

The Daily Port & Shoreline Emission Inventory Model

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Outline

The Daily Port & Shoreline Inventory Model

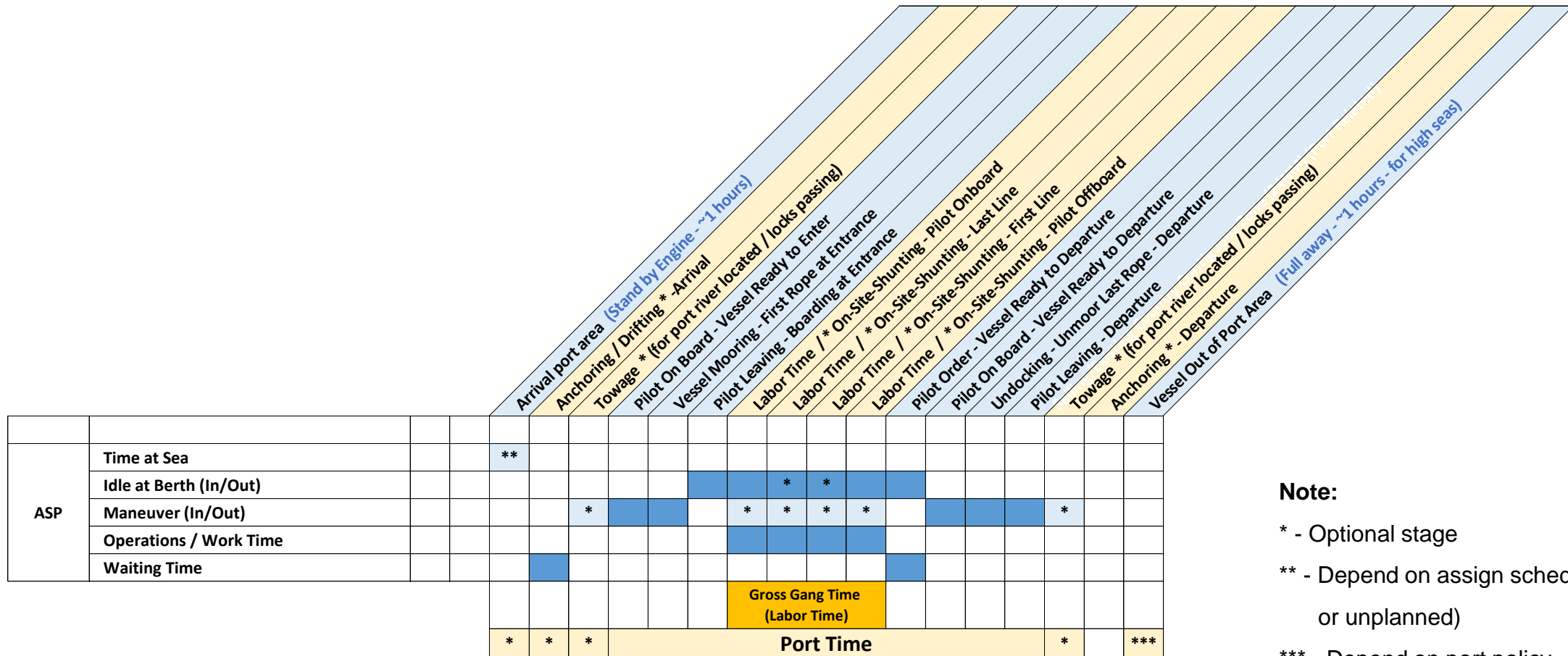
- Motivation
- Methodology (Model framework)
- Empirical Work Case study – Israel ports (P2P Israel Shoreline and Haifa, Ashdod – Containers Vessels)
- What next?



Motivation

Lost Time - Port performance terminology

Journey from Port Perspective



Note:

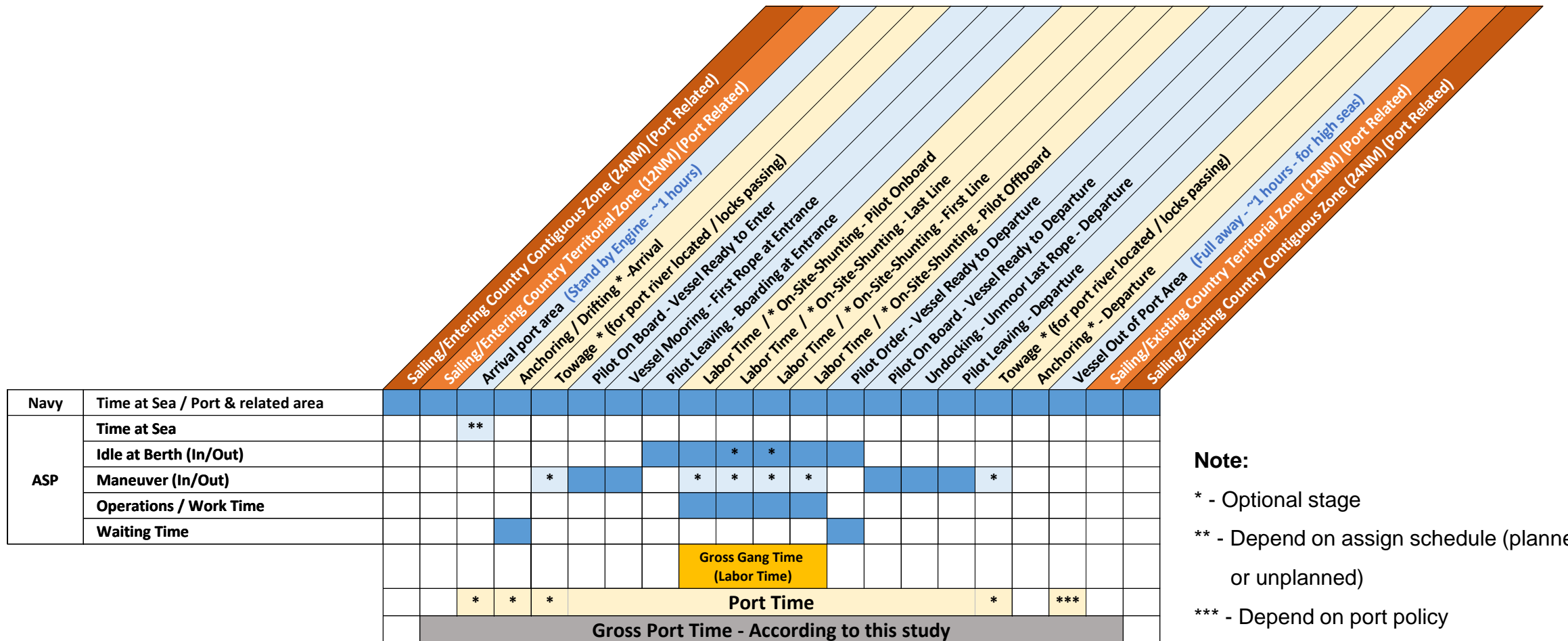
- * - Optional stage
- ** - Depend on assign schedule (planned or unplanned)
- *** - Depend on port policy

Source: Own compilation, based on Israel ASP dataset observation and vessel stages analysis

Motivation

Gap in Knowledge - "Lost Time" at Port

Journey from Navy Perspective - First Scenario: Enter Port for Cargo Operation



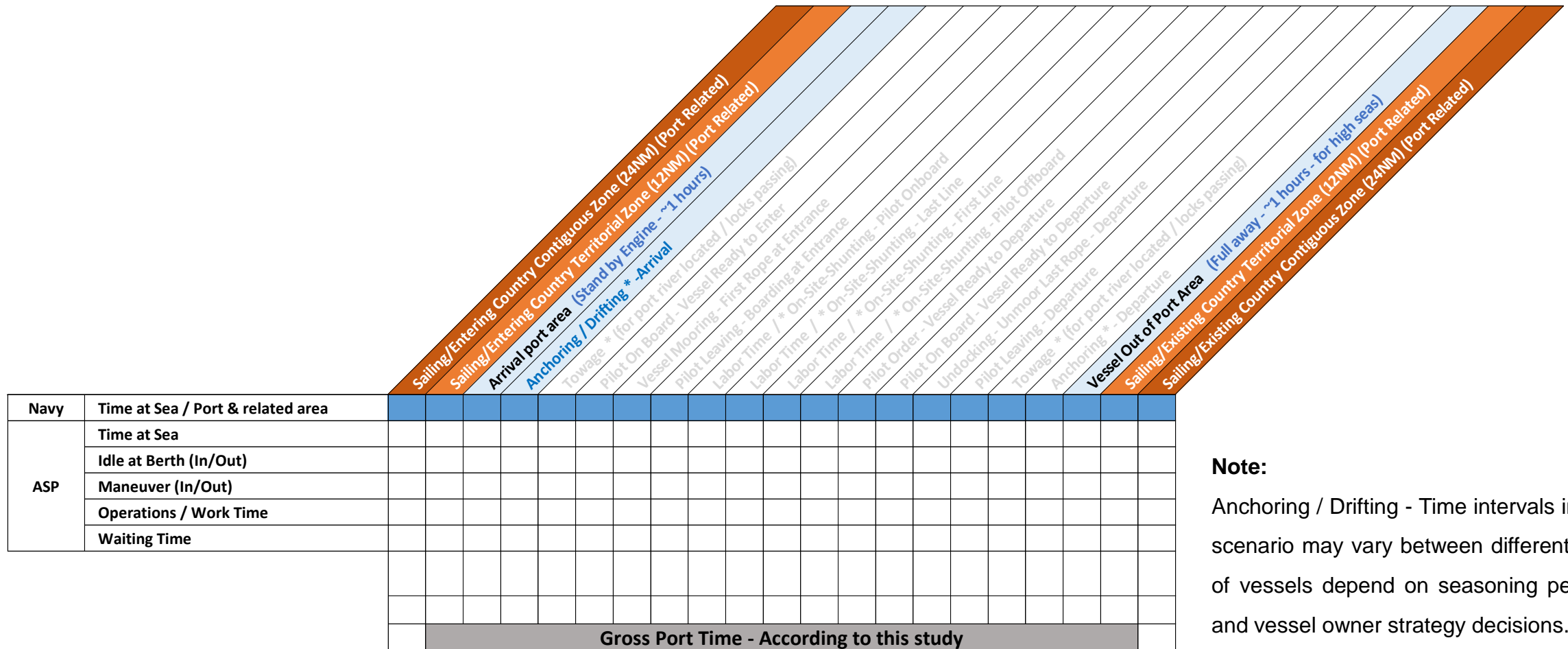
Note:
 * - Optional stage
 ** - Depend on assign schedule (planned or unplanned)
 *** - Depend on port policy

Source: Own compilation, based on Israel Navy observation and stages analysis

Motivation

Gap in Knowledge - "Lost Time" at Port

Journey from Navy Perspective - Second Scenario: Enter Port Area for Anchorage Reason



Note:

Anchoring / Drifting - Time intervals in this scenario may vary between different type of vessels depend on seasoning periods and vessel owner strategy decisions.

Source: Own compilation, based on Israel Navy observation and stages analysis

Motivation

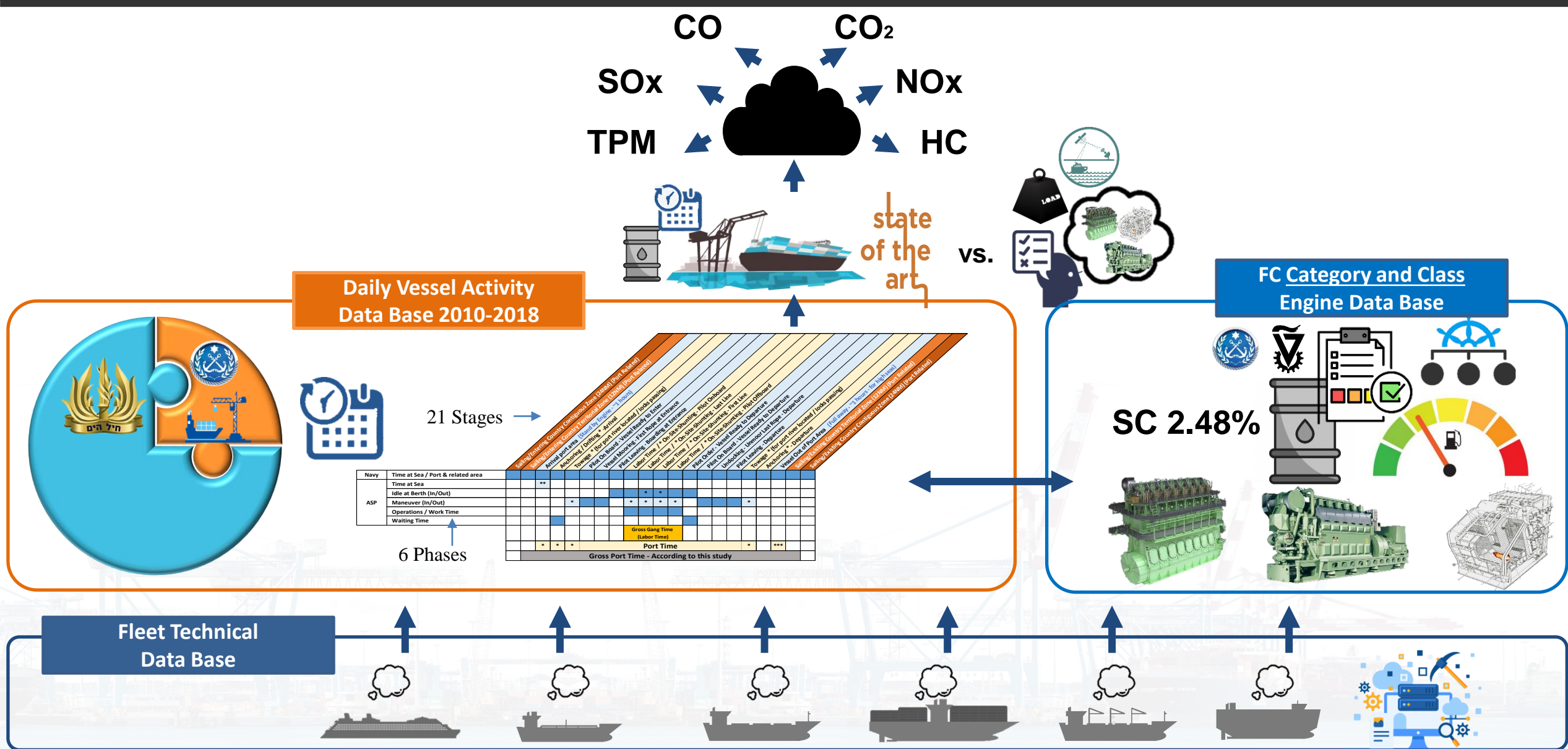
Gap in Knowledge



- Israel – 99% of the country trade in goods is transported by sea (Israel ASP, 2019)
- **Israel - The Missing Piece – Maritime sector contribution**
 - Identify main contributors.
 - Identify daily and annual contribution.
- **Preserve economic growth with green shipping.**
- **Effect of IMO 2020 0.5% Sulfur Regulation**

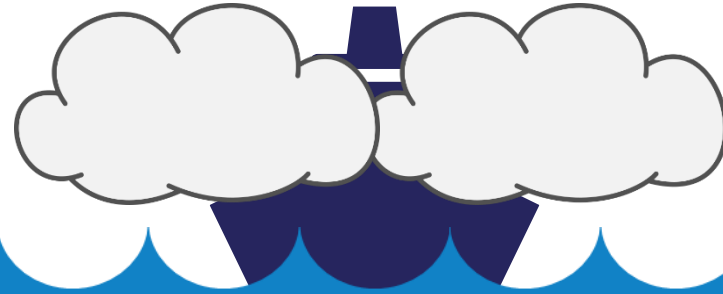
Methodology

Overview Description Daily Port Emission Inventory – Bottom-Up Activity Based



Israel Maritime Traffic

Fast Numbers (2010-2018)



~6K Unique Vessels (ASP)



10,380 Unique Vessels (Navy ~5,7K OGV, Other Yachts, etc..)

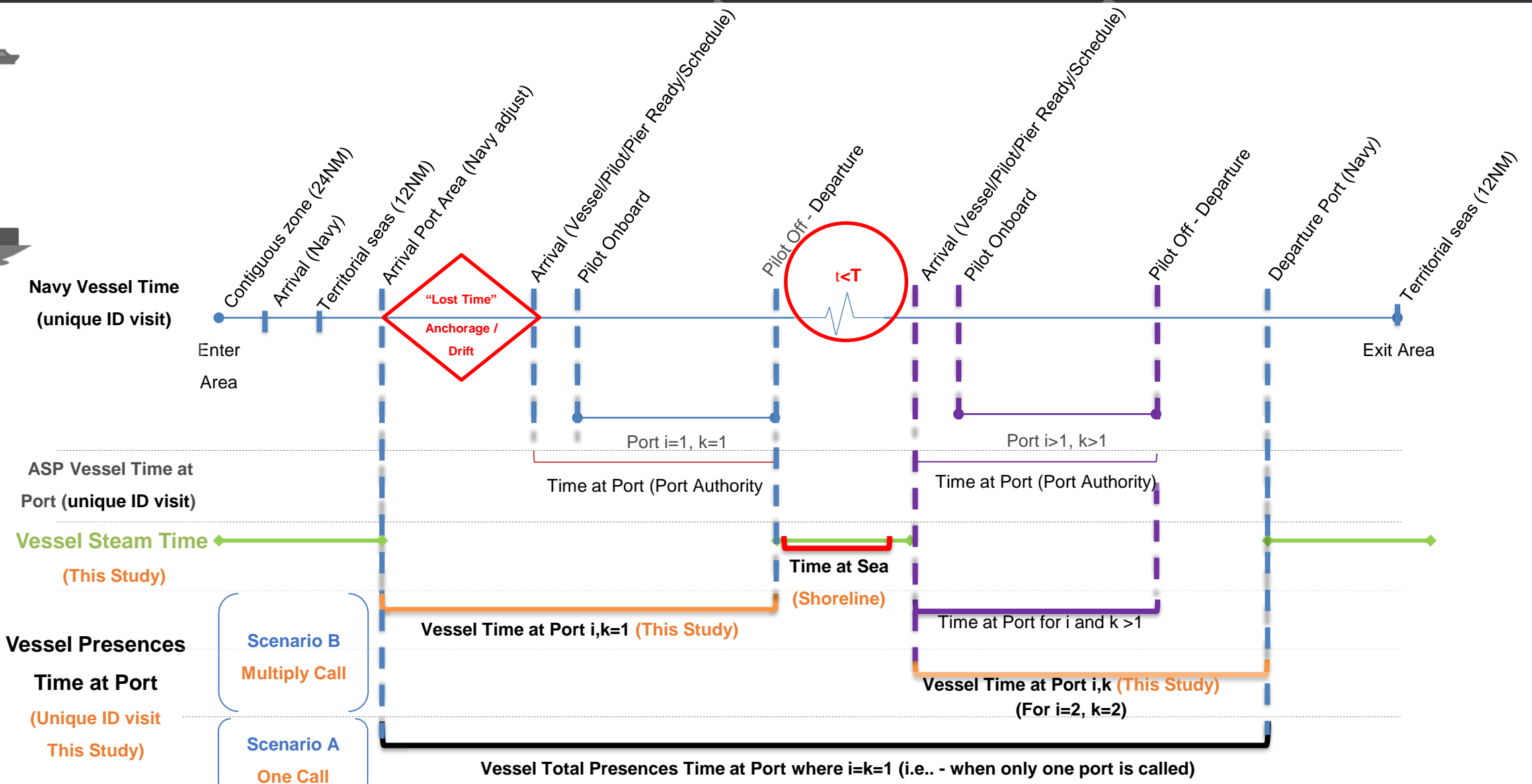
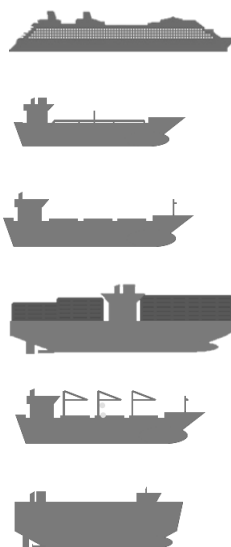
98,448 Movements ID (ASP - Pier; Load, Unload, Shunting)

43,517 Movements ID (Navy)

5,384 Unique Vessels, **448,686** Movements ID (Model Logic)

Methodology

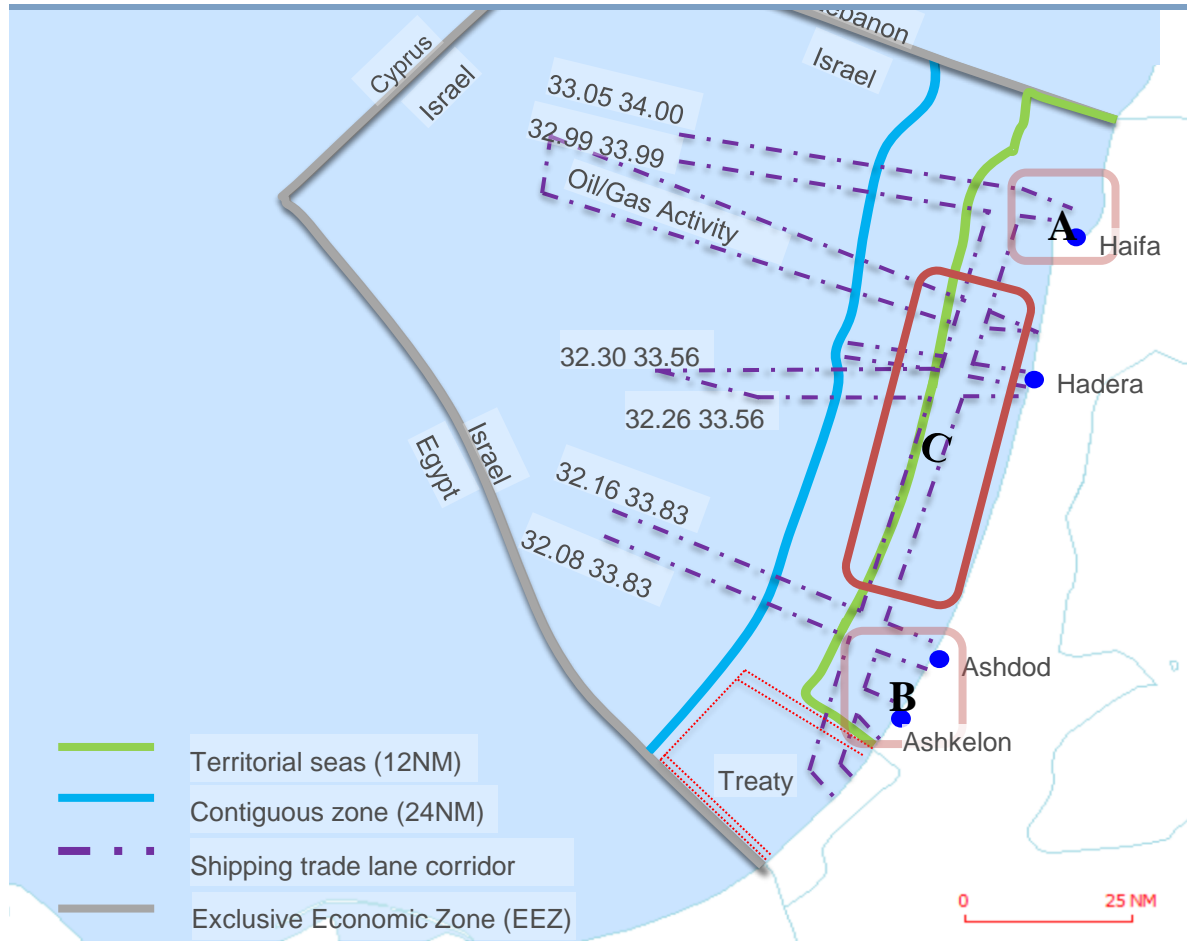
Stage Two – Computation of Vessel Presences Time at Sea / Port - According to the Model Logic



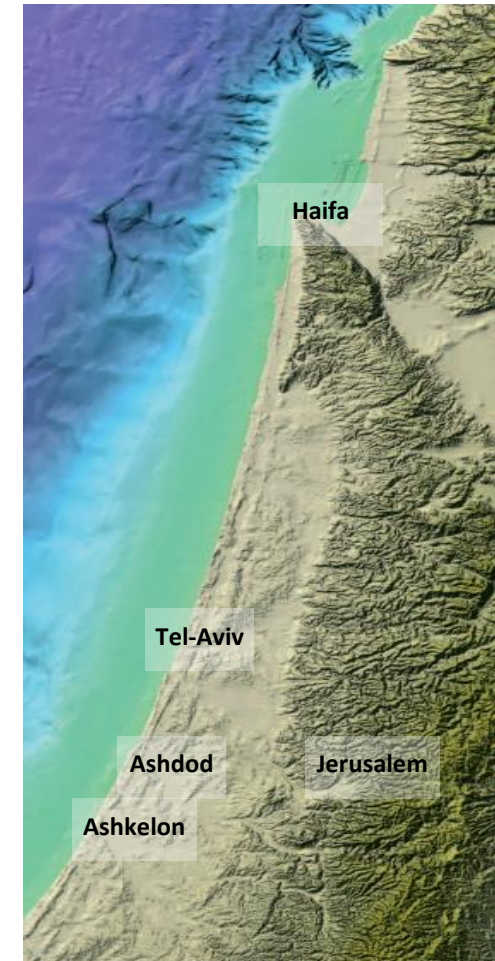
Case study: Israel P2P & Shoreline Emission Inventory

P2P - ILASH-ILHFA & ILHFA-ILASH

Israel Shoreline Emission Inventory

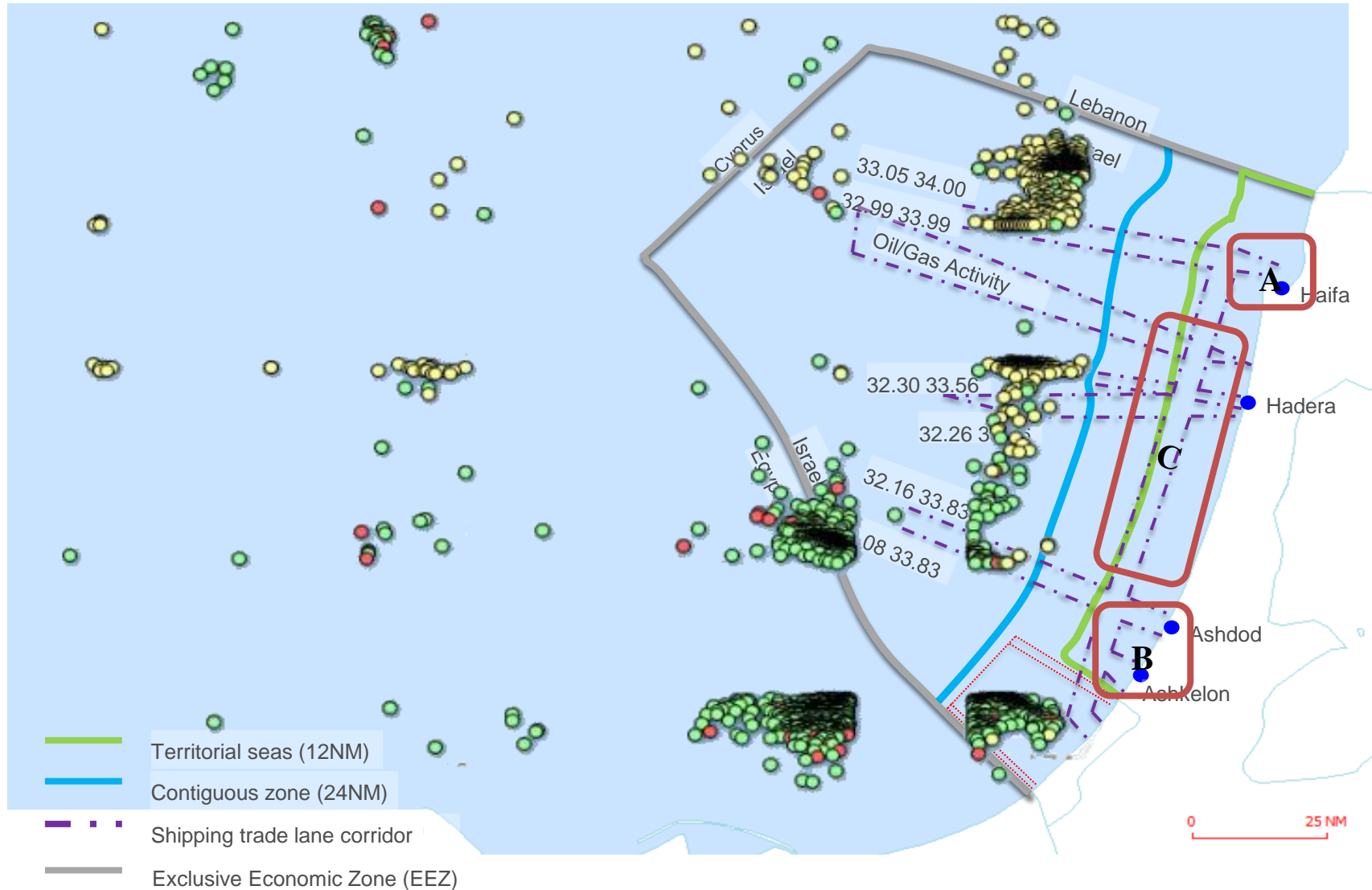


- Wind direction - dominant direction - West to the East.
- Narrow majority of Israel population.



Motivation - Traffic Map by Port Destination (Entrance)

Navy Initial Geo Location - Years 2015-2018

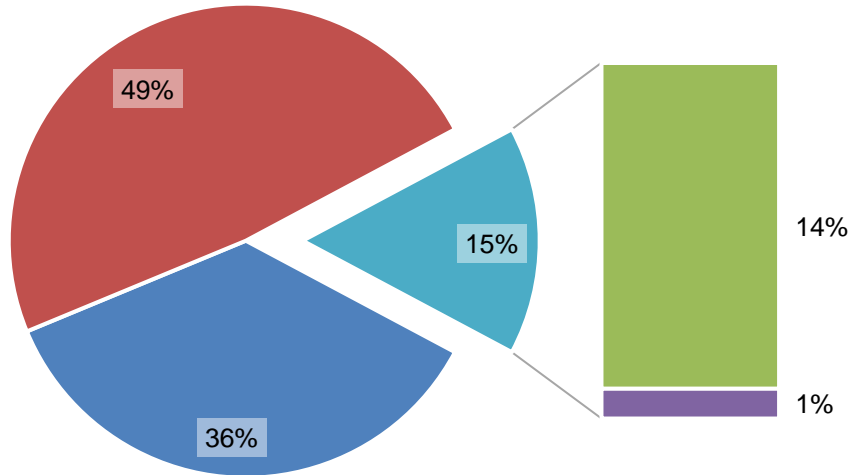


Israel Visiting Fleet

Tier Analysis

Total Fleet visits Israel Ports (2010-2018) - Age Distribution By Tier n = 5,384

- Tier 0
- Tier I
- Tier II
- Tier III

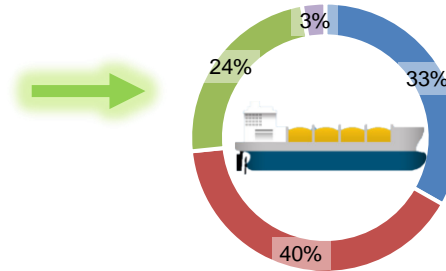


- **~85% - Lower Tier - High NOx Emitted**
- Lack of local emission regulation - attracted old Tier grade vessel (incentive is required!).

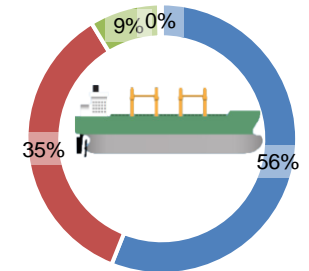
$$Tier_{i,l} (IMO_{number} | BuildYear) = \begin{cases} 0 & \text{Before 2000} \\ 1 & \text{2000 - 2010} \\ 2 & \text{2011 - 2015} \\ 3 & \text{2016 and above} \end{cases}$$

Source: Own compilation, NOx limit illustration - IMO, MARPOL Annex VI, Reg. 13

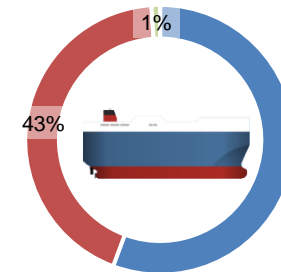
Bulk Carrier - Age Distribution By Tier
n = 1,544



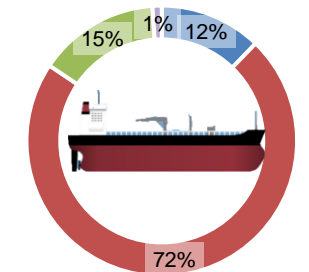
General Cargo - Age Distribution By Tier
n = 1,818



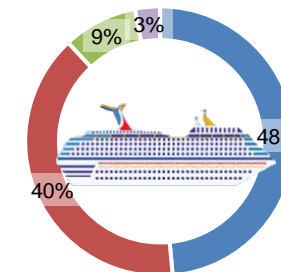
RO-RO - Age Distribution By Tier
n = 97



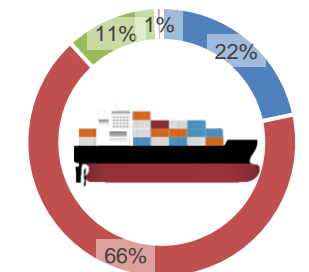
Oil / Chemical - Age Distribution By Tier
n = 1,090



Passenger - Age Distribution By Tier
n = 134



Containers - Age Distribution By Tier
n = 701



Methodology

Stage Two - “Lost Time” Analysis Example

Date	Vessel Type & Class	Estimated DWT or GRT (Y/N)	IMO	Navy	Navy	ASP	ASP	United	United	Shoreline	Shoreline
				ILHFA (min)	ILASH (min)	ILHFA (min)	ILASH (min)	ILHF A (min)	ILAS H (min)	- N2S (min)	- S2N (min)
1/1/2017	12.1	N	8010635	0	273	0	0	0	273	0	0
1/2/2017	12.1	N	8010635	0	1440	0	968	0	1440	0	0
1/3/2017	12.1	N	8010635	0	1440	0	1440	0	1440	0	0
1/4/2017	12.1	N	8010635	0	1440	0	1440	0	1440	0	0
1/5/2017	12.1	N	8010635	0	599	0	410	0	599	0	0
1/6/2017											
1/7/2017											
1/8/2017											
1/9/2017											
1/10/2017											
1/11/2017	12.1	N	8010635	0	294	0	0	0	294	0	0
1/12/2017	12.1	N	8010635	0	1440	0	911	0	1440	0	0
1/13/2017	12.1	N	8010635	0	1440	0	1440	0	1440	0	0
1/14/2017	12.1	N	8010635	0	1440	0	1440	0	1440	0	0
1/15/2017	12.1	N	8010635	0	1440	0	1440	0	1440	0	0
1/16/2017	12.1	N	8010635	0	1407	0	1300	0	1407	0	0

IMO 8010635 – According to Model Logic

Note A:

Color **Orange** and **Blue** were assigned to “United” columns in order to highlight model logic work and the importance of including “lost time” to the vessel presence time at port

Note B:

N2S mean North to South and S2N mean South to North

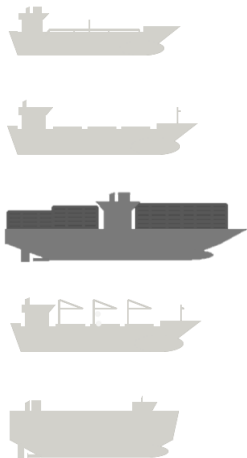
Note C:

12.1 is programming code to describe vessel type: General cargo and class of small vessel size (i.e.. <5k DWT).

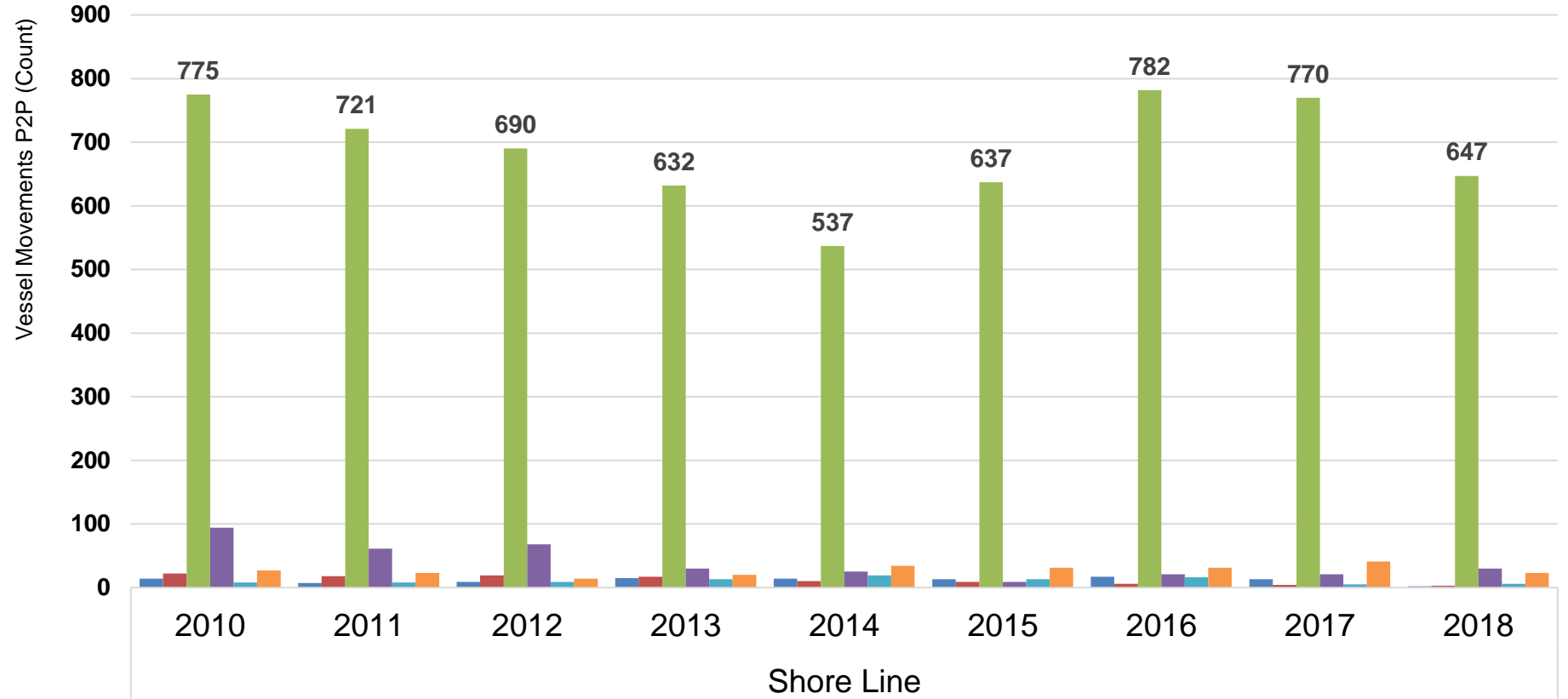
Israel Shoreline Emission Inventory

Shoreline – Movements Analysis

- Bulk
- Chemical
- Container
- General Cargo
- Oil
- Ro-Ro



Merchandise Vessels - Movements Between Ports Count - Haifa and Ashdod



- 2015 – 2017 - on average of 14 containers vessels movements (P2P) per week.

Source: Own compilation, based on ASP FC Survey (2015), A major liner shipping company and charter agency operational database analysis

Israel Shoreline Emission Inventory

FC Rate, Steam Time & Sulfur Content (%) Per Vessel Assign ID

<i>Line</i>	<i>ILASH-ILHFA - No. Passes</i>	<i>Avg. Speed (Kn)</i>	<i>Avg. Steam Time (Hr)</i>	<i>Avg. Distance (NM)</i>	<i>Line</i>	<i>ILHFA-ILASH - No. Passes</i>	<i>Avg. Speed (Kn)</i>	<i>Avg. Steam Time (Hr)</i>	<i>Avg. Distance (NM)</i>
1	42	14.7	5	74	1	303	12.9	6	74
2	55	15.5	5	71	2	6	14.6	6	75
3	12	15.3	5	72	3	286	15	5	72
4	4	13.8	5	69	4	19	13.7	5	72
5	78	14.6	5	71	5	83	16.7	4	71
6	75	14.6	5	73	6	1	18.5	4	74
7	6	17.1	4	76	7	1	13.3	6	80
8	37	16.9	4	71	8	90	13.5	6	75
9	4	14.2	5	71	9	6	14	5	73
10	12	13.3	8	76	10	18	14.8	5	71
11	10	14.1	5	69	11	10	11.4	7	72
12	140	13.6	6	75	12	1	14.3	5	77
13	252	14.3	6	75	13	22	13.4	6	73
14	9	15.6	5	74	14	11	13.7	6	74
15	74	13.3	6	74	15	8	12.4	6	73



<i>ILASH-ILHFA (2014-2019. Aug)</i>	<i>Sailing Speed (Kn)</i>	<i>Steam Hours (Hr)</i>	<i>Distance (NM)</i>
<i>Sample Size (No. Passes)</i>	810	810	810
<i>Weighted sample average</i>	14.40	5.57	73.68

<i>ILHFA-ILASH (2014-2019. Aug)</i>	<i>Sailing Speed (Kn)</i>	<i>Steam Hours (Hr)</i>	<i>Distance (NM)</i>
<i>Sample Size (No. Passes)</i>	865	865	865
<i>Weighted sample average</i>	14.1	5.4	73.00

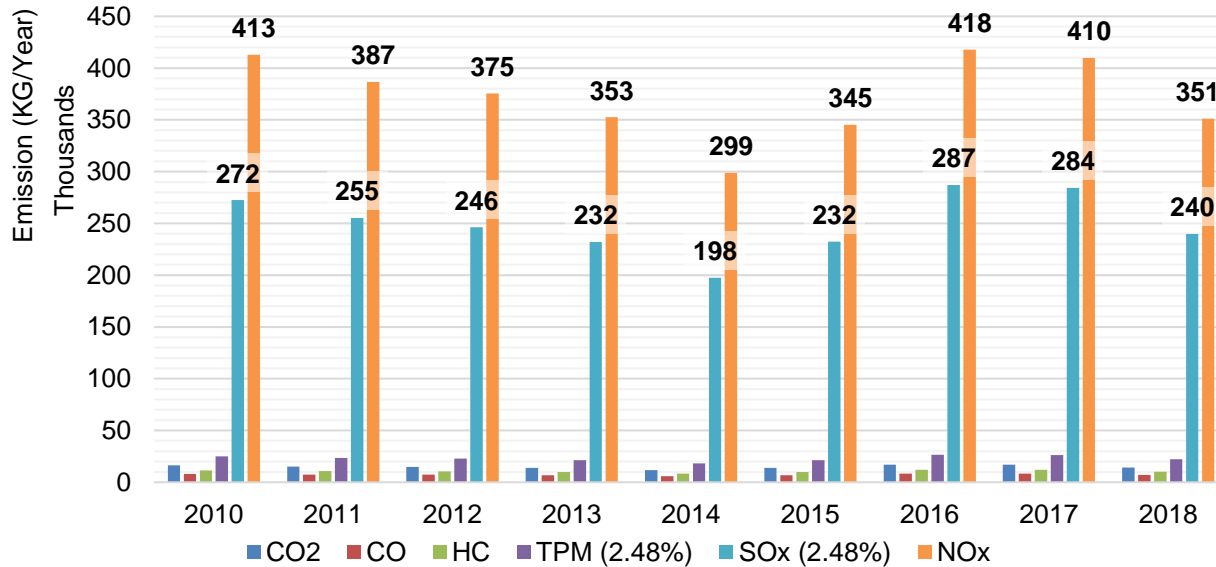
Source: Own compilation, based on data received from a major shipping company in the liner sector.

Israel Shoreline Emission Inventory

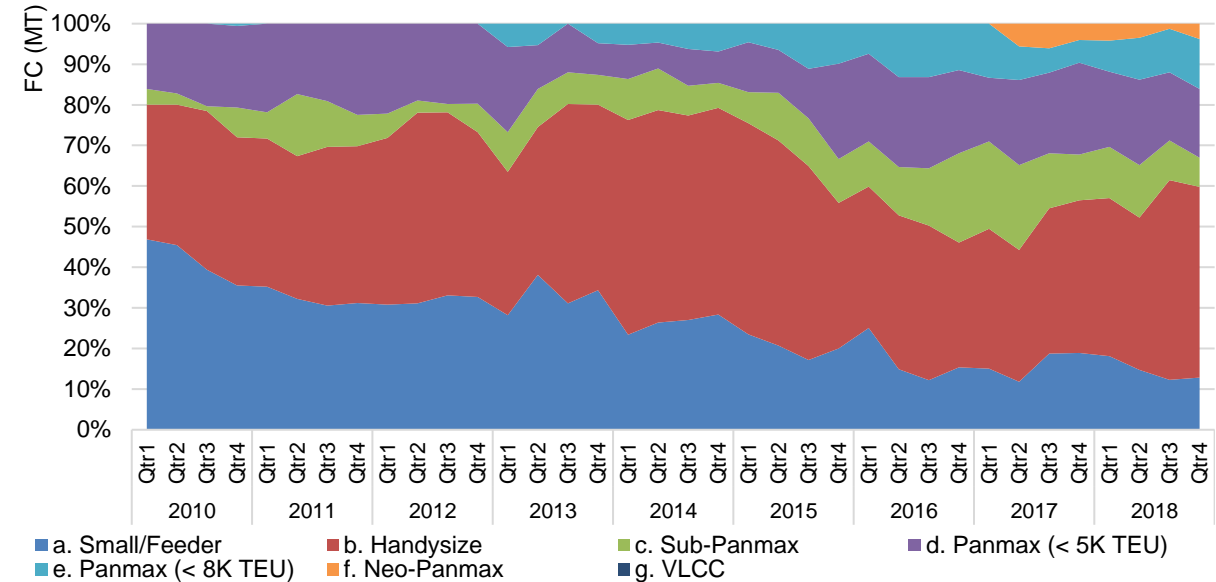
P2P - ILASH to ILHFA / ILHFA to ILASH

Israel Shoreline Emission Inventory

Israel Shoreline - Segmented by Emission Category Analysis
2010-2018



Container Vessels - FC - Movements Between Israel Ports
2010-2018 Segmented by Class - Quarterly Analysis



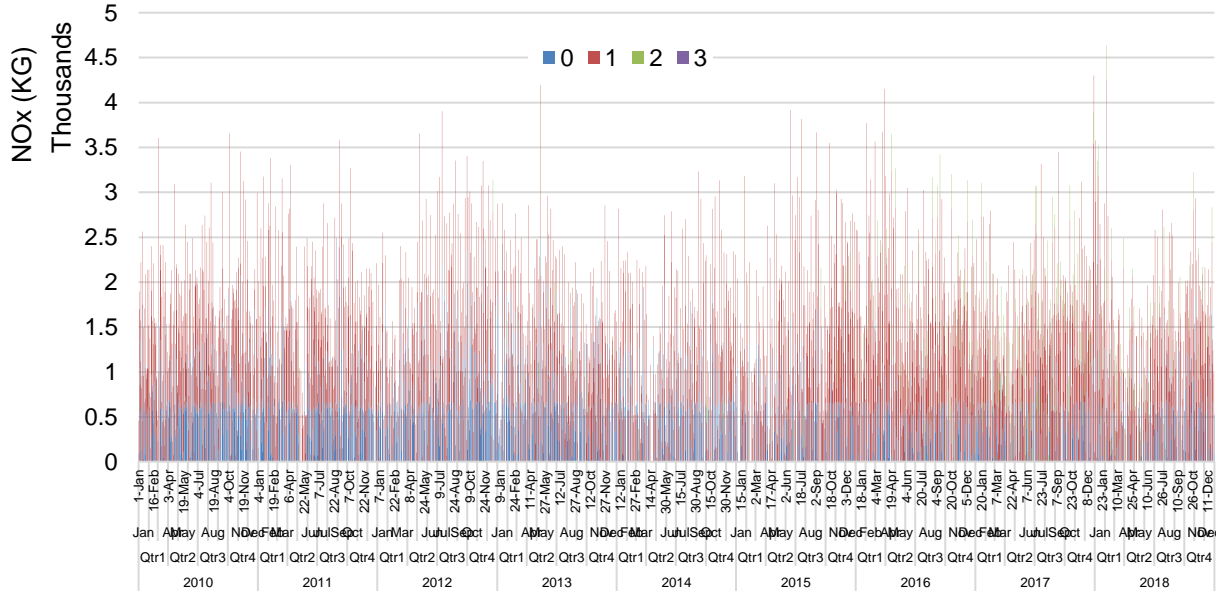
- Logistics balancing – Decrease in Small/Feeder activity increase in Panamax (<8K TEU) and Neo-Panamax
- Increase in NOx emission – due to Panamax (<8K TEU) and Neo-Panamax.

Container Vessel

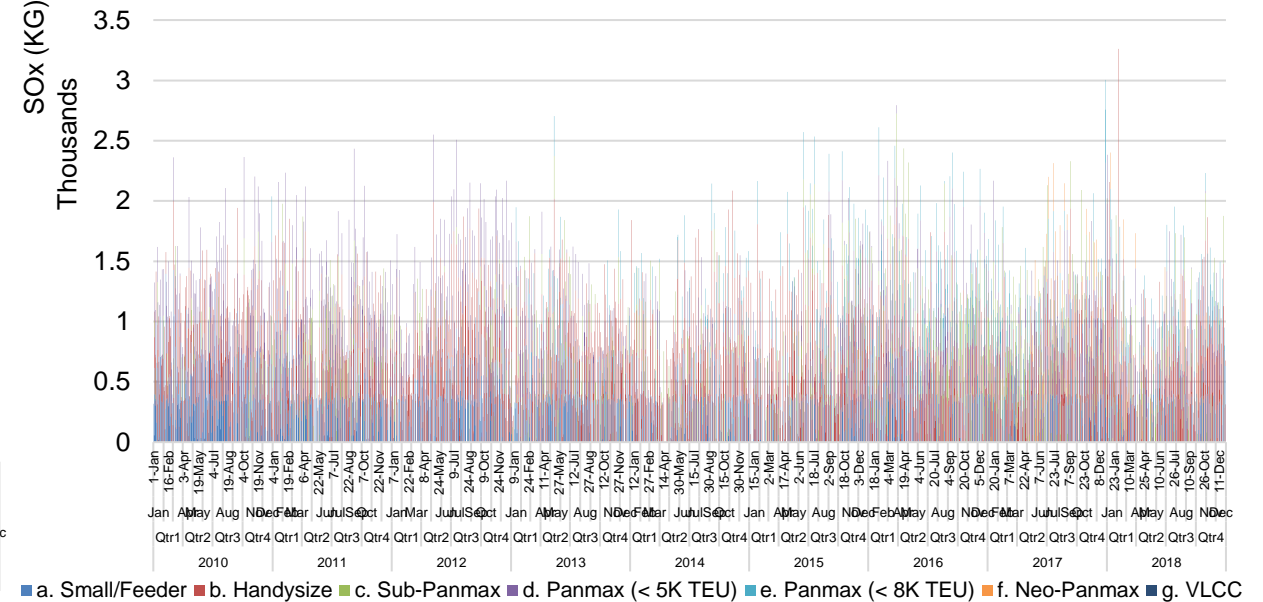
Nitrogen Oxides (NOx) - Haifa Vs. Ashdod

P2P Haifa & Ashdod - Container Vessel - Nitrogen Oxides (NOx – Left Chart) & Sulphur Oxides (SOx – Right Chart)

Israel Shoreline - Container Vessels - NOx Emissions
P2P Movements - Tier - Daily Analysis - 2010-2018



Israel Shoreline - Container Vessels - SOx Emissions (SC - 2.48%)
P2P Movements - Segmented by Class - Daily Analysis - 2010-2018

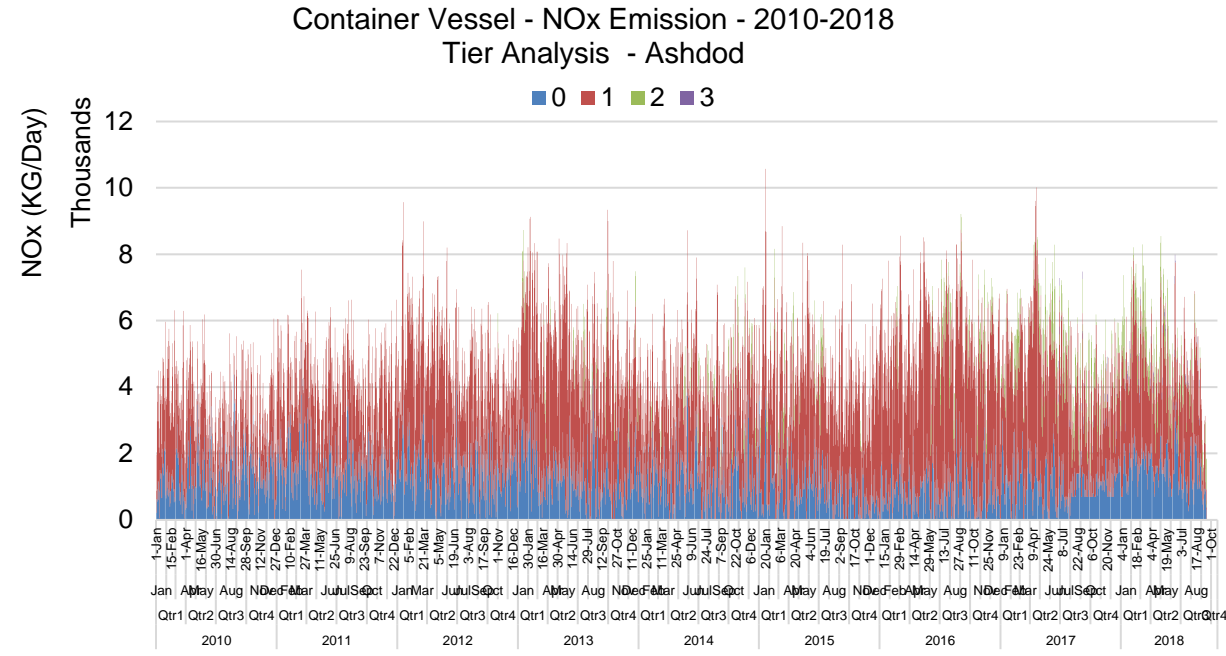
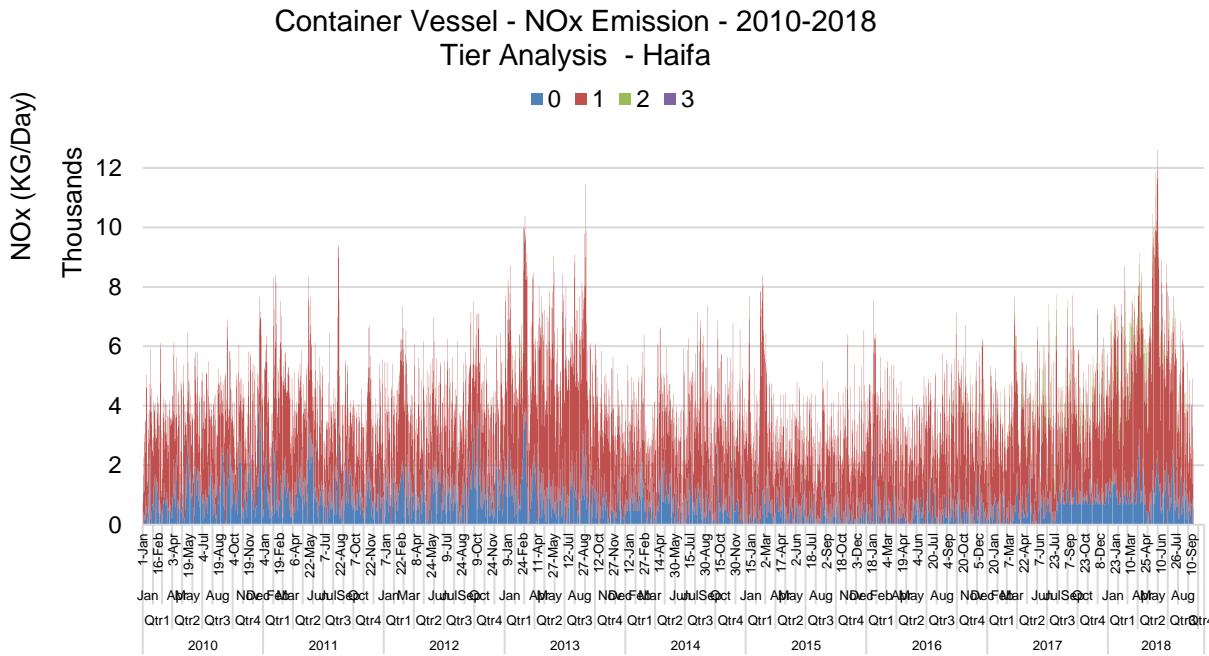


- Tier 1 – Dominate, Tier 3 – Rare
- P2P – NOx Daily Average 2-2.5 Ton/Day
- P2P – SOx Daily Average 1.5-2.2 Ton/Day

Container Vessel

Nitrogen Oxides (NOx) - Haifa Vs. Ashdod

Port – All Container Vessel - Nitrogen Oxides (NOx) – Haifa Vs. Ashdod

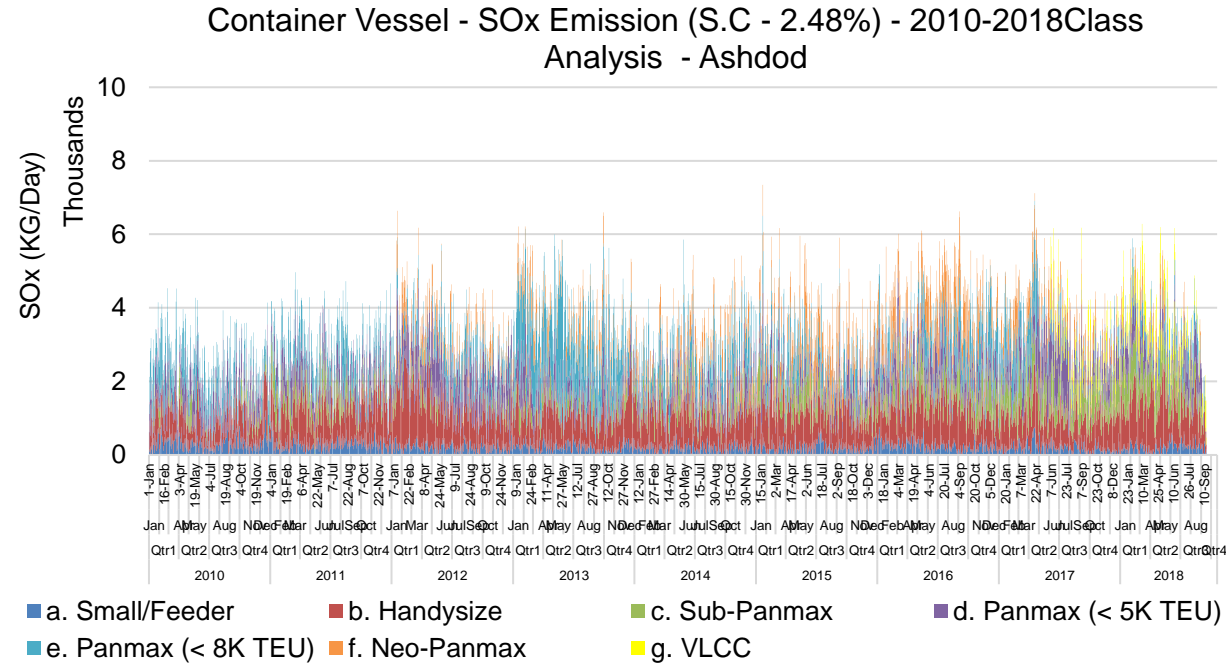
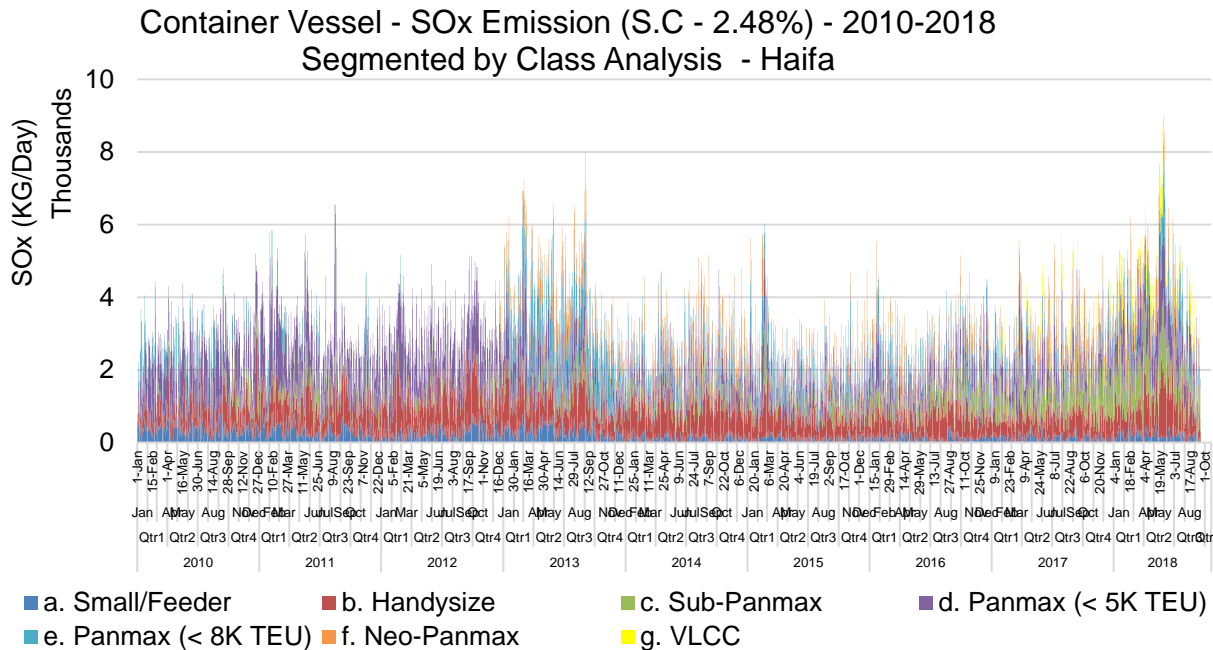


- Tier 1 – Dominant, Tier 3 – Rare
- Daily Average 4-6 Ton/Day (Haifa & Ashdod).

Container Vessel

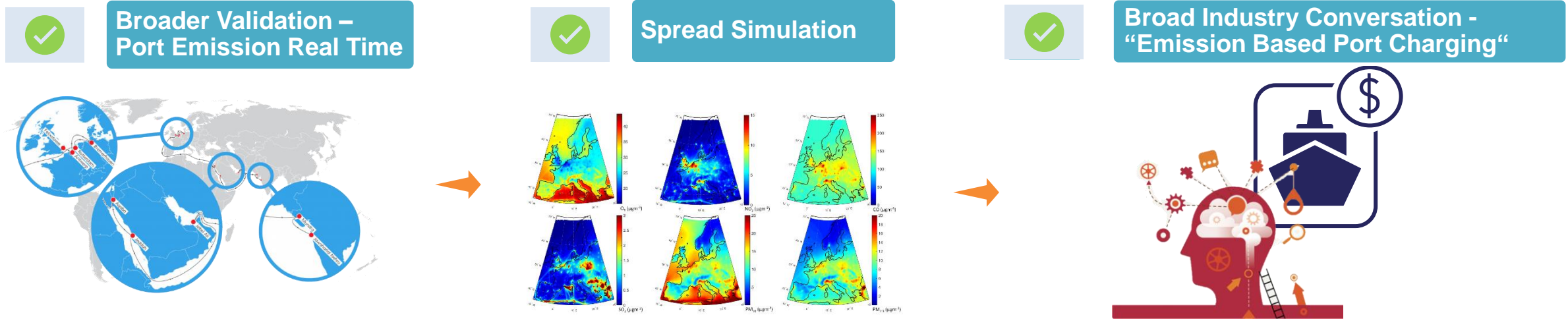
Sulphur Oxides (SOx) - Haifa Vs. Ashdod

Port – **All Container Vessel** Container Vessel - Sulphur Oxides (SOx) – Haifa Vs. Ashdod



- Ashdod / Haifa - Impact of Mega-Ships - vessel (12 TEU +) replace the small one and the total daily emission increased.
- Haifa – Container Vessel contribute daily Avg. of 3.5 Ton (2010-2016) and daily Avg. of 4.5 Ton (2016-2018).
- Ashdod – Container Vessel contribute daily Avg. of 4 Ton (2010-2016) and daily Avg. of 5 Ton (2016-2018).

What Next?



Thank you!

Elyakim BenHakoun, PhD

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AHOY!

