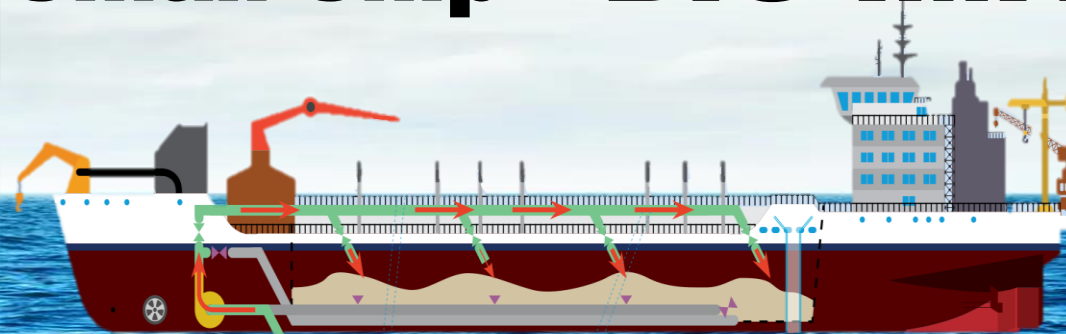


# THE LITTLE SHIP THAT GOT AWAY



## Small Ship – BIG IMPACT



May 25-27th, 2022

Presented by:

Dr. Elyakim BenHakoun

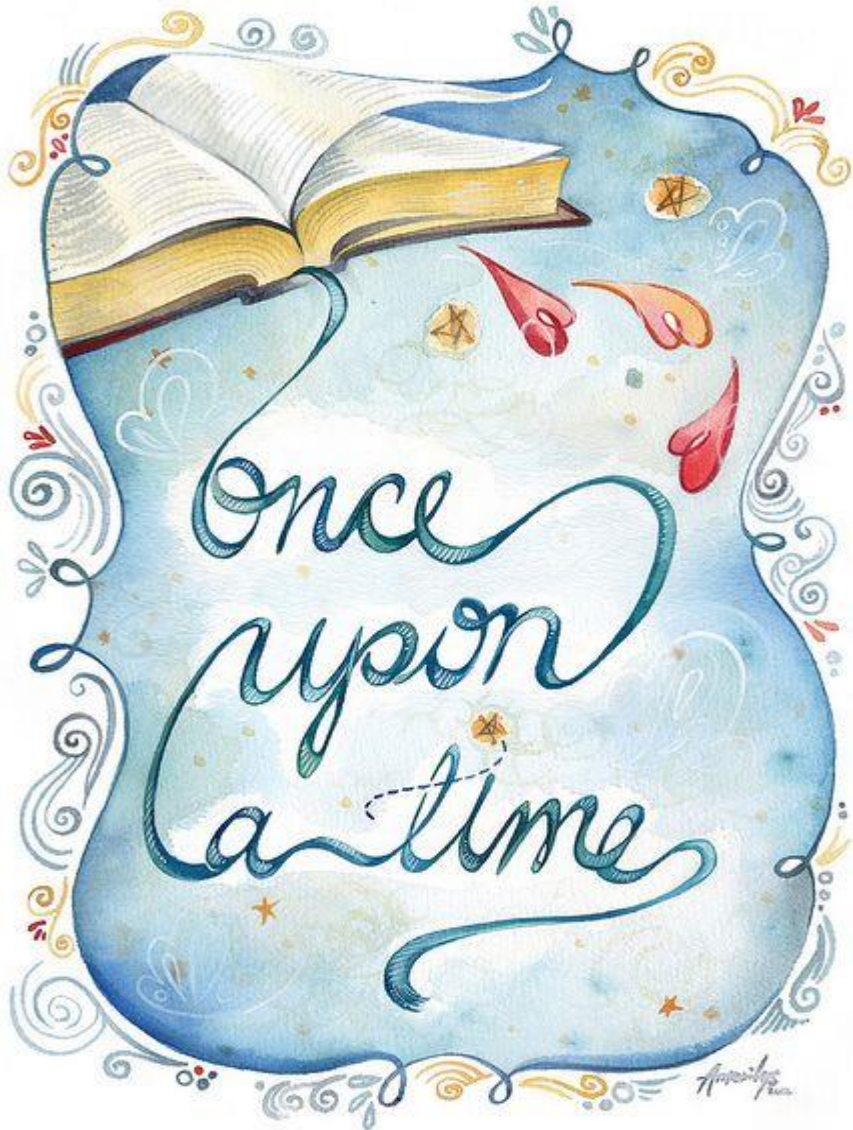
PhD Dissertation Advisors:

Prof. Yoram Shiftan

Prof. Eddy Van De Voorde



**2022**  
**I-NUF**

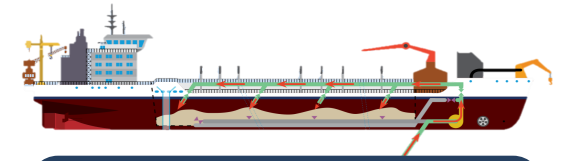
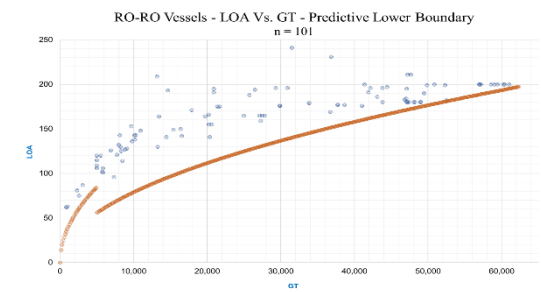
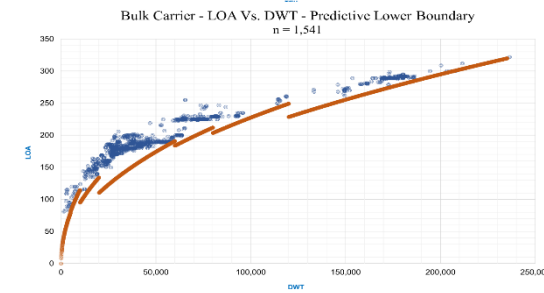
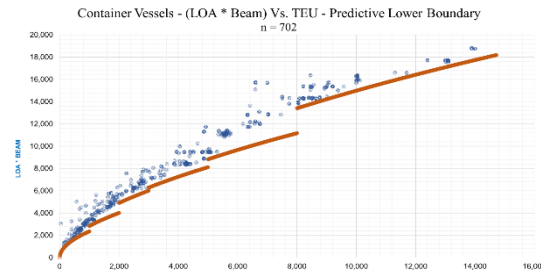


So like every good story.. Our story have an opening of fairytale and ending suitable for an investigation documentary TV program

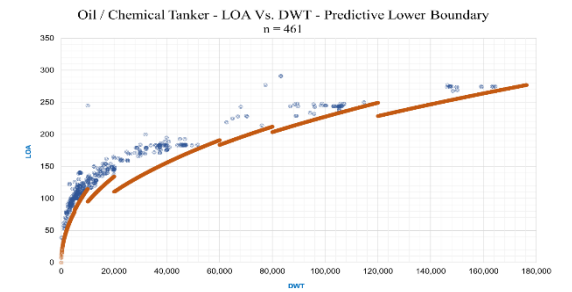
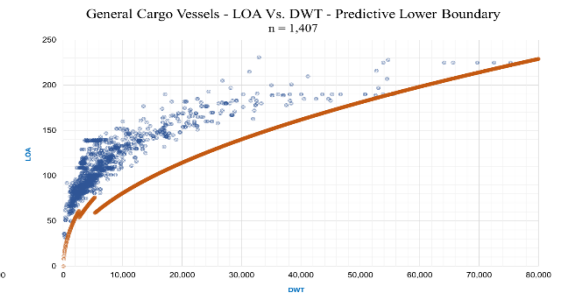
This is a study of a “little office” that tries reducing emission levels in Haifa and its suburban residential areas on an everyday basis, but almost never succeeds.

So, it declares and activates a Low Emission Zone (LEZ) program and waits and waits and waits..

Until one special day when a single ship leaves the area and emission levels fade away...



## TSHD Anomaly Engine Power vs LOA/Beam Duration of stay



# Outline

**Motivation**

**Research Objectives**

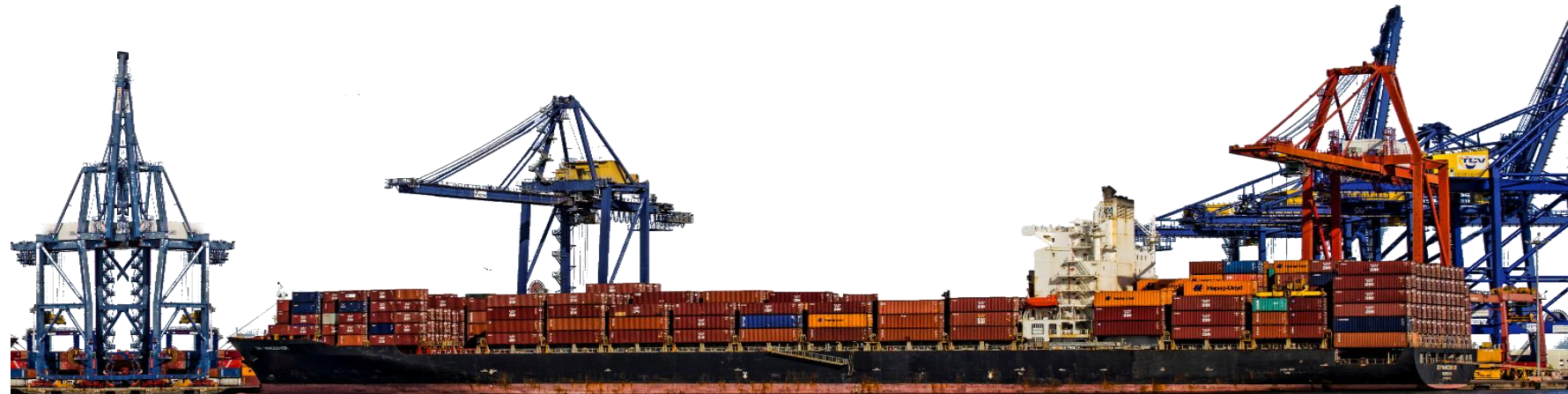
**Methodology (Model framework)**

**Case study – TSHD & Haifa LEZ Program**

**Empirical Work – Results**

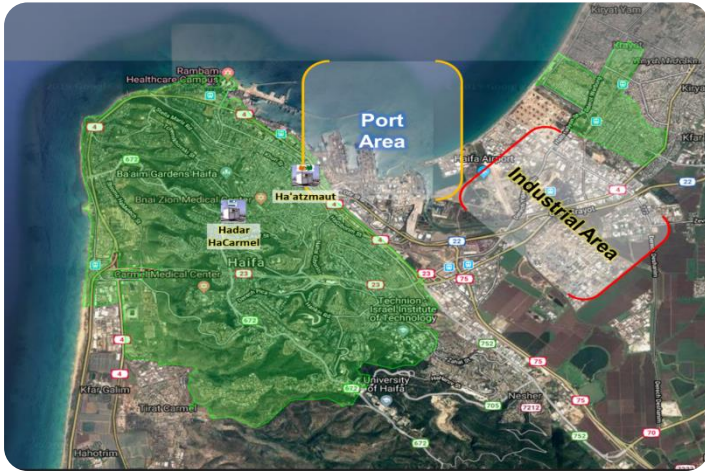
**Conclusions & Policy Recommendation**

**Discussion**

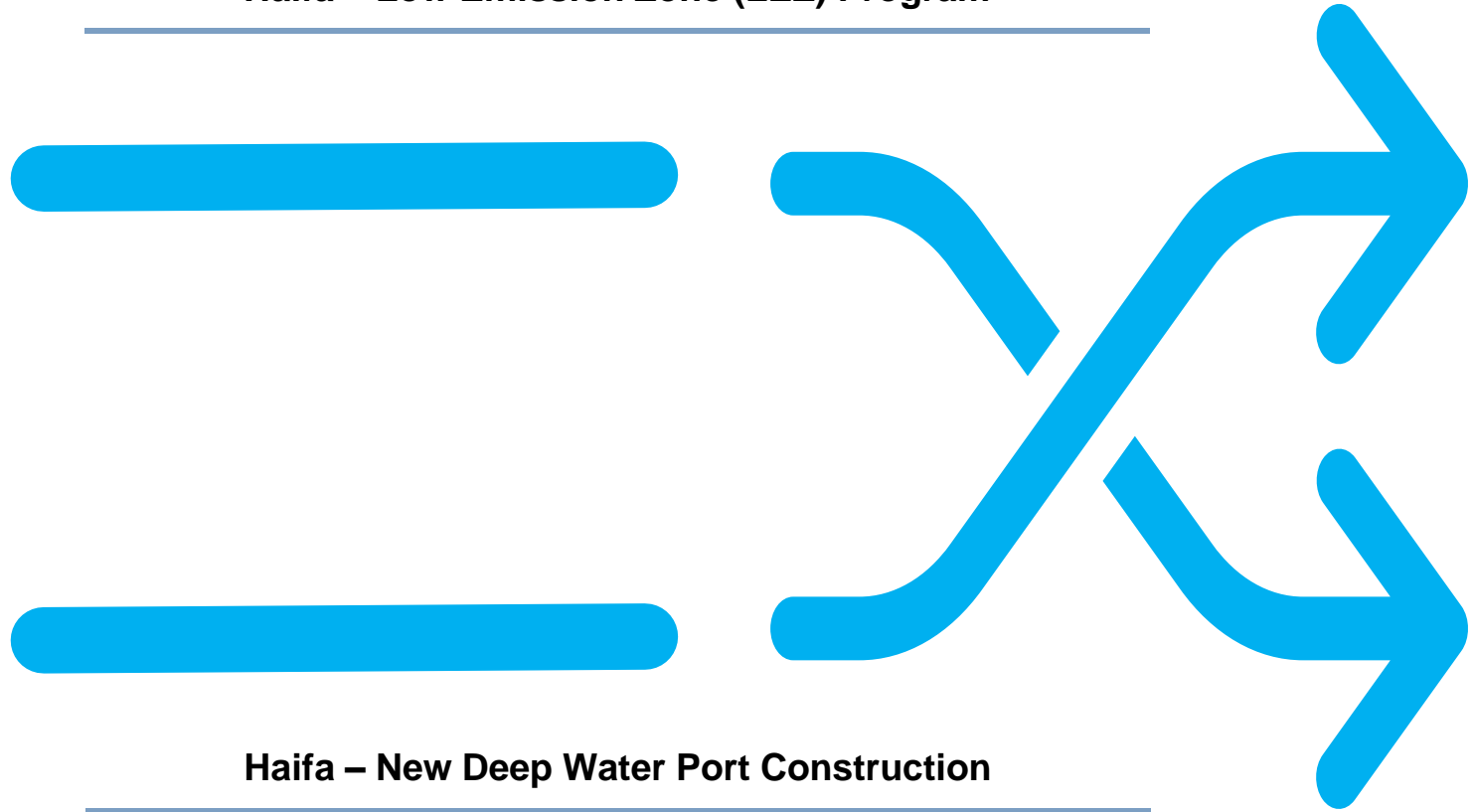


# Motivation

## Timeline - Outline



### Haifa – Low Emission Zone (LEZ) Program



### Haifa – New Deep Water Port Construction



# Motivation

The Haifa Bay Area One of the Most Polluted Places in Israel

## Haifa – Low Emission Zone (LEZ) Program



## LEZ Enforcements Actions

Source: "HaifaHaifa", 2019



Funding investment of 62 million NIS (~23M\$).

- Subsidizes incentive for traffic diversion (trucks – tunnel).

- Fully electric buses - 25



- Installing SCR gradually ~700



- Subsidization of natural gas retrofit ~ 12 trucks

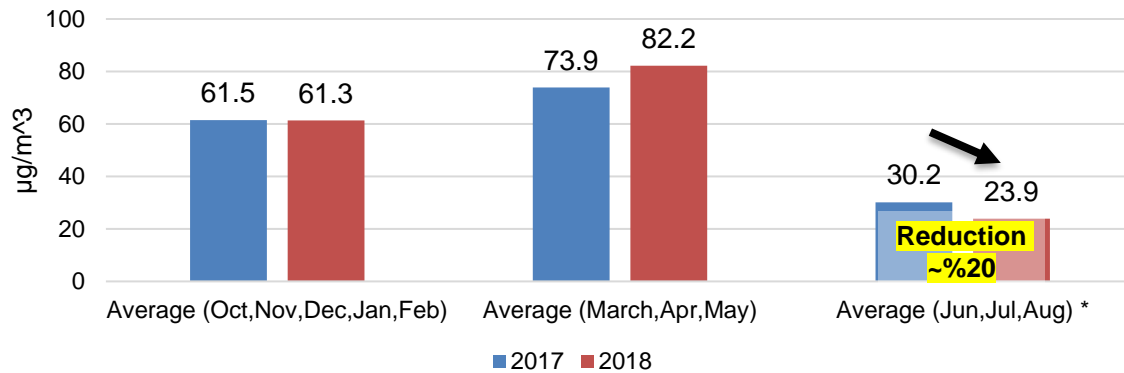


# Motivation

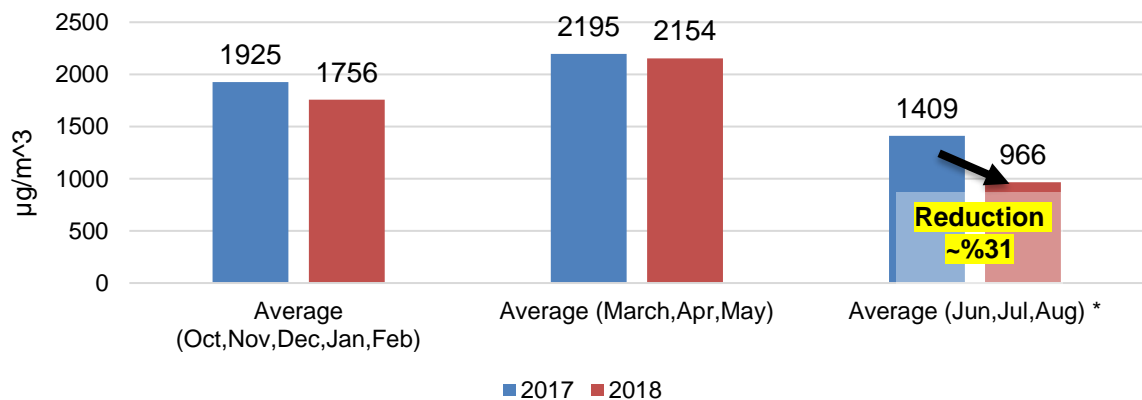
## Haifa Low Emission Zone (LEZ) Program

### Haifa Low Emission Zone (LEZ) Program

Ha'atzmaut (Haifa) BC



Ha'atzmaut (Haifa) NOx



### LEZ Enforcements Actions

Source: "HaifaHaifa", 2019



### Funding investment of 62 million NIS (~23M\$).

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- Fully electric buses - 25



- Installing SCR gradually ~700



- Subsidization of natural gas retrofit ~ 12 trucks



# Motivation

## New Port - Environmental Impact Assessment (EIA) & Environmental Management Program (EMP) Reports

### New Port - EIA Report - Haifa & Ashdod – Air Quality

#### Changes in Air Quality Only Four Major Factors

- Increase in trucks operation
- Increase in heavy machinery equipment.
- Dust plumes – stones storage / concrete plant.
- Dust plumes - unloading stones / concrete

No effect on air quality is expected in the area (both for Haifa and Ashdod (DHI 2013a, 2013b, 2013c).



Source: The Israel Ports Development & Assets Company publication

### Israel MoEP Professional Team Members

- Haifa district MoEP manager
- Israel Marine Environment Protection Division general manager (MoEP)
- Israel Ports general manager
- Senior Deputy Director General for Policy and Planning at MoEP
- Head of Environmental Planning and Green Building Division at MoEP

The expected deviation in the total emission (i.e., NO<sub>x</sub>, TPM etc.) concentration in the area, due to the construction of the new ports are in normal range.

These deviations are insignificant and therefore, should be disregarded. (MoEP 2015a).



# Motivation

## Haifa New Port EIA & EMP Reports



### Haifa New Port - TSHD Vessel ID

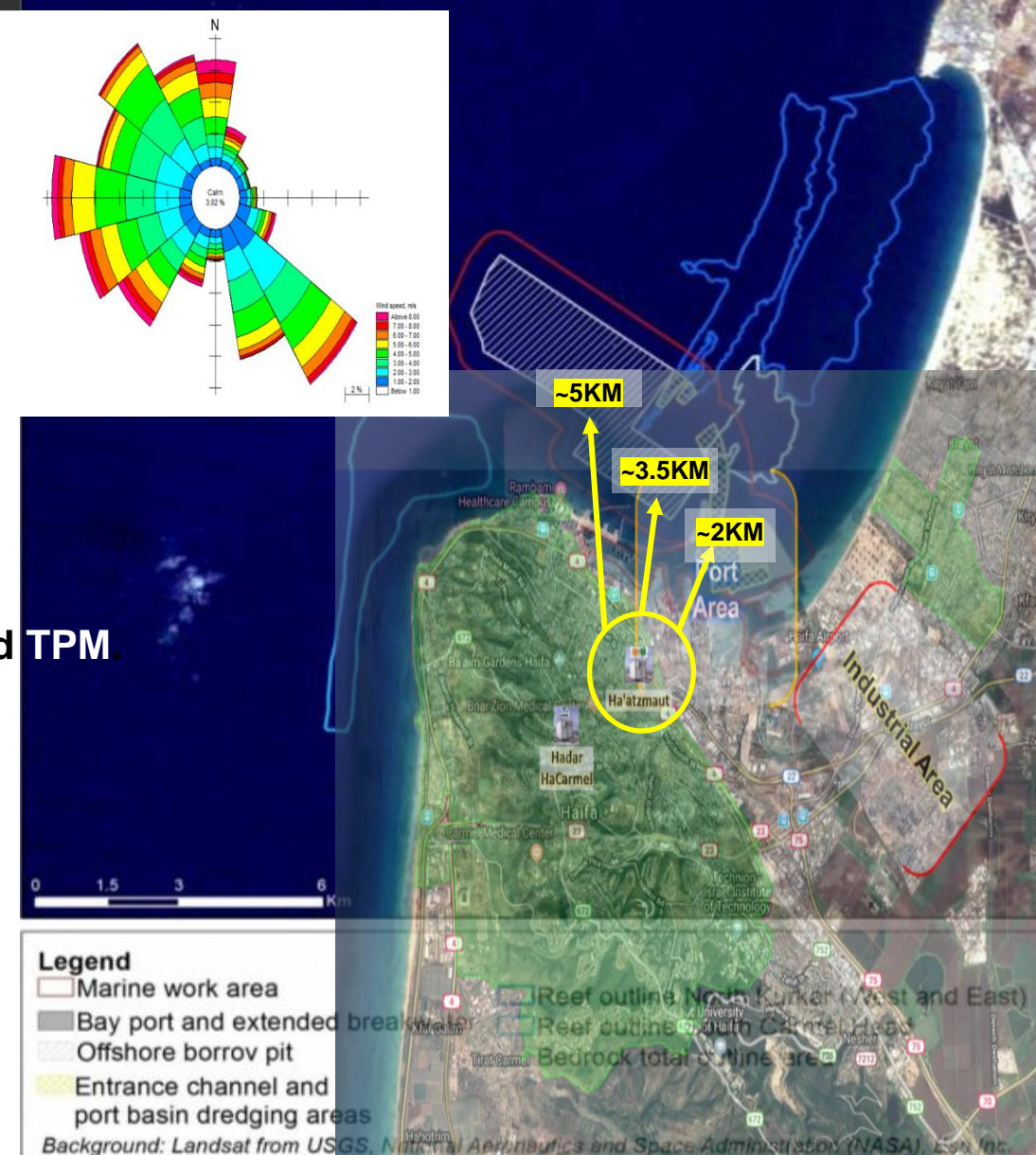
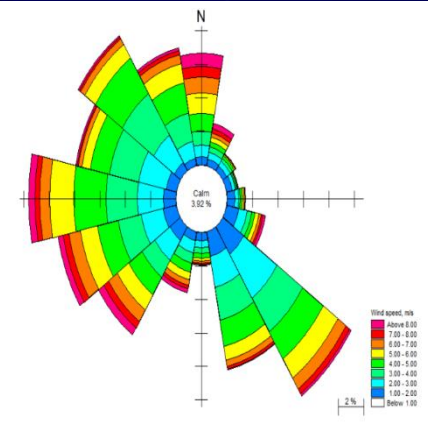
- IMO - 8110851
- Name - “Shahaf”
- Built - 1982
- Hopper Capacity - 8530 m<sup>3</sup>
- Total Install Power ~ 12,658 Kw
- Owners - Join (Boskalis & IPC)
  
- Work period:
  - 01-04-2016 28-06-18
  
- Engine - 2XHSD ME 4-Stroke
- Engine Tier - 0
- Exhaust Boiler - Y
- Fuel Type: HFO
- Sulfur Content: **3.5% (taken ~3%)**
- NOx /SOx - Uncontrolled



Ministry of Environmental Protection

# TSHD vs. LEZ Program - Scope of Study

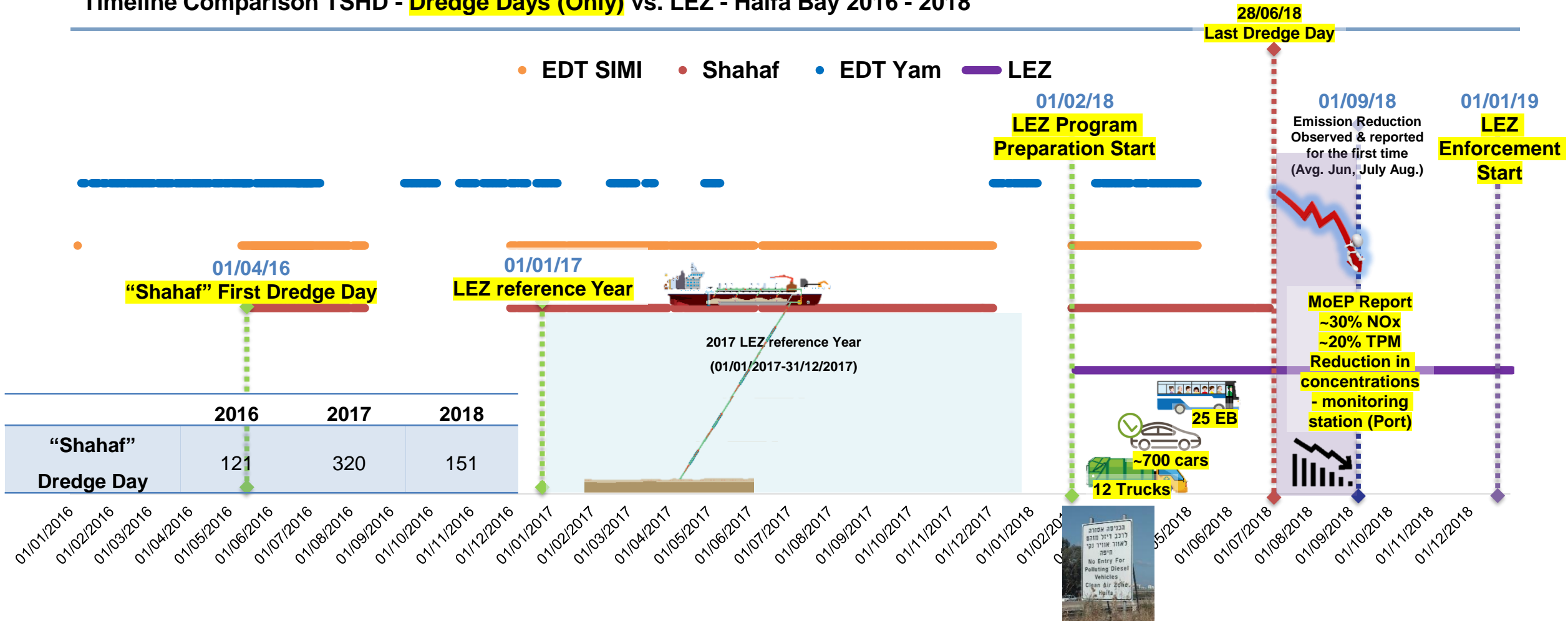
- Areas of focus: Haifa and Surrounding
- Vessels type of focus: **TSHD only.**
- Year of observation: **2016 till 2018**
- Motivations: **Gap in knowledge, Data availability**
- Emission type of focus:
  - Common Air Contaminants (CACs) - **SO<sub>x</sub>, NO<sub>x</sub>, CO, HC and TPM.**
  - Greenhouse Gases (GHGs) - **CO<sub>2</sub>**
- **Objective - Is the LEZ Success Claim True?**
- **Methodology -TSHD vs. Total Industry, Energy & LT**



# TSHD vs LEZ Program - Haifa Bay

Timeline Comparison - Dredge Days Only vs. LEZ Operational & Enforcement

Timeline Comparison TSHD - **Dredge Days (Only)** vs. LEZ - Haifa Bay 2016 - 2018

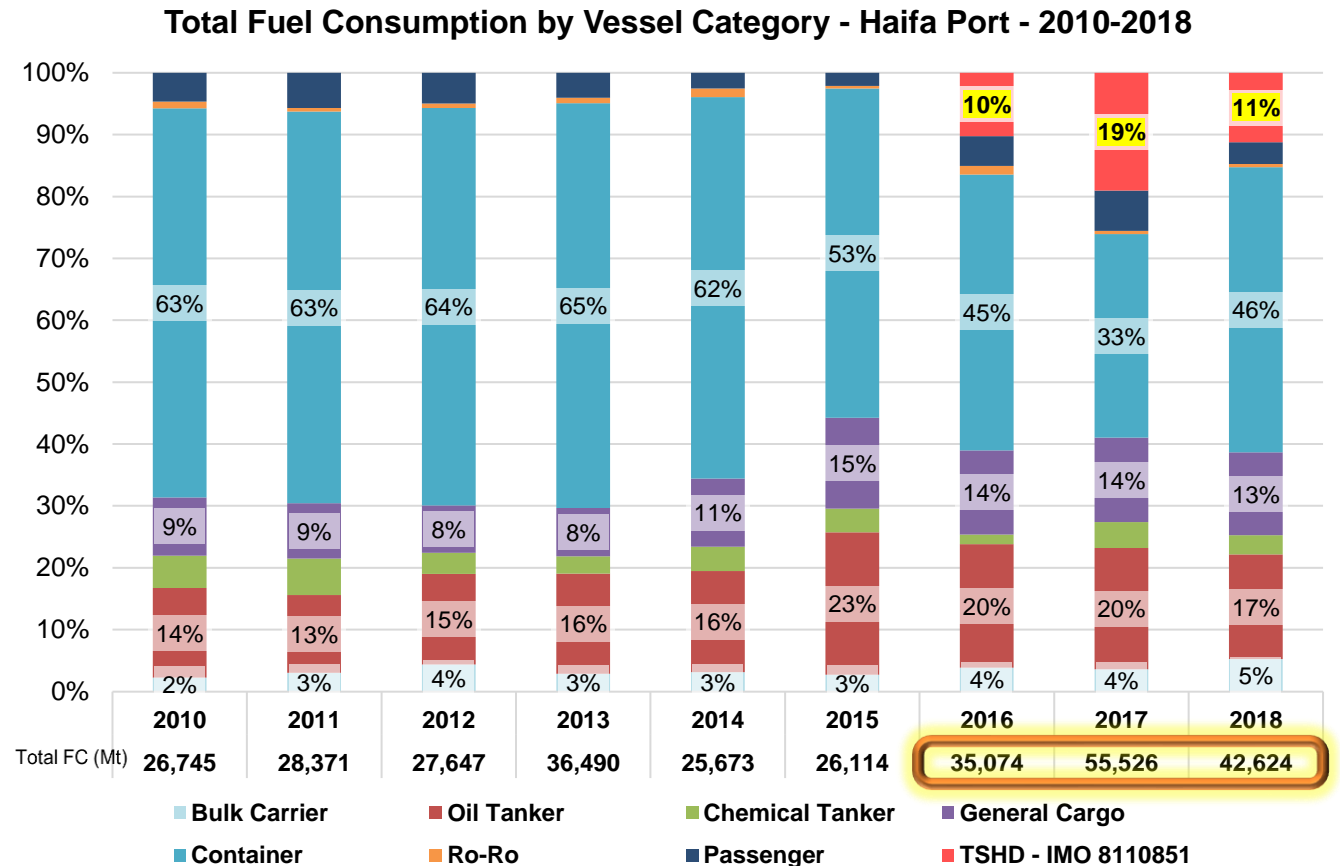
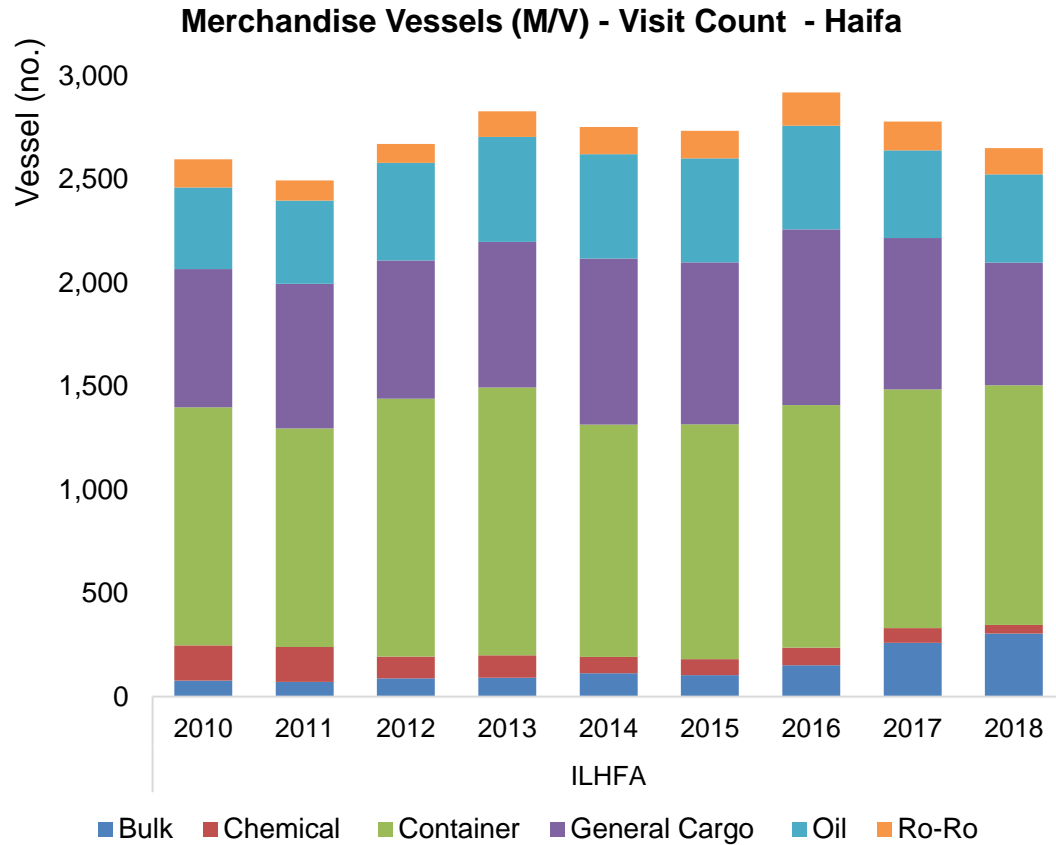


Source: Own composition – Data collected from and was based on Shahaf’s crew, dredge work log

# Haifa Port

## Overview

### Haifa Port - Vessel M/V & TSHD ("Shahaf") - Statistics Call and Total Fuel Consumption (Mt) - (2010-2018)



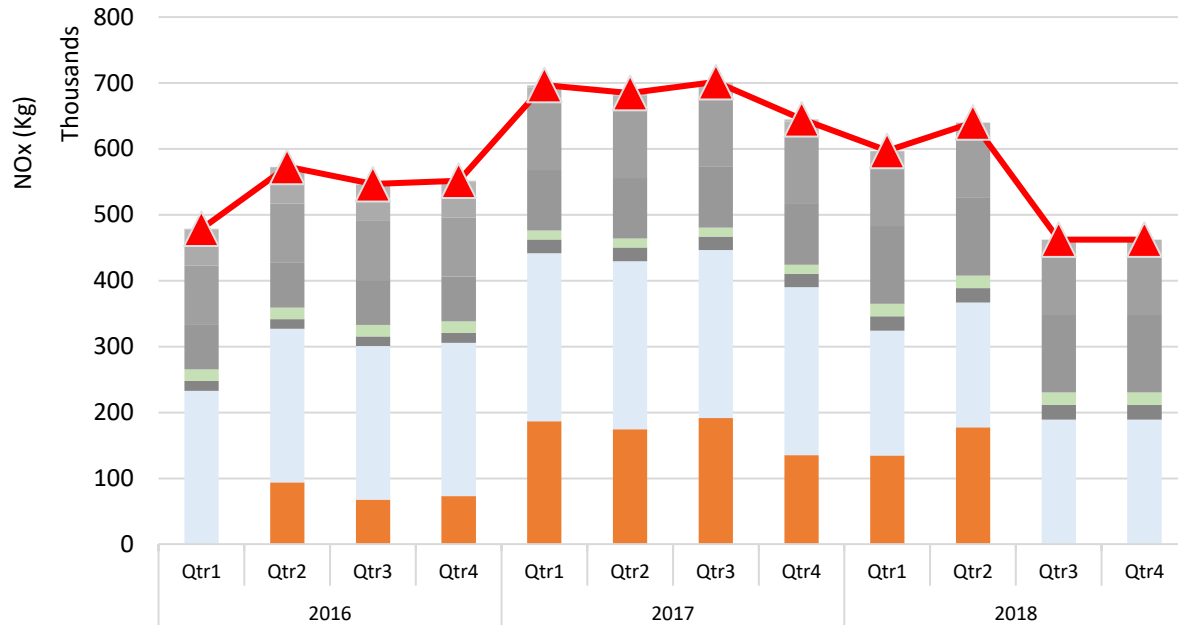
2013, 2017-2018 - Increase in annual FC due to increase in waiting time - Employee Sanctions ("Ports Reform")  
 Average annual OGV FC within port ~28K MT (excluding 2016-18) – vs. TSHD 2017 FC 10.5K MT >> 1/3 Total port FC (regular year)

# TSHD Emission Inventory

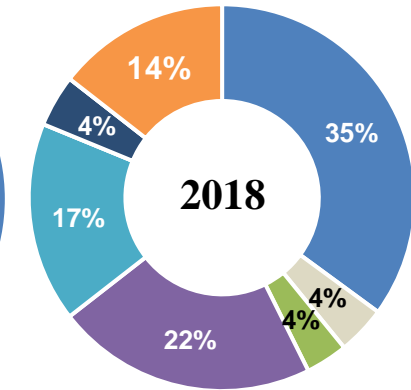
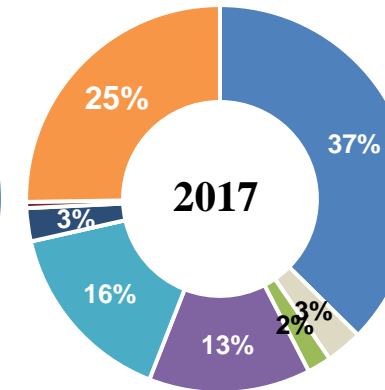
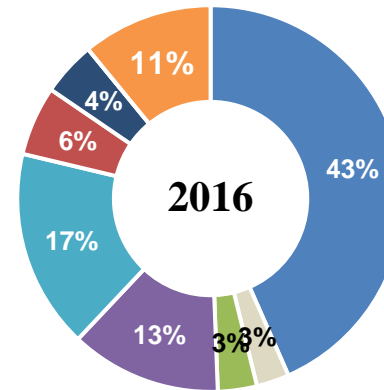
## Haifa Bay, NOx Emission by Contributors

Haifa Total Inventory NOx (Kg) - Industrial Area, Power Station vs. TSHD (2016-2018)

	2016	2017	2018
"Shahaf" Dredge Day	121	320	151



- Transportation
- Gadiv Petrochemical Industries Ltd
- Carmel Olefins (Bazan Group) Ltd
- ICL Fertilizers Ltd
- BAZAN Group - Oil Refineries Ltd
- NOx Accumulative
- Haifa Region Association of Towns - Sewerage Treatment
- Haifa Chemicals - Production Ltd
- Israel Electric Corporation Ltd - Haifa Power Station
- Shemen Industries Ltd
- Shahaf - TSHD IMO 8110851



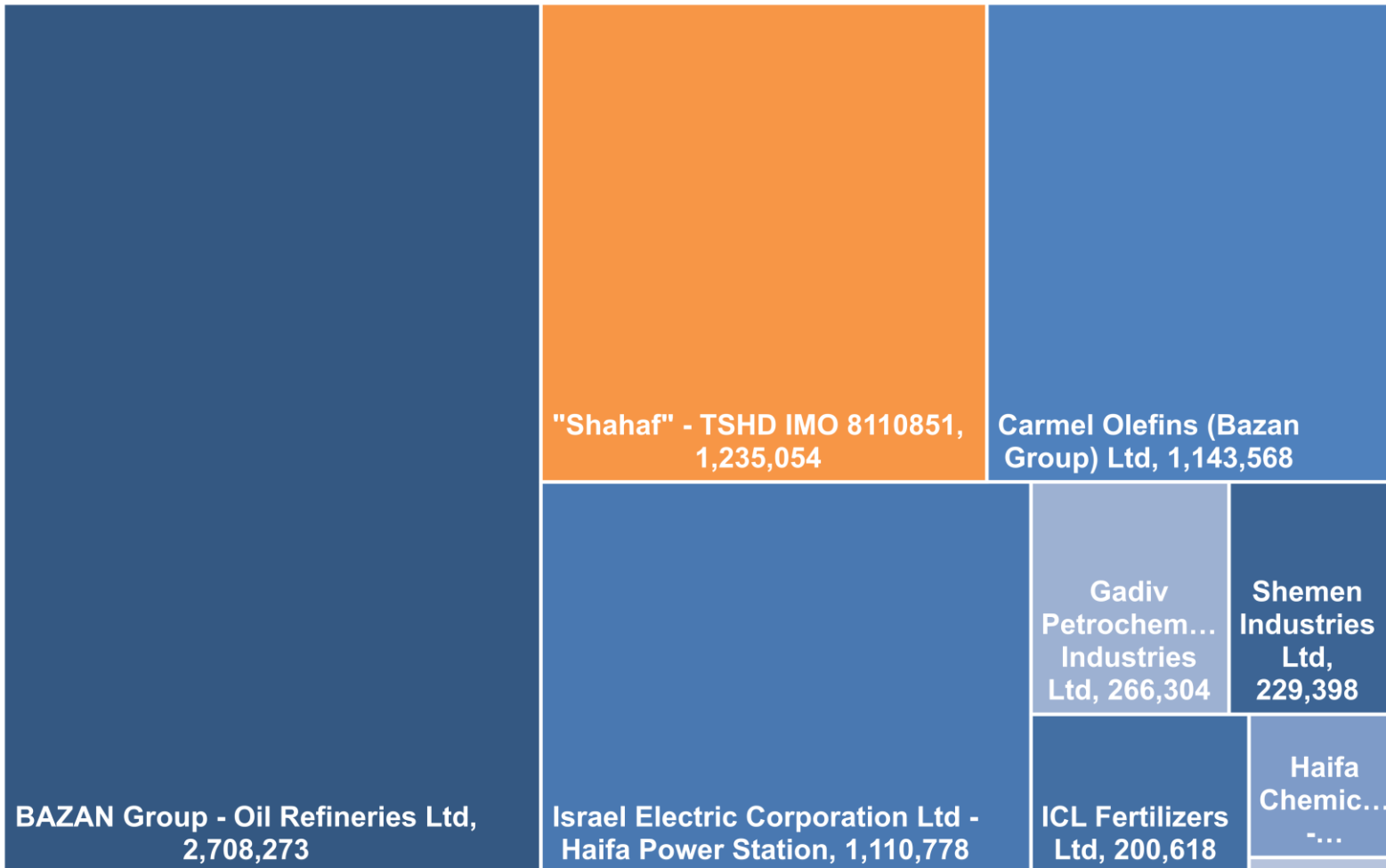
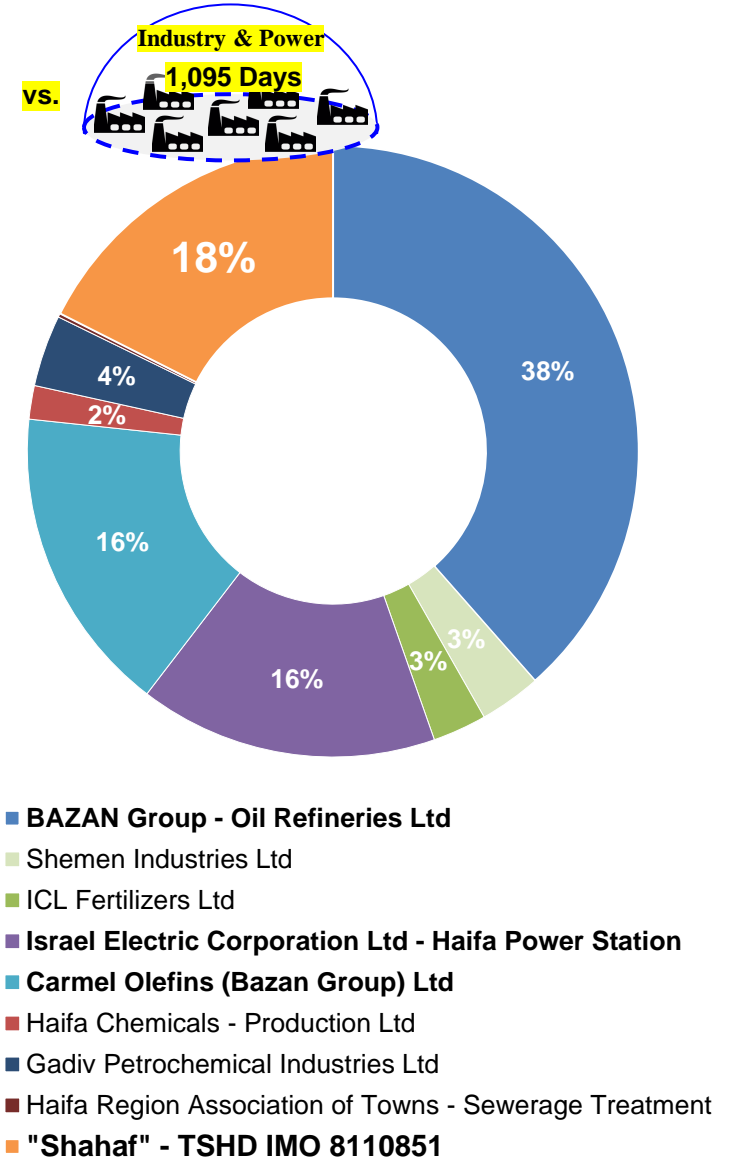
- BAZAN Group - Oil Refineries Ltd
- ICL Fertilizers Ltd
- Carmel Olefins (Bazan Group) Ltd
- Gadiv Petrochemical Industries Ltd
- "Shahaf" - TSHD IMO 8110851
- Shemen Industries Ltd
- Israel Electric Corporation Ltd - Haifa Power Station
- Haifa Chemicals - Production Ltd
- Haifa Region Association of Towns - Sewerage Treatment

Source: Own composition, Emission data regarding industrial sources and power station based on Israel MoEP PRTR inventory database

# TSHD Emission Inventory

Haifa Bay, NOx Emission by Contributors

NOx (Kg) - All Known Sources - Haifa Bay - 2016 till 2018 (Cumulative)

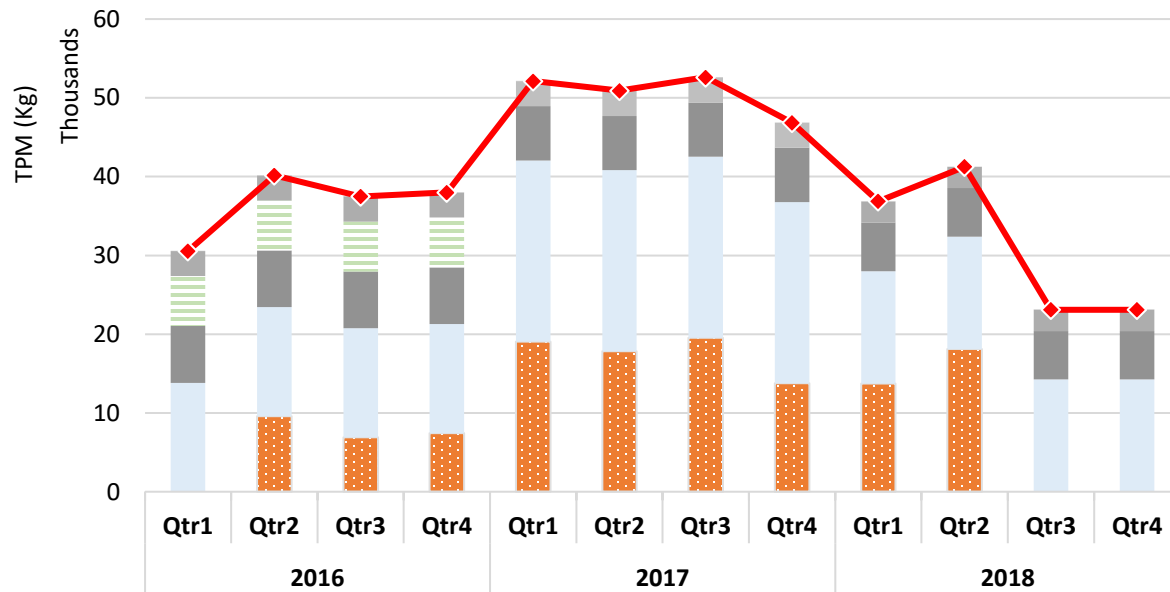


# TSHD Emission Inventory

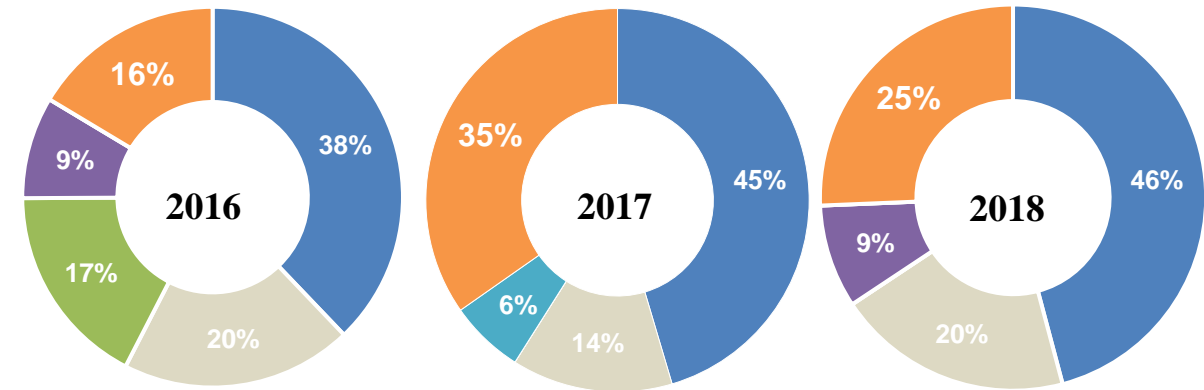
Haifa Bay, TPM Emission by Contributors

Haifa Total Inventory TPM (Kg) - Industrial Area, Power Station, LT vs. "Shahaf" TSHD

	2016	2017	2018
"Shahaf" Dredge Day	121	320	151



- "Shahaf" - TSHD IMO 8110851
- BAZAN Group - Oil Refineries Ltd
- Shemen Industries Ltd
- Transportation
- Israel Electric Corporation Ltd - Haifa Power Station
- Haifa Chemicals - Production Ltd
- Carmel Olefins (Bazan Group) Ltd
- ◆— TPM Accumulative

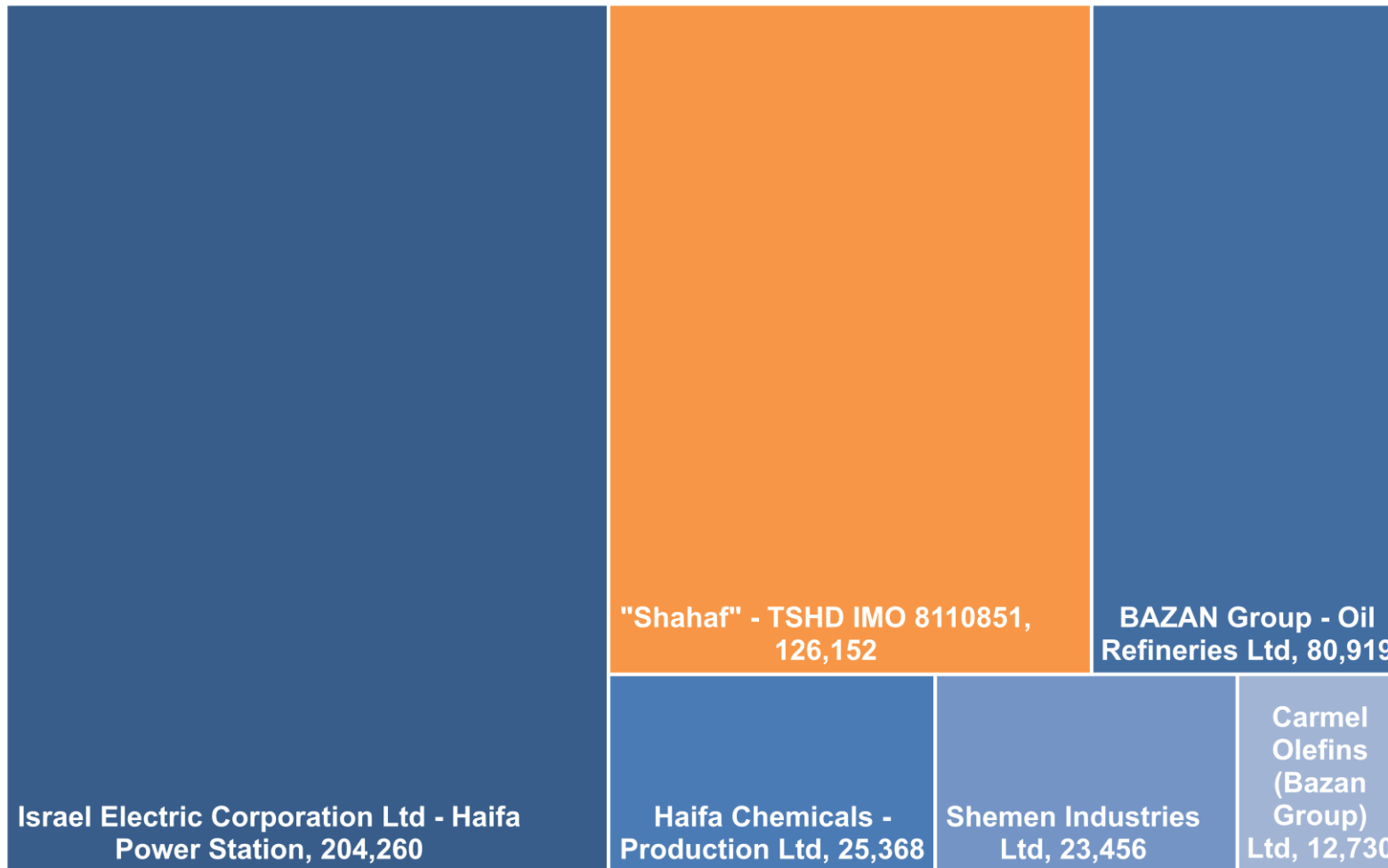
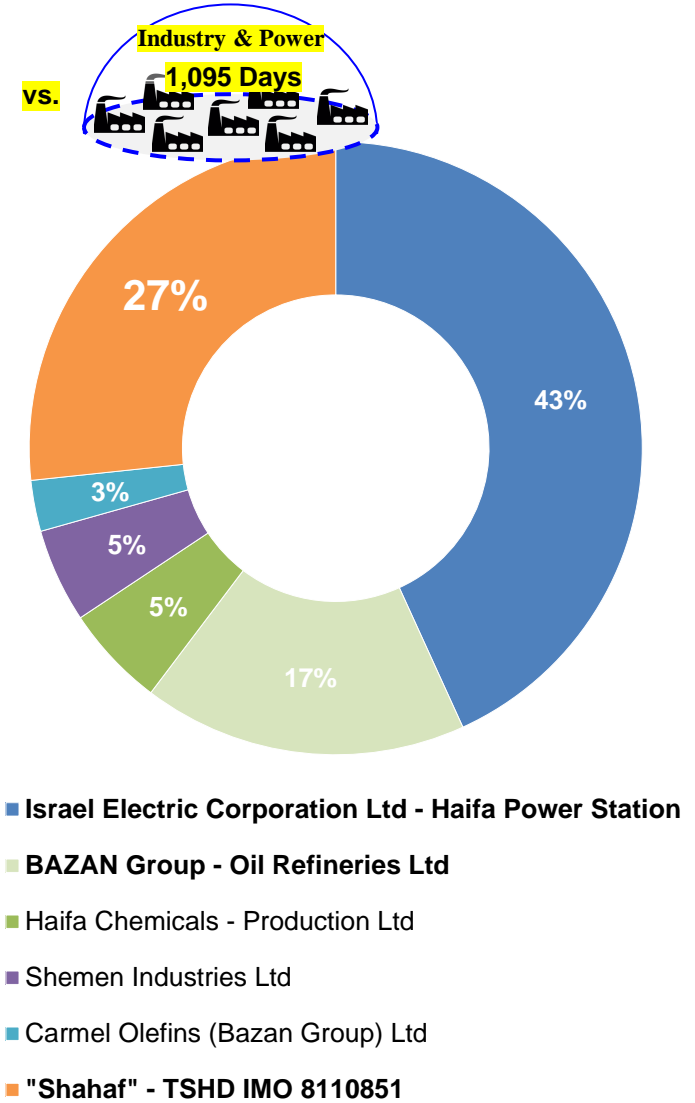
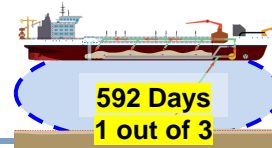


- Israel Electric Corporation Ltd - Haifa Power Station
- Haifa Chemicals - Production Ltd
- Carmel Olefins (Bazan Group) Ltd
- BAZAN Group - Oil Refineries Ltd
- Shemen Industries Ltd
- "Shahaf" - TSHD IMO 8110851

# TSHD Emission Inventory

Haifa Bay, TPM Emission by Contributors

TPM (Kg) - All Known Sources - Haifa Bay - 2016 till 2018 (Cumulative)



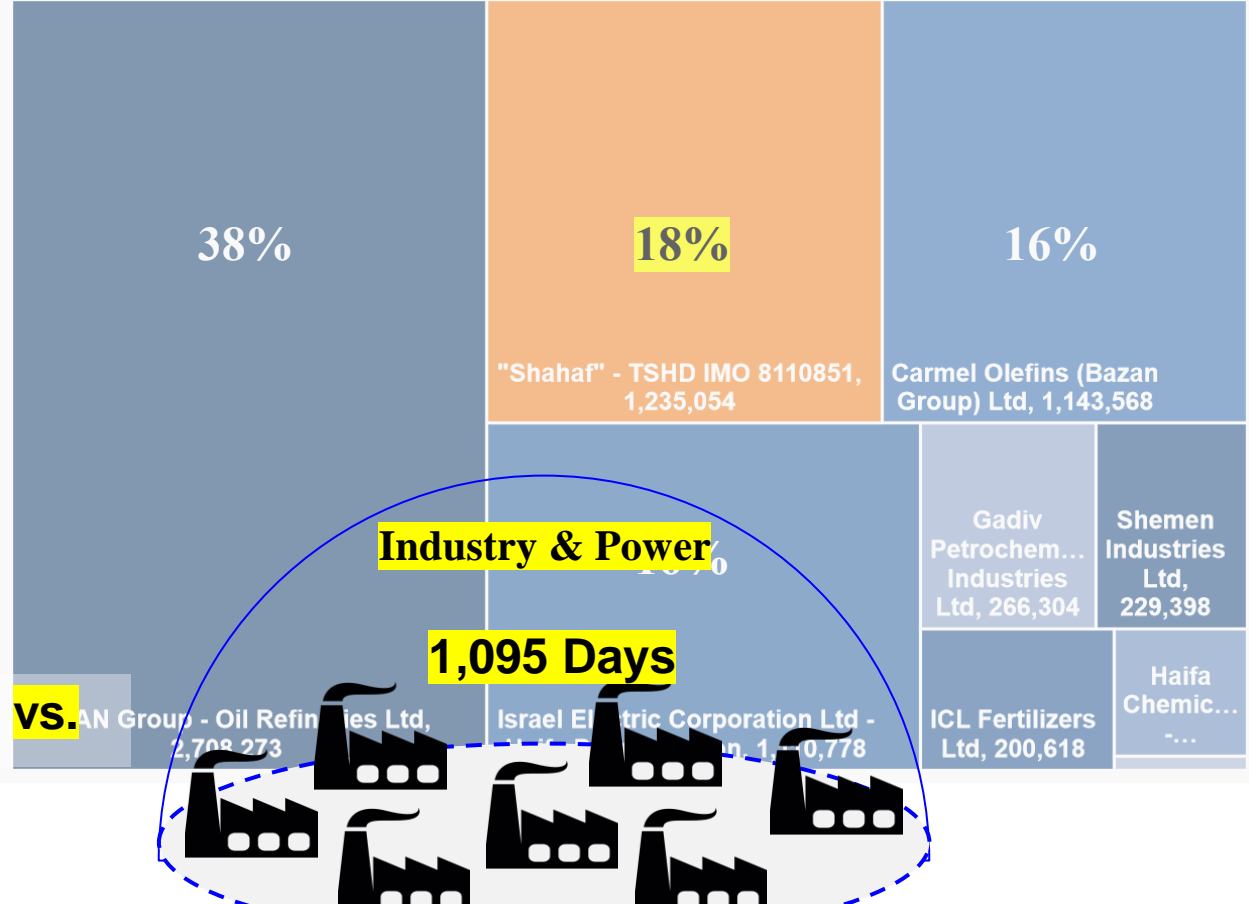
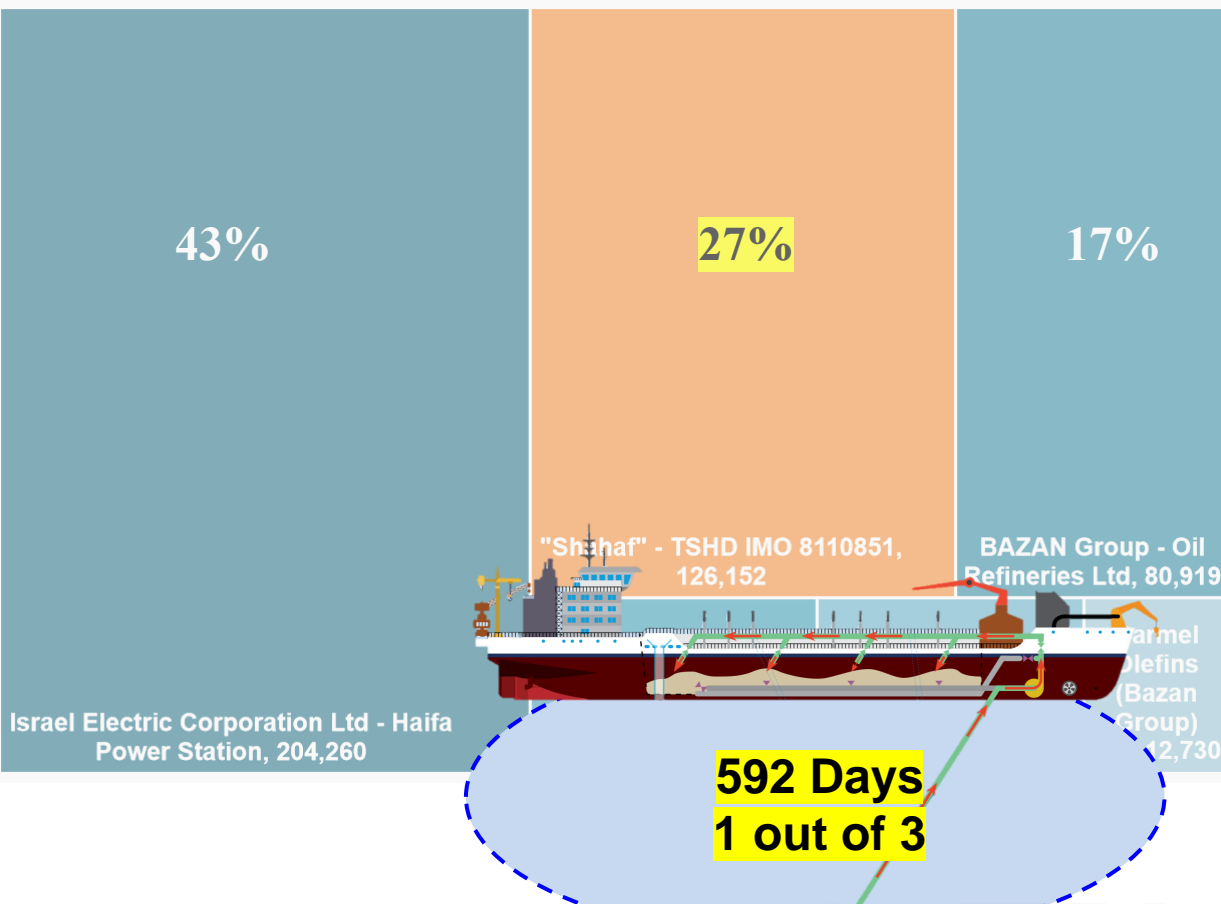


# Motivation

The Haifa Bay Area One of the Most Polluted Places in Israel

TPM (Kg) - All Known Sources - Haifa Bay 2016-2018 (Cumulative)

NOx (Kg) - All Known Sources - Haifa Bay 2016-2018 (Cumulative)



# Lebanon War Period - 12/07-14/08/06



@ IDF (2006)



Atmospheric Environment  
Volume 42, Issue 3, January 2008, Pages 428-440



## The impact of a forced reduction in traffic volumes on urban air pollution

Yuval <sup>1</sup> & <sup>2</sup>, Bernada Filcstein <sup>3</sup>, David M. Broday <sup>4</sup>

Show more

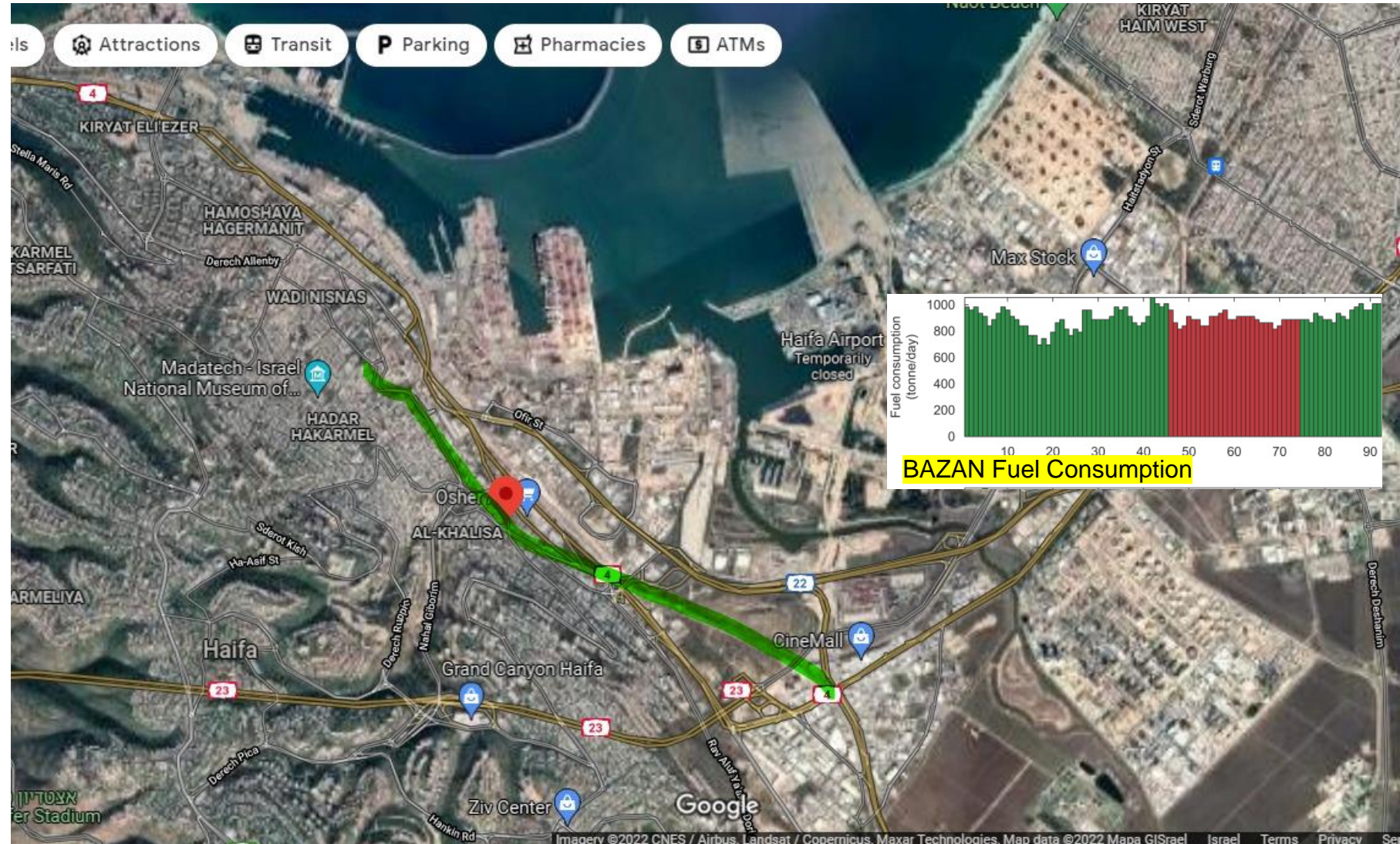
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<https://doi.org/10.1016/j.atmosenv.2007.09.066>

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### Abstract

The Middle East military conflict of summer 2006 resulted in a few weeks in which the city of Haifa, Israel, and its environs experienced very profound variations in the commercial and personal activities. Large industrial plants continued almost normal operations but activities of small scale industry, shopping, and personal commuting were drastically reduced, leading to a dramatic decrease in the commercial and personal traffic volumes. This period of reduced activity serves as a real life experiment for assessment and demonstration of the impact that human activity, and mainly road traffic, may have on the air pollution levels in a bustling middle-sized city. The analysis is made especially sharp and reliable due to the abruptness of the beginning and the end of the reduced activity period. The results of the study are summarized in the following table for the summer



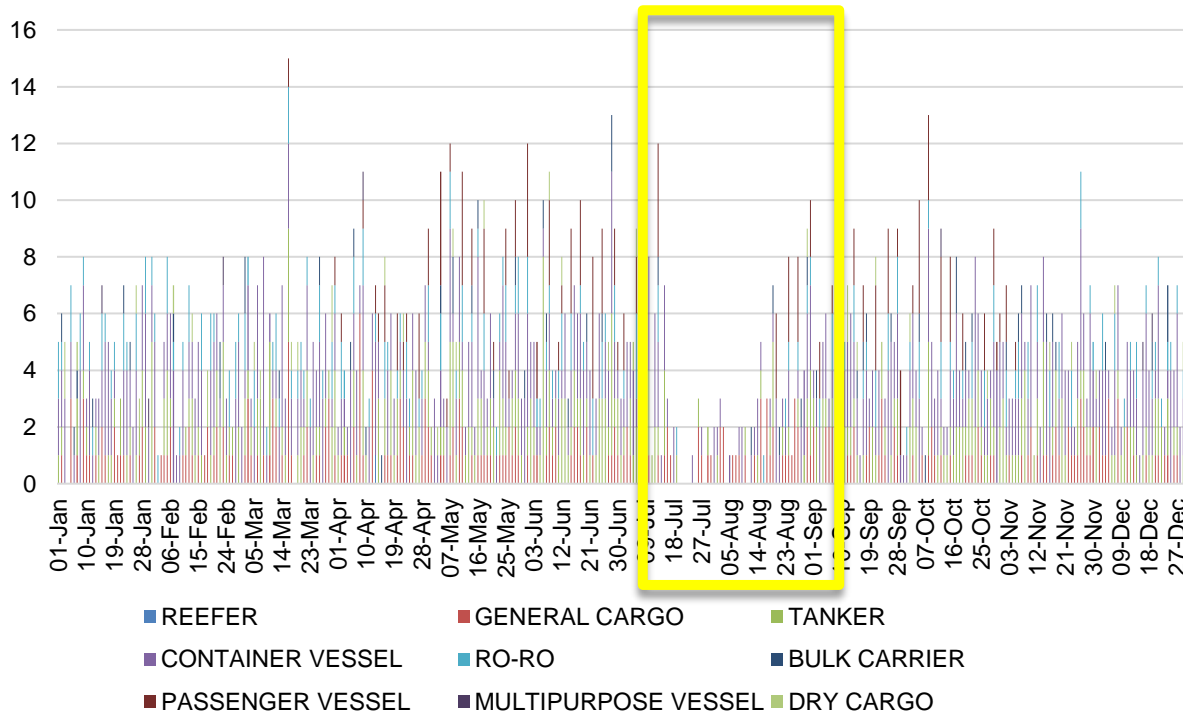
# Lebanon War Period - 12/07-14/08/06

## Port of Haifa vs. Ashdod Visit Count Comparison

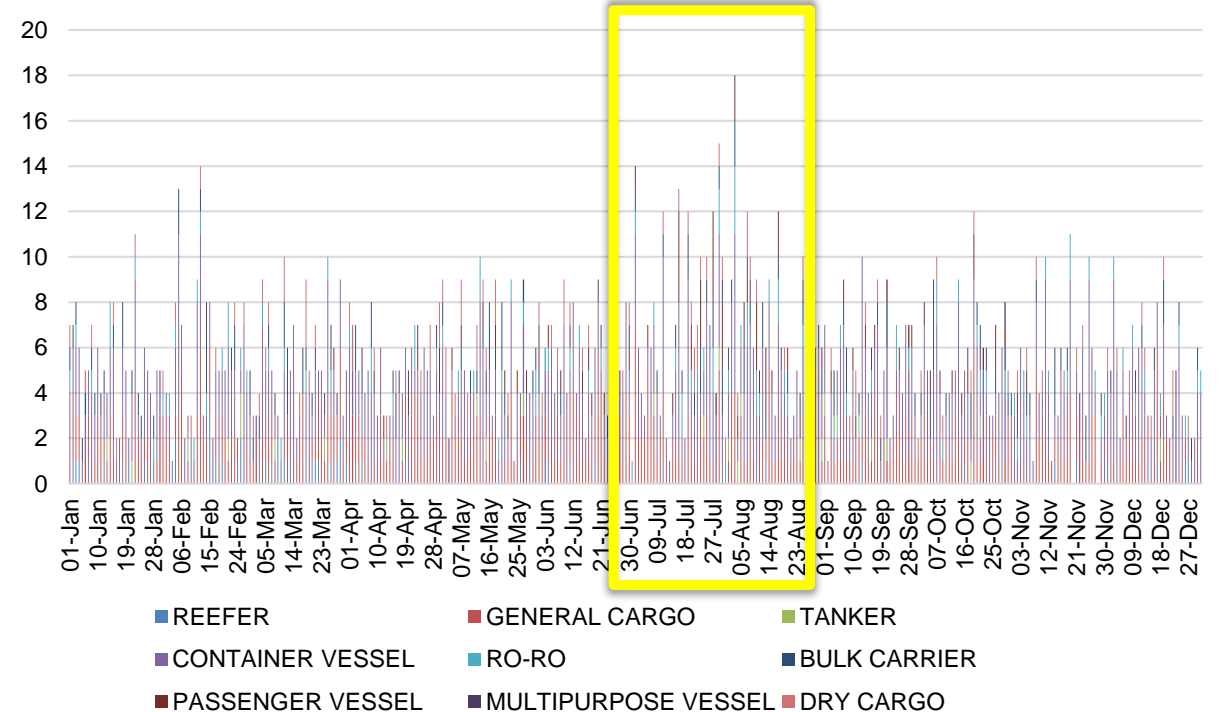
### Port of Haifa – 2006 Lebanon War - Fast Facts

The port of Haifa has been shut down completely.  
 All vessels (anchorage and port) were diverted to Ashdod Port (Sharvit 2009).  
 Port re-open handled only essential materials (1-2 vessels per day).

Port of Haifa - Visit Count - 2006 Daily Analysis



Port of Ashdod - Visit Count - 2006 Daily Analysis



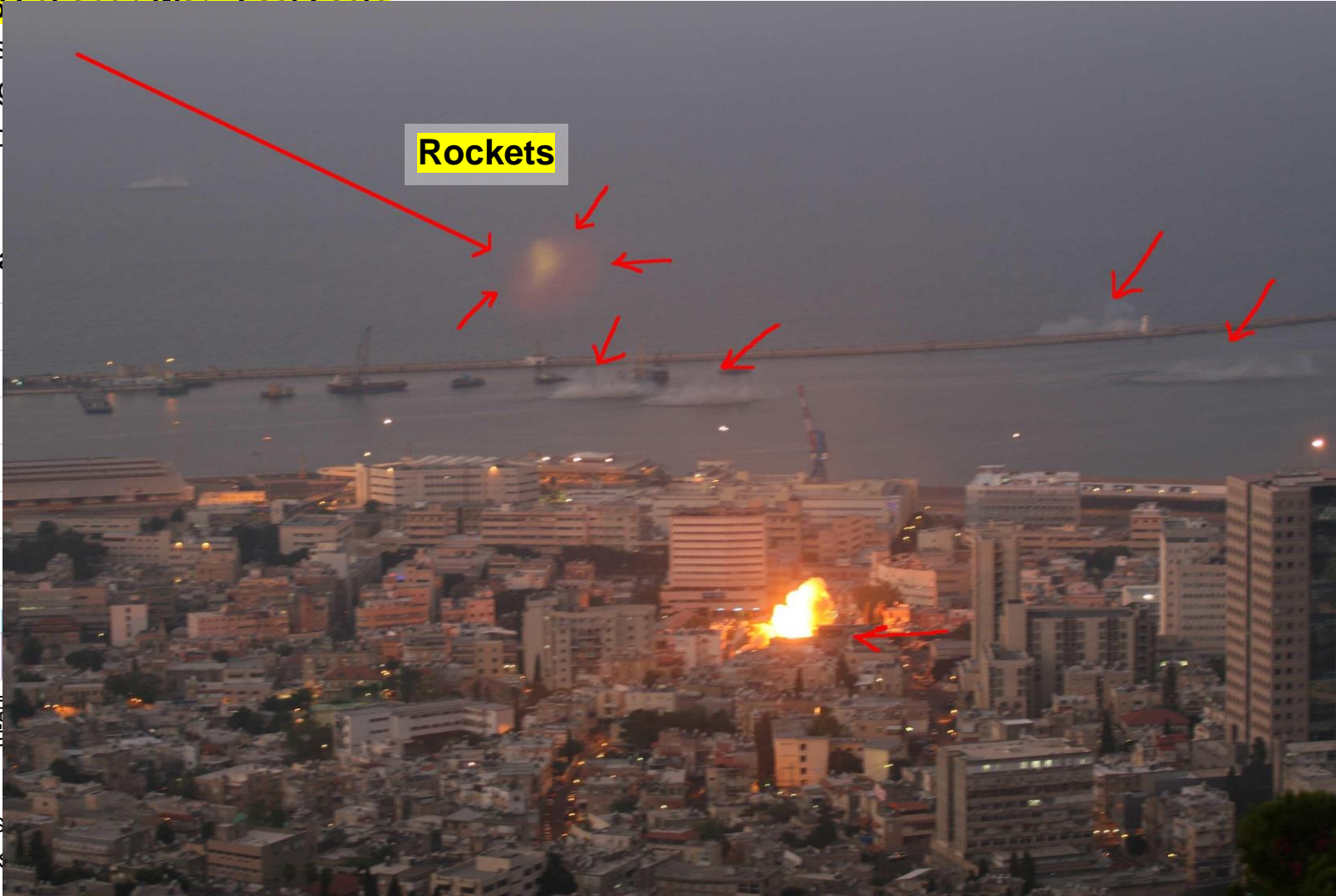
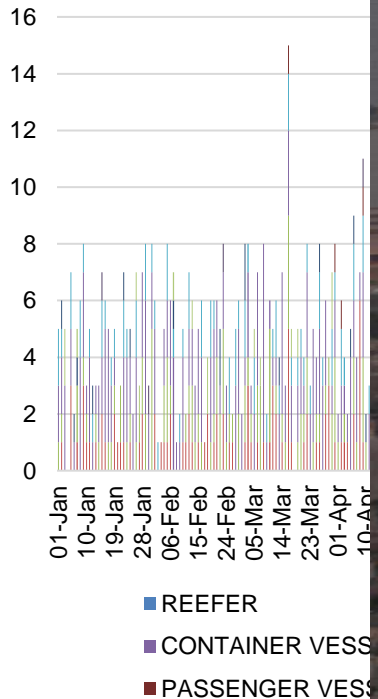
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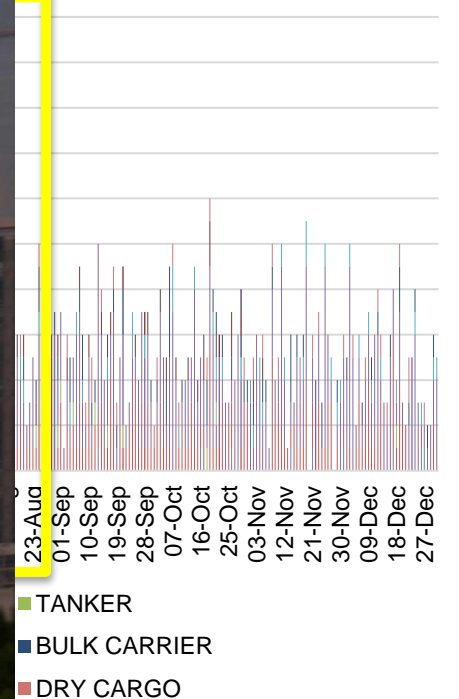
### Port of Haifa – 2006

The port of Haifa has  
All vessels (anchorage  
Port re-open handled

Port of Haifa



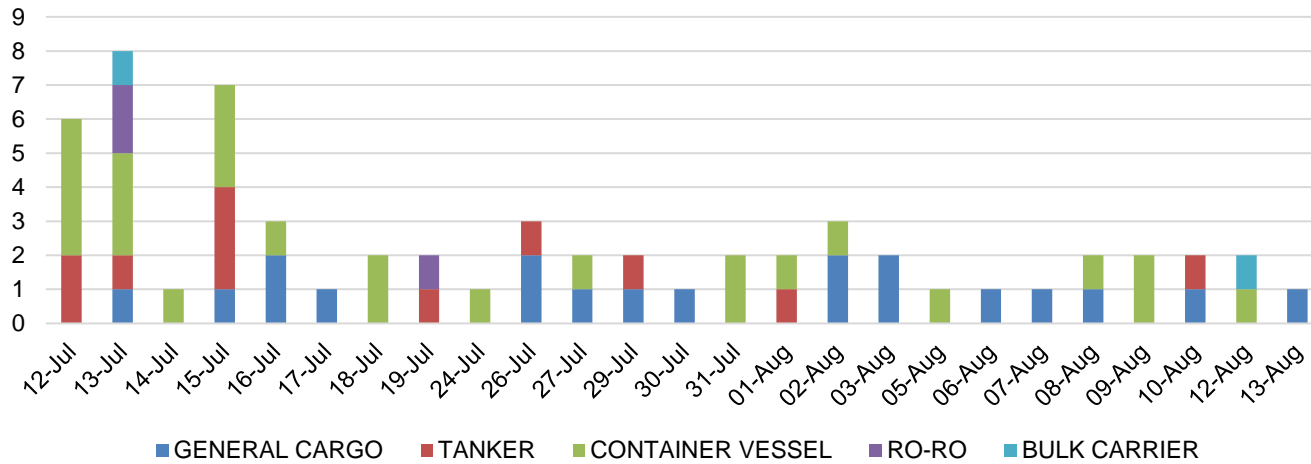
Daily Analysis



# Lebanon War Period - 12/07-14/08/06

## Air Pollution Analysis

Total Vessel Calls in Port of Haifa - During Lebanon War Period  
12/07-14/08/06



Source: Own composition

### Port of Haifa – 2006 Lebanon War - Fast Facts

The port of Haifa has been shut down completely.

All vessels (anchorage and port) were diverted to Ashdod Port (Sharvit 2009).

Port re-open handled only essential materials (1-2 vessels per day).

In 2006 - total of 2079 visits.

A monthly average of 175 vessel calls

**Lebanon second war – total 60 vessels, 1-2 vessels per day (duration <~24hr).**

Anchorage in Port of Ashdod only.

Source: Own composition reference: 05-06<sup>th</sup> May 2021, Antwerp



Atmospheric Environment  
Volume 42, Issue 3, January 2008, Pages 428-440



### The impact of a forced reduction in traffic volumes on urban air pollution

Yuval<sup>a, A. B.</sup>, Bernanda Filicstein<sup>b</sup>, David M. Broday<sup>a</sup>

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**PM10 concentrations** in all the stations but one decreased by ~4-26% (during the daytime of the conflict period).

**NOx concentrations** in all the stations but one decreased by ~65%.

It is noteworthy that the authors' personal (and admittedly subjective) impression is that visibility during the conflict period was markedly improved compared to the control time and compared to corresponding periods in previous years (Yuval et al., 2008).

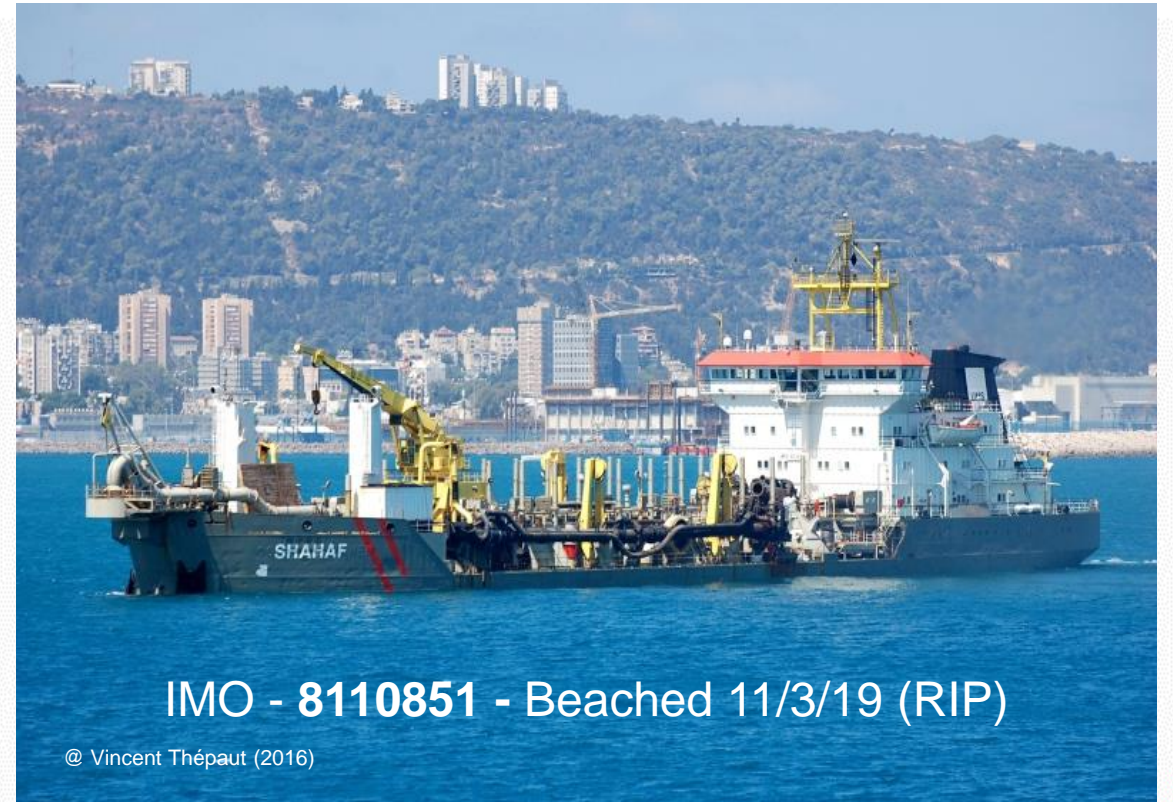
# Conclusions

## Vessel Operate in Proximity to Residential Area

### Conclusions

Reduction in air pollution for NO<sub>x</sub> and PM in Haifa bay was achieved mainly due to end of the TSHD “Shahaf” vessel dredging work and not due to the enforcement of the LEZ program.

Environmental Impact Assessment (EIA) & Environmental Management Program (EMP) for the new ports – Did not include vessels emission contribution (short & long term).



IMO - 8110851 - Beached 11/3/19 (RIP)

@ Vincent Thépaut (2016)

# Policy Recommendations

## Vessel Operate in Proximity to Residential Area

### Policy Recommendations

---

Every Request for Proposal (RFP) for vessels operate in proximity to residential area should include a score option for emission standards:

#### For the Short Range

- Limit age (NOx Tier II standard)
- Daily reporting (FC)
- Fuel SC restrictions of 0.1%.
- Encouraging score RFP for Best Available Techniques/Technology (BAT) (SCR/ECGS, MGO 0.1% - tomorrow LNG fuels).

#### For the Long Range

- Legislate a local set of laws regarding SC and NOx limits
- Update the ports' EIA report study (ships emission)
- Monitoring the single ship!



# Discussion

Thank you!

Elyakim Ben-Hakoun, PhD

- Technion (Currently on the Postdoc Market)

 [ebh@technion.ac.il](mailto:ebh@technion.ac.il)

 [ElyakimBH](https://twitter.com/ElyakimBH)





**AHOY!**

