



PIANC French Section

**PIANC Mediterranean Days
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25 to 27 october 2023 in Sete France**

**Impact of GHG Regulations at Container Terminals on the
Container Handling Equipment Market**

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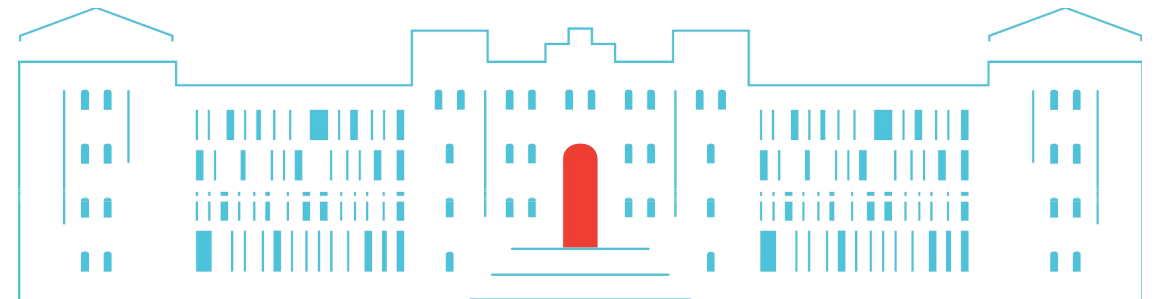
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Impact of GHG Regulations at Container Terminals on the Container Handling Equipment Market

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07.12.2023



Moritz Neltner & Andreas Mohr

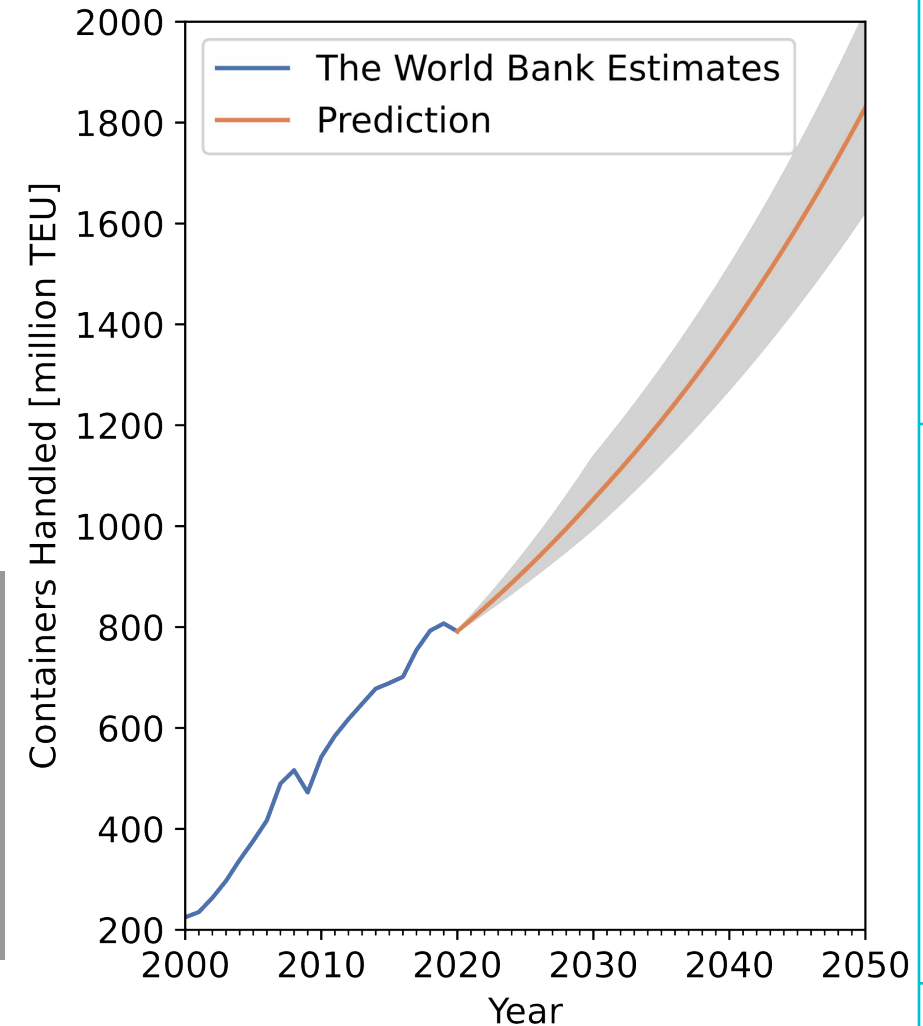


Motivation and Problem Statement

- Emission reduction agendas by governments don't focus on landside cargo operations
 - International Maritime Organisation (IMO)
 - European Union (EU)
- Ports have acknowledged their role in emission reduction

R1 Which regulations and strategies require emission-free Container Handling Equipment (CHE)?

R2 How will the demand for emission-free CHE be affected by these regulations and strategies?

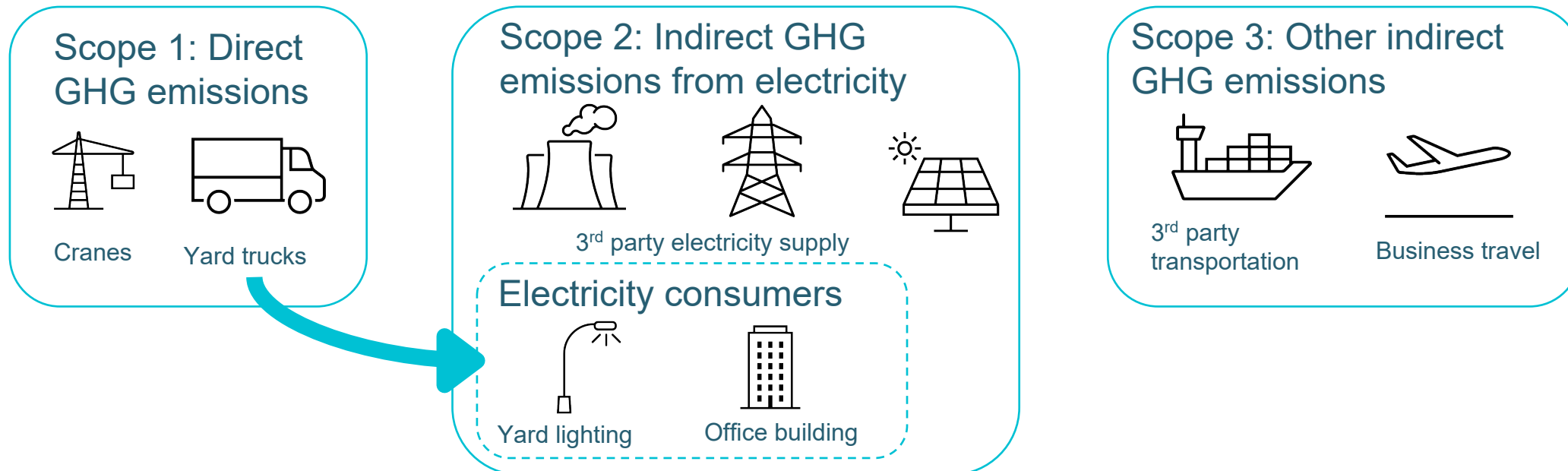


Own figure, based on data from International Transport Forum, Skrzypek and The World Bank.

Reporting GHG Emissions

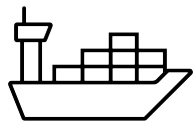
- No standard method for reporting Greenhouse gas (GHG) emissions
- Emission inventory summarises emissions from defined sources
 - Organisational scope: equity share, control basis
 - Are CO2 certificates considered?

Operational scope

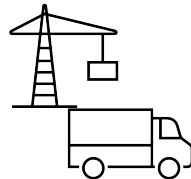


Emissions from Container Handling Equipment

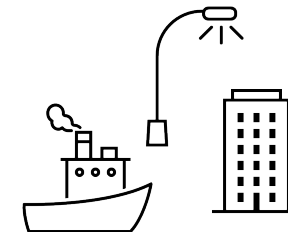
- Emission-free CHE does not directly produce GHG emissions by combusting carbon-based fuels
 - Not relevant are
 - Particle emissions from other sources e.g. tires
 - Noise emissions
 - Indirect emissions, e.g. emissions from electricity or hydrogen production
- Emission share of CHE depends on inventory boundaries, but generally



Ocean going vessels



CHE



Harbour craft, yard lighting, offices, reefer containers, ...

Regulations and Initiatives

Large Scope Regulations

- IMO's MARPO Annex VI
- EU Fit for 55

Individual Initiatives


- City of Oslo plans emission free good handling in 2025
- APM's targets aligned with Science Based Targets initiative

Financial Incentives

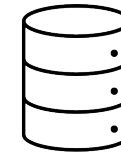
- Grant by the California Air Resource Board

Knowledge sharing interest groups

- Green Shipping Challenge at COP27
- World Ports Sustainability Program
- Northwest Ports Clean Air Strategy

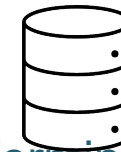
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- Efforts are not coordinated and lack common ground
 - Combined impact hard to quantify

- 1) Structured review of strategic objectives
 - Search for starting points
 - Follow links between initiatives



Objectives

- 2) Create data base with information about CHE at container terminals (CT)
 - Focus on CT by objectives identified in step 1

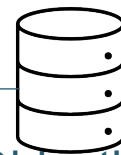


Terminals

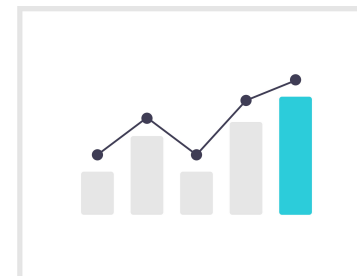
- 3) Market forecast based on step 1 & 2 and shipping market development



Terminals

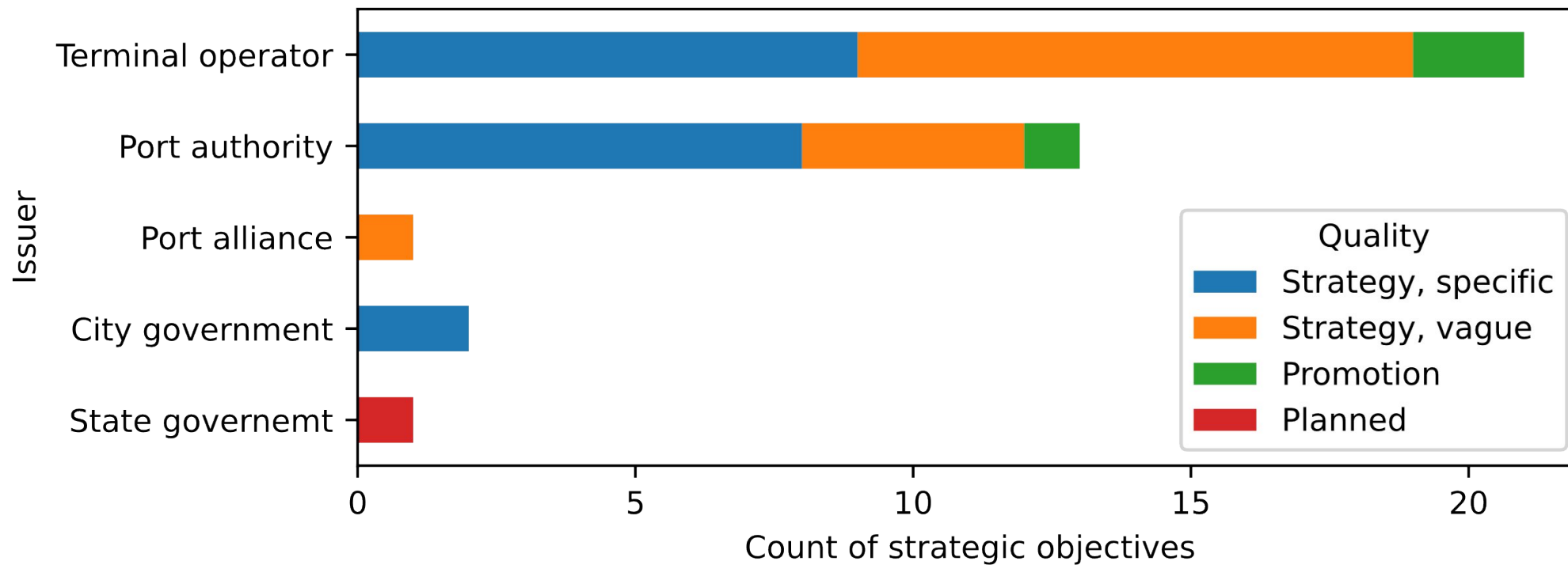


Objectives



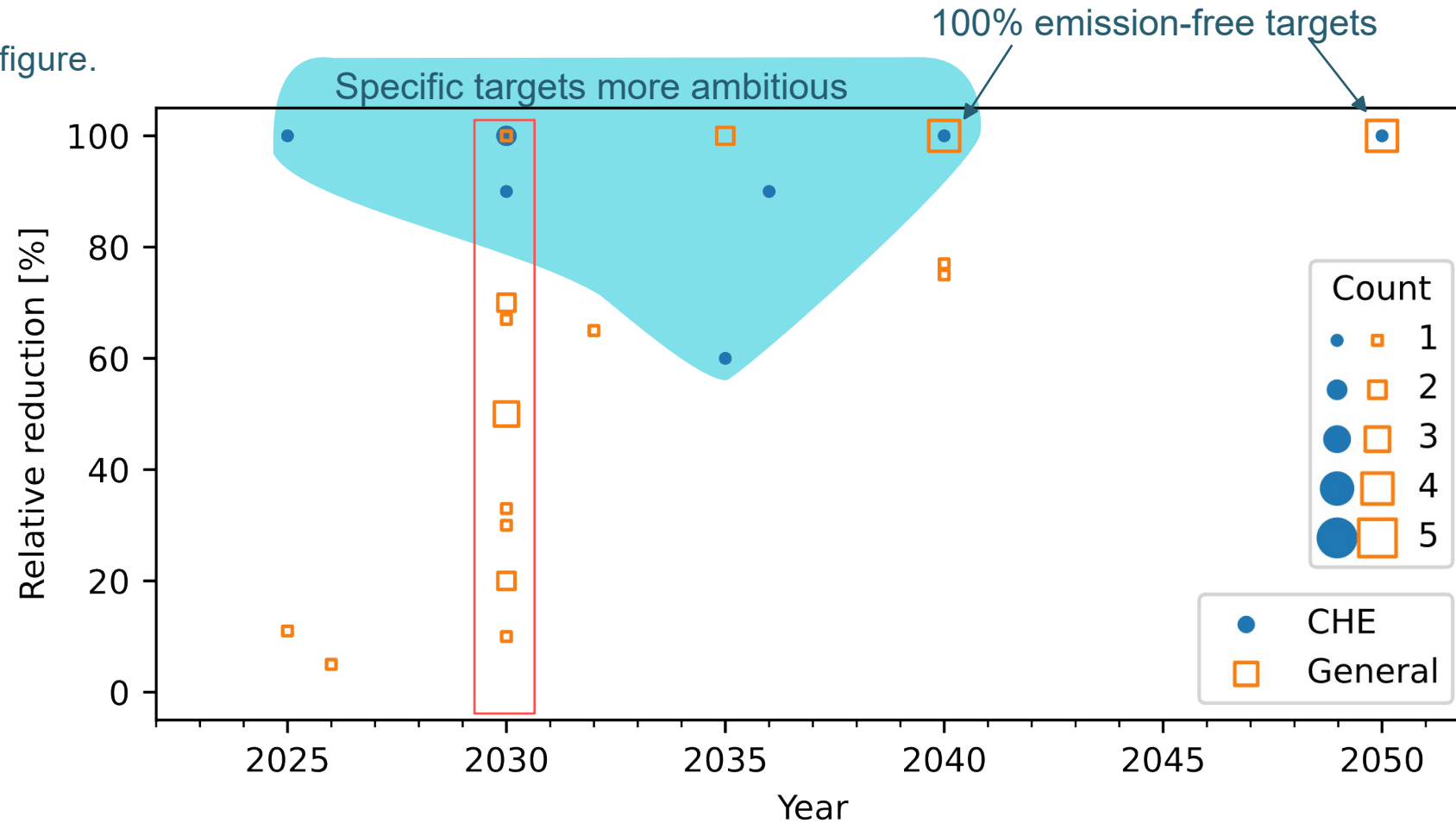
Review of Strategic Objectives 1

- Own figure

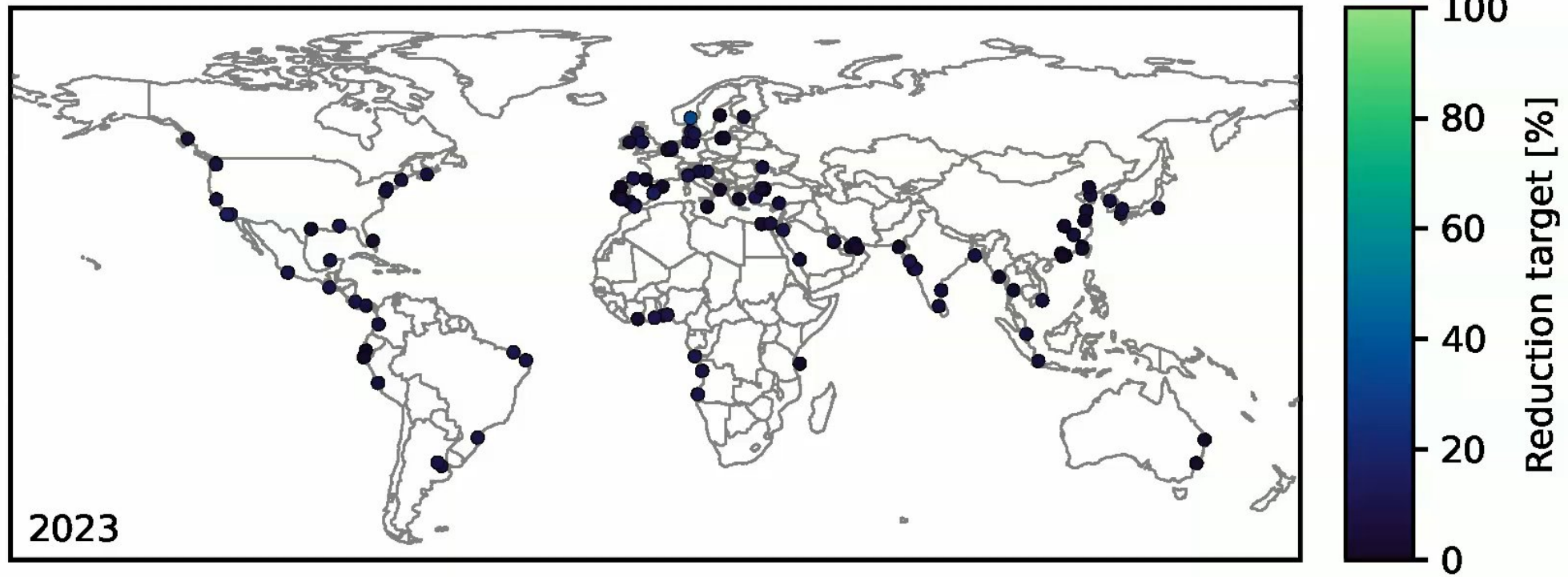


Review of Strategic Objectives 2

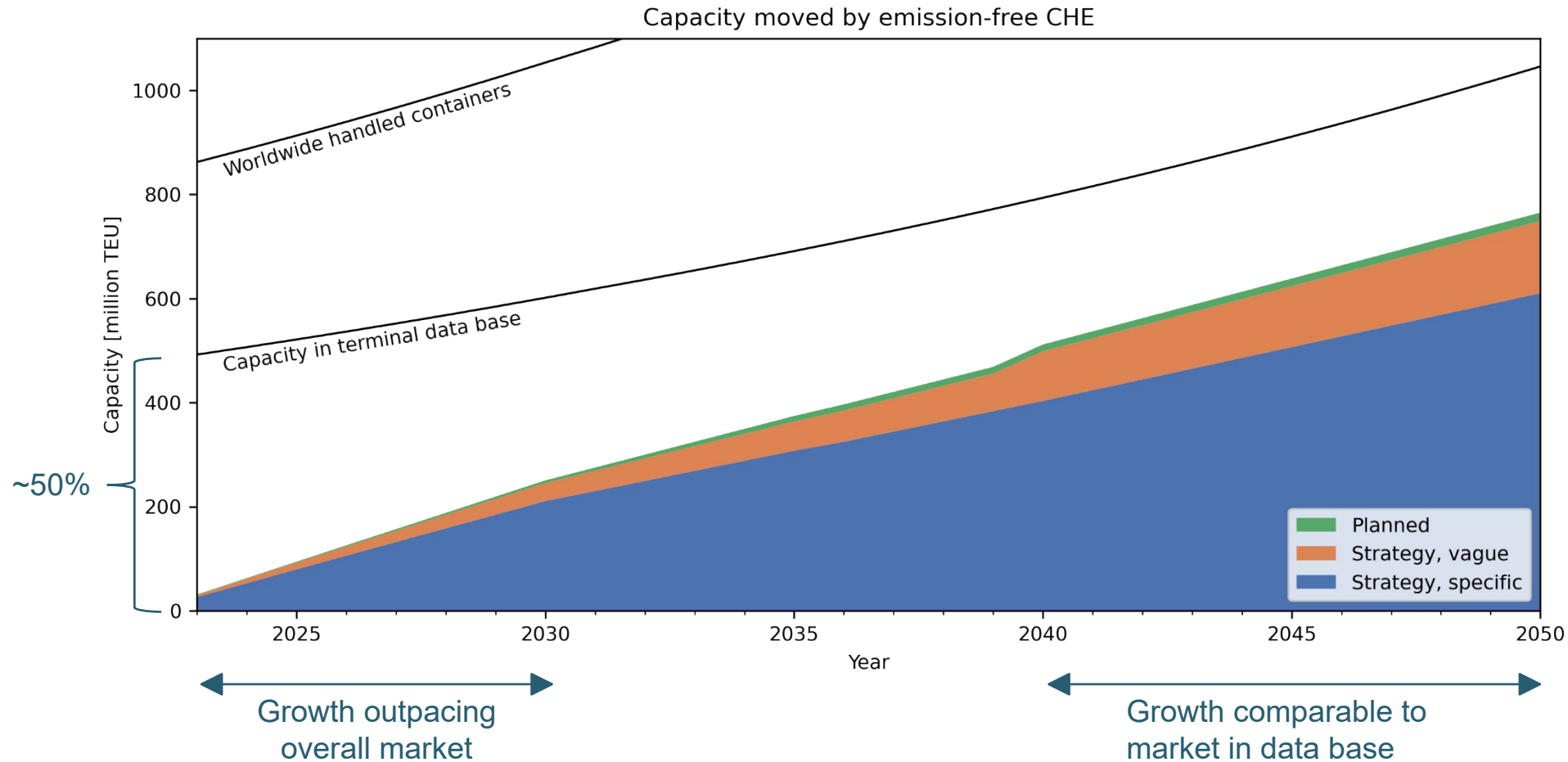
• Own figure.



Geographical Distribution



Forecast: Required Emission Free Capacity



- Too little effort to be in line with 1.5 °C target of shipping sector SBTi

Uncertainty in strategic objectives

- Varied reporting standards
 - Different organisational and operational boundaries
 - Use of CO2 certificates
- Most strategic objectives are non-binding
- Demand driven by few actors
- Most objectives not CHE focused

Uncertainty of CHE information

- Information on individual CHE types limited
- CHE information is biased
 - Overrepresentation of certain CHE types based on sources
 - Underreported already emission-free CHE
- Individual technology maturity level not considered

Outside sources

- Future changes in policy
- Technological leaps

Summary



24% of global market handled by emission-free CHE in 2030 (250 million TEU)



Popular 2030 planning horizon



Objectives driven by private actors



Current objectives not in line with 1.5 °C target of shipping sector

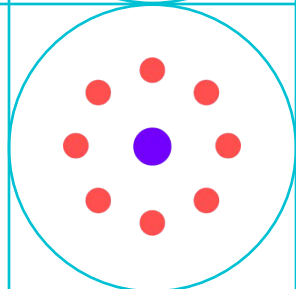
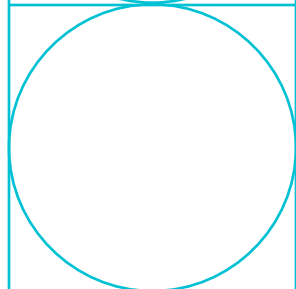
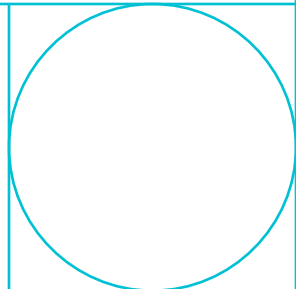
Further Research

- Understand development trajectories of individual CHE types
- Does demand match production capacity?
- How do strategic objectives change with time?
- Understand motivations and approaches of driving actors

Thank You very
much!

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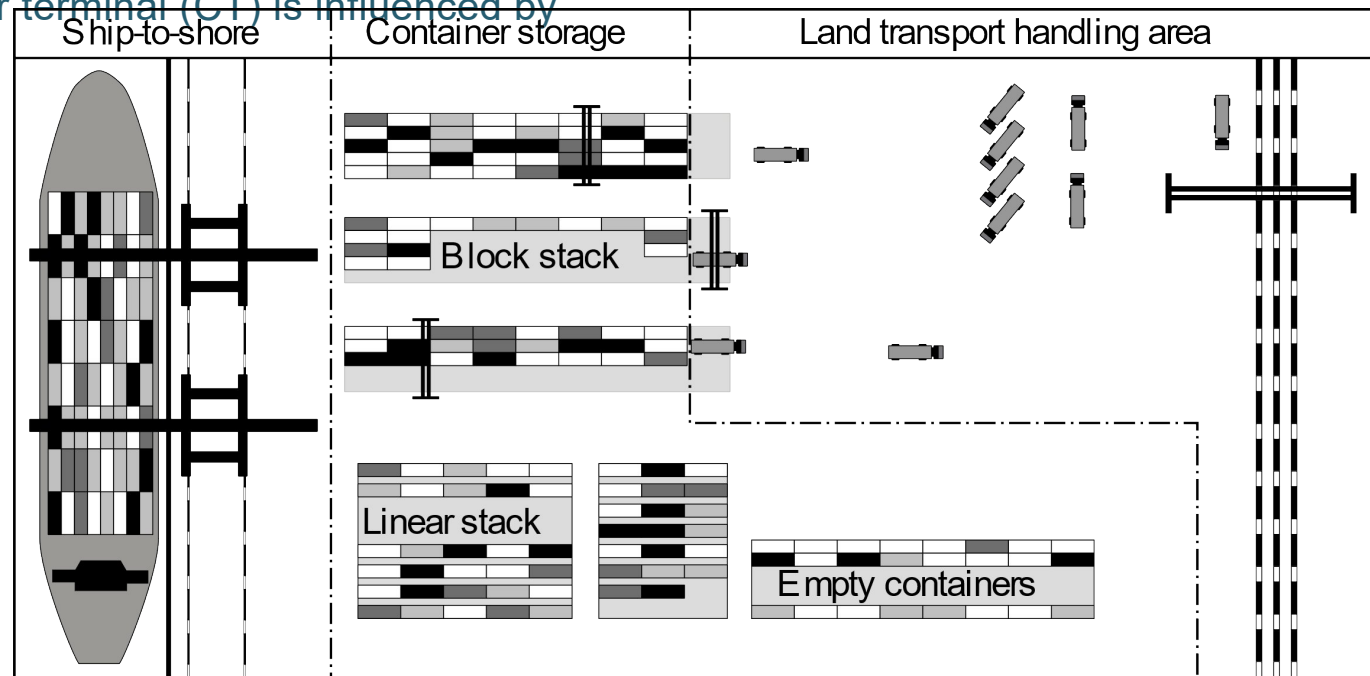


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Container Terminal Operations

- Specialised container handling equipment is used to move containers between three functional areas
- Optimal operating system of container terminal (CT) is influenced by
 - container volume
 - available space
 - connected modes of transport
 - cost structure
 - climate



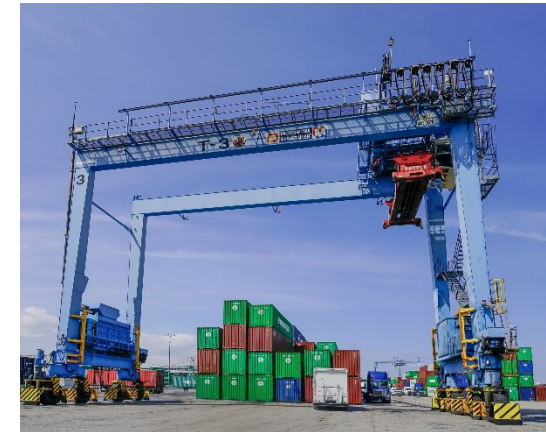
Container Handling Equipment

- Ship-to-shore crane (STS)
- Rubber-tired gantry crane (RTG)
- Rail-mounted gantry crane (RMG)
- Straddle carrier
- Reach stacker
- Top handler
- Side handler
- Yard tractor
- Automated guided vehicle (AGV)
- Empty container handler (ECH)



Straddle carrier

Image: HHLA



Rubber-tired gantry

Rubber-tired gantry crane
Image: World Ports Sustainability Program



Reach Stacker

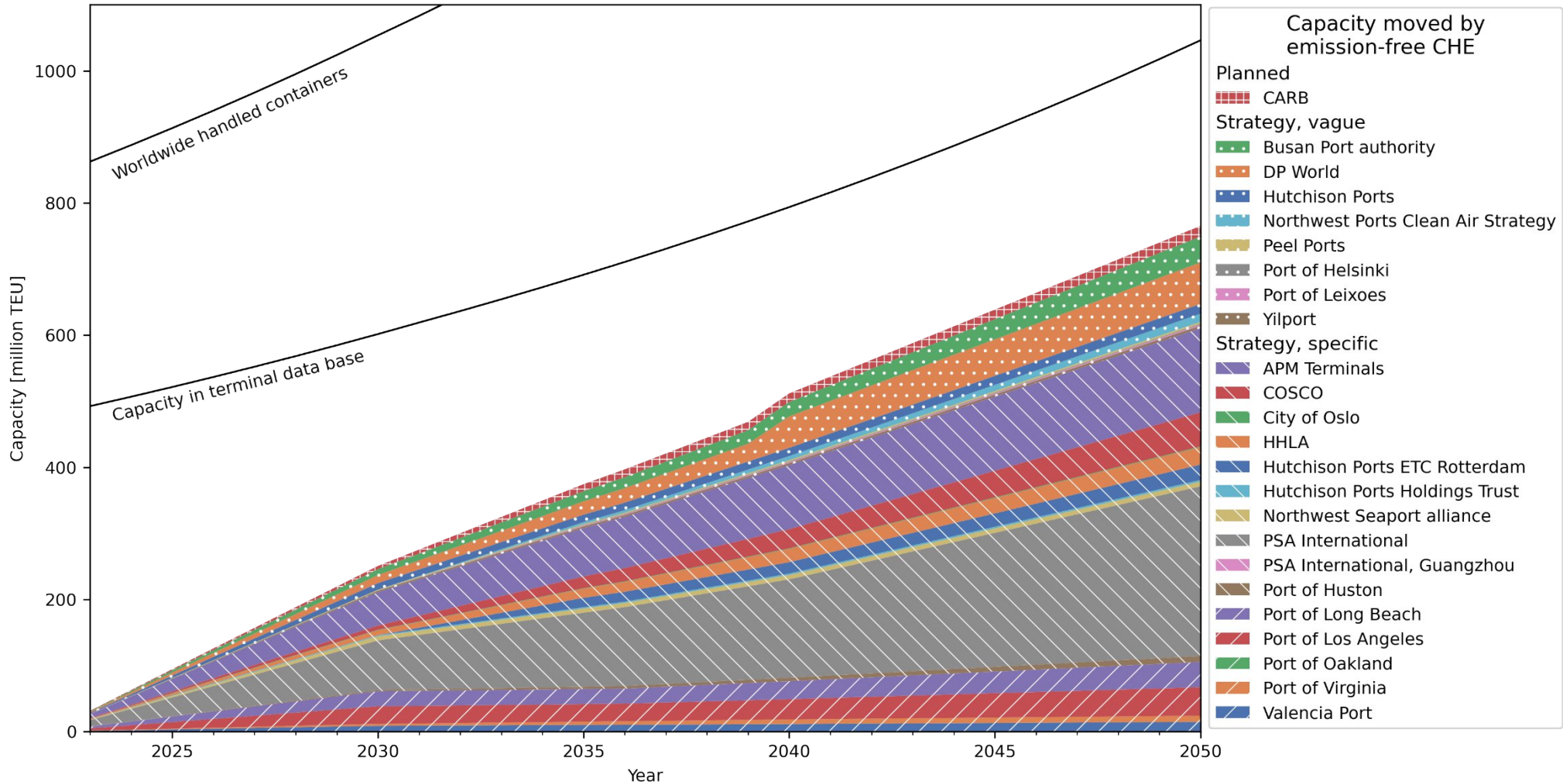
Image: World Ports Sustainability Program



Yard tractor

Image: World Ports Sustainability Program

Identify Cooperation Partners

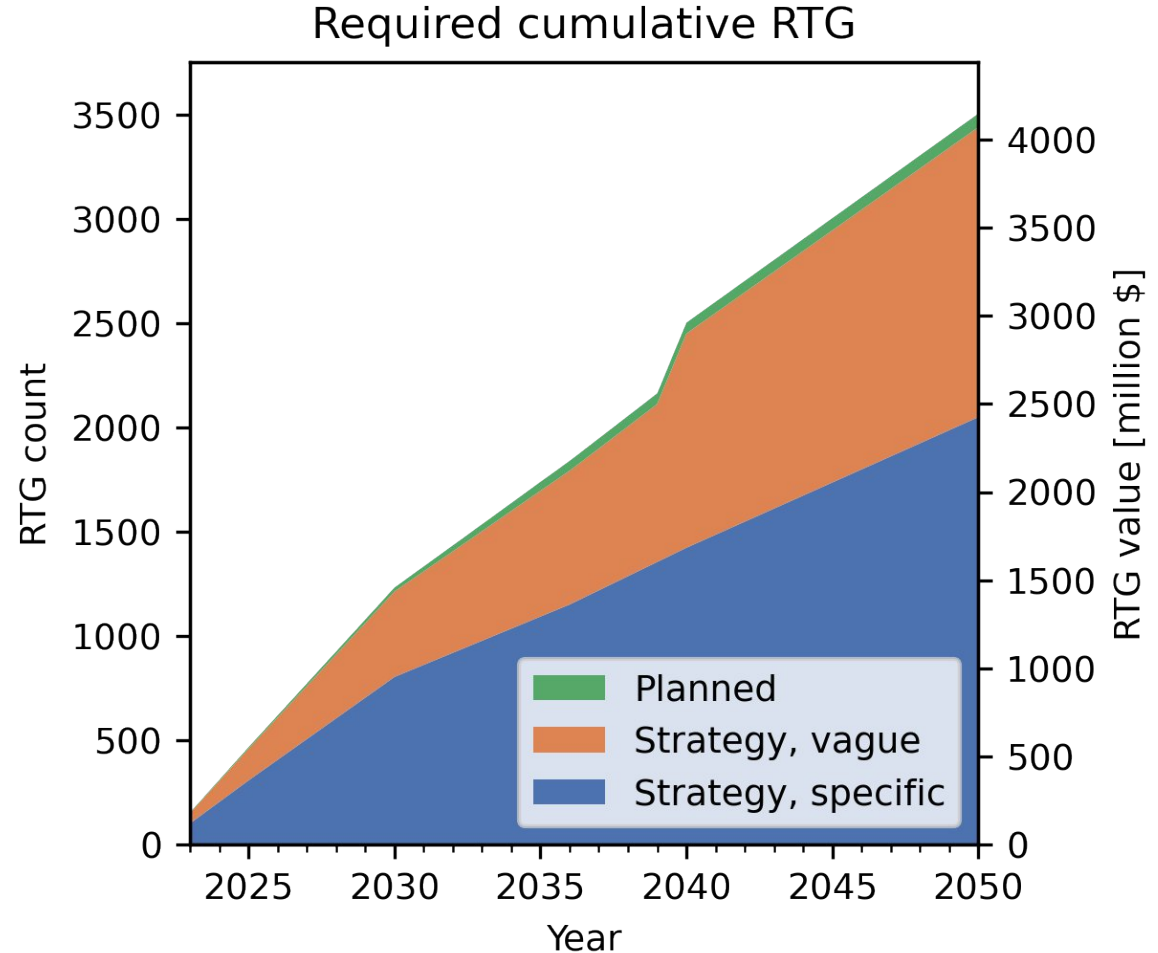


Investigate CHE Types

Which CHE types will be converted first?

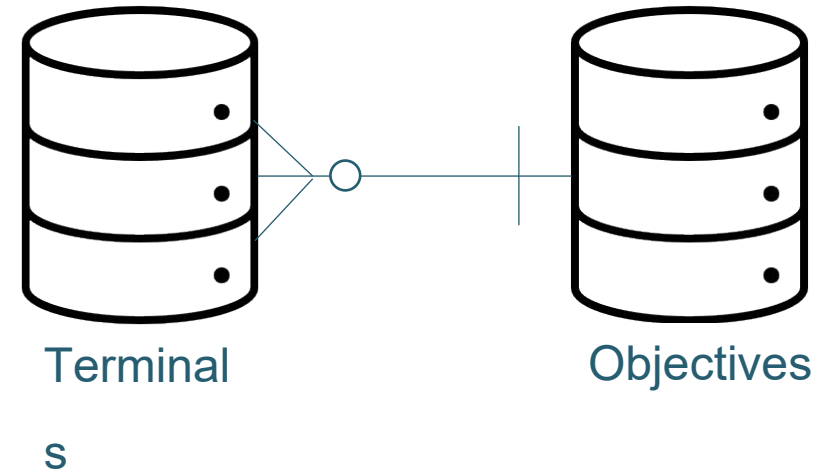
CHE	Equipment cost per unit
Electric RTG	\$1.2M
Hybrid Straddle carrier	\$1M
Hybrid AGV	\$636K
Electric Terminal tractor	\$143K

Reference values from CK Hutchison Holdings Limited (2021)



Forecast Method

- 1) Parse and cascade objectives to terminals
- 2) Infill missing capacity data
- 3) Subtract current emission-free CHE
- 4) Map objectives to terminal information
- 5) Incorporate general container market growth
- 6) Apply most restrictive objective
- 7) Aggregate, filter and interpret results



Summary Terminal Data Base

CHE Type	Total	Emission-Free	Number of entries with value
STS	1 883	1 883	155
RTG	6 187	537	211
RMG	537	29	15
Yard Tractor	5 133	11	29
Straddle Carriers	764	0	9
Side Handler	57	0	8
Top Handler	694	4	16
Reach Stacker	206	0	26
AGV	598	72	6
ECH	116	0	19