Bazan complex should be updated to factor in the new global situation. The generous assumption of 90% re-employment was made in the pre-COVID environment and this estimate should be reevaluated based on the current labor market. However, the outlook for Bazan in the 2030s may be even more optimistic than what the study forecast.
- 2. Important gaps in McKinsey's analysis.** The report itself identifies important gaps in its analysis that the committee should consider before making a decision about the Bazan complex's future. We counted 15 such remarks in the report.

¹ As reported in the press: <https://www.timesofisrael.com/report-on-polluting-haifa-refinery-finally-emerges-but-outlook-still-hazy/>

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3. Significant deficiencies in the economic analysis:

- **Incorrect methodology for quantifying the Bazan complex's full economic value.** The methodology analyzing the Bazan complex's economic contributions is severely limited and incorrect. An appropriate methodology that captures the full extent of these contributions is one that applies a social account modelling (SAM) framework.
- **Limited view of facility closure costs.** Any comprehensive consideration of the costs of closing the Bazan refinery should include key factors such as Bazan's existing debt, compensation to employees, financial and commercial damages caused by the decision itself, lost income tax from direct and indirect employment, and the ability of employees who lost jobs to find employment in general and in positions that offer similar wages.
- **Incomplete valuation of land and assessment of potential for residential use.** The report's estimate for the value of reclaimed developed land is based on questionable cost estimates, figures that the study itself admits should be updated and refined. The report does not calculate the land value versus real alternatives in the region nor does it consider comprehensively the impacts of converting the land into a residential area, including pollution. Moreover, the development of residential properties on land reclaimed from a refinery is an extremely rare real estate development concept.
- **"No shutdown" scenario generates greatest economic benefits.** McKinsey's own analysis indicates that the later the shutdown, the higher the Bazan complex's economic contribution to Israel. Accordingly, the approach with the great economic benefits would be to allow Bazan to continue as an ongoing business.
- **Inaccurate economic assumptions.** The analysis does not account for land value in the "Business as usual" scenario but it should. If land value is included in the analysis, a "no shutdown" scenario would provide the greatest economic value to Israel.

4. Significant deficiencies in the oil and chemical market analysis:

- **Insufficient analysis of security of refined product supplies.** The report's analysis of the security of supply for refined products is incomplete and may significantly underestimate both Israel's true stock requirements as well as the adequacy of the country's import and storage infrastructure and its associated costs in the case that the Bazan complex is shut down. A detailed evaluation of the physical infrastructure necessary to allow for increased refined products supplies should be carried out.
 - **Imprecise assessment of storage infrastructure requirements.** The storage analysis should be carried out in significantly more detail in order to better quantify its needs, specifications, and cost and timing implications.
 - **Insufficient analysis of Israel's chemicals supply chain and potential harmful downstream effects:** The use of Carmel Olefins products in sensitive applications with long procedures for switching to alternative raw materials has not been investigated. In the worst-case scenario, some small and medium-sized enterprises (SME) customers may be forced to close, which has implications on Israel's employment, economy, and trade flows, including in some high value-added sectors.
 - **Scenario analysis is too limited to be useful.** The report's two scenarios appear too similar to provide a useful framework for considering how Bazan would perform financially across a variety of possible realistic futures.
5. **Bazan's adaptability to regulatory change.** The operational adaptability that Bazan has demonstrated while remaining profitable is an important consideration that deserves mention because Bazan generates important economic benefits – even beyond those mentioned in the McKinsey report – while remaining compliant and lawful. Since no reason is apparent to doubt that Bazan would not successfully adapt to future regulatory requirements, it questions the real benefits to Israel of closing a set of businesses that have a solid track record of profitability and compliance.

1 Introduction

On October 25, 2020, the cabinet of the government of Israel appointed an inter-ministerial committee of senior officials to examine the future of the petrochemical industry in Haifa Bay. In June 2018, the National Economic Council procured a report authored by McKinsey, a consultancy firm, that is expected to serve as a key source of the economic analysis to help guide this committee in reaching its conclusions, for which the government has allocated 90 days. The purpose of this current report is to assess the McKinsey report's assumptions, data, and methodology in order to determine whether there are significant deficiencies in its analysis and outputs. If so, this report is then to identify these deficiencies and recommend additional technical and economic analyses for the committee should undertake before the government reaches a final decision about the industry.

As this report will detail, our conclusion is that there are indeed significant deficiencies in the McKinsey report's analysis. In stating this, we only support the statement of the report's authors who write in its introduction "(w)e did not address all aspects relevant to the committee's decision, and therefore do not provide recommendations as part of this study." In specific areas of the report itself, the authors draw attention to a number of these deficiencies. The current report cites these instances, as well as others, as areas for further study.

To be sure, the Bazan refinery and its petrochemical complex, which have existed in Israel since the 1940s, are important economic actors and employers, particularly in the Haifa Bay area but also more broadly across Israel. As such, any decision that may significantly affect their future operations deserves careful consideration. As the McKinsey report notes, "(a) decision on the future of an operation of the scale of Bazan is a complex one that involves, amongst other things, financial considerations alongside environment, urban planning, and employment concerns. It is a policy decision that should be taken by the government, taking the full picture into consideration." We fully agree. And insofar as there exist significant deficiencies in the analysis to provide the government with the full picture it requires, we recommend that the government remedy these issues.

Following this introduction, this report includes two additional sections. The next section identifies areas in the McKinsey report's analysis that we find lacking. The last section provides our recommendations for changes to McKinsey's methodology and additional analysis to be carried out. Like our colleagues in McKinsey, we sincerely hope that this report will be useful to the committee in choosing the best path forward for the future of the Haifa Bay petrochemical industry.

2 McKinsey Report Gap Analysis

2.1 Self-reported gaps in analysis

IHS Markit counts 15 separate places in the report where the authors state that further work in should be carried out before decisions are made. These are listed below:

- Page 2: “We did not address all aspects relevant to the committee’s decision...”
- Page 3: “Data on land value was received from REMI, REMI is further refining these estimates”
- Page 3: “Due to security restrictions, data on actual availability of refined product storage capacity was not made available”
- Page 3: “Land remediation costs ... may vary widely based on site-specific elements, REMI is further refining these estimates”
- Page 4: “Due to these limitations, we suggest that a final decision should be made once detailed land value, land remediation costs, and required storage capacity analyses are completed by the relevant stakeholders.”
- Page 8: “Detailed analysis of actual available capacity, and plans for expanding this capacity, should be completed by the committee.”
- Page 10: “As land remediation costs vary widely between sites, this figure should be verified through a detailed land survey.”
- Page 10: “These estimates are based on initial analysis..... the figures should be updated, with revised REMI figures, once made available.”
- Page 13: “However, due to the preliminary nature of some of the data used in this study, a final decision should be made after refining several analyses, in particular, analyses pertaining to the value of released land, land remediation costs, and available storage infrastructure.”
- Page 39: “Remediation costs can vary widely between sites and require further, detailed, corroboration”
- Page 39: “We do not account for the potential increase in value of real estate in adjacent areas. We also do not account for the additional indirect value is likely to be created by increased economic development of Haifa as a northern metropolis...”
- Page 39: “REMI is currently refining its analysis [of land value utilized for residential development], once made available, updated figures should be used”
- Page 47: “(A) decision on shutdown is a policy decision that should take into account additional considerations, which are not in scope of this economic analysis.”
- Page 53: “Several of the analyses are based on initial or incomplete data, therefore, before making a decision, refining/updating some of the analyses would be advised”
 - Here the report lists nine separate topics, including all points covered above, summarized as follows: full environmental impact and compliance study; land value estimates; land remediation costs, storage capacity; capex estimates for import infrastructure; the progress of LPG-to-Natural Gas substitution to determine actual infrastructure needs; European refining margin update; unemployment estimates; and detailed valuation of Bazan to support potential compensation negotiations.

- Page 54: “(A) decision on shutdown is a complex policy decision which should balance a variety of considerations, not all of which were addressed within the scope of this economic analysis.”
 - This is the last statement in the report, and it clearly acknowledges that the analysis performed does not comprehensively cover all relevant issues for deciding the future of the Bazan complex.

Key takeaway: The McKinsey report has identified important gaps in its analysis that the committee should consider before making a decision about the Bazan complex's future. We fully agree.

2.2 Economic analysis inaccuracies and deficiencies

2.2.1 Incorrect methodology for quantifying the Bazan complex's full economic value

The McKinsey report attempts to quantify the economic value that the Bazan complex provides to the region, both at present and in the future. However, through its application of an incorrect methodology, the report's economic analysis lacks sufficient rigor and misses crucial elements.

The report's methodology focuses primarily on the Net Present Value (NPV) of Bazan's Haifa Bay businesses. But an NPV approach provides only a simplistic and limited view of the impact of the complex on Israel's economy. In order to appropriately evaluate its full impact, a standard approach used by economists – and one that would be expected as a first choice for McKinsey's report – would be to undertake a comprehensive economic impact analysis through the application of a social account modelling (SAM) framework. There are two key analytical differentiators between these approaches. First, an economic impact analysis that uses the SAM framework captures the full extent of intra- and inter-industry transactional activity, providing a comprehensive view of the economic impacts that occur throughout the entirety of regional extended supply chains. Second, this analysis incorporates household spending activity, allowing for an assessment of the induced economic impact generated by workers who spend their wages in the local economy. The NPV methodology, however, is blind to these activities. As such, the SAM economic impact analysis is a more comprehensive – and more accurate – assessment of GDP and associated employment creation (or destruction) across all sectors as generated by the Bazan complex's activities or closure.

The report correctly identifies three critical areas that measure the economic contribution of an entity to a region: tax generation, GDP contribution, and job impact. But these contributions only represent what are considered direct impacts – impacts that derive directly from the Bazan complex's operations. This includes Bazan's 1,350 employees, its ILS 20.9B GDP contribution, and its estimates of corporate, income, and local taxes. By limiting its scope to the Bazan complex proper and its core industry output, employment, and income, however, the report greatly undervalues the Bazan complex's overall economic contributions. This is because it does not fully quantify the strategic supply chain sector's GDP, tax, and income contributions that the complex's operations support on both local and national levels. Additionally, the report does not attempt to quantify the economic activity of those employed by Bazan and its supply chain contribution to the regional economy. This induced income effect is spread across Israel's entire economy and would capture the many businesses that might struggle during the closure, land remediation, and redevelopment timeframe before that economy activity is replaced. A SAM framework, however, is designed specifically to capture all of these broader effects.

While omitting this analysis, the McKinsey study does recognize supply chain impacts and indirect contributions. It also makes one reference to the supply chain impact of the Bazan facility, stating that the Ministry of Economy estimates that the Bazan complex, which directly employs ~1,350 people, generates an additional indirect employment of ~5,400 jobs – an employment multiplier of four (p. 40). The basis for this assessment and methodology for its calculation, however, are opaque. Again, for a study whose primary purpose is to assess the economic value of the Bazan complex, a comprehensive economic impact analysis that is standard for economists would be the most appropriate tool. It would correctly capture not only the direct, but also indirect and induced economic impacts – and quantify the important multiplier effects they generate.

Key Takeaway: The analysis of the economic contributions of the Bazan complex is severely limited by the McKinsey report's use of an incorrect methodology that focuses on its direct activities, thereby missing an accurate accounting of the significant indirect and induced impacts generated by Bazan's operations.

2.2.2 Limited view of facility closure costs

The study identifies two major costs related to the shutdown of the facility: dismantling and land remediation. It does not address other important costs, however, such as those of the debt held by the Bazan complex that would need to be reconciled during the shutdown. Nor does it consider any compensation to Bazan for requiring the company to relinquish its rights to its long-term lease on the land. Moreover, it neglects to include the financial costs and damage to Bazan that would be caused by the mere notice that a decision to close Bazan has been taken by the government.

In addition, the study does not adequately assess the losses that a Bazan closure would generate associated to employment. Bazan employees who lost their job would deserve compensation, as possibly would the employees of external subcontractors that served Bazan but who are now without work. Moreover, it is not clear from its analysis of expected lost income tax whether it also considers lost income tax from indirect employment.

Another important point relates to the loss of jobs at Bazan which, as the study notes, pay an average salary that is twice the average for all of Haifa. The world is now grappling with the greatest global crisis since the 1929 Great Depression. With the closure of Bazan and the impact that closure will have on their supply chain, it seems unlikely that even if the study's generous estimate of 90% of impacted employees were to find new jobs, that these jobs would pay similarly high wages as those currently enjoyed by these employees. Moreover, the assumption of 90% re-employment was made in the pre-COVID environment, and this estimate should be reevaluated based on the current dynamics of the labor market.

More broadly, the closure of the Bazan operations and resulting shift to imports will have a negative impact on the balance of payments for the country, as oil products will be purchased abroad rather than produced domestically. The cost of this shift should also be incorporated into the analysis.

A comprehensive view of the costs of closing the facility, combined with a comprehensive view of the economic contributions of Bazan, are the only way to accurately assess the total impact of any decision on the future of the site.

Key Takeaway: Any comprehensive consideration of the costs of closing the Bazan refinery should include key factors such as Bazan's existing debt, compensation to employees, financial and commercial damages caused by the decision itself, negative impact on Israel's balance of payments, lost income tax from direct and indirect employment, and the ability of employees who lost jobs to find employment in positions that offer similar wages.

2.2.3 Incomplete valuation of land and assessment of potential for residential use

The McKinsey study states that "the main quantifiable benefit from a Bazan shutdown is the revenue from marketing the released land for alternate uses" (pg. 10). To this point, it presents analysis that focuses on the value derived from residential development from the Bazan refinery's land through the creation of 50,000 to 100,000 residential units.

To develop a residential project on land that is remediated from use as a refinery, however, is an extremely rare real estate development concept with significant environmental, technical and economic challenges and risks. And if the government's goal is to increase the region's housing supply and to use that lever to drive economic benefits, a more appropriate analysis would be to assess not just the potential development value of the Bazan land but also other nearby development options that do not include a refinery or ex-refinery in its midst. After all, the true potential value of the residential development opportunity involves not just the Bazan area but also other real estate alternatives.

The study also states that remediation would take 5-10 years and cost an estimated ILS 1,225M-1,575M. As the study's authors admit, however, land remediation costs can vary widely, and a true cost estimate would require further analysis.

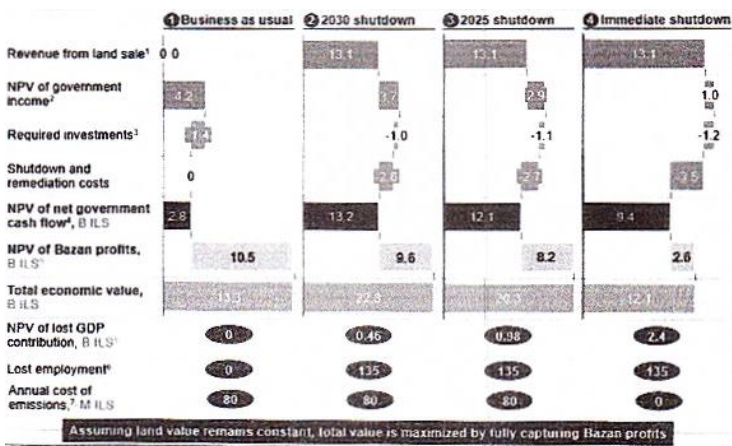
Also likely is that alternative sites for residential development in the Haifa Bay area would not incur the site preparation costs of the scale that Bazan's land requires. Indeed, the study notes that initial estimates for the remediation of Bazan's land comes to roughly 10% of the base case land value. But greenfield areas, such as the vast agriculture fields found in the vicinity or on the western slopes of Haifa, would require fewer resources to develop, and could be developed more quickly.

In addition, the study does not consider the broader impacts of residential development. How would the influx of 50,000-100,000 new residential units affect issues such as the local housing market, the provision of services to the region, and traffic challenges and its associated pollution, and what additional resources would be needed to support the region? These are all important issues ignored by the study and warrant further and thorough study.

Key Takeaway: The McKinsey study's estimate of the value of reclaimed developed land is based on questionable cost estimates, figures that the study itself admits should be updated and refined. The report does not calculate the land value versus real alternatives in the region nor does it consider comprehensively the impacts of converting the land into a residential area, including pollution. Moreover, the development of residential properties on land reclaimed from a refinery is an extremely rare real estate development concept.

2.2.4 "No shutdown" scenario generates greatest economic benefits

The McKinsey report's analysis of the four alternative time horizons for the future of Bazan is puzzling because the analysis seems to refute the report's own conclusions (pg. 44). A table from the report is reproduced below:



Across the three shutdown cases (2020, 2025, and 2030) the total discounted economic value of the Bazan complex increases the later the shutdown occurs. This suggests that a shutdown that takes place in 2035 or 2040 – or beyond – would result in increased value to Israel relative to earlier years.

We can test this conclusion by converting the "Business as usual" case, which assesses the Bazan complex's NPV to 2040, into a "2040 shutdown" case, and applying McKinsey's own economic logic to it, as follows:

- Using the report's estimate for land value, assume ILS 13.1B in revenue from the sale of land

- Add ILS 4.2B cost of “government income”
- Subtract ILS 1.4B for the cost of “required investments”
- Subtract ILS 2.6B for the cost of “shutdown and remediation costs”
- Then add to this the ILS 10.5B “Business as usual” NPV of Bazan profits

This results in a total “2040 shutdown” economic value of ILS 23.8B – which is nearly 7% higher than the “2030 shutdown” case. Hence, according to McKinsey’s own economic logic, it appears that the later the shutdown, the higher the NPV. This seems to support an argument for allowing the Bazan complex to continue to operate and avoid a shutdown altogether.

Key takeaway: McKinsey’s own analysis indicates that the later the shutdown, the higher the Bazan complex’s economic contribution to Israel. Accordingly, the approach with the great economic benefits would be to allow Bazan to continue as an ongoing business.

2.2.5 Inaccurate economic assumptions

The economic assumptions in the McKinsey report’s analysis of the four alternative time horizons for the future of Bazan (pg. 44) are inaccurate.

Though the “Business as usual” case lists the revenue from the sale of land as zero, the land nonetheless does have value. Therefore, to accurately compare the options, land value should be accounted for, which the McKinsey report estimates as ILS 13.1B. Under this assumption, the total economic value of the “Business as usual” case – meaning, “the refinery is not shutdown,” and which would add land value to the NPV of Bazan profits (ILS10.5B) – would come to ILS 26.4B. This is about 18% higher than the “2040 shutdown” case we estimated above, and is significantly higher than the other cases.

Regardless, as discussed above, NPV by itself is not an appropriate measure of Bazan’s economic value. Rather, this value should also consider Bazan’s indirect and induced economic impacts. Hence, the economic contributions noted in this chart are likely significantly understated.

Several comments about the land value estimate are also warranted here. Land value is highly consequential, representing around 50% of the total NPV. As the report acknowledges, to estimate its value is very difficult, and it recommends refining these estimates further. Suffice to say that when land value has such a significant impact on total NPV, this only underscores how much more closely it should be considered.

The McKinsey report also apparently assumes that the value of land will hold over time and will not be discounted, or rather that its discounted value will remain static at ILS 13.1B. Since the discount rate used in the calculations is 11.5% per year, this means that the report assumes that the land will likewise increase in value by 11.5% every year. While this is certainly possible, it is a major assumption that should be subject to challenge.

Regarding the time value of money, it is not clear whether the report uses the nominal or real value of money in its refinery margin and NPV calculations. This point should also be clarified.

A final note: Section 3.1 of the report notes that the total 2018-40 economic value from land under the “Business as Usual” scenario is ILS 12.6-14B, “with a mid-range figure of 12.1 Billion ILS” (pg. 12). Since the table above uses the figure of ILS 13.1B, the ILS 12.1B referenced here appears to be a typographical error.

Key takeaway: McKinsey’s analysis does not account for land value in the “Business as usual” scenario but it should. As noted above, if land value is included in the analysis, a “no shutdown” scenario would provide the greatest economic value to Israel. And this outcome results even though the report only calculates NPV, which by itself, as mentioned above, most likely greatly understates Bazan’s full economic contributions.

2.2.6 Full compensation costs for Bazan's closure are omitted

The calculations in the report do not consider compensation that may be due to Bazan for its closure beyond for the dismantlement of its facilities and remediation of the land that Bazan currently leases. The report neglects compensation to Bazan for its assets and economic value, for supporting the servicing of its debt, and for repaying its creditors. Nor does it address compensation to Bazan's employees, not to mention the employees of the companies that serve Bazan who would lose their jobs together with the closure of the Bazan complex.

Key takeaway: In the case of Bazan's closure, compensation to Bazan for its assets and economic value, for servicing its existing debt, and for its employees should be taken into account in the socio-economic assessment. Compensation should also be considered for the employees of Bazan's service companies who jobs are a if Bazan is closed.

2.3 Oil and chemical market analysis inaccuracies and deficiencies

2.3.1 Insufficient analysis of security of refined product supplies

In its assessment of a "full shutdown scenario," the McKinsey report correctly concludes that the Israeli market would become highly dependent on refined products imports. The report's assessment of the implications of this scenario is insufficient, however, omitting analysis of critical importance to Israel.

Security of refined products supply is a key concern for every oil importing country, and particularly for "isolated" countries – countries that lack contiguous export markets with which they can readily, safely, and consistently trade. For an isolated country like Israel, this issue should be of even greater concern because, if Bazan closed, the country would depend heavily on imports of refined products and have an above average risk that its refined products distribution could be materially disrupted. For example, if the Haifa refinery were to shut down, then Israel would be left with only one refinery in Ashdod – which means that facility would become a prime target for Israel's enemies. The Israeli authorities, well aware of the risks related to the discontinuation of refining operations, included Bazan in the list of essential enterprises under the Emergency Employment Service Law (No. 5727 of 1967), which in emergency situation enables enterprises to force employees to come to work to guarantee continuity of operations. How would refined products distribution in Israel be affected if the Ashdod refinery were then disabled due to a missile attack? How can Israel prepare for this possibility, and what would the country do were it to occur? This unfortunately realistic scenario has important economic implications, but the McKinsey report does not address it.

Furthermore, in its assessment of the adequacy of storage and distribution facilities for refined product security of supply, the report indicates that "currently importers generally maintain 2-4 weeks of reserves" and that "closing Bazan would likely require an increase to a 60 day reserve requirement (aligned with the IEA regulations)." It then concludes that "(b)ased on the 60-day reserve requirements, and the share of local demand met through imports, current installed capacity should meet required storage capacity" (pp. 8 – 9). This assessment is imprecise, however, and misses several critical elements with respect to Israel's security of supply vulnerabilities and requirements.

First, the actual reserve requirement should be higher than what the report states. Under the IEA's International Energy Program (IEP) Agreement, a country's minimum emergency stocks should be equal to 90 days of average daily net imports – and not 60 days as written in the report. Similarly, under the EC Council Directive 2009/119/EC, the minimum emergency stock level must equal 90 days of average daily net imports or 61 days of average daily inland consumption, whichever is higher. Given Israel's particular geopolitical and geographical position, it is reasonable to assume that Israel's security of supply concerns should be considered to be at least as serious as those countries contemplated in the European Commission legislation. For this reason, the issue of whether to set Israel's stock reserve at 60 days, as the report indicates, or to follow higher standards based on international best practices, or to exceed even these standards due to Israel's special geopolitical situation and needs, should be thoroughly analyzed and further reviewed.

Several European countries have even adopted rules on product reserves that are stricter than those recommended by the European Commission. For example, France's stockholding agency Société anonyme de gestion de stocks de sécurité (SAGESS) requires that each of the seven regional "Zones de Défense" – France's strategic storage infrastructure – should store enough jet, gasoline, and gasoil fuel on-site to cover at least 14 days of demand. Similarly, the German stockholding agency Erdölbevorratungsverband (EBV) requires that each of the five "refinery centers" in the country maintain 15 days of diesel consumption. Therefore, especially in the case that the Bazan complex may be closed, international practice suggests that Israel should consider establishing additional security of refined product supply not only according to the overall number of days required to keep in stock at the country but also across regional locations.

In addition, European legislation limits what counts as emergency stocks. This definition excludes, however, quantities held in pipelines, rail tank cars, seagoing ships' bunkers, tankers at sea, service stations, retail stores, or as military stocks. Since it is unclear from the McKinsey report which capacity was taken into account, it may be advisable to ensure that considerations around storage capacity follow the same definitions as set forth in European legislation.

The report also does not account for costs associated with security of supply risks, beginning with the cost for additional storage infrastructure. Other costs to consider are the potential loss of economic activity from a supply disruption that necessitates, for example, discontinuing the use of oil products in commercial and private transportation, or, for the stationary sector, in industrial, agricultural, or commercial operations.

Key takeaway: The McKinsey report's analysis of the security of supply for refined products is incomplete and may significantly underestimate both Israel's true stock requirements and the adequacy of the country's import and storage infrastructure and associated costs in the case of the shutdown of the Bazan complex.

2.3.2 Imprecise assessment of storage infrastructure requirements

In its assessment of storage infrastructure capacity for product imports, the report appears to group kerosene, diesel/gasoil, gasoline, and fuel oil together. It then concludes that switching storage between these products can be done "in a matter of very few days and at negligible cost" (pg. 35). IHS Markit finds this conclusion puzzling, since the design of oil storage is specific to individual products, as described below:

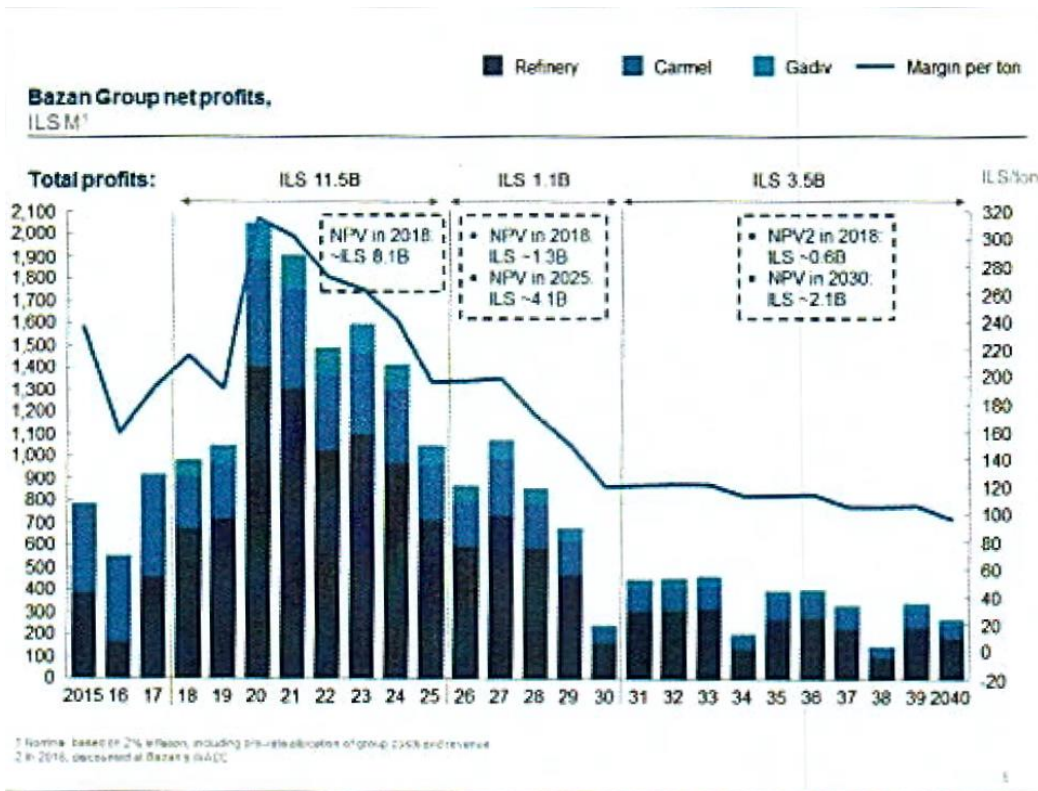
- **Gasoline/light hydrocarbons (including crude oil).** These require a floating roof design in order to minimize vapor emissions, both a safety and environmental requirement. The floating roof, however, increases construction and maintenance costs. While it is possible to install a floating roof on a tank that lacks one, this certainly takes more than a "very few days" but rather months when taking into consideration planning, obtaining designs and price quotes, and then installing and converting units. In addition, this will involve costs that are not "insignificant."
- **Kerosene/jet fuel.** Tanks for these products typically feature floors which slope downward to the tank's center in order to facilitate the removal of water. In addition, jet fuel specifications are particularly exacting because the fuel goes directly from storage into an airplane with all the associated strict aviation standards. Therefore, jet fuel storage is subject to rigorous specifications, down to such details as the kind of paint used inside storage facilities. Again, converting storage facilities for these products is not a matter of "very few days."
- **Diesel/gasoil.** They tend to have a fixed roof and do not normally need or have a floating roof.
- **Fuel oil.** Tanks are often insulated to keep the product warm and fluid, and usually they are also heated.

In addition, due to the importance of product specifications, tanks often require thorough cleaning as well as physical modifications if they are converted to store different products. This is especially true when storage is for long periods and when switching between clean products (gasoline, kerosene/jet fuel, diesel/gasoil) and dirty products (fuel oil).

Key Takeaway: A storage analysis should be carried out in significantly more detail in order to better quantify its needs, specifications, and cost and timing implications.

2.3.3 Pre-COVID oil market analysis is not relevant for today's market

Since the McKinsey report was published in June 2018, the refinery margin and economic forecasts that were used to create the Bazan revenue and GDP contribution estimates date back to this time, (pp. 24-25). In both its base case and high oil demand scenarios, the report assumes Bazan's margins will benefit from the enactment of the International Convention for the Prevention of Pollution from Ships (MARPOL) legislation in the period immediately after 2020. Margins and revenue would then decline towards 2030 and remain low afterwards because "reduced demand lowers European refinery utilization by 2022, which continues to decrease through 2040, resulting in lower refining margins" (p. 21). The report's base scenario outlook is shown below:



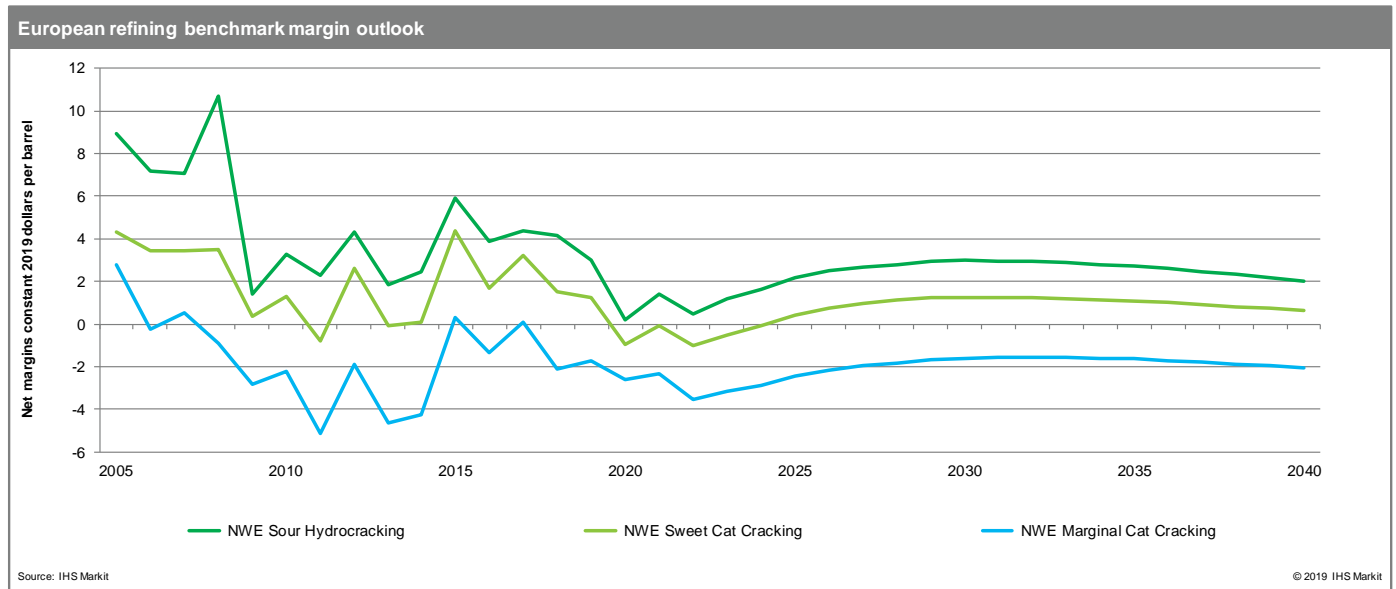
However, at least 30 months have passed since those forecasts were produced and this report was written. And what actually happened in the world, and to European refining margins in particular, is dramatically different than what the report predicted. During 2020, the COVID pandemic-driven lockdowns that took place worldwide destroyed oil demand in historic proportions, severely compressing refinery oil demand. In addition to the decline in demand, 5.7 million barrels per day of refinery capacity additions globally are expected to come onstream before 2025. This includes new capacity east of the Suez, primarily in Asia, and excludes the expected rationalization of less efficient refineries, particularly across Europe. The result of these two elements is expected to put pressure on refinery margins for the next few years.

The expected positive benefit from MARPOL legislation also never materialized, another casualty of COVID. Consequently, it is almost certain that Bazan's real margins and revenue from 2020 and 2021 will be less than what was forecasted.

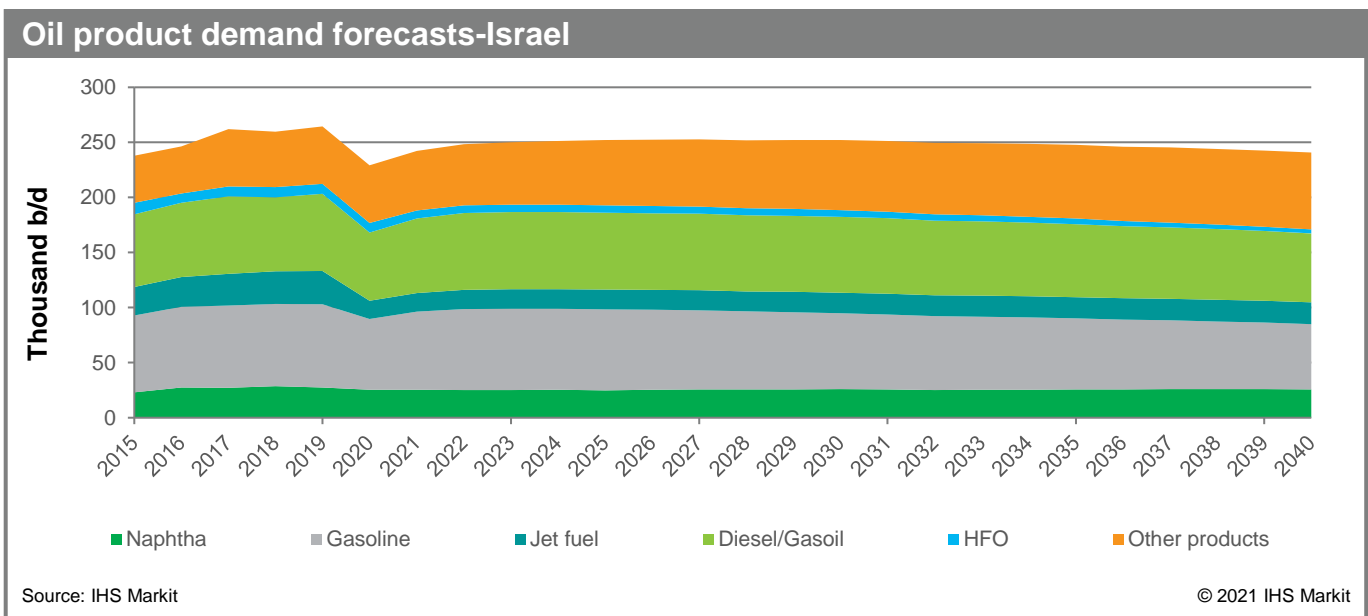
But IHS Markit expects most of the oil demand reduction to begin to dissipate in line with the introduction of effective vaccines, and the impact of COVID on refinery profitability in 2020 appears to be have caused a round of refinery rationalizations and closures that occurred more quickly than what was previously expected. IHS Markit's

current view is that European refinery margins will strengthen in the mid-2020s. Therefore, the outlook for Bazan in the 2030s may be even more optimistic than what the study forecast. This difference can be seen by comparing the trends in refinery margins in the figures above and below.

European refining margins expected to be weak until 2023 when the trend will begin to reverse



The forecast for Israel’s oil product demand to 2040 has also changed significantly from the pre-COVID forecasts referenced in the McKinsey report. What is most relevant, however, is that IHS Markit's latest forecast (see figure below) indicates that the Israeli market will still require significant volumes of refined products in 2040, underscoring the importance of this energy sector in the long term.



Key takeaway: The COVID pandemic dramatically changed the world since the time the McKinsey report was written, having caused severe shocks that reverberated across global oil and chemical demand, oil prices, and refinery margins. Any economic analysis of the Bazan complex should be updated to reflect the new market situation and dynamics both in Israel and globally.

2.3.4 Insufficient analysis of Israel's chemicals supply chain and potential harmful downstream effects

The McKinsey report's assessment of security for Israel's chemical supply chain is insufficient and potentially misses the harmful downstream effects that could be caused by closing the Bazan's chemical companies.

Israel's small to medium-sized enterprises (SMEs) could be impaired if these companies close due to downstream impacts on supply availability, flexibility, and customer support. Carmel Olefins is the only manufacturer of polyethylene and polypropylene in Israel, and according to Bazan it has approximately 350 domestic customers and 200 outside Israel. Domestic customers are largely SMEs, and they rely on the ability of Carmel Olefins to adapt supply to meet their rapidly changing needs – which domestic production can efficiently accommodate. Carmel Olefins is also best placed to service domestic customers to troubleshoot technical hurdles they may encounter while using Carmel's polymer products.

Closing Carmel Olefins would force its domestic customers to rely wholly on imports of polymers, which could increase prices and put at risk the viability of some SMEs. In practice, a customer that imports small volumes is obliged to use a distributor or agent, which adds costs due to a longer supply chain compared to direct purchases from a producer, such as Carmel Olefins. Since SMEs in plastics processing typically operate with low margins, if the availability of polymer resins that they use is disrupted or their costs increase, this could threaten the viability of some of these businesses.

In addition, the McKinsey report's assessment of import price versus domestic price is also oversimplified and may understate the impact of Bazan's closure on its Israeli customers. The report notes that “polymers can likely be sourced from East Asian markets at competitive prices” (pg. 7), but this fails to account for the complexity of polymers, which come in different grades and are branded products that are distinct between producers. For example, Carmel Olefins lists 36 different grades of its Ipethene® LDPE (Low Density Polyethylene), 28 standard grades of its Capilene® Polypropylene (PP), and 18 specialty grades of PP. Israel imports some LDPE and PP to meet its demand needs, but this is mostly because Carmel Olefins does not manufacture every polymer grade needed in Israel, so this demand must be complemented by imports. And while pricing is important, it is not the only important consideration for supply selection. Other important criteria are security of supply, performance and grade offering, flexibility with relatively short lead times, customer support, and technical services.

For applications that are sensitive to specific resin grades, however, closing the Bazan complex could result in an additional cost burden. The effects of removing Carmel Olefins products from the Israeli market could ripple broadly across Israel's economy since polyethylene and polypropylene are used in a wide variety of sectors. Uses may include films and packaging for agriculture use, piping for irrigation and pharmaceutical molding applications. But while polymers can be substituted relatively easily in many applications, such as plastics bags or consumer product containers, it is considerably more difficult to do this in other sectors, such as pharmaceutical/medical devices/diagnostics, automotive, electronics, and aeronautics, which are subject to much stricter controls on raw materials selection. Customers in these sectors generally are very reluctant to change not only resin grades but even the producers, and sometimes even a producer's specific manufacturing unit. These customers have processes for introducing the use of alternative resins which typically involve long testing procedures in order to test the performance of alternative products over time. Given sufficient notice of at least a year, IHS Markit would expect customers to find alternative resins, however, where Carmel Olefins products are used domestically in such sensitive applications, it will impart a greater burden on these customers, especially the smaller sized ones, in terms of costs and resources to switch to new suppliers.

Moreover, the important issue of supply chain security is only addressed superficially in the McKinsey report. If it will be necessary to import end-products that could otherwise be manufactured in Israel by using Carmel Olefins

products, this will shift supply chain security one or more steps further downstream, which could harm Israel's interests. The report omits mention of this potential consequence.

Finally, while the main aromatic products Gadiv sells into Israel are more like commodities than Carmel Olefins' more specialized products, the import substitution of these products could have similar impacts on supply availability, pricing, and for some customers, the viability of their long-term operations.

Key takeaway: The closure of Carmel Olefins could harm its SME customers. The use of Carmel Olefins products in sensitive applications with long procedures for switching to alternative raw materials has not been investigated and will have major negative implication for a number of Bazan's customers. In the worst-case scenario, some customers may be forced to close, which has implications on Israel's employment, economy, and trade flows, including in some high value-added sectors. This could also potentially create security of supply challenges in downstream sectors in Israel. The above is also relevant to Gadiv's customers.

2.3.5 Scenario analysis is too limited

The European refining margin scenarios that the McKinsey report applies to "stress-test" its financial analysis of Bazan's profits seem too similar to one another, to the extent that the difference between them is marginal. The report uses two scenarios: a base case and a high oil demand case. In the base case, Israel's oil demand decreases on average 0.7% per year in the 2020-40 period, while in the "high case" during the same timeframe, oil demand falls by only 0.3% per year (pp. 5 – 6). The resulting difference between the two scenarios is only around 10% in NPV. So it is hard to understand how two scenarios that are so similar to one another would be useful for considering the broad range of potential and realistic possibilities that an uncertain future may bring, especially given the importance of the decisions that the scenario analysis is to inform.

A more useful scenario framework is one along the lines that IHS Markit regularly maintains, which is based on three integrated, plausible pathways for the global energy future that fundamentally differ from one another². For example, our Rivalry base case scenario assumes a gradually evolving energy transition to decarbonized energy supplies. The Autonomy scenario assumes an aggressively implemented energy transition, and the Discord scenario envisages a future characterized by less global cooperation, more trade wars and higher geopolitical uncertainty, and more commodity boom and bust and recessionary cycles. The three scenarios' demand outlooks for Europe are also highly differentiated; the spread in oil product demand growth between the highest and the lowest scenarios during the 2021-40 period is a compounded annual growth rate (CAGR) of 1.4%. In comparison, in the McKinsey report, the differential between its high and the low case scenarios is a barely noticeable CAGR of 0.4%.

The application of highly differentiated scenarios would be much more useful for testing possible futures than the scenarios used in the McKinsey report.

Key takeaway: Scenario analysis is an important tool for assessing the robustness of a strategy in a future that is impossible to predict. However, the McKinsey report's two scenarios appear too similar to one another provide a useful framework for considering how Bazan would perform financially across a variety of possible realistic futures.

² For more information about IHS Markit's energy and climate scenarios, see <https://ihsmarkit.com/products/energy-climate-scenarios.html>

2.4 Bazan's adaptability to regulatory change

The focus of McKinsey's report is the Bazan complex's economic value, but some reference is made to its emissions, indicating that this may play a factor in considerations for closing the refinery, even though this point is not made explicitly. In any case, it appears that with each change in regulations, Bazan has adapted successfully and ensured its operations are compliant.

Indeed, refining and chemical companies are used to operating in volatile market environments that are also highly regulated. Operating companies must abide by domestic and sometimes regional or even global regulations (for example, IMO regulations on bunker fuels). In addition, the refining and chemical sectors are highly competitive, which drive companies to continually seek to improve their operations through regular asset investments that go beyond maintenance capital.

So Bazan is no exception in its need to constantly adapt to regulatory and market changes. A case in point is the measures Bazan took to reduce its air emissions. The Pollutant Release and Transfer Register published by the Israeli government (September 2020) noted that in 2019, NMVOC emissions at Bazan decreased by 44% due to its implementation of the Ministry's requirements for reducing emissions at the tank farm (white paint, installing gaskets, etc.), repairing leaks from equipment parts, and a 75% reduction in the flow of gas to the furnaces. At Carmel Olefins, storage containers were connected to the CTO facility and leaks from equipment parts were reduced. At Gadiv, NMVOC and benzene emission sources were connected to treatment facilities and leaks from equipment parts were reduced.

Consequently, emissions of substances that are suspected or known carcinogens into Haifa Bay atmosphere decreased in 2019 by 35% due to the environmental measures enacted by Bazan and Carmel Olefins. Moreover, if measured from 2012, emissions have decreased by 87%. Though the cost over a decade to achieve this level of environmental compliance was ~1.1 B ILS, Bazan has remained a profitable business.

Key takeaway: The operational adaptability that Bazan has demonstrated while remaining profitable is an important consideration that deserves mention because Bazan generates important economic benefits – even beyond those mentioned in the McKinsey report, as noted above – while remaining compliant and lawful. Since no reason is apparent to doubt that Bazan would not successfully adapt to future regulatory requirements, it questions the real benefits to Israel of closing a set of businesses that have a solid track record of profitability and compliance.

3 Recommendations

This non-exhaustive list is intended to highlight key recommendations selected from this report for critical changes to the McKinsey report's methodology and additional analysis to be undertaken before the government makes a final decision about the future of the Bazan complex.

3.1 Economic analysis

More extensive review of Bazan's economic impacts. The McKinsey report's use of NPV as the primary determinant to assess the economic contributions of Bazan's Haifa Bay businesses is the wrong approach. By largely omitting any analysis of second- and third-tier economic impacts, it almost certainly severely understates the Bazan complex's economic value. We recommend instead conducting a comprehensive economic impact analysis that uses an industry-standard SAM framework to assess the full range of the Bazan complex's economic contributions to Israel's economy – which extend well beyond the readily apparent contributions generated by the facility itself.

This approach would quantify the contributions attributable to Bazan across multiple years based on a detailed forecast scenario of output, OPEX, and CAPEX as key inputs for developing a robust account of how all the various activities of the facility flow through the economy. Any dollar of industrial revenue results in both direct and indirect repercussions on final demand. Similarly, any capital expenditures trigger additional direct and indirect responses.

It would also identify a third level of impacts – induced (income) contributions – which covers the economic contributions due to the household spending activity of people who work for either Bazan or are utilized through the facility's supply chain businesses.

Such analysis would produce a much more comprehensive and accurate picture of the economic contributions that an industry or facility would generate within the economy both at present and in the future. After determining an appropriate operational timeframe, this process can be adapted to generate a forecast of economic contributions as well, using forecasts of market, economic, and monetary factors to calibrate the model throughout the forecast period.

Failure to conduct this kind of analysis would produce results that would be skewed and misleading. As such, the type of economic impact analysis described above should be undertaken to truly capture the value that Bazan provides, as well as to understand what would be at risk in any shutdown scenario.

Expand and deepen analysis of facility closure costs. The analysis of the costs of closing the Bazan refinery should include key factors such as Bazan's existing debt, compensation to employees, financial and commercial damages caused by the decision itself, negative impact on Israel's balance of payments, lost income tax from direct and indirect employment, and the ability of employees who lost jobs to find employment in general and specifically in positions that offer similar wages.

Improve and deepen analysis of land options and their value. The McKinsey study acknowledges key inputs to the land value analysis that require further study, and we agree. First, the committee should understand the risks of developing a residential project on remediated land on which a refinery was situated – an extremely rare real estate development concept – and decide whether it is advisable to proceed with the project at all. If so, the analysis of land value should be revised, using the most accurate data available for determining the value of land, including the updated REMI figures, and a professional and independent evaluation of the costs to remediate Bazan's land. In addition, the value that would be generated by developing Bazan's land should be compared to alternative options for residential development.

Impact of loss of skills and capabilities in sciences and engineering. The closure of Bazan and loss in employment opportunities would be expected to result in a loss of Israel's capabilities in science and engineering subjects and professions. The petrochemicals industry creates employment for professionals, skilled and semi-skilled workers with science, technology, engineering, and mathematic (STEM) qualifications in direct and support services. Producers such as Bazan are also more likely to spend money on training in technical skills and management than SMEs that have limited budgets. If Bazan were to close, it is expected that Israel would experience a loss in valuable industry-related knowledge and skills. We recommend a study that assesses the extent of this loss and its potential impact in Israeli industry.

3.2 Oil product and chemical market analysis

Expand analysis on security of supply. The McKinsey report's analysis of the security of supply for refined products is insufficient and may significantly underestimate Israel's true stock requirements. We recommend reviewing whether the McKinsey assumption that Israel's stock reserves should be set at 60 days is appropriate, given that European regulations are stricter, as well as whether Israel should maintain product stocks across geographic regions, following best international practices.

In addition, the McKinsey report's assessment of storage infrastructure is insufficient and misses certain critical elements that impact Bazan's economic value. We recommend conducting a detailed evaluation of the physical infrastructure necessary to allow for increased refined products supplies.

This analysis should also transparently disclose associated costs such as the possible loss of economic activity in case of supply shortages and physical security measures that the additional physical infrastructure may require.

Update oil and chemical market analysis, including impact on Bazan's margin. Due to the COVID pandemic, global oil and product markets have changed dramatically since the report was published. The world today is much different than it was in 2018. We recommend updating the Bazan margin analysis to account for today's market conditions.

Improve evaluation of chemical margins. The McKinsey report's analysis of chemical margins does not account for several important facts. For example, Bazan operates a mixed-feed cracker, not just using naphtha feedstock, and offers a broad range of PP and LDPE products, including premium grades. Moreover, Bazan is located in Israel, not Europe, so the pricing of feedstocks and products would not be fully aligned with those of a European producer. The same would apply to products manufactured by Gadiv. We recommend that an updated analysis use relevant domestic and import-parity product prices to evaluate margins and assess the impact of switching from domestic production to imports of these materials.

Assess impact on Bazan's chemical customers. We recommend conducting a study to assess the impact of Bazan's closure specifically on its chemical customers, especially for Carmel Olefins, whose customers would be compelled to import resins. Of particular focus should be on the size of the enterprises and the sectors they operate in or sell into, since the impacts on SME customers and in security-sensitive or high-value sectors may be disproportionately high.

Improve scenario analysis. Scenario analysis is an important tool for considering the resilience of future decision-making. The McKinsey report's European refining margin scenarios are so similar to each other, however, that their value in assessing Bazan's profitability would be limited at best. We recommend assessing Bazan's future profitability using a scenario framework that is much more robust.

3.3 Environmental analysis

Benchmark Bazan's emissions. The McKinsey report does not address the capability of Bazan to successfully adhere to stringent environmental regulations, though it identifies Bazan's emissions as a possible contributing factor in a decision to close Bazan's operation. It may also be useful to benchmark Bazan's emissions to those of similar urban facilities across OECD countries to understand Bazan's relative performance. Similarly, it may be useful to compare Israel's environmental regulations to those of other OECD countries to determine their level of stringency and the cost of regulation in comparison to their intended ameliorative effects.

The report also mentions that "Bazan is planning to construct a new 340MW cogeneration plant" (pg. 16). Since cogeneration facilities that co-produce heat and power are more energy efficient than standalone power generation, it is expected this would provide emission reductions to Bazan's operations. In addition, the increased efficiency at the Bazan refinery would be expected to make the refinery more profitable.

Assess and compare emissions of land development options. We recommend assessing the impact on emissions if Bazan land is redeveloped for residential use in comparison to allowing the Bazan complex to operate and developing housing units on alternative sites. In each scenario, there will be new emissions linked to the construction of residential use, domestic use of energy in homes, and transportation through the addition of new commuters in the Haifa Bay area. If imports increase, this could lead to more port traffic, particularly from container shipping, which would also contribute to emissions in the area.