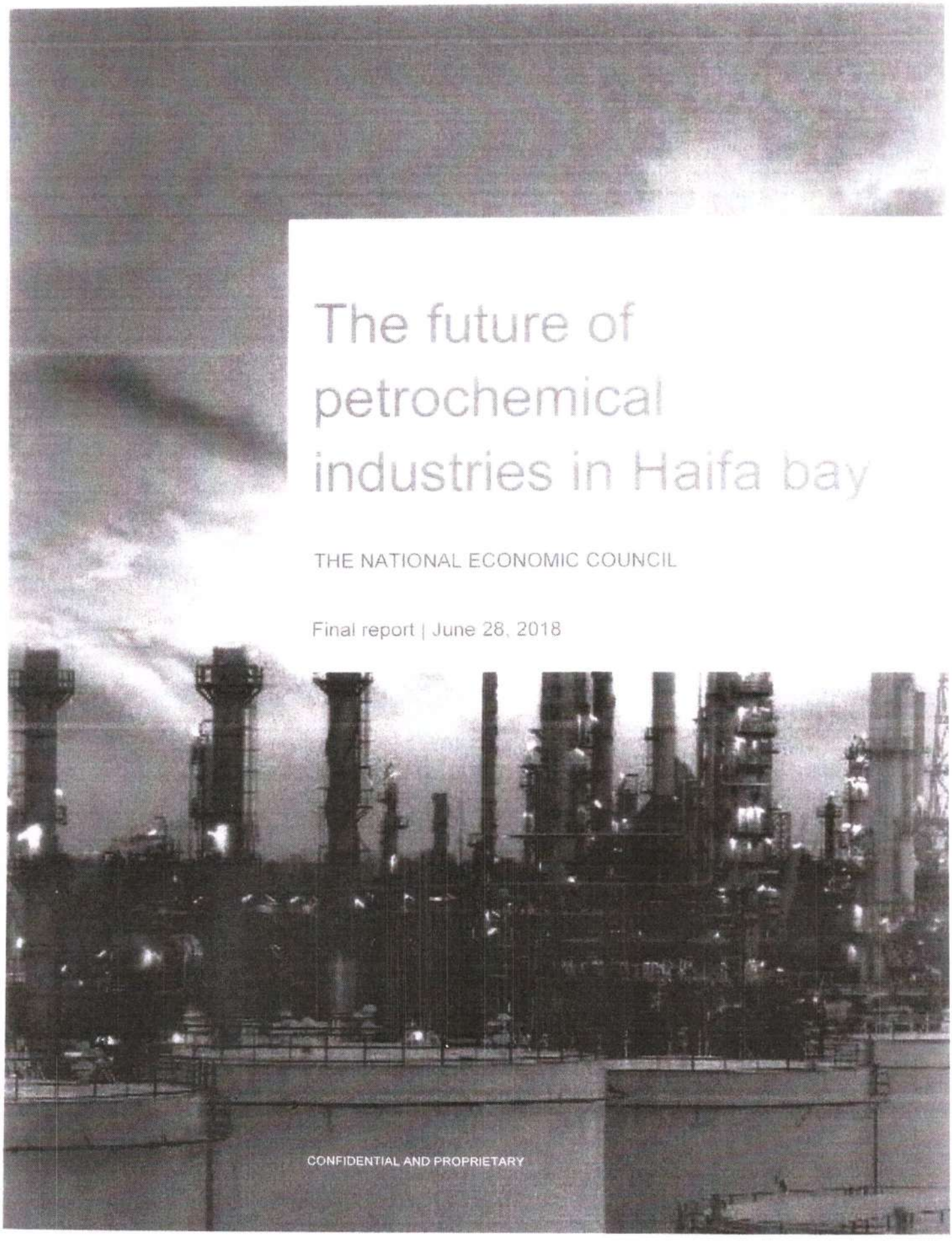


The future of petrochemical industries in Haifa bay

THE NATIONAL ECONOMIC COUNCIL

Final report | June 28, 2018

Table of Contents

The National Economic Council convened an inter-ministerial committee to explore the future of the petrochemical industry in Haifa bay. The committee was led by the National Economic Council and included representatives of the Ministries of Economy, Energy, Environmental Protection, and Finance, and of the Israeli Land Authority (REMI). We were asked to support the committee by providing an economic analysis of 4 alternative solutions for the future of the Bazan complex:

A. Retaining Bazan in its current location and configuration

B. Reallocating Bazan to a non-urban location

C. A partial shutdown of the Bazan complex, within the same location

D. A full shutdown of the Bazan complex, under different timing scenarios

Over a period of 7-weeks we worked with the various stakeholders to assess Bazan's contribution to the local energy market and national and regional economies:

- We assessed Bazan's future profitability and contribution to the local economy, leveraging our European outlook for refined product demand and refining margins
- We estimated the impact on prices, and required investment in import infrastructure, resulting from replacing Bazan's production with imports
- We leveraged analysis from the ILA, MoEP, and international benchmarks to evaluate the costs and benefits of the four aforementioned alternatives

Thorough this study, we strived to provide the committee with an economic fact-base to help the committee determine the optimal course of action. 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 environmental, urban planning, and employment concerns. It is a policy decision that should be taken by the government, taking the full picture into consideration. We did not address all aspects relevant to the committee's decision, and therefore do not provide recommendations as part of this study. We sincerely hope that the following report will assist the committee in making the optimal decision for the future of Haifa Bay.

Executive summary

This report summarizes an assessment of the future of the petrochemical industry in Haifa conducted over 7 weeks in May-June 2018. Our study was conducted in support of, and in conjunction with, the National Economic Council for presentation to the inter-ministerial committee composed of representatives of the Ministries of Economy, Energy, Environmental Protection, Finance, and the Israeli Land Authority (REMI), charged with examining the future of the petrochemical industry in Haifa bay.

The study focused on the Bazan complex, evaluating its contribution to the Israeli energy market, and the potential costs and benefits of closing the complex. We worked with the various stakeholders, and leveraged our international experience and benchmarks, to develop an outlook on:

- Bazan's future profitability and contribution to the local economy, based on our European outlook for refined product demand and refining margins
- The impact on local prices of refined products, and required investment in import infrastructure, resulting from replacing Bazan's production with imports
- The expected costs and benefits of 4 alternative scenarios:
  - Retaining Bazan in its current location and configuration
  - Reallocating Bazan to a non-urban location
  - A partial shutdown of the Bazan complex, within the same location
  - A full shutdown of the Bazan complex, under different timing scenarios

This outlook is based on our best understanding of current and expected trends in the European and global refining markets, and analysis of the local energy market. It should be noted that:

- Our perspective on Bazan profitability is based upon an outside-in analysis, leveraging publicly available data
- Data on emissions was received from the Ministry of Environmental Protection
- Data on land value was received from REMI, REMI is further refining these estimates
- Due to security restrictions, data on actual availability of refined product storage capacity was not made available
- Land remediation costs, based upon an international benchmark, may vary widely based on site-specific elements, REMI is further refining these estimates

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.

Additionally, to assess the potential upside of a Bazan shutdown we used the value to government from selling the land for residential development. This does not capture the maximal potential value of a shutdown, which is likely to include external benefits such as reduced emissions, accelerated development of the Haifa metropolis, indirect increase in land value and more. These difficult to quantify benefits, may increase the value from a potential shutdown.

1 Context

1.1 Bazan Group

Bazan Group consists of the oil refinery, Carmel Olefins, Gadiv Aromatics, Haifa Basic Oils (BO) and Ducor. This report refers only to the Group's activity in Israel, excluding Rotterdam based Ducor.

Bazan occupies a 526-acre (2,130 dunams) complex in Haifa Bay. It directly employs [redacted] people in Israel, and the Ministry of Economy estimates that it generates additional indirect employment of ~5,400 employees. During 2015-2017 Bazan reported an average annual profit of ILS ~750M, with the refinery and Carmel generating the majority of profits [redacted]

According to the Ministry of Environmental Protection, Bazan is responsible for ~25-30% of NMVOC, NOx and SO_2 emissions in the city of Haifa. Based on estimates from the Ministry of Environmental Protection NOx and SO_2 emissions lead to an annual cost of ILS ~87M/year. However, over the past decade Bazan has invested ~1.1B ILS in environmental compliance, reducing NOx (~50%) and SO_2 (~90%) emissions in recent years.

The refinery processes imported crude oil to refined products, producing several key products:

LPG – supplied to the local Israeli and PA markets (residential and industrial consumption)

Naphtha – supplied primary to Carmel for polymer production

Gasoline – supplied to the local road transport market

Jet/kerosene – supplied to the local aviation market

Diesel – supplied to the local road transport market and exported to European markets

Fuel oil – predominantly exported to the European market, with some local supply to the marine transport market (bunker fuel)

Bitumen – supplied to the local construction industry. Bazan is the only Bitumen supplier in Israel

In addition, Carmel converts naphtha and propylene into polymers, producing polypropylene (PP) and low-density polyethylene (LDPE) for the local and export markets. Gadiv's major products are mixed xylenes, toluene, para-xylene and benzene, out of which the first two are consumed locally. Basic Oils produces a variety of waxes, oils and lubricants.

1.2 The Israeli market

Refined products: There are two refineries in Israel; Bazan, located in Haifa Bay, is the larger of the two [redacted] The two refineries supply most of local demand with additional products sourced from global markets and imported through two main facilities; A small energy terminal in Haifa port and offshore buoys in the EAPC terminal off the coast of Ashkelon. Israel is currently a net importer of LPG and jet/kerosene and a net exporter of diesel and fuel oil.

Polymers: Carmel is a major supplier of local polymer demand (LDPE and PP), [redacted]

Aromatics: Gadiv is the sole local aromatics supplier as well as a major exporter, with local demand for only two of its main products – mixed xylenes and toluene. [redacted]

1.3 European refining outlook

The Israeli market is strongly influenced by the European refining market, being the main import/export market for the Israeli market. Therefore, our estimate of Bazan's future profitability is derived from our outlook regarding the European refining market. We developed two European refining margin scenarios:

A **base scenario** representing our outlook for the market. Under this scenario European demand declines by ~0.7% p.a. over 2020-2040 due to increased fuel efficiency in internal combustion engines and strong penetration of EVs (30% of passenger fleet).

A **high scenario** representative of a bullish refining outlook. Under this scenario European demand declines by ~0.3% p.a. over 2020-2040 due to lower improvement in fuel efficiency and weaker EV penetration (20% of passenger fleet).

[redacted]

2. Alternatives to Bazan

Building upon our Bazan profitability outlook we assessed 4 alternative solutions for the future of the Bazan complex:

Retaining Bazan in its current location and configuration assumes continuous operations of Bazan, generating the aforementioned NPV, with no land value released for development of the Haifa metropolis.

Relocating Bazan to a non-urban location, releasing land value and reducing emissions, without changing Israel's energy import balance. However, based on international benchmarks, the cost of building a new refinery of similar size and configuration is estimated at over 18B ILS. Construction would require at least 7 years with the plant coming online no sooner than 2026. Based on our market outlook such an investment would generate a strongly negative ROI (25-50%) over 2026-2040, making the relocation scenario economically unattractive.

A partial shutdown of the Bazan complex can reduce emission but will not release land value which will remain locked within an operating refining complex. [redacted] **A full**

shutdown of the Bazan complex, will release 7-20B ILS in land value while reducing emissions.

[redacted]

As **Carmel** is the key local **polymer** producer, all local demand would have to shift to imports [redacted] Based on international data and expert interviews polymers can likely be sourced from East Asian markets at competitive prices. However, local producers currently paying a premium for local production will have to realign their supply chain.

---

[1] Active refining capacity is defined as the expected unutilized capacity in active refineries. It does not include capacity in refineries likely to be shut down in low demand scenarios

[2] Markets of geographic and political relevance to the Israeli market

[redacted] **Gadiv's aromatics** production is exported. Small scale local demand would have to be sourced from European markets. As no local aromatics prices are available, we were not able to assess any potential change in prices.

2.2 Required import infrastructure

Assuming global markets can supply local demand at similar prices, we evaluated the ability of local import infrastructure to support a substantial increase in imports. [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

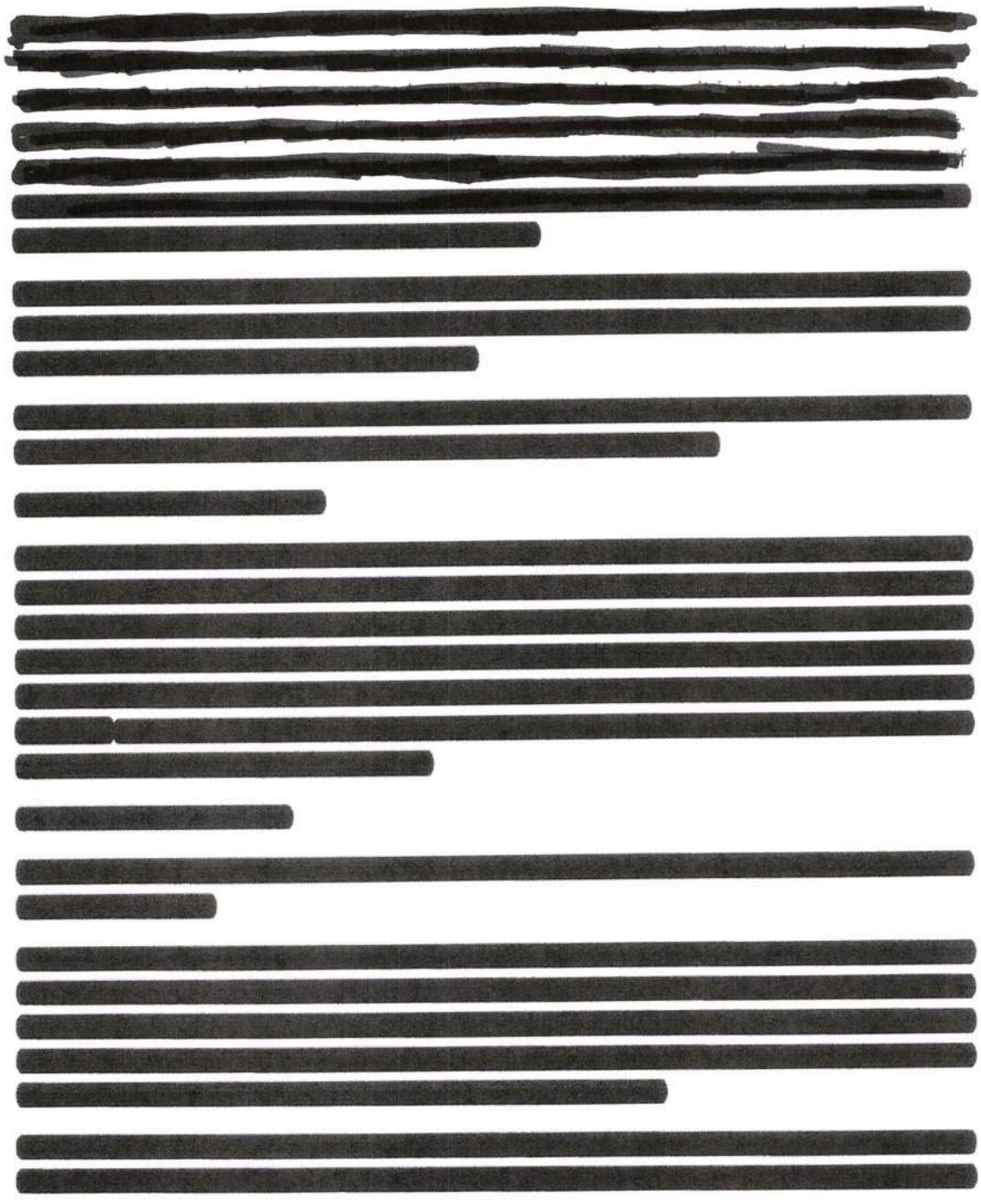
[redacted]

[redacted]

[redacted]

---

3 [redacted]



[4] [redacted]

[redacted]

2.3 Dismantling and remediation costs

Releasing Bazan land for residential development requires a complete dismantling of the complex and land remediation. To assess this cost, we used cost benchmarks from similar complexes' abroad. Based on this benchmark the total shutdown and [redacted] cost is estimated at [redacted] As land remediation costs vary widely between sites, this figure should be verified through a detailed land survey.

This process is expected to take ~10-years for full remediation, however, the land in the buffer zone is not expected to require remediation and can likely be marketed at an earlier stage.

2.4 Released land value

The primary quantifiable benefit from a Bazan shutdown is the value released through marketing the land for alternate uses. Our analysis focuses solely on the direct value of released land, including both the Bazan complex and the surrounding buffer zone. Our analysis is based on the Israel Land Authority's (REMI) initial estimate of land value, utilized for residential development. We built three value scenarios based on the figures received:

Aggressive scenario – land value of ~20 B ILS (100,000 units at 200,000 ILS per unit)

Base scenario – land value of ~13.1B ILS (75,000 units at 175,000 ILS per unit)

Conservative scenario – land value of ~7.5B ILS (50,000 units at 150,000 ILS per unit)

Under all these scenarios land value remains constant over time, based on the assumption that the increase in land value over time is at least as high as the government cost of funding (~3%).

These estimates are based on an initial analysis, relating only to residential development, the figures should be updated, with revised REMI figures, once made available. Additionally, this estimate does not reflect an increase in value of existing real estate development in Haifa, nor external benefits from reduced emissions and accelerated metropolitan development.

2.5 Impact on tax revenues

A Bazan shutdown would have a negative impact on government revenue, due to the loss of taxable income generated be Bazan's operations through corporate tax, lost income tax, and the cost of unemployment benefits (assuming long term loss of 10% of direct employment). In addition, the municipalities surrounding the Bazan complex – Haifa, Kiryat Ata, Nesher and Zvulun – would experience a short-term loss of ~60M ILS per year in municipal taxes (Arnona), until the area is redeveloped and tax payments resume.

2.6 Impact on GDP

We estimated Bazan's direct impact on GDP by accounting for the profits, corporate taxes, municipality taxes (Arnona) and wages (assuming long term loss of 10% of direct employment) generated by Bazan [redacted]

3. Shutdown under various timeframes

Leveraging these analyses, we evaluated Bazan's impact on the various parameters under four alternate scenarios:

Business as usual – Bazan's operations continue indefinitely, all figures are calculated until 2040

Value optimized 2030 shutdown – Bazan is closed in 2030 [redacted]

MARPOL optimized 2025 shutdown – Bazan is closed in 2025 [redacted]

Immediate shutdown (2020) – Bazan is closed as soon as possible

All 4 scenarios were assessed with and without Gadiv operations, assuming a potential partial shutdown.

Each scenario was assessed by evaluating the expected impact on the following parameters:

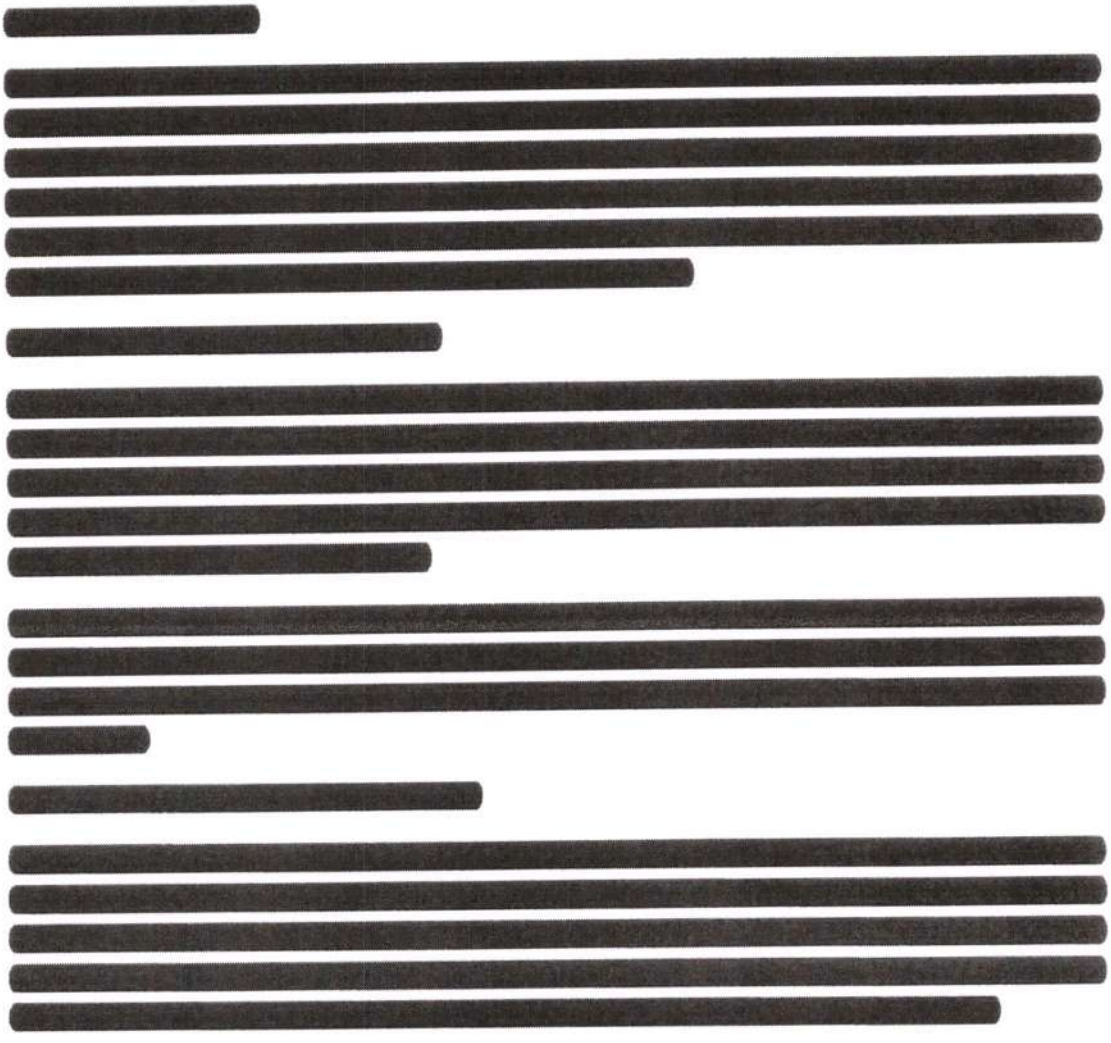
Expected revenues from: land sales, Bazan profits, Bazan's corporate tax, net income tax generated by Bazan[5], and avoided government investments on redundant projects

[5] Assuming 10% of wages are not replaced by alternative employment

Expected costs of: Shutdown and remediation, import infrastructure, and the maximal potential compensation to Bazan shareholders (based on expected NPV of profits at closure)

Socio-economic impact: Bazan's contribution to GDP, employment in the Haifa area, municipal tax revenues, and emissions in the Haifa area

All shutdown scenarios, will require a period of preparation, construction of import facilities, would need to begin at least 4 years before shutdown, with full remediation achieved ~10 years after shutdown.



[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

- [redacted]
- [redacted]

[redacted]

[redacted]

[redacted]

---

8 [redacted]

Additionally, if a decision is made to shutdown Bazan, a detailed action plan will be required to ensure that all required import infrastructure is put in place prior to the shutdown, allocating sufficient time for both construction and zoning and permitting process. The cost and complexity of this plan can be reduced through strategic initiatives to increase EV and natural gas penetration in transport, domestic and industrial uses, potentially decreasing the quantity of imports required in the future, decreasing required storage needs.

Any decision, aside from maintaining business as usual, will require careful planning, coordination and management of the significant, large scale program needed to facilitate a Bazan shutdown. We believe that the magnitude of the challenge, and the potential value it can create, justifies approaching it in a strategic and holistic manner.

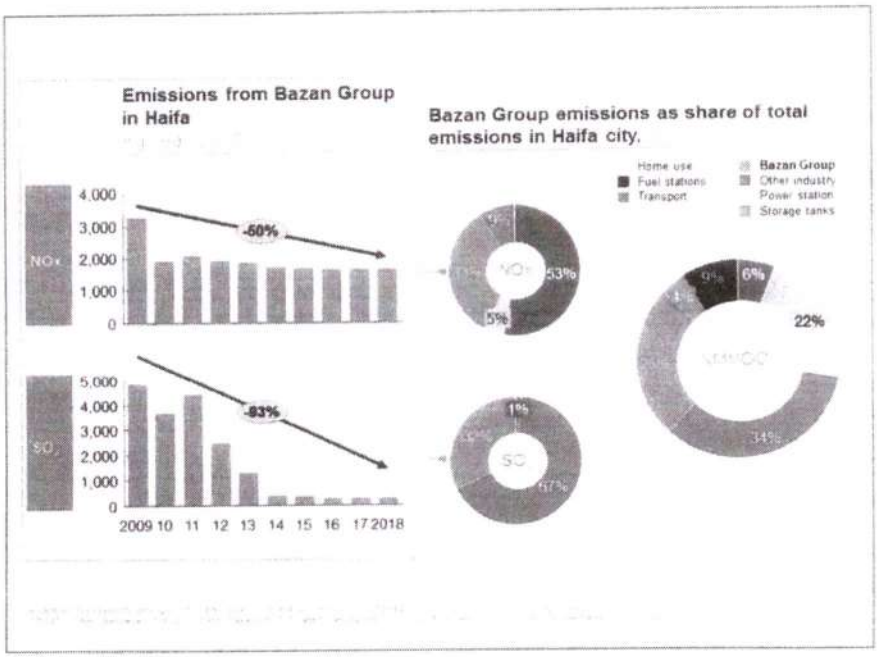
1 Introduction

1.1 BAZAN GROUP

Bazan Group consists of the oil refinery, Carmel Olefins, Gadiv Aromatics, Haifa Basic Oils (BO) and Ducor. This report refers only to the Group's activity in Israel, excluding Rotterdam based Ducor.

Bazan occupies a 526-acre (2,130 dunams) complex in Haifa Bay, commonly referred to as "Bazan complex". It directly employs [redacted] people in Israel, the Ministry of Economy estimates that it generates additional indirect employment of ~5,400 employees. Bazan's average annual profits (net) between the years 2015-2017 was ILS ~750M, with the refinery and Carmel generating most of the profits.

According to the Ministry of Environmental Protection, Bazan is responsible for ~25% of NMVOC emissions in the city of Haifa, in addition to ~32% of NOx and SO_2 emissions. Based on estimates from the Ministry of Environmental Protection NOx and SO_2 emissions lead to an annual cost of ILS ~87M/year[7]. However, over the past decade Bazan has invested ~1.1B ILS in environmental compliance, reducing NOx (~50%) and SO_2 (~90%) emissions in recent years.



[7] Estimated costs for NOx emissions: 27,651 ILS/ton, SO2 emissions 32,990 ILS/ton. Based on 2017 data for emissions: NOx 1,388 tons/year, SO2 314 tons/year

The group operates as a going concern, and has made substantial investments in recent years:

- [redacted]
- [redacted]
- [redacted]

Additionally, both Bazan and relevant government agencies are planning new investments:

- **Bazan is planning to construct a new [redacted]cogeneration plant.** The plant is planned to be constructed in two phases, the first phase, is estimated to cost over [redacted]and allow Bazan to decrease dependence on external power supply. The second phase, to be completed at a later date, will generate power for supply to the grid, allowing Bazan to diversify its revenue streams. Bazan's generation license requires commissioning by 2023
- Government agencies are planning two major projects associated with Bazan:
  - The **"Karkaot Hazafon"** project is intended to release high value shorefront real estate and minimize disturbance to Kiryat Haim by relocating shorefront storage tanks[8] to the Bazan area. The project is expected to take over 4 years and cost [redacted] Relocation of the crude storage element will not be required without Bazan [redacted]however, the remaining cost, associated with dismantling and cleaning the Kiryat Haim site, and possible reconstruction of refined product storage, will still be required
  - The **EAPC is planning to relocate its** Haifa-Ashdod pipeline from the coastal plain to Highway 6 to release high value land and reduce periodic maintenance costs. The project, estimated to cost [redacted]will not be required without Bazan

1.1.1 Overview of the refinery:

Reporting an average net profit of ILS 488M for the years 2015-2017, the refinery represents ~60% of Bazan's profits in Israel (i.e., excluding Ducor) and directly employs [redacted]

The refinery processes imported crude oil to refined product, producing several key products:

- **LPG** – supplied to the local Israeli and PA markets (residential and industrial consumption)

---

[8] Crude terminals in Kiryat Haim and "20 acres" refined products terminal in Haifa port

[9] Includes only cost of rebuilding the terminal, dismantlement will still be required

- **Naphtha** – supplied primary to Carmel for polymer production
- **Gasoline** – supplied to the local road transport market
- **Jet/kerosene** – supplied to the local aviation market
- **Diesel** – supplied to the local road transport market and exported to European markets
- **Fuel oil** – predominantly exported to the European market, with some local supply to the marine transport market (bunker fuel)
- **Bitumen** – supplied to the local construction industry. Bazan is the only Bitumen supplier in Israel

1.1.2 Overview of Carmel:

Reporting an average net profit of ILS 239M for the years 2015-2017, Carmel represents ~35% of Bazan's profits in Israel and directly employs [redacted]

Carmel processes naphtha and propylene into polymers, key products being:

- **Polypropylene (PP):** The world's second-most widely produced synthetic plastic, resistant to fatigue and used for piping systems, clothing and more
- **Low density polyethylene (LDPE):** First grade of polyethylene with good flexibility, used in plastic bags, containers, agriculture and more

[redacted] of Carmel's production is supplied to the local plastics industry, with the rest exported to nearby markets. The majority of Carmel's feedstock is provided directly by the refinery [redacted]

1.1.3 Overview of Gadiv:

Reporting an average net profit of ILS 20M for the years 2015-2017, Gadiv represents only ~2% of Bazan's profits in Israel and directly employs [redacted]

Gadiv's major products are:

- **Mixed xylenes:** Petrochemical liquid, used primarily as a raw material for para-xylene production (see below) and an organic solvent for paint and pesticide industries
- **Toluene:** Petrochemical liquid, used primarily as a raw material for polyurethane production (used to produce foam for insulation/coating) as well as for benzene and paraxylene
- **Para-xylene:** An important component of polyester (textile industry) and a raw material beverage packaging

- **Benzene:** Basic chemical for a variety of widely used products (e.g., polystyrene foam, polycarbonate used in electronics, transport and construction)

Out of these products, only mixed xylenes and toluene are consumed locally, with [redacted] of Gadiv's production being exported.

Gadiv's activity is required for gasoline blending, particularly for operating the continuous catalytic reformer (CCR).

1.1.4 Overview of Basic Oils

Reporting an average net profit of ILS 5M for the years 2015-2017, Basic Oils represents ~1% of Bazan's profits in Israel and directly employs [redacted]

BO produces base oils, paraffin waxes and specialty lubes. It has no significant interdependencies with the other facilities in the Bazan complex and is not a substantial emitter.

1.2 THE ISRAELI REFINING MARKET

1.2.1 Market structure

There are two local refineries in Israel:

- **Bazan** – located in Haifa with installed capacity of [redacted]
- **Paz Ashdod** – located in Ashdod with installed capacity of [redacted]

The two refineries used to be part of a single company, but were separated to two competing entities in 2006.

While refineries provide most of Israeli consumption, additional products are sourced from global markets and imported through two main facilities:

- [redacted]
- [redacted]

1.2.2 Refined products

Israel is a net importer of LPG and jet/kerosene and net exporter of diesel and fuel oil. Bazan currently supplies most of the local refined product demand. The following list outlines supply and demand for refined products in the local market:

- **LPG:** local demand of 0.6 mtpa is [redacted]
- **Naphtha** – local demand of 0.7 mtpa [redacted]
- **Gasoline** – local demand of 3 mtpa [redacted]
- **Jet/kerosene** – local demand of 1.3 mtpa [redacted]
- **Diesel** – local demand of 2.8 mtpa [redacted]
- **Fuel oil** – local demand of 0.4 mtpa [redacted]
- [redacted]

1.2.3 The polymer and aromatics market

Carmel is a major supplier of local polymer demand (LDPE and PP), with a market share of [redacted]

- **Polypropylene:** [redacted] local demand of ~350 kT/year can be fully met by Carmel, however, [redacted] local demand is imported
- **Low density polyethylene –** [redacted] Local demand of ~100 kT year can be fully met by Carmel, however, [redacted] local demand is imported

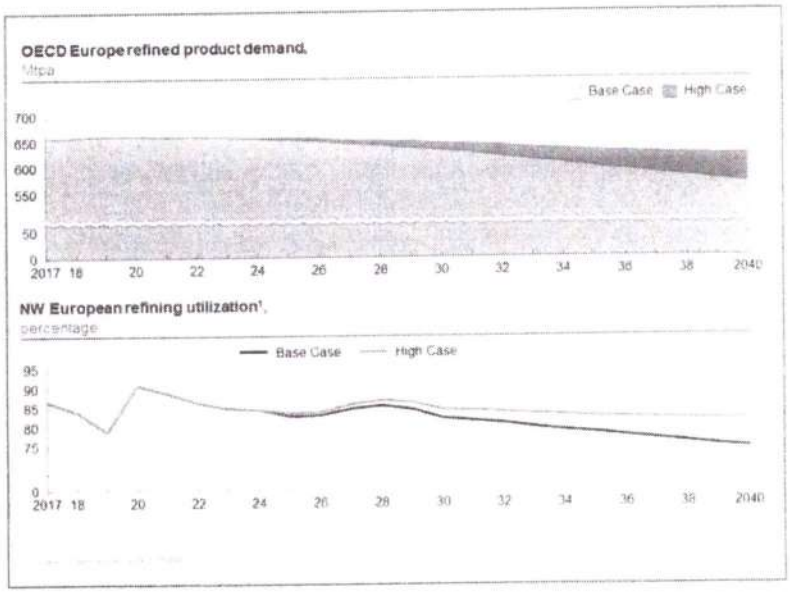
Gadiv is the sole local aromatics supplier as well as a major exporter, with local demand for only two of its main products – mixed xylenes and toluene. [redacted] of production being exported.

1.3 DEVELOPMENTS IN THE EUROPEAN REFINING MARKET

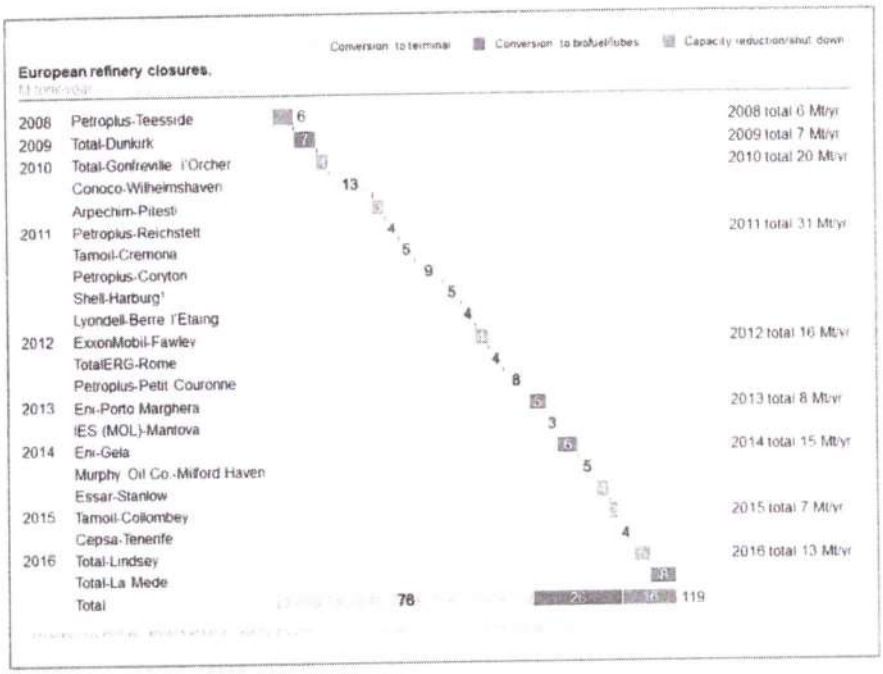
The Israeli market is strongly influenced by the European refining market, being the main import/export market for the Israeli market. European demand for refined products and refining margins, are assumed to largely determine the refining margins for Israeli refineries. To assess the attractivity of the European refining market we forecasted demand for refined products and refining margins under two scenarios:

- A **base scenario** represents our outlook for the market. Under this scenario European demand declines by ~0.7% p.a. over 2020-2040 due to increased fuel efficiency in internal combustion engines and strong penetration of EVs (30% of passenger fleet)
- A **high scenario** representative of a bullish refining outlook. Under this scenario European demand declines by ~0.3% p.a. over 2020-2040 due to lower improvement in fuel efficiency and weaker EV penetration (20% of passenger fleet)

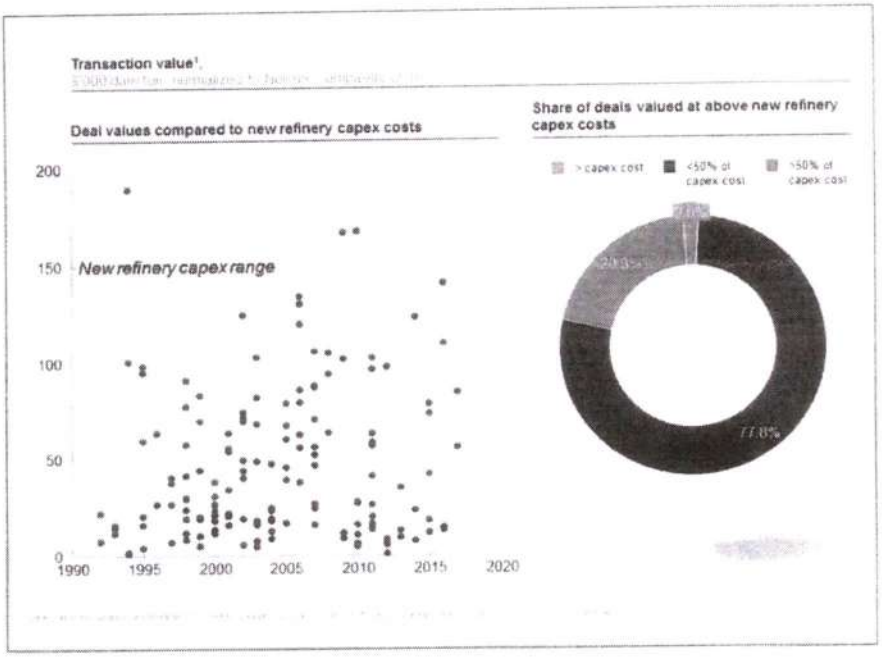
Under both scenarios, reduced demand lowers European refinery utilization by ~2022, which continues to decrease through 2040, resulting in lower refining margins.

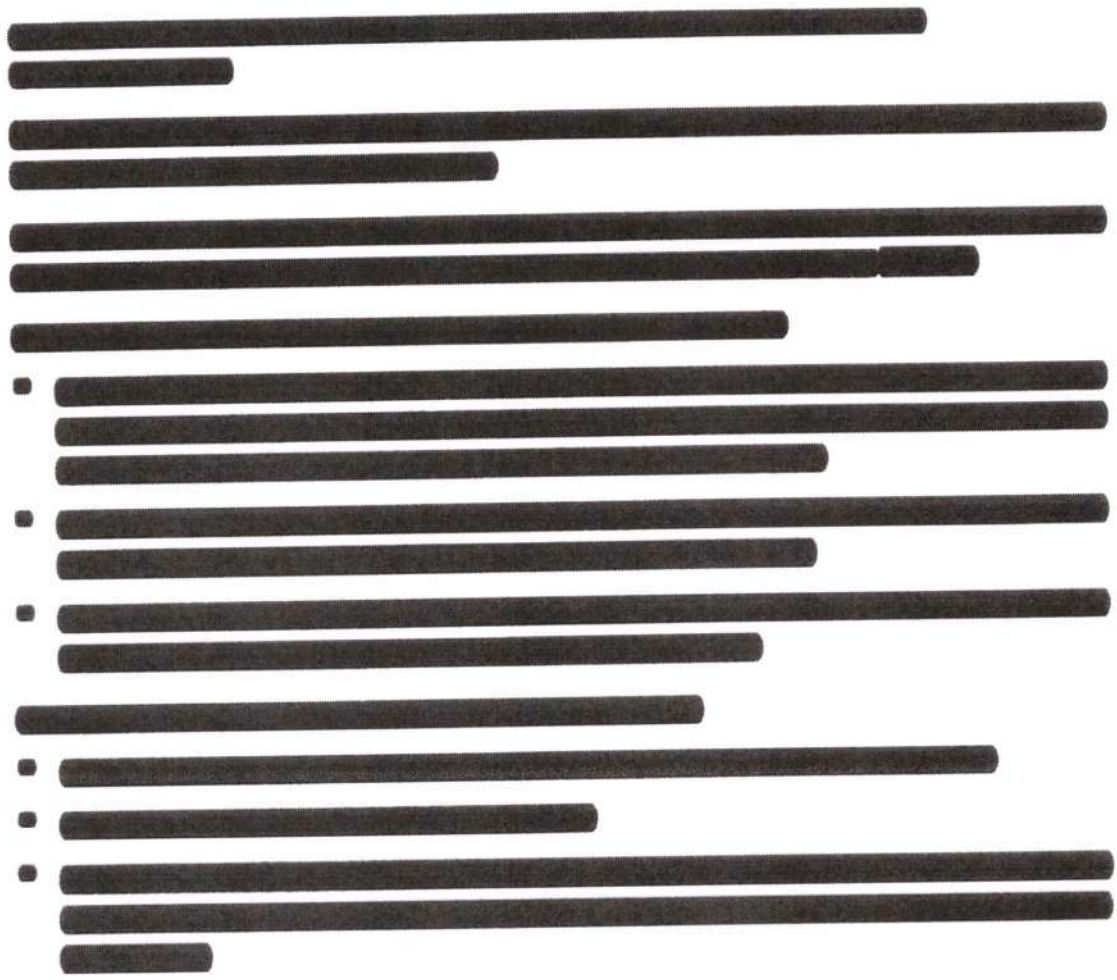


The European market seems to be preparing for decreased margins by reducing 12% of capacity (~11 million tons/year) over the past decade, usually by converting process units to storage terminals.

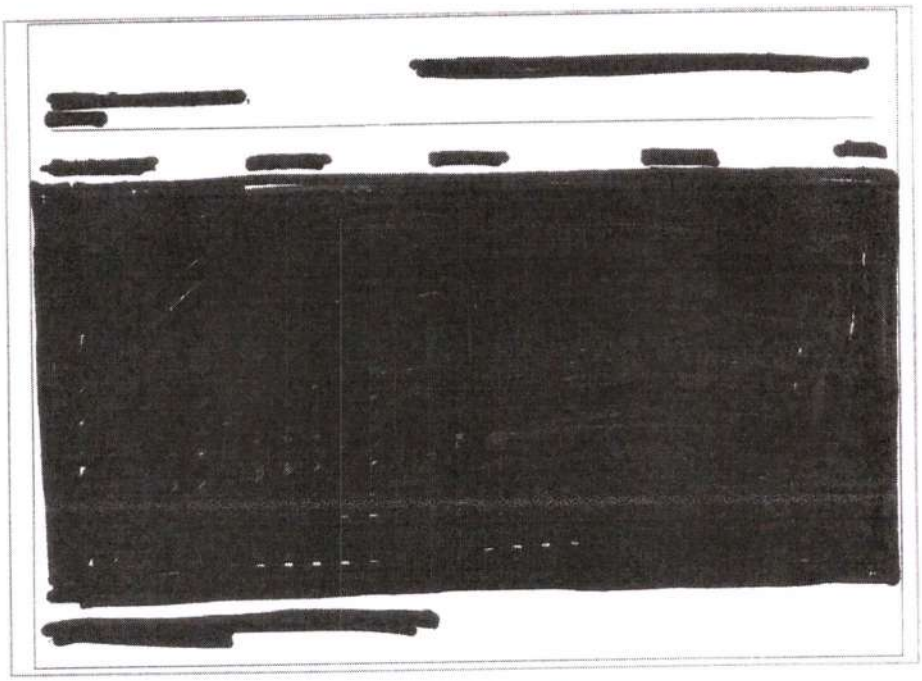


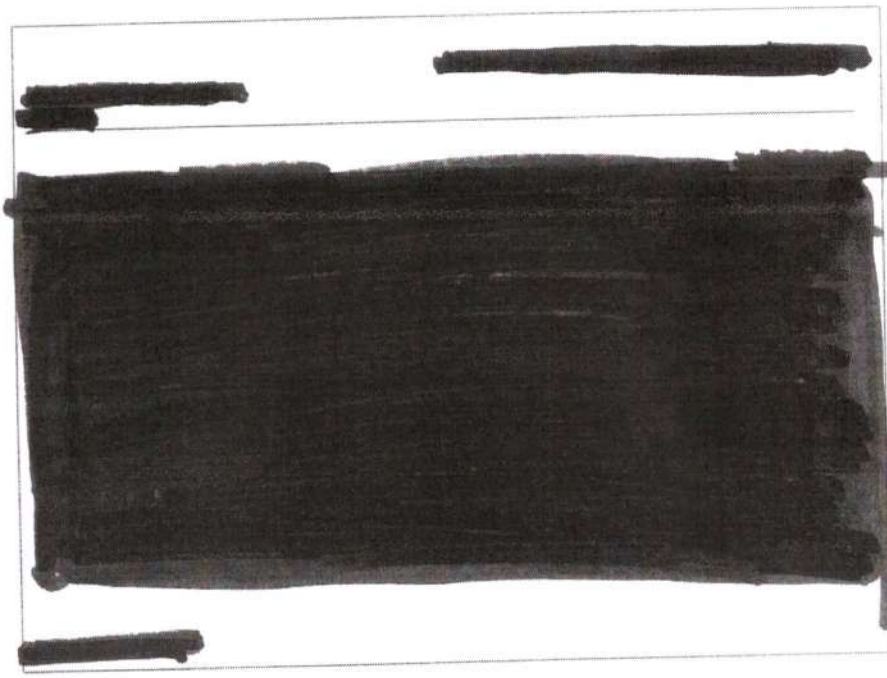
Decreasing margins are also reflected in M&A valuations, with ~80% of transactions closed at below 50% of the cost of constructing a new refinery.





[10] See more detailed assumptions in the appendix





2 Alternatives to Bazan

Building upon our Bazan profitability outlook we assessed 4 alternative solutions for the future of the Bazan complex:

A. Retaining Bazan in its current location and configuration

B. Reallocating Bazan to a non-urban location

C. A partial shutdown of the Bazan complex, within the same location

D. A full shutdown of the Bazan complex, under different timing scenarios

2.1 SCENARIO B – RELOCATION

To estimate the cost of building a new refinery of similar size and configuration we benchmarked construction costs of similar facilities.

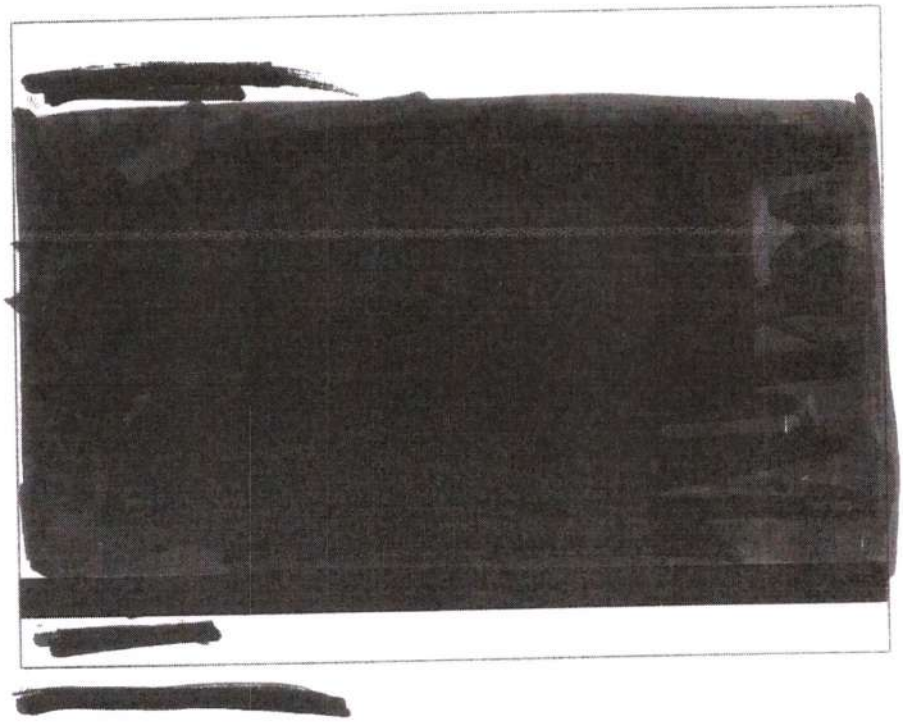
Taking into account benchmarks of facilities of similar complexity as Bazan, building a refinery of this capacity would cost ILS ~18B. In addition, indirect costs (e.g. connections to pipelines and port facilities) will further increase costs.

Building a new refinery of this scale and complexity would require at least 7 years to complete, meaning it would come online in 2026 at the earliest. Under both the base and high demand scenarios such an investment would generate a negative ROI over 2026-2040 (~-50% and ~-25% respectively), making the relocation scenario economically unattractive. European refining margins in 2026-2040, under the base case, suggest a negative ROI of -48%. Looking solely at economic considerations, a relocation of Bazan scenario is unfavorable.

2.2 SCENARIO C - PARTIAL SHUTDOWNS

As relocation of Bazan seems economically unfavorable, we evaluated partial shutdown scenarios as a middle-ground between business as usual and a complete shutdown. A partial relocation can contribute to emission reductions. However, it cannot generate any value from released land, which will remain locked within an operating refining complex.

To identify partial closure potential, we compared plants' contribution to Group profits versus their share of total group emissions.



2.2.1 Shutting down Carmel

Carmel represents a significant share of the Group's profits and is the largest benzene emitter. Shutting down Carmel would reduce emissions, with the most significant changes being a 34% reduction in benzene emissions and a 26% reduction in NOx/NO_2 emissions.

However, on the cost side, a Carmel shutdown would reduce profits by:

2.2.2 Shutting down Gadiv

Gadiv is the largest aromatics emitter while representing only a small share of the Group's profits. Shutting-down the facility would reduce benzene emissions by 27%, toluene emissions by 46%, and xylene emissions by 76%.

However, on the cost side, a Gadiv shutdown would reduce profits by:

- [redacted]
- [redacted]

[redacted]

2.3 SCENARIO D - FULL SHUTDOWN OF THE BAZAN COMPLEX

2.3.1 Replacing Bazan's supply in a full shutdown scenario

2.3.1.1 Meeting local demand – supply and impact on prices

In the case of a Bazan shut down its supply to the local market will have to be replaced by imports, with a marginal capacity increase in Ashdod (increased utilization of existing production units).

Refined products

Required imports

[redacted]

- LPG:
  - **Demand:** Under the 2030 base case, [redacted]
  - **Relevant markets:** In 2030, the USA, Russia and Kazakhstan are expected to be major net export markets of LPG. Norway and Greece, in closer proximity, will likely be net

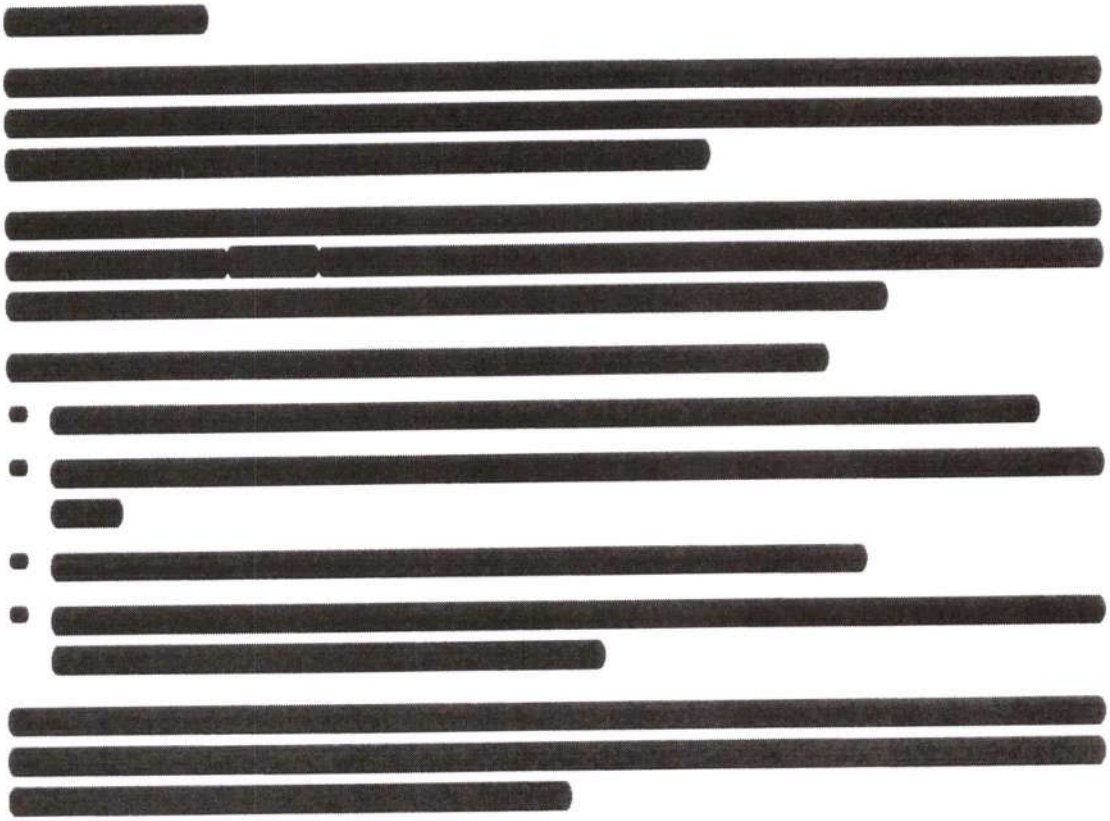
[11] Million tons per annum

[12] Such a shift will require investment in T&D and industrial equipment (e.g., furnaces, burners etc.)

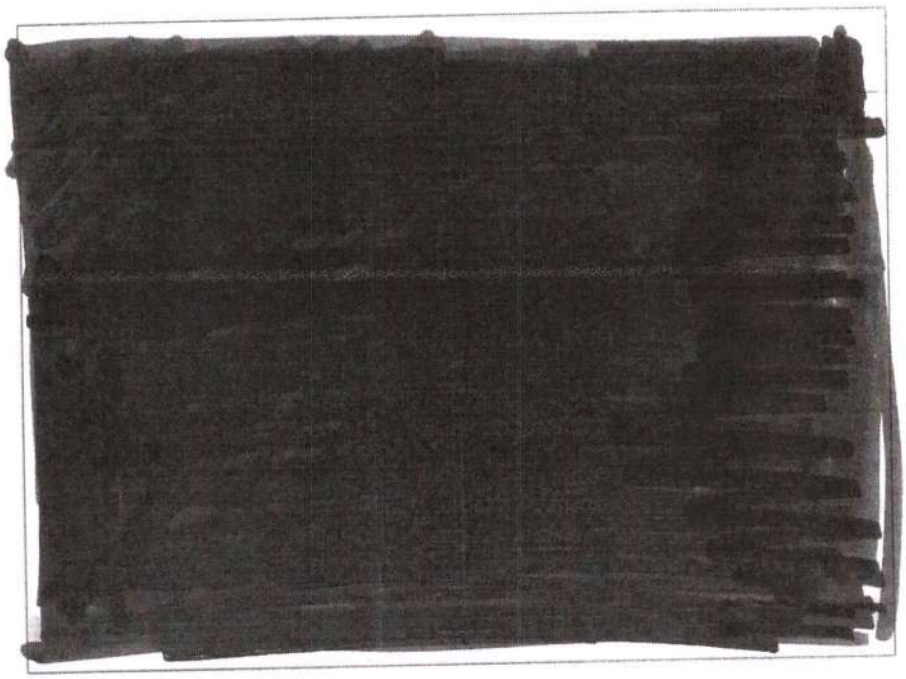
[13] ~ 25-30% accounts for consumption by the Palestinian Authority

exporters as well. These countries are expected to have excess supply of ~105 mtpa, out of which Israeli imports would represent ~0.6%

- Naphtha
  - **Demand:** [redacted] the Israeli market will become a net naphtha exporter
- Gasoline:
  - **Demand:** Under the 2030 base case [redacted] required imports will reach ~1.5 mTpa
  - **Relevant markets:** In 2030, the US, Italy, South Korea, Spain, Greece, and Turkey are expected to have excess supply of ~52 mTpa, out of which Israeli imports would represent ~2.8%
- Jet/kerosene:
  - **Demand:** Under the 2030 base case [redacted] required imports will reach ~1.4 mTpa
  - **Relevant markets:** In 2030, the US, China, South Korea and India are expected to be major net export markets of gasoline with excess supply of ~79 mTpa, out of which Israeli imports would represent ~1.8%
- Diesel:
  - **Demand:** Under the 2030 base case [redacted] required imports will reach ~1.5 mTpa
  - **Relevant markets:** By 2030, the US, Russia and China are expected to be major net export markets of gasoline. Netherlands and Greece, in closer proximity, will likely be net exporters as well. These countries are expected to have excess supply of ~165 mTpa, out of which Israeli imports would represent ~0.8%
- Fuel oil:
  - **Demand:** Under the 2030 base case [redacted] maintain Israel's position as a net exporter
- Bitumen:
  - **Demand:** Demand for bitumen is expected to remain stable till 203[redacted] In case of shutdown an alternative source of local production will have to be generated, as Bitumen importing is complex and costly (details follow)



[14] Do not include marketing margin and taxes. According to Israel's Law on Commodity Price Controls, the maximum price of refined products is set based on the Med Lavera cif hub price plus a marketing margin and taxes



LPG prices

The price delta between imported and locally produced LPG is ~[redacted] ILS/ton of local discharge and storage fees. We evaluated the impact this would have on consumer prices by calculating the effective (weighted) price of LPG.

[redacted]

Bitumen

Importing bitumen is not practical due to complex and costly import costs, likely doubling the landed cost per ton. To replace Bazan's production, a standalone bitumen plant will have to be constructed. A plant capable of meeting local demand, would require a fuel oil feedstock of ~300kT/year, and is expected to cost ILS ~105M-175M[15]. Such a plant has a small physical footprint, requiring 200-300 Sq.m.

---

[15] Based on reported capex costs and M&A costs from 5 recent projects: for M&A deals, construction cost assumes 200% premium over M&A value

A bitumen plant can be constructed in either of the following locations:

- The **Ashdod refinery** would be the simplest solution [redacted]
- The **coastal power plants** have available fuel oil infrastructure allowing direct imports from tankers and would allow locating the bitumen plant within an existing industrial zone.
- The plant can also be constructed in **the Negev,** likely providing easy zoning and permitting. Under this scenario, fuel oil would have to be trucked from Ashdod, adding transport costs of ~42ILS/ton[16].

Polymers and aromatics

Required imports

Local demand for polymers produced by Carmel and aromatics produced by Gadiv will have to be met through imports. [redacted]

Using the ICIS Supply and Demand database we expect demand for the polymers to reach 600kT/year (~80% PP and ~20% LDPE) and aromatics to 0.35kT/year (~60% mixed xylenes and ~40% toluene) by 2030.

We assessed expected available excess supply for 2030 in global markets. As polymer transport is relatively cheap we assume that purchase prices, rather than geography, will be the deciding factor. Based on expected excess supply the USA, S. Korea, Thailand and Singapore are the likely sources of import. Israeli imports would represent ~5% of expected excess supply in these countries.

As transport costs are significantly higher for aromatics, we prioritized markets based on geographical proximity. Under these parameters, the primary source of imports would likely be in the European market (e.g., Germany, Spain, Serbia, Portugal and the Netherlands). Israeli imports would represent less than 1% of expected excess supply.

In terms of import infrastructure, polymers are imported in containers, not requiring dedicated import facilities and the low volumes of aromatics could likely be imported through the existing chemical terminals in the Ports of Haifa and Ashdod.

---

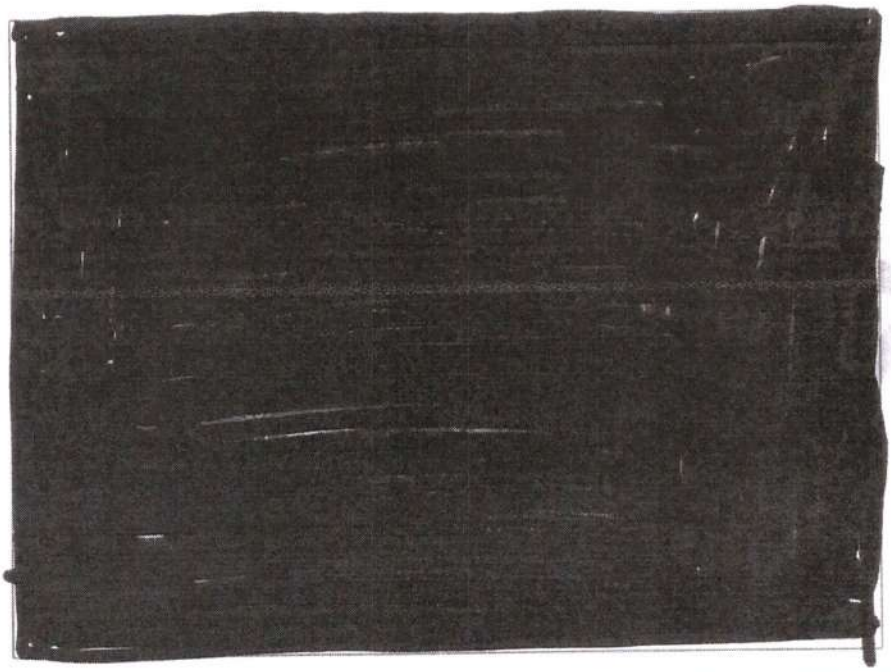
[16] Large tanker trucks with a capacity of 33.7 kL (~318 ton), costs are for a 100km trip, not including loading "truck loading fees"

Impact on prices

To evaluate the price impact on the polymers and aromatics. we used the average import price, excluding outliers, based on the customs tax database (מכס) as the domestic price. There is no available data to determine the domestic price of aromatics, however, low quantities suggest that any change will not generate a significant economic impact.

To determine import prices, we added the price of acquisition from likely sources of import, and the cost of transport cost to Israel:

- **Polymers:** the acquisition price is based on the average FOB price in S. Korea, Singapore, and Thailand[17]. Transport cost reflect standard container costs from Asia to Israel, no significant local logistics cost are to be expected.
- **Aromatics:** the acquisition price is based on the average FOB price in Germany and the Netherlands. Transport cost reflects chemical tanker costs from the port of Antwerp to Israel and local logistics cost are an estimate of local bulk chemical unloading.



[redacted]

[17] ITC trade map prices

2.3.1.2 Import infrastructure

Assuming global markets can supply local demand at similar prices, we evaluated the ability of local import infrastructure to support such a substantial increase in imports.

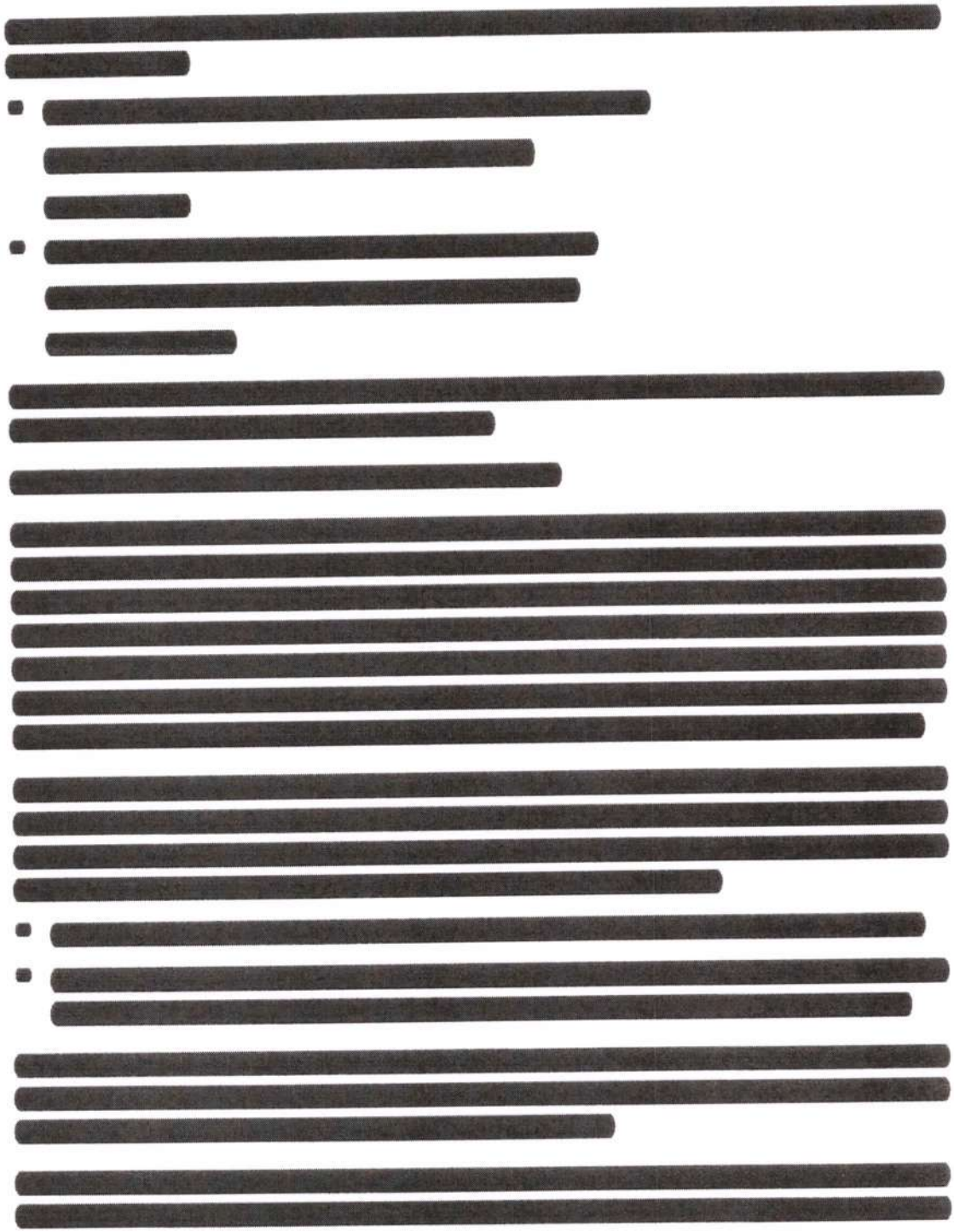
[redacted]

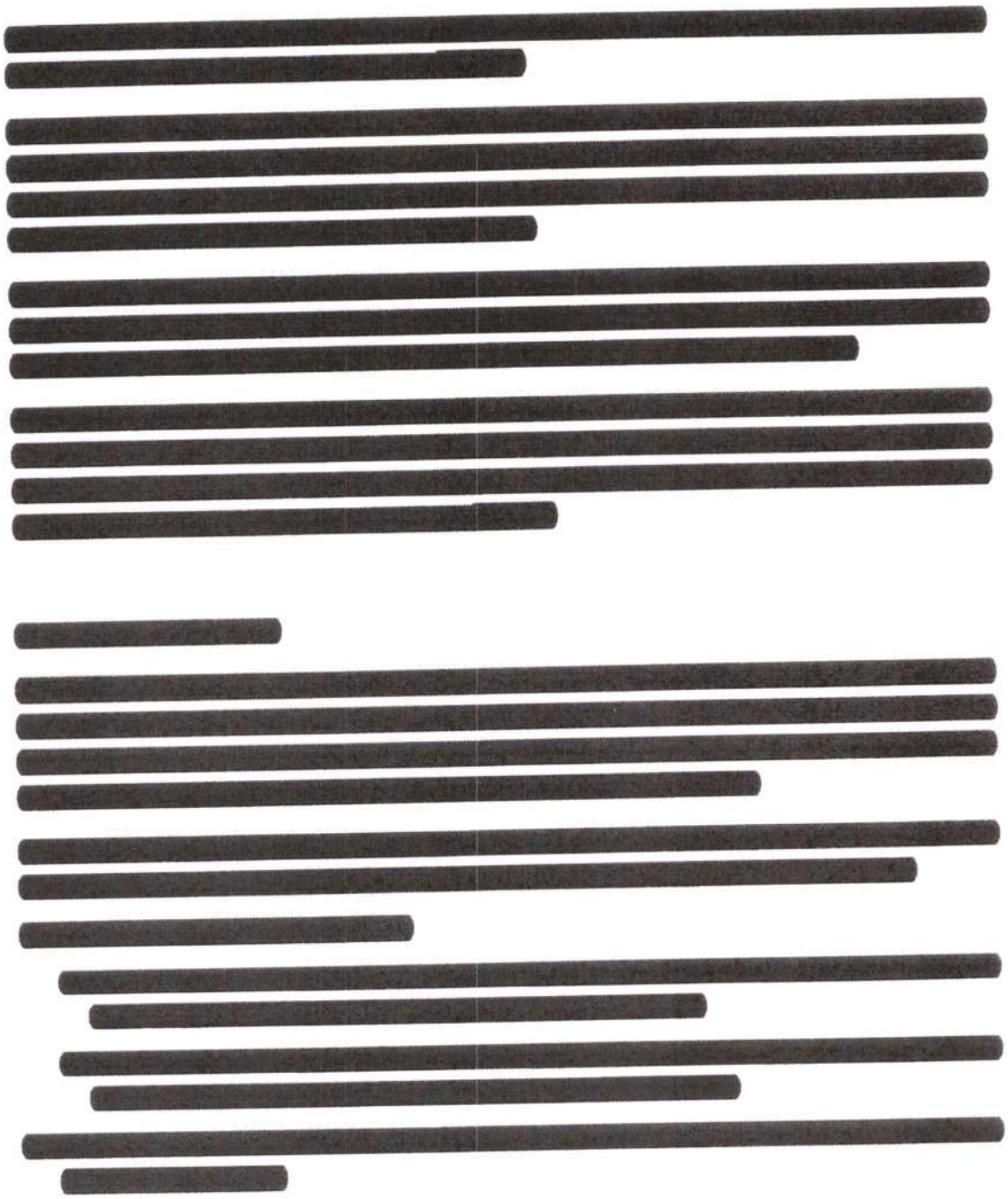
- [redacted]

- [redacted]

[18] Assuming 25% of total consumption of diesel and gasoline, no consumption of kerosene as civilian consumption is mostly in central Israel

[19] 75% of total diesel and gasoline consumption, 100% of kerosene consumption





[20] CAPEX ~665-875 ILS/m^3

[21] PEI estimate for a distribution hub, collocated with Bazan, is estimated at ILS 70M. We assume an additional ILS 52.5-87.5M for piping to an inland location)

[redacted]

Total Investments

Avoided investments in a shutdown scenario

In addition to the aforementioned investments, government investment in two large projects will be avoided in case of a Bazan shutdown:

- **"Karkaot Hazafon"** – relocation of refined products and crude oil terminals ("20 acres" and "Kiryat Haim" respectively) at a total cost of ~ILS [redacted]
- **Pipeline relocation** – EAPC Haifa-Ashdod pipeline pipeline from the coastal plain to Highway 6 at a total cost of [redacted]

In the case of a shutdown of Bazan, crude oil would only have to be provided to Paz Ashdod, canceling the need to have crude oil storage facilities in the Haifa Bay. Under such a scenario the share of cost of the "Karkaot Hazafon" project attributable to rebuilding the Kiryat Haim crude terminal would be avoided, generating savings of ~815M. The remaining cost, associated with dismantling and cleaning the Kiryat Haim site, and possible reconstruction of refined product storage, will still be required. The cost of the pipeline relocation, a total of ILS [redacted] would also be avoided, as there would be no reason to pipe crude from EAPC to the Haifa bay.

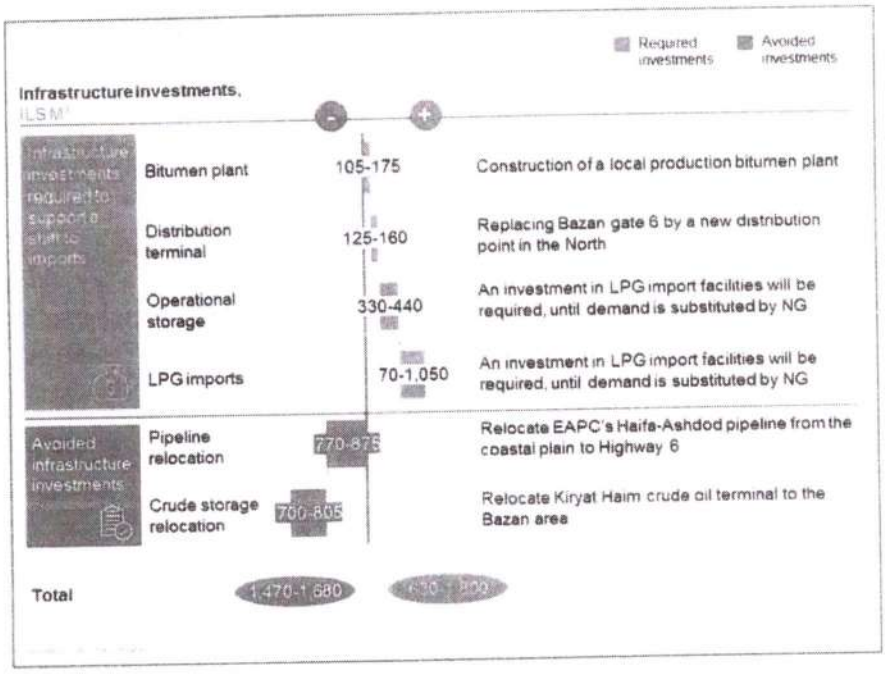
Taken together this would save the government ILS ~1.62B.

Summary of all investment in a shutdown scenario

In summary, there is potential benefit from avoided investments which may be larger than investments required to support a shift to imports:

- Increase capacity of LPG storage expected to take 3-4 years at a cost of ILS 70-1,050M
- Build a local bitumen plant, expected to take ~1 year at a cost of ILS 105-175M
- [redacted]
- [redacted]

[22] Ministry of Finance input



Balancing required and saved investments suggests potential savings of up to ~ILS 1,000M

2.3.2 Shutdown costs and benefits

In the previous chapter we examined the feasibility of a Bazan shutdown and the required infrastructure investments. In this chapter we focus on the direct shutdown costs and on potential benefits from releasing the land.

2.3.2.1 Shutdown and remediation

To assess the shutdown costs, we used cost benchmarks from similar complexes' abroad. The total cost for shutdown and remediation is estimated at 3,150-3,850M ILS and is expected to take ~10 years before the land can be used for residential development. It should be noted that land in the buffer zone is not expected to require remediation and can likely be marketed at an earlier stage.

The benchmarks cover two relevant components:

- **Dismantling cost:** The net dismantling cost is expected to cost 1,900-2,300M ILS and take 3-4 years. Physical dismantling and removal of installed elements (above and below ground) are estimated at ILS 230-268 per ton of installed crude capacity (9.8mtpa). Out of this cost, ~35 ILS per ton can be recovered through sales of scrap metal.
- **Land remediation cost:** full land remediation, to a degree required for residential usage, is estimated at ILS 1,225M-1,575M[23] typically requiring 5-10 years. Remediation costs can vary widely between sites and require further, detailed, corroboration

2.3.2.2 Released land value

The main quantifiable benefit from a Bazan shutdown is the revenue from marketing the released land for alternate uses. Our analysis is solely focused on the net value of the land released, including the buffer zone. 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, this value is not captured in this study.

We based our analysis on the Israel Land Authority's (REMI) initial estimate of land value, utilized for residential development. REMI is currently refining its analysis, once made available, updated figures should be used. Due to the dominant impact of land value on overall shutdown economics, we built several land value scenarios, under all scenarios land value remains constant over time, assuming the annual increase is roughly equivalent to the governments discount rate (3%):

---

[23] Benchmark estimate of 630-700 ILS per sqm for remediation to residential standard (2.130K sq.m)

A. Aggressive scenario – land value of ILS ~20B
   - Land yields 100,000 residential units
   - Unit market value is ~200,000 ILS
   - 2,500 units p.a. can be sold at market price (over 20 years)

B. Base scenario – land value of ILS ~13.1B
   - Land yields 75,000 residential units
   - Unit market value is 175,000 ILS
   - 1,500 units p.a. can be sold at market price (over 30 years)

C. Conservative scenario – land value of ILS ~7.5B
   - Land yields 50,000 residential units
   - Unit market value is 150,000 ILS
   - 1,500 units p.a. can be sold at market price (over 50 years)

Please note that this estimate assumes use of land for residential development, additional/alternate uses may change the land value. Additionally, this estimate does not reflect an increase in value of existing real estate, adjacent to the Bazan complex.

[redacted]

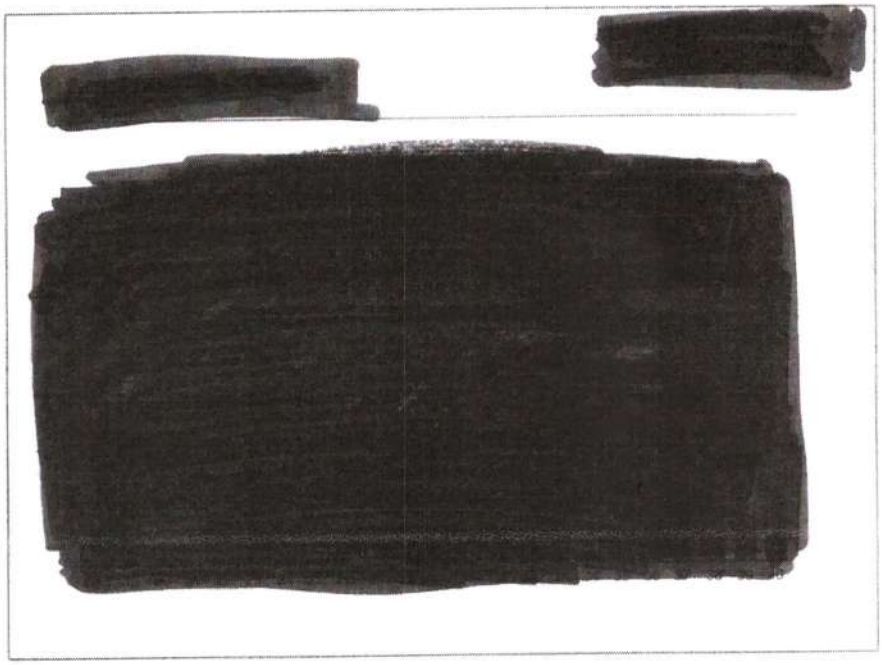
C. "Arnona" – Municipality taxes

The municipalities surrounding the Bazan complex – Haifa, Kiryat Ata, Nesher and Zvulun – receive a small portion of their income from "Arnona" taxes paid by Bazan. In 2015 Arnona income paid by Bazan was:

- Haifa – 32.4M ILS representing ~1.5% of total income
- Kiryat Ata – 11.8M ILS representing ~6% of total income
- Nesher – 10.5M ILS representing ~8% of total income
- Zvulun – 4M ILS representing ~10% of total income

Municipal revenue would be lost in the short-term, before being replaced by Arnona revenue from new real estate development.

[redacted]



3 Shutdown under various timeframes

3.1 SHUTDOWN SCENARIOS – COMPARISON

Leveraging the aforementioned analyses, we evaluated Bazan's impact on the various parameters under the four alternate scenarios:

- **Business as usual** – Bazan's operations continue indefinitely, all figures are calculated until 2040
- **Value optimized 2030 shutdown** – [redacted]
- **MARPOL optimized 2023 shutdown** – [redacted]
- **Immediate shutdown (2020)** – Bazan is closed as soon as possible

In addition, all four scenarios were assessed with and without Gadiv.

We assessed each scenario by evaluating the expected impact on the following parameters:

- Expected revenues from:
  - Land sales
  - Bazan profits[24]
  - Bazan's corporate tax
  - Net income tax generated by Bazan[25]
  - Avoided government investments on no longer required projects
- Expected costs:
  - Shutdown and remediation
  - Import infrastructure
- Socio-economic impact:
  - Bazan's contribution to GDP
  - Bazan's contribution to employment in the Haifa area
  - Bazan's contribution to municipal tax revenues

---

[24] Not included in government cash flow

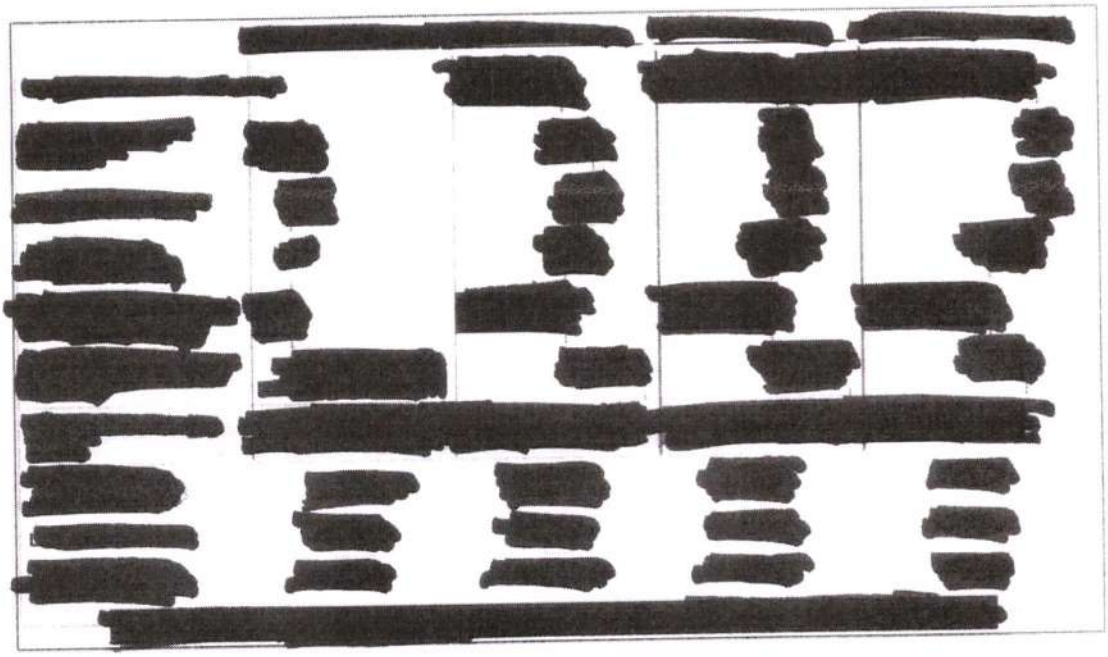
[25] [redacted]

– Emissions in the Haifa area

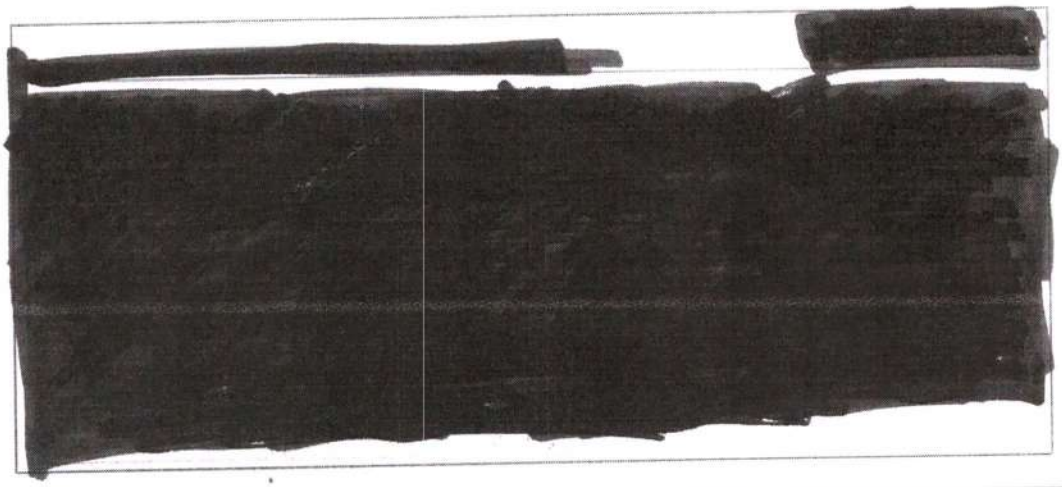
To compare the various scenarios in today's terms, we evaluated:

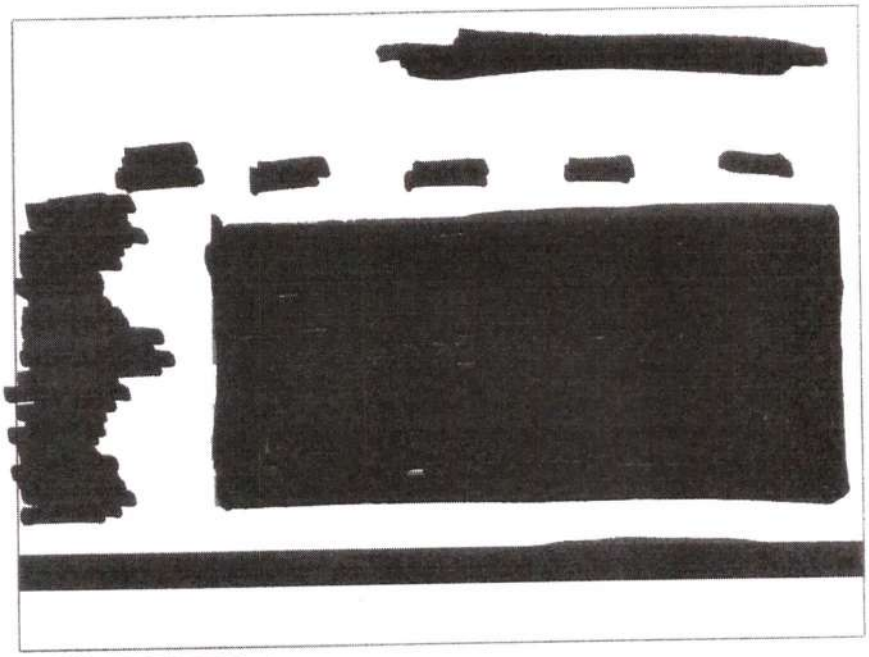
- NPV of total economic value created (in 2018 value)
- NPV of lost GDP contribution (in 2018 value)

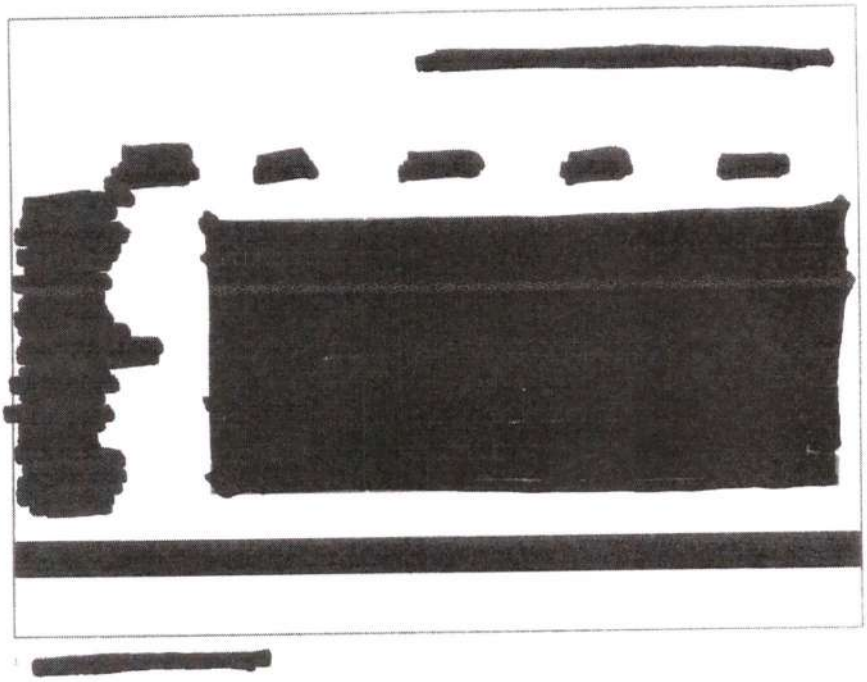
[redacted]



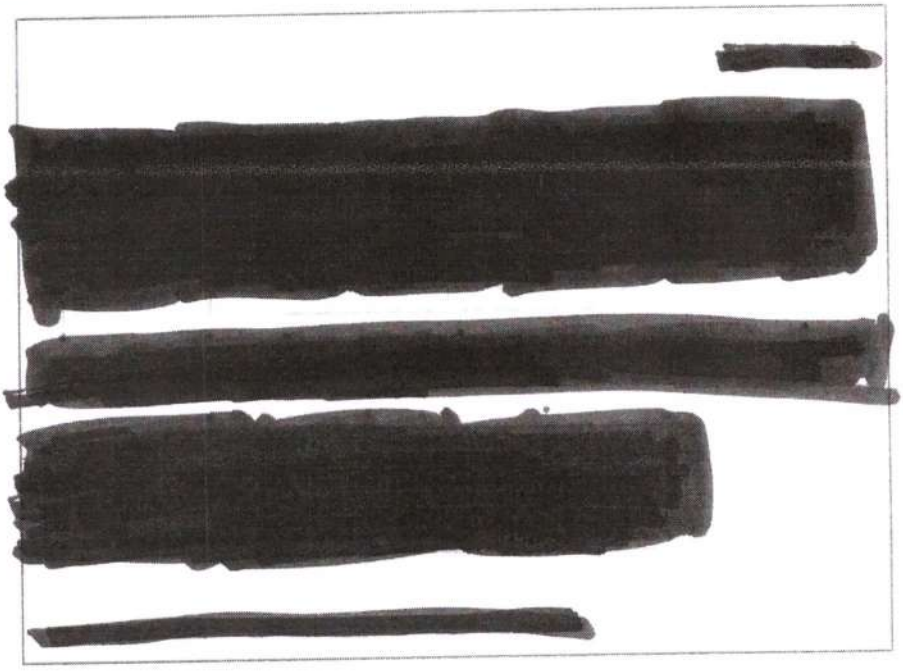
[redacted]







[redacted]

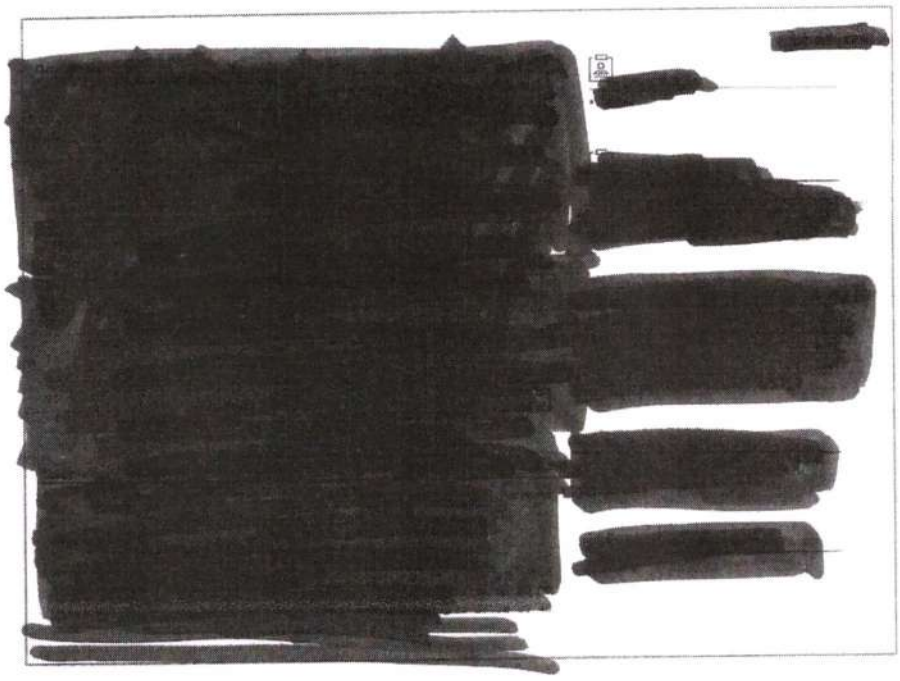


[redacted]

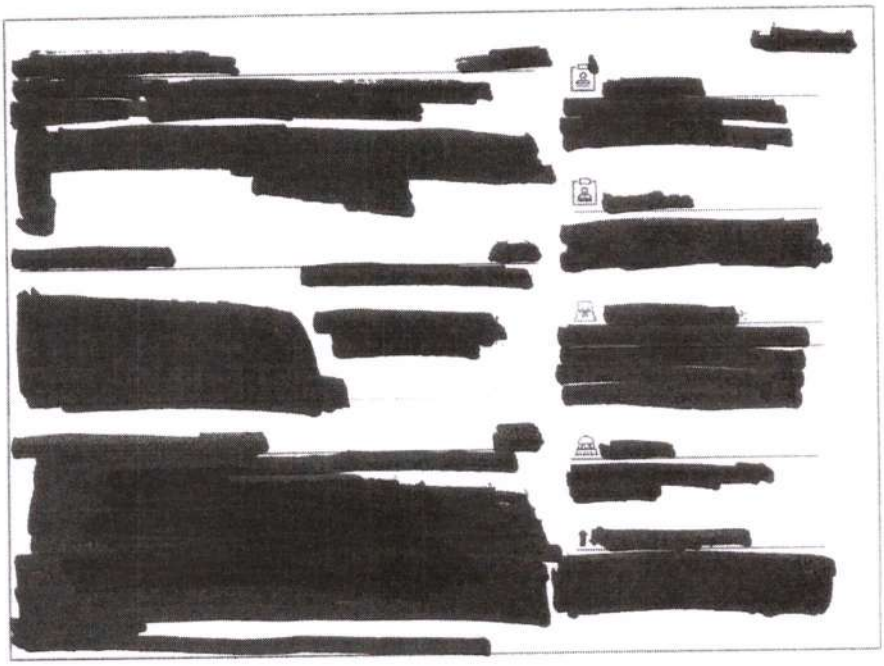
3.2 Shutdown scenarios – evaluation

To better understand the four alternatives, we conducted a detailed analysis of each alternative, across the aforementioned parameters.

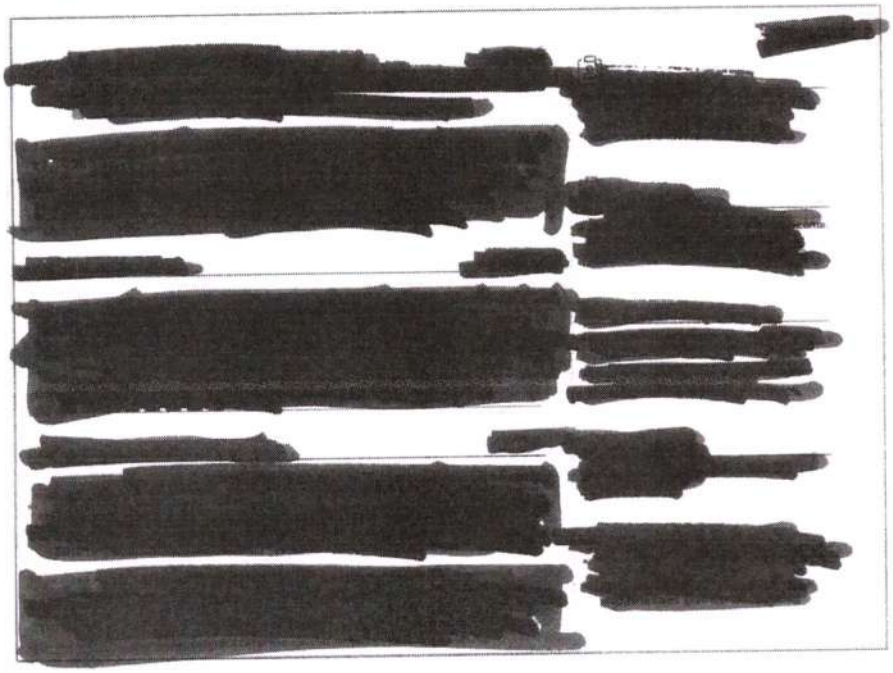
[redacted]



[redacted]



[redacted]



[redacted]

Summary

Over the course of the study we worked with the various stakeholders, and leveraged our international experience and benchmarks, to develop an outlook on:

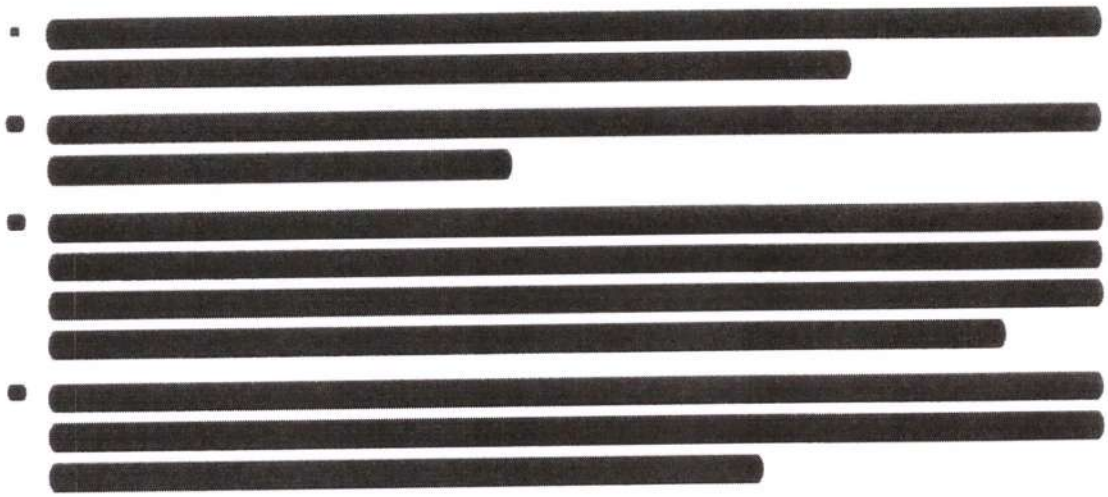
- Bazan's future profitability and contribution to the local economy, based on our European outlook for refined product demand and refining margins
- The impact on local prices of refined products, and required investment in import infrastructure, resulting from replacing Bazan's production with imports
- The expected costs and benefits of 4 alternative scenarios:
  - Retaining Bazan in its current location and configuration
  - Reallocating Bazan to a non-urban location
  - A partial shutdown of the Bazan complex, within the same location
  - A full shutdown of the Bazan complex, under different timing scenarios

Our analysis indicates that:

- [redacted]
- Relocating Bazan is not economically viable. An investment of over 18B ILS will be required, with the new refinery coming online only after the decrease in refining margins is expected to kick-in (2026), generating a negative ROI (25-50% through 2040)
- Local demand can be supplied through imports. A shift to imports will require investment in storage infrastructure and construction of a stand-alone bitumen plant. Construction of required investment is expected to take ~4-years.
- A partial shutdown is feasible, yet expected to impact Bazan profitability [redacted]

[redacted]

- [redacted]



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:

- Bazan's full environmental impact and compliance with regulation should be determined, as well as expected performance after full BAT/BREF implementation
- Land value estimates should be refined, taking into account the demand for real estate in the Haifa area
- Land remediation costs should be refined, accounting for site-specific factors
- Actual available storage capacity should be verified to assess the need for additional investment in storage expansion
- Detailed capex estimates for the required import infrastructure should be assessed
- The progress of LPG-to-Natural Gas substitution should be assessed to examine actual import infrastructure needs
- The European refining margin outlook should be updated to changes in the market
- Unemployment estimates should be reevaluated based on the prevailing macro-economic environment
- A detailed valuation of Bazan should be conducted to support potential compensation negotiations

Assuming the government would choose to pursue a Bazan shutdown, substantial effort would be required to ensure that all infrastructure development required to support a shift

to imports is put in place, prior to the shutdown. Such an effort would require cross-government collaboration to ensure rapid zoning, permitting, funding and construction of the required facilities. Additionally, detailed plans and execution capabilities are required to dismantle the current complex, remediate the land, and efficiently develop the released area.

We believe that several strategic initiatives can support a potential shutdown:

- Formulate a strategy for increasing EV penetration across vehicle fleets, addressing infrastructure, incentives and more
- Build a roadmap for substituting LPG with natural gas and electricity, including rapid infrastructure zoning and investments, conversion grants for industrial users, and more
- Mitigate potential spillover effects on industry by developing a strategy for industrial development, aligned with CO_2 and emission reduction targets

However, and as expressed throughout this document, 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.

****

Preparation of this document required intensive cooperation and support from a wide variety of stakeholders across both government and the private sector. We would like to thank the NEC, REMI, and the Ministries of Energy, Economy and Environmental protection for their collaboration throughout the study. We would also like to thank PEI (Tashan) for their availability and assistance along the way. Special thanks to the Bazan management team for providing us with meaningful insights and inputs, all within a very brief period of time.

Appendix

GAS-BASED OLEFINS PRODUCTION

Olefins can be produced via a methanol route, leveraging local deposits of natural gas. However, such a plant is not expected to be economically viable at Israeli natural gas prices:

- **Available technology:** Olefins are typically converted from naphtha, as a byproduct of refining processes. On-purpose olefin production can be achieved by methanol conversion. However, China is the only region currently applying this technology (coal conversion)
- **Construction cost:** Construction costs of a methanol-to-olefin plant range from $1,000-1,500 per ton.Replacing Carmel's current capacity will require investment of $600-900M
- **Feedstock prices:** Competition with crude based production requires feedstock prices of 1-2.5 USD per mmbtu, dependent upon prevalent crude prices. Planned methanol-to-olefin plants in the Persian gulf, fed with subsidized natural gas (0-1 USD per mmbtu) are expected to constrain future margins

P&L ASSUMPTIONS

General:

- [redacted]
  - [redacted]
- Discount period of 23 years (2018-2040)
- Inflation of 2%
  - Based on the Bank of Israel inflation target of 1-3%
- Terminal value
  - Assume terminal value based on turnaround and maintenance cost depreciated to 1 year
- [redacted]
- [redacted]

Refinery:

- Gross margin
  - NWE Brent hydrocracking margin; delta of margin outlook applied to 2017 EBITDA to project future EBITDA
  - Gross refining margin on a variable cash basis (product revenue net of variable operating costs (chemicals, catalysts, utilities) and crude and other feedstock costs
- Europe product demand
  - -0.7% demand growth from 2020-2040 in the Base Case and -0.3% in the High Demand Case ("High Case")

Chemical:

- Aromatics gross margin
  - Based on IHS estimate for benzene and xylene to 2022; reverts thereafter to long run average taking into account cyclicality
- Polymer gross margin

- IHS outlook on Western Europe LDPE to naphtha price differential plus stand alone PP margin – both to 2022; reverts to long run historical average thereafter

GOVERNMENT CASH FLOW ASSUMPTIONS:

Revenues from land sale:

- Release land yields 50-100k residential units, depending upon scenario
- Units are valued ILS 150-200k per unit
- Units are marketed at a rate of 1,500-2,500 units per year
- Land value is not discounted, as the discount factor is offset by increasing land value