Energy efficiency and sustainability in ports

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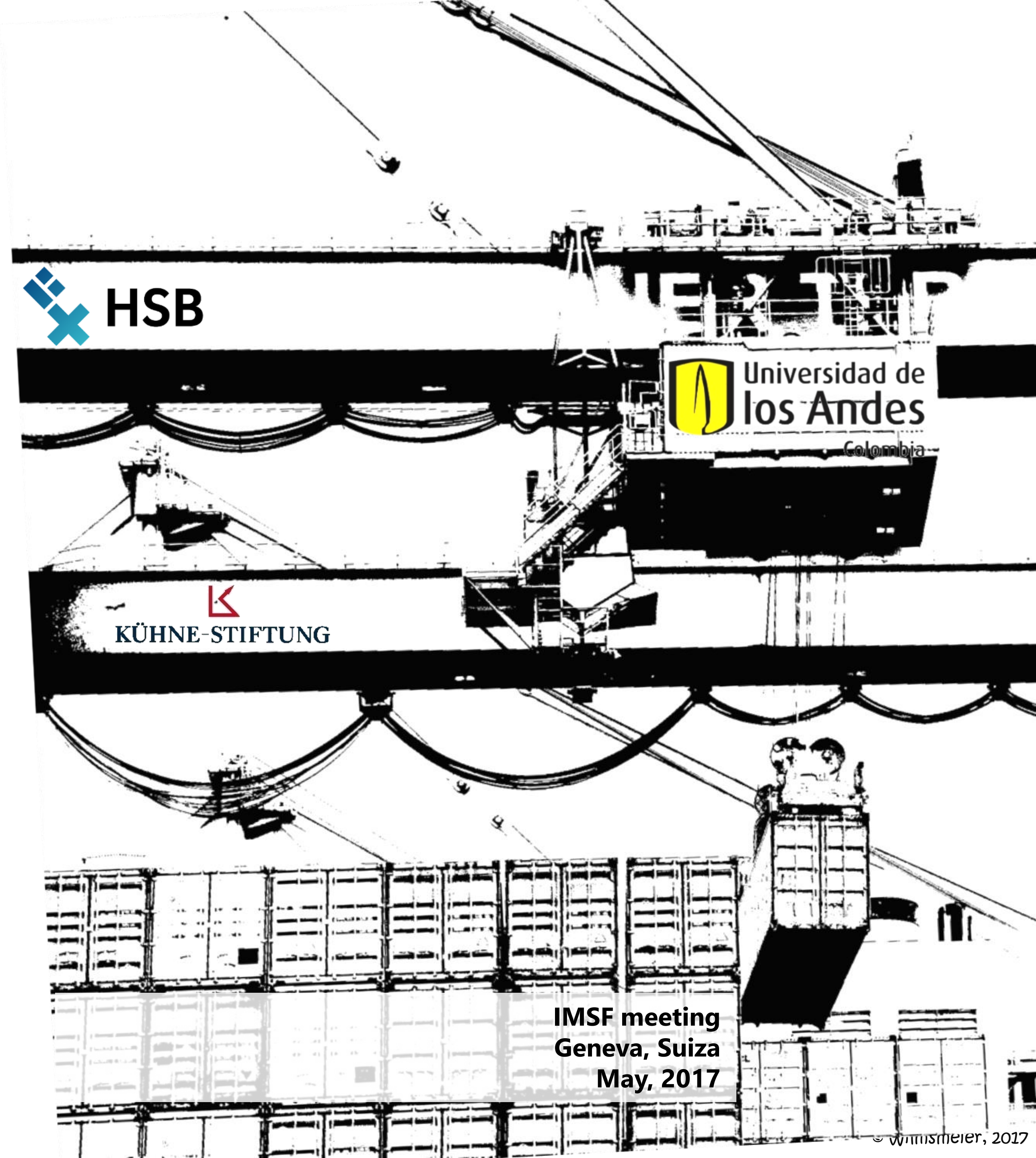
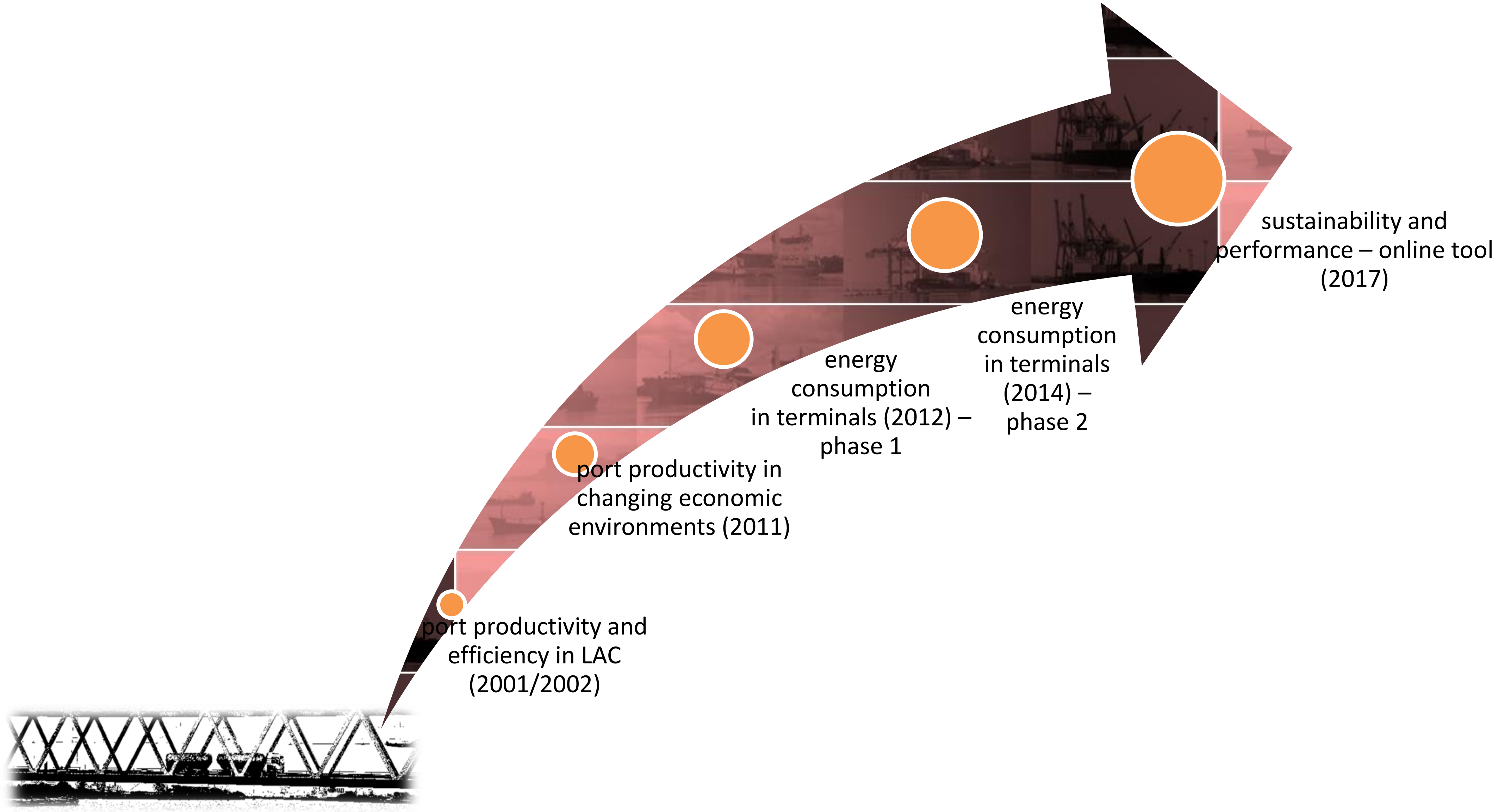


What is a sustainable port?

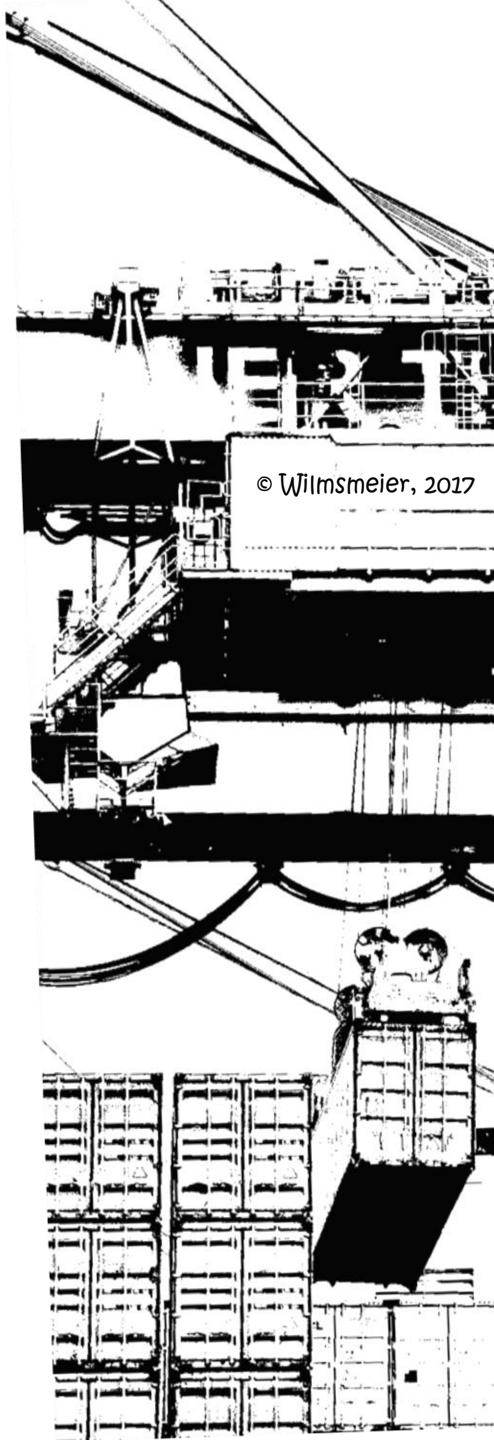
Energy consumption and efficiency in logistics chains

? + ? =  ?

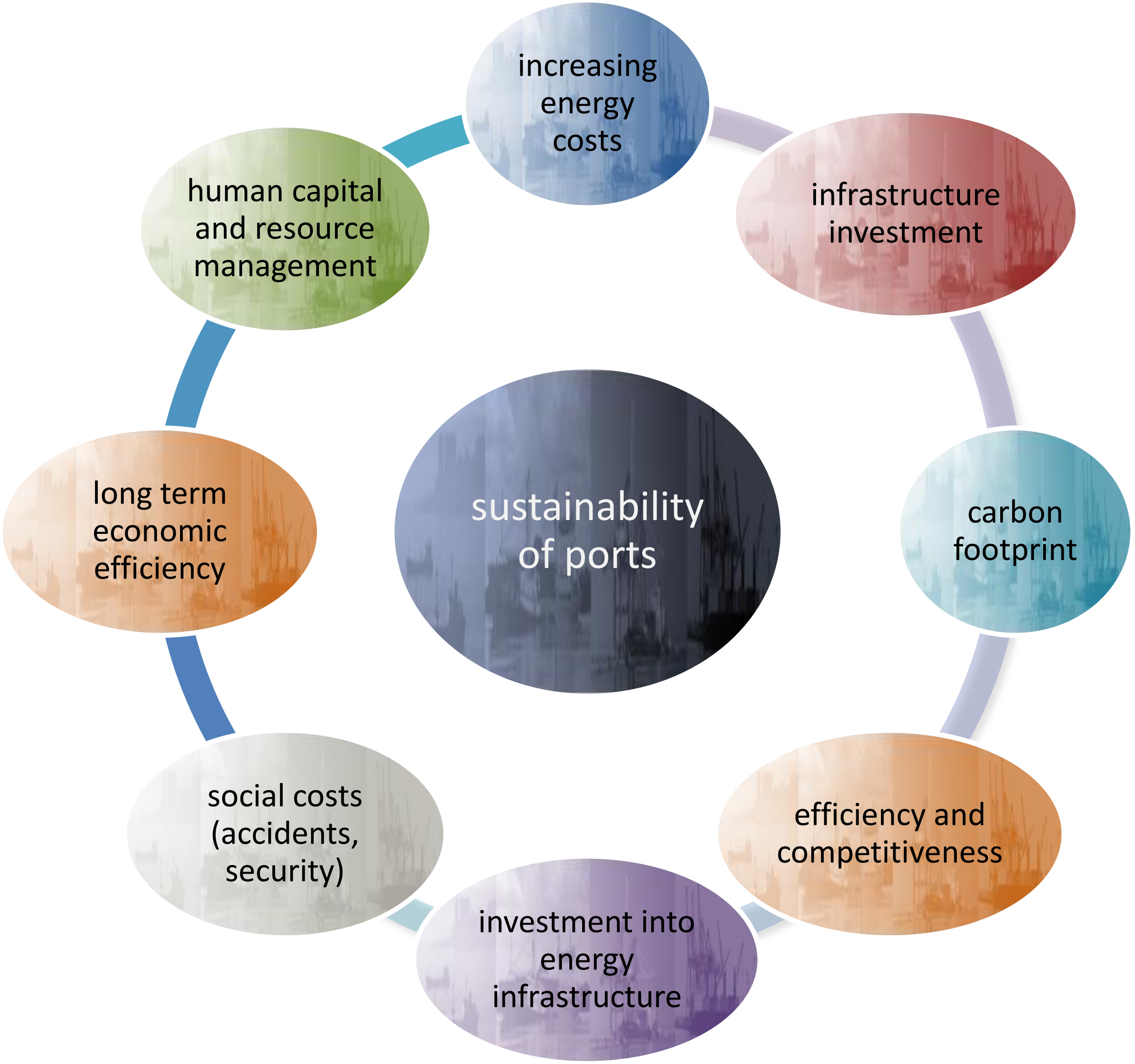

port productivity and efficiency in LAC (2001/2002)
port productivity in changing economic environments (2011)
energy consumption in terminals (2012) – phase 1
energy consumption in terminals (2014) – phase 2
sustainability and performance – online tool (2017)

Common themes and principles of responsible businesses and international organizations

- Sustainability includes three dimensions: economic, social and environmental.
- Sustainability is not a phase or a fashion - it is a necessity.
- It is equivalent to being competitive in the long term.
- Sustainability must be measurable (benchmark).
- It requires proactive approaches.
- Sustainability can only be reached when public and private sector co-operate.
- Sustainability means that organizations need to reach beyond their organizational boundaries (co-ordination, we cannot do it alone).

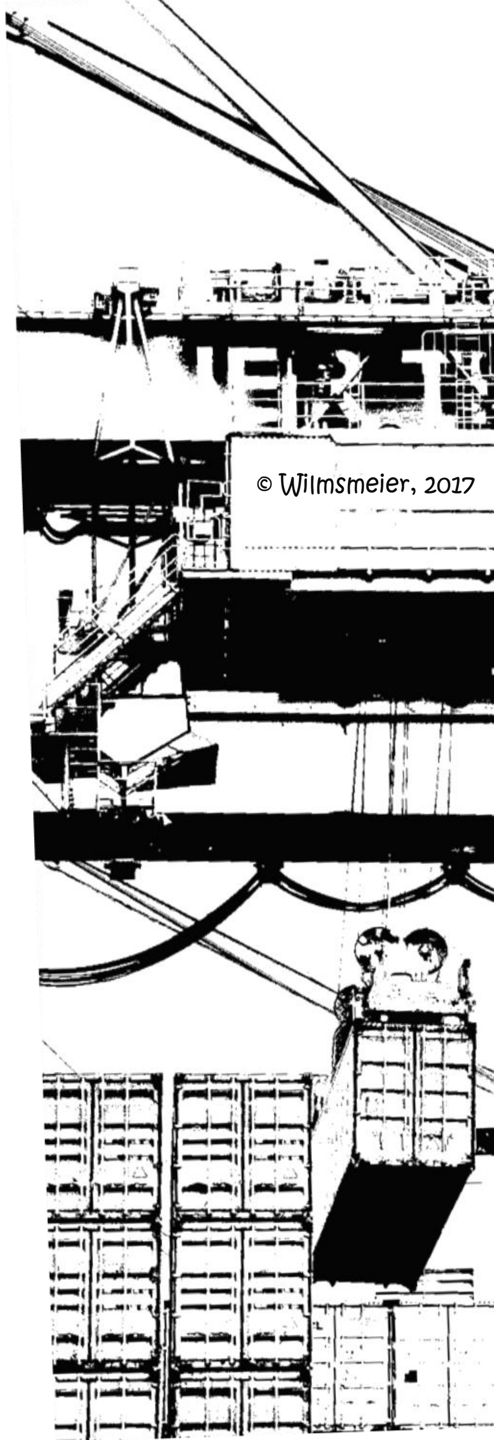


why should sustainability be discussed in the context of ports?

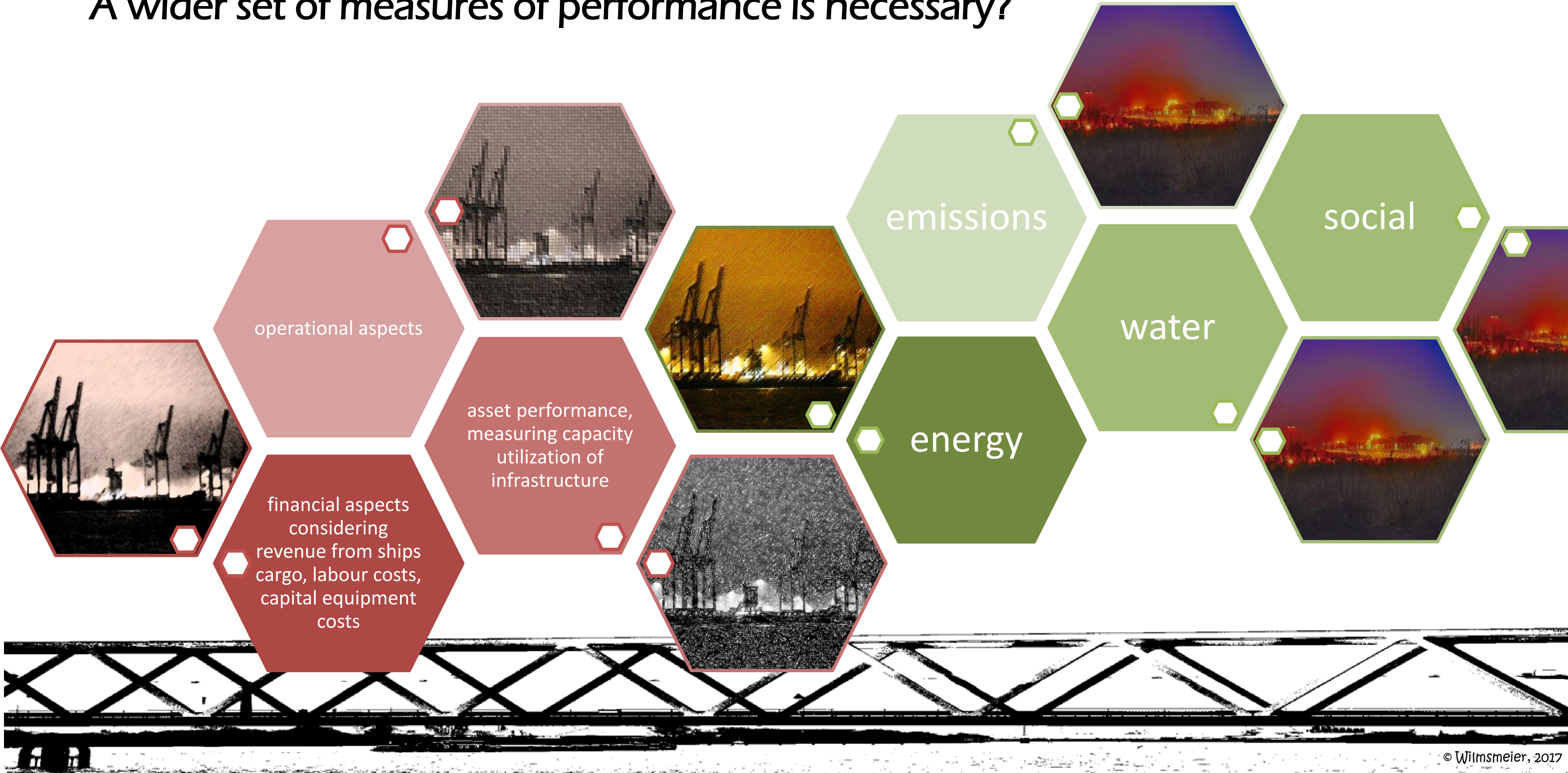


To reach efficient, sustainable and coordinated port performance the practitioner and governments need:

- Measurable outcomes;
- Commitment from the boardroom to the shop-floor;
- Effective and predictable public administration and policies;
- Collaboration;
- CSR (corporate social responsibility).



A wider set of measures of performance is necessary?



New data and measures are not simple

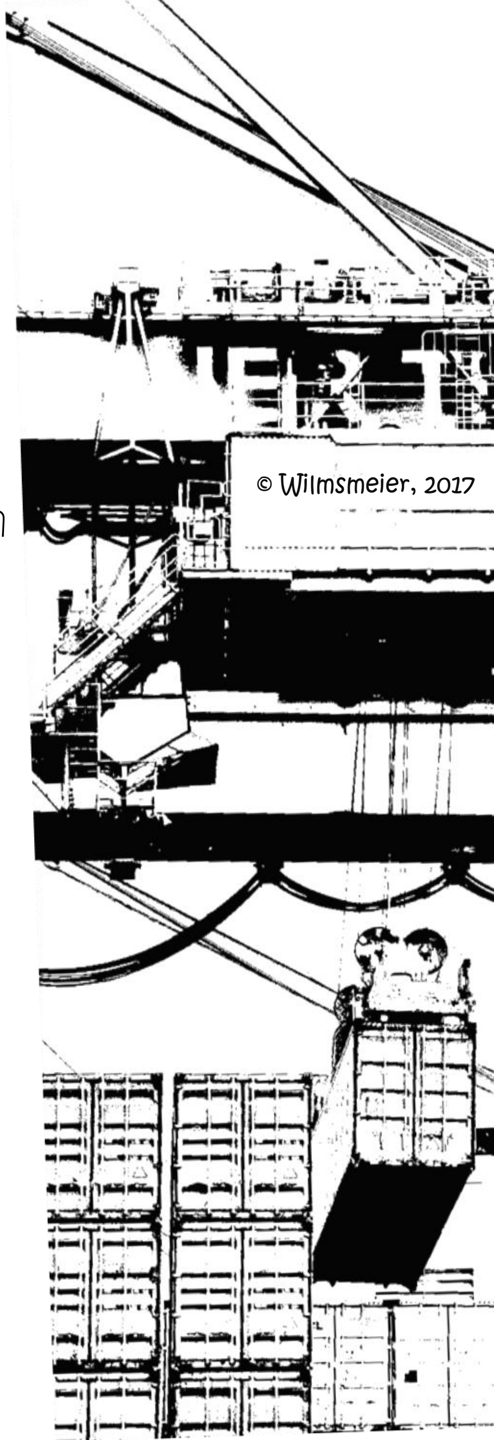
energy
- LNG
- diesel
- LPG
- electricity

water
- blue water
- green water
- grey water
- virtual water

emissions
- CO_2
- NO_x
- black carbon
- SO_x

Relevant certifications

- ISO 14001: this is a group of management system standards which are applied to improve the environmental performance in organizations.
- Green Ports: a certification that shows balancing between environmental protection and economic demand.
- Ecoports: This is integration between two concepts: effective environmental and port management.
- ISO 50001 - Energy management standards target to use energy efficiently through the development of an energy management system (EnMS).
- CEN 16258
- GHG Protocol (adopted by ISO 14064-1)
- ISO 14046 –Water footprint



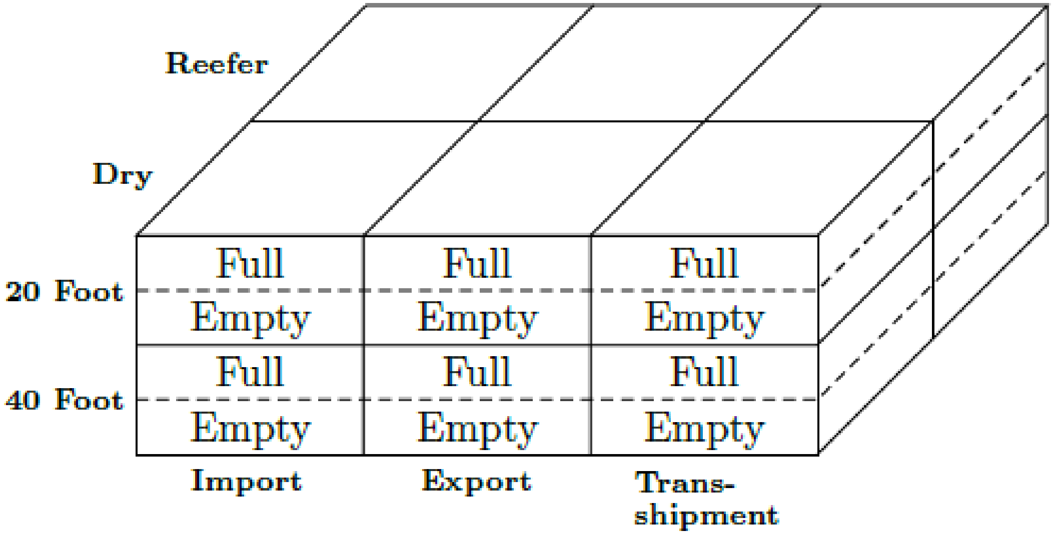
energy consumers inside a container terminal

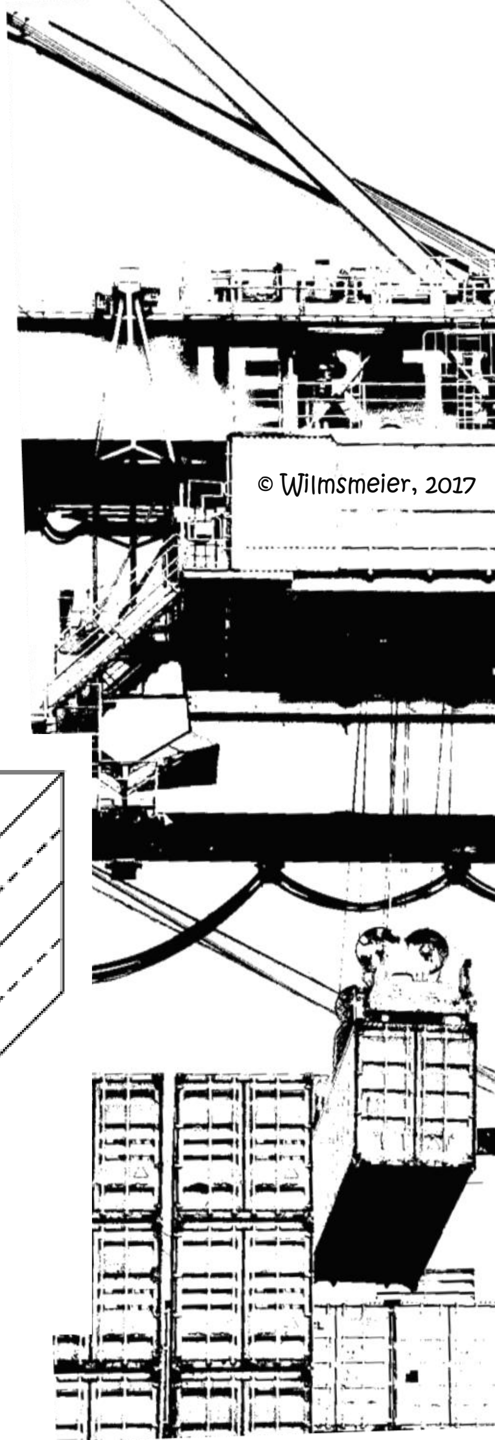
Energy Consumer	Energy Source			
	Diesel	Petrol	Gas	Electricity
Ship-to-shore cranes	●			●
Mobile cranes	●			●
Rail-mounted gantry cranes	●			●
Rubber-tyred gantry cranes	●			●
Reachstackers	●			●
Straddle carriers	●			●
Tractor-trailer units and lorries	●		●	●
Generators	●		●	
Consumption by buildings				●
Lighting				●
Consumption by reefer containers				●
Other port vehicles	●	●	●	●

container terminals are multi product operations

- differentiation necessary between:
  - container types (i.e. dry, reefer)
  - transhipment and impo/expo cargo
  - full and empty

Thus, different products have different requirements and performance

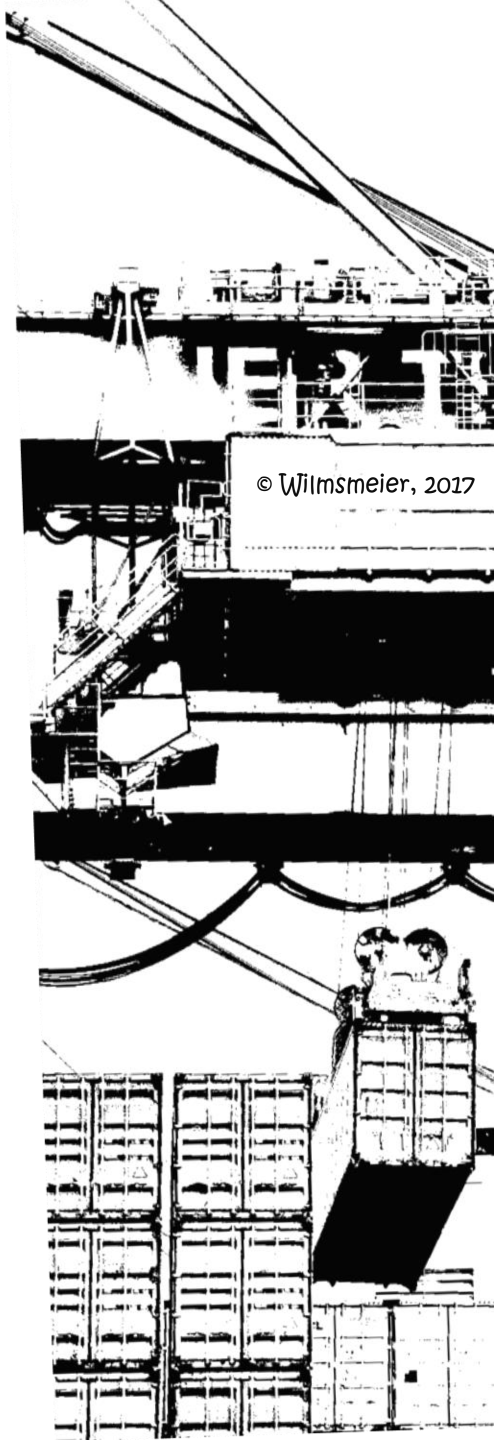




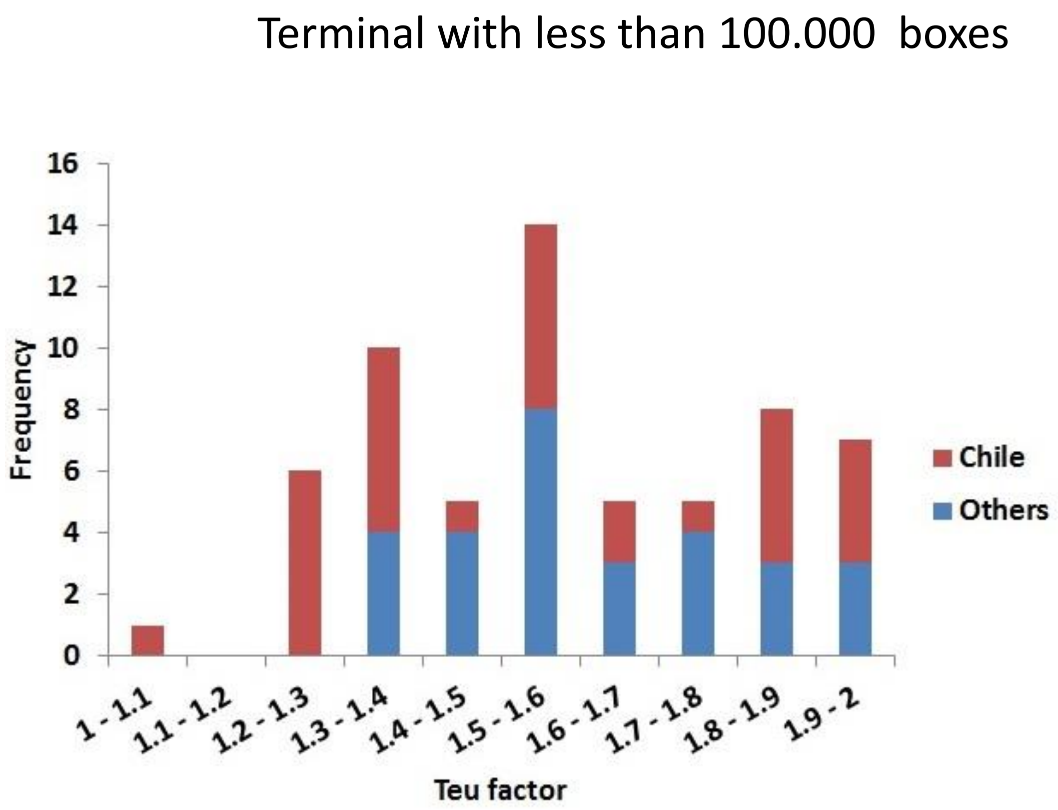
Boxes or TEU?

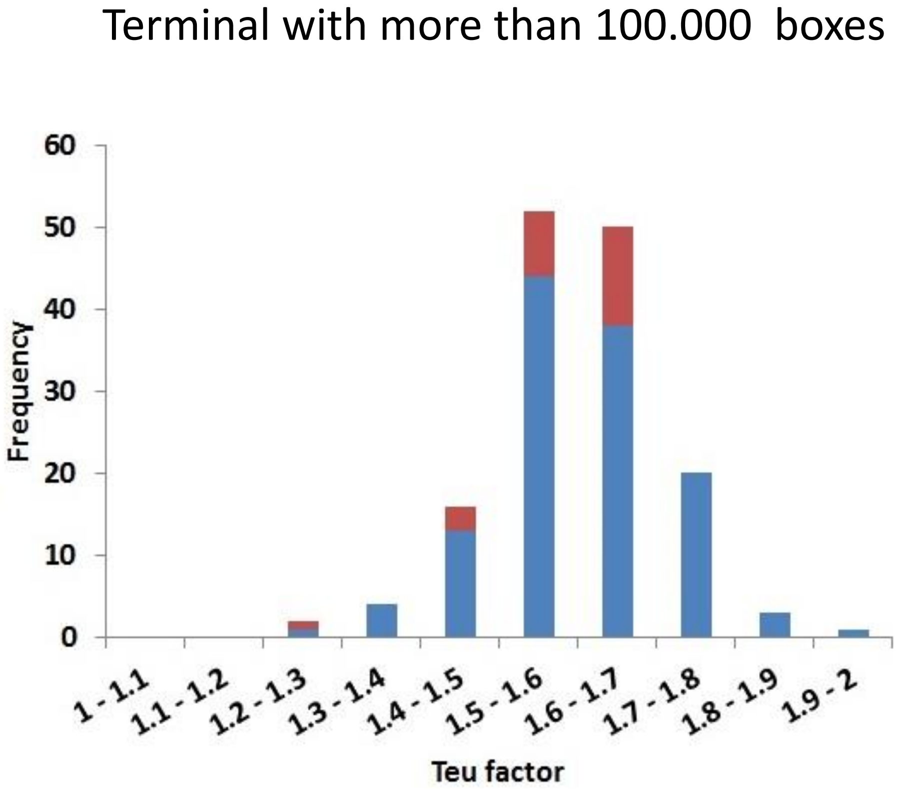

LIEBHERR
CMA CGM
CMA CGM
CMA CGM
CAI

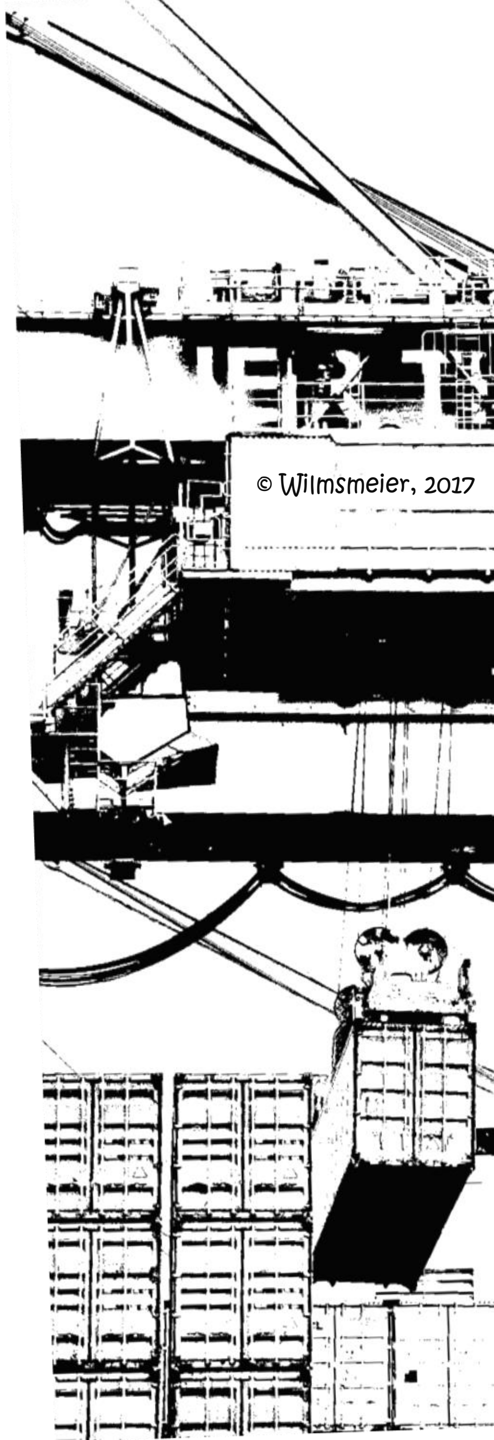

KONECRANES
SMV 4535 TB5
MAERSK
MAERSK SEALAND
MAERSK



TEU factors

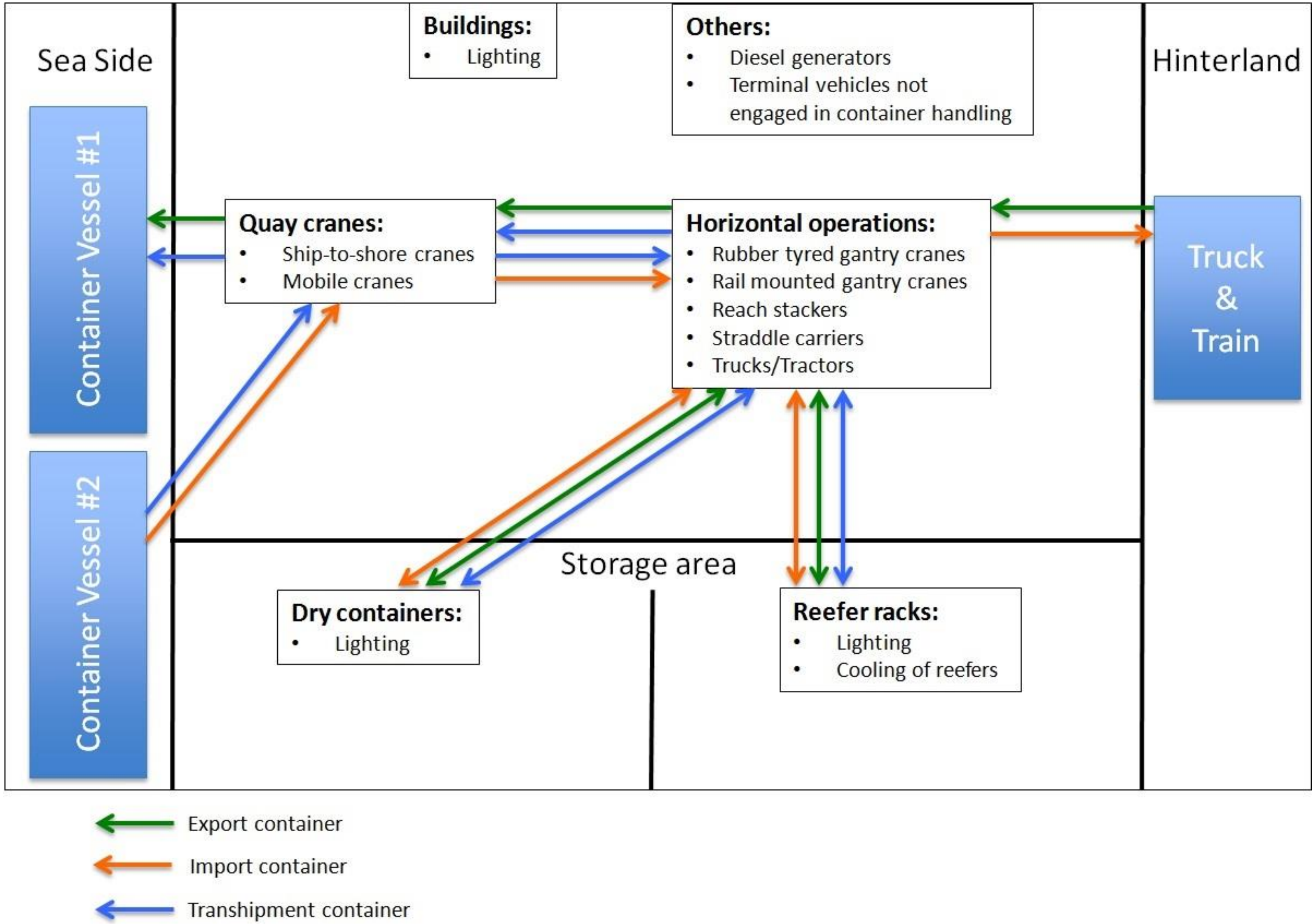




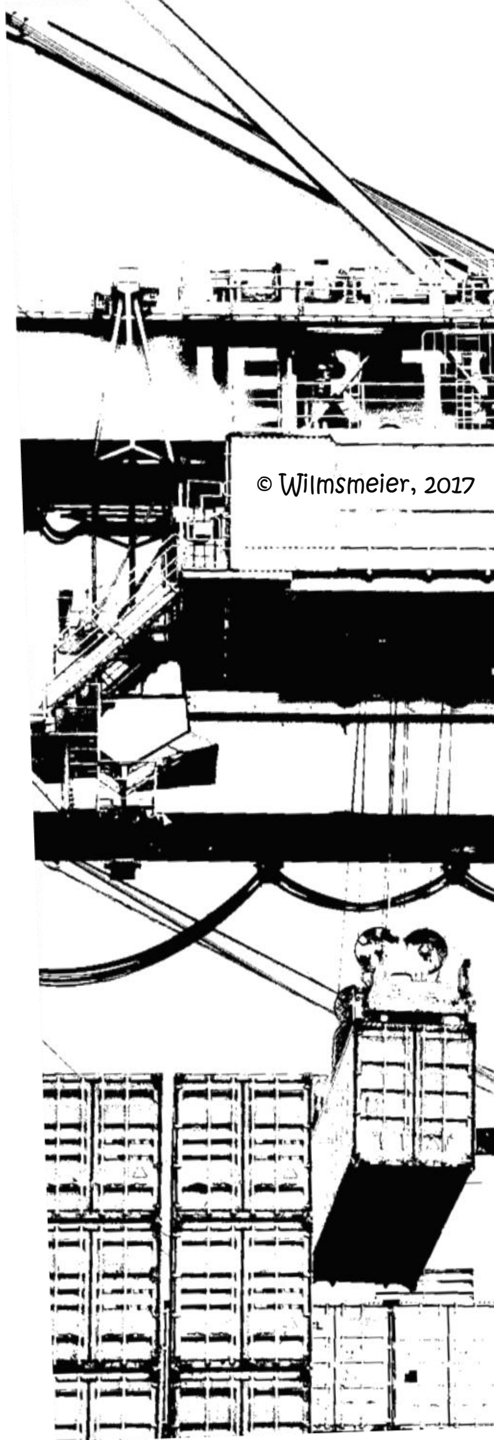


Source: Wilmsmeier and Spengler 2016

example:
an activity based approach to allocate energy consumption



Source: Spengler 2015



The formula

TC = (QCC+HOC+CRC+BC+LC+OC+GEN) + UC

where: UC = Undefined consumption

TC = Total energy consumption from all sources

QCC = Energy consumption from all sources within the process cluster of quay cranes

HOC = Energy consumption from all sources within the process cluster of horizontal operations

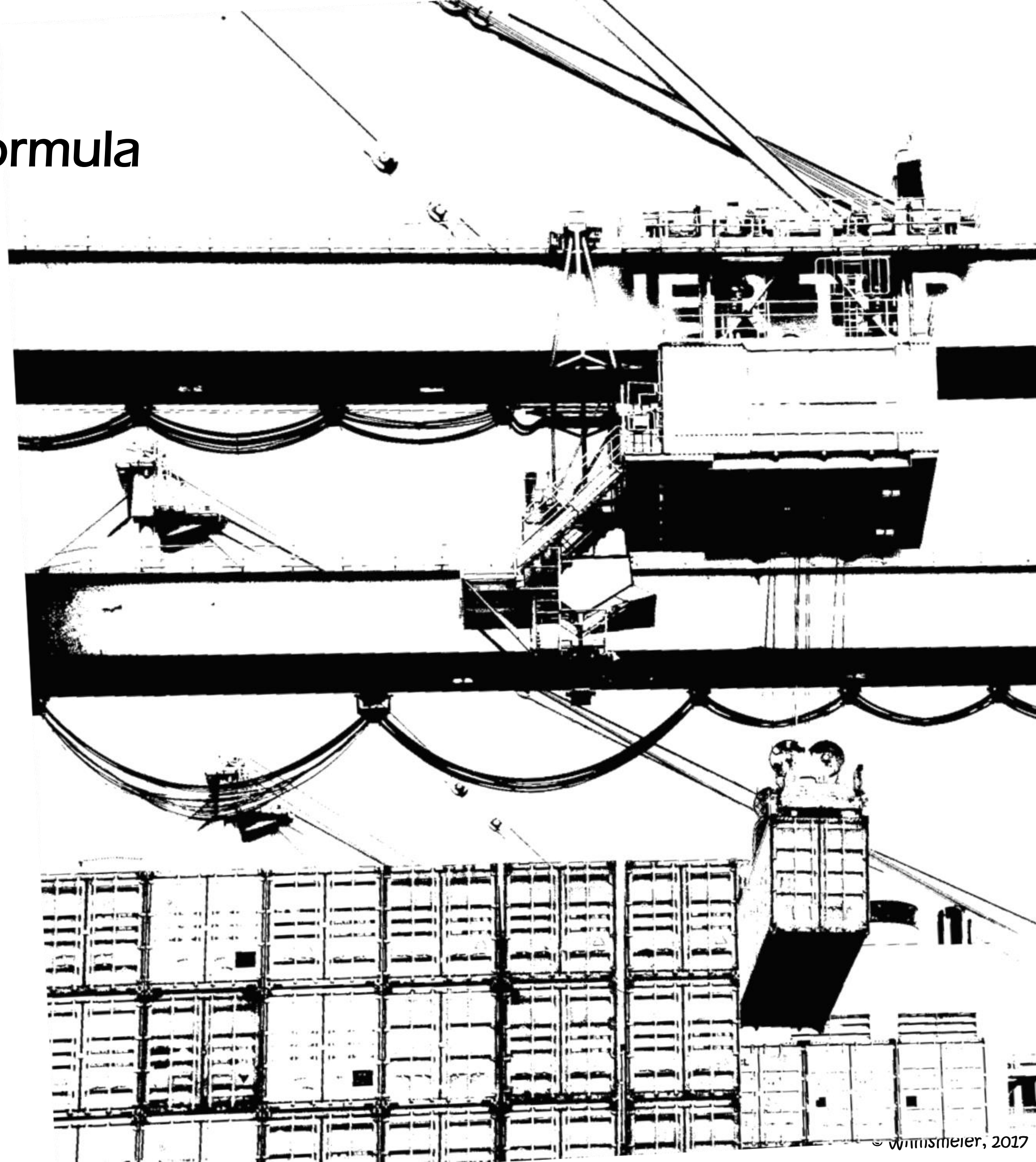
CRC = Energy consumption from all sources within the process cluster of reefer cooling

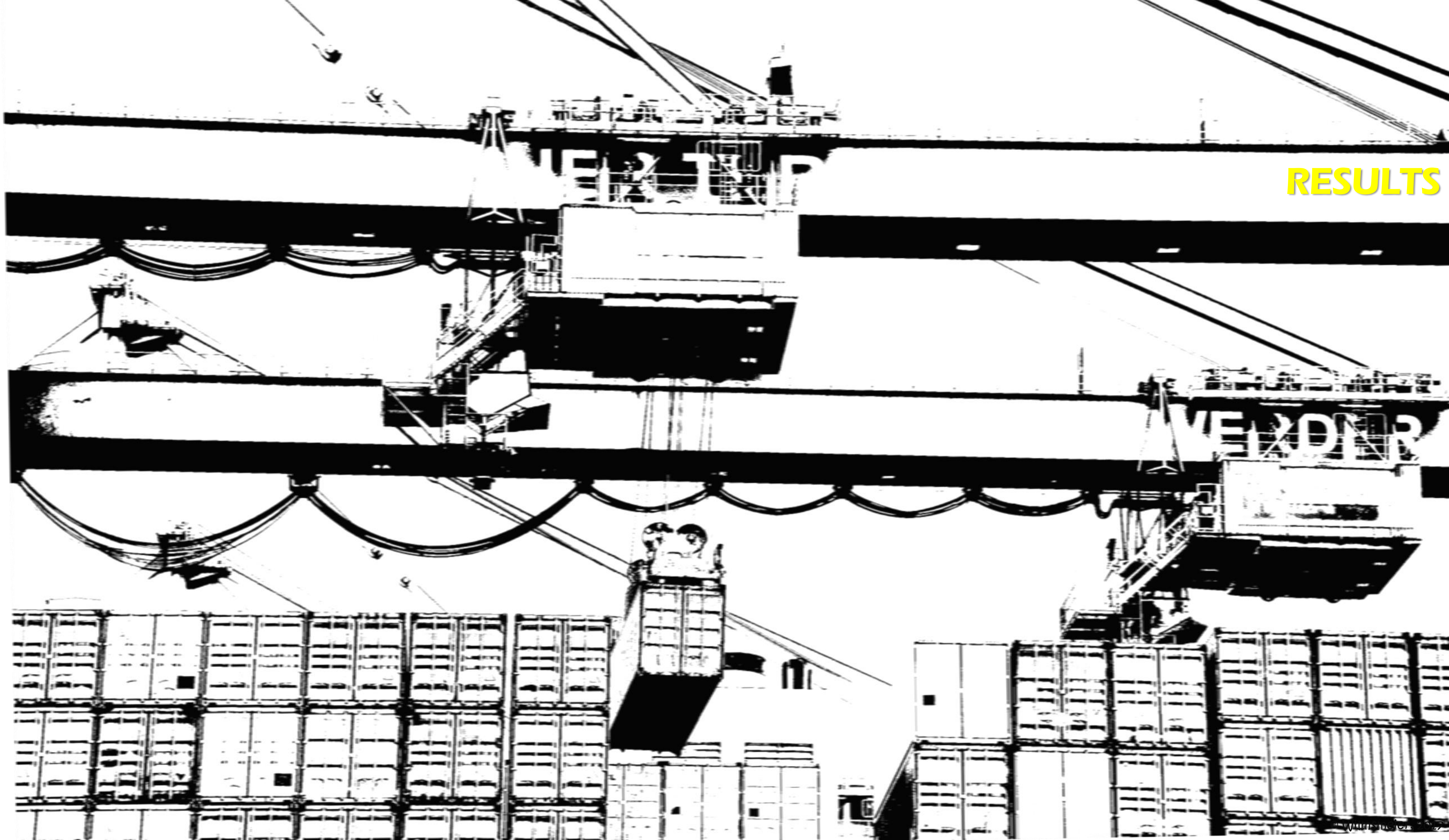
BC = Energy consumption from all sources within the process cluster of buildings

LC =Energy consumption from all sources within the process cluster of lighting

OC =Energy consumption from all sources within the process cluster of others

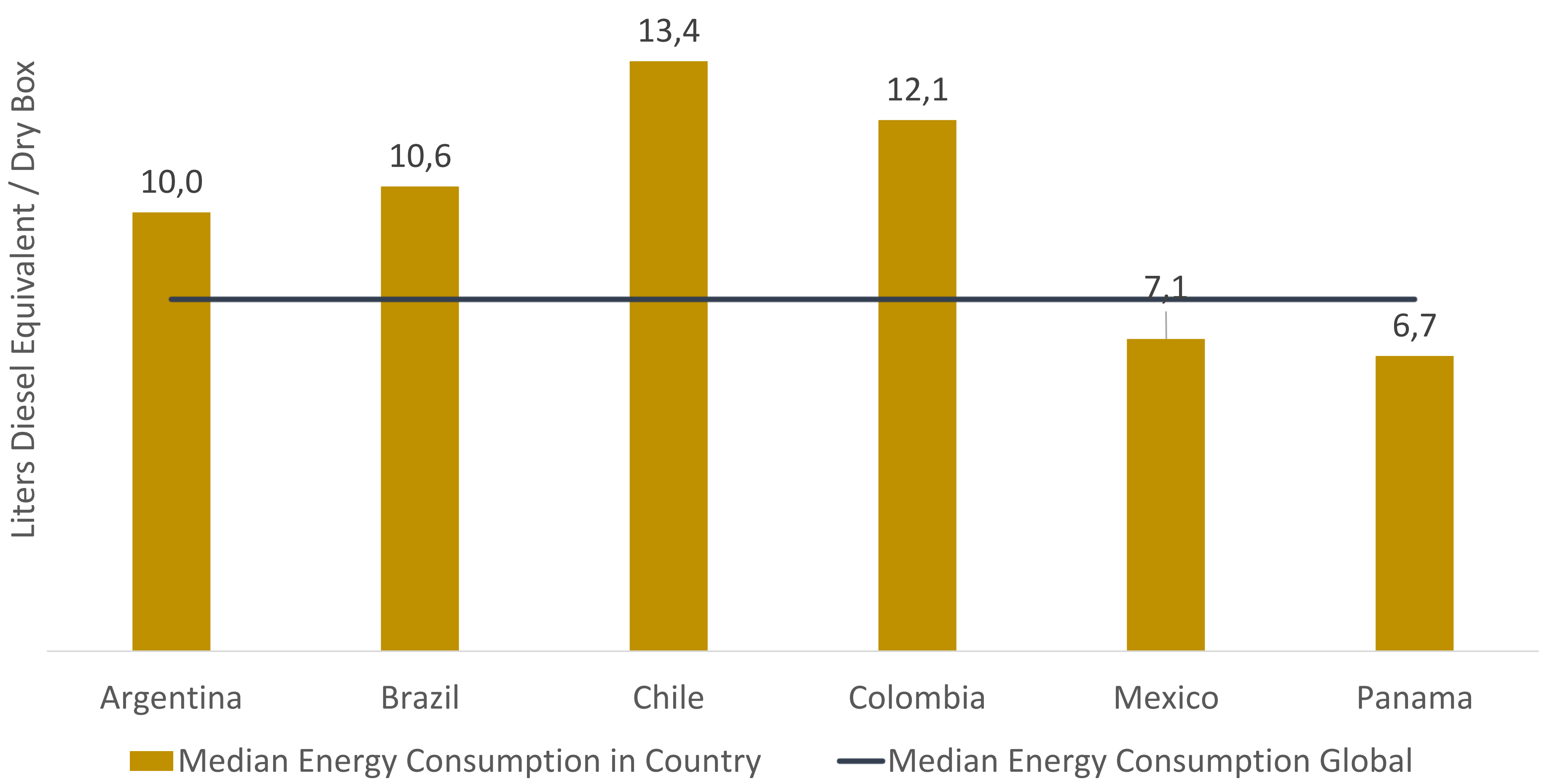
GEN = Energy consumption from all sources within the process cluster of generators





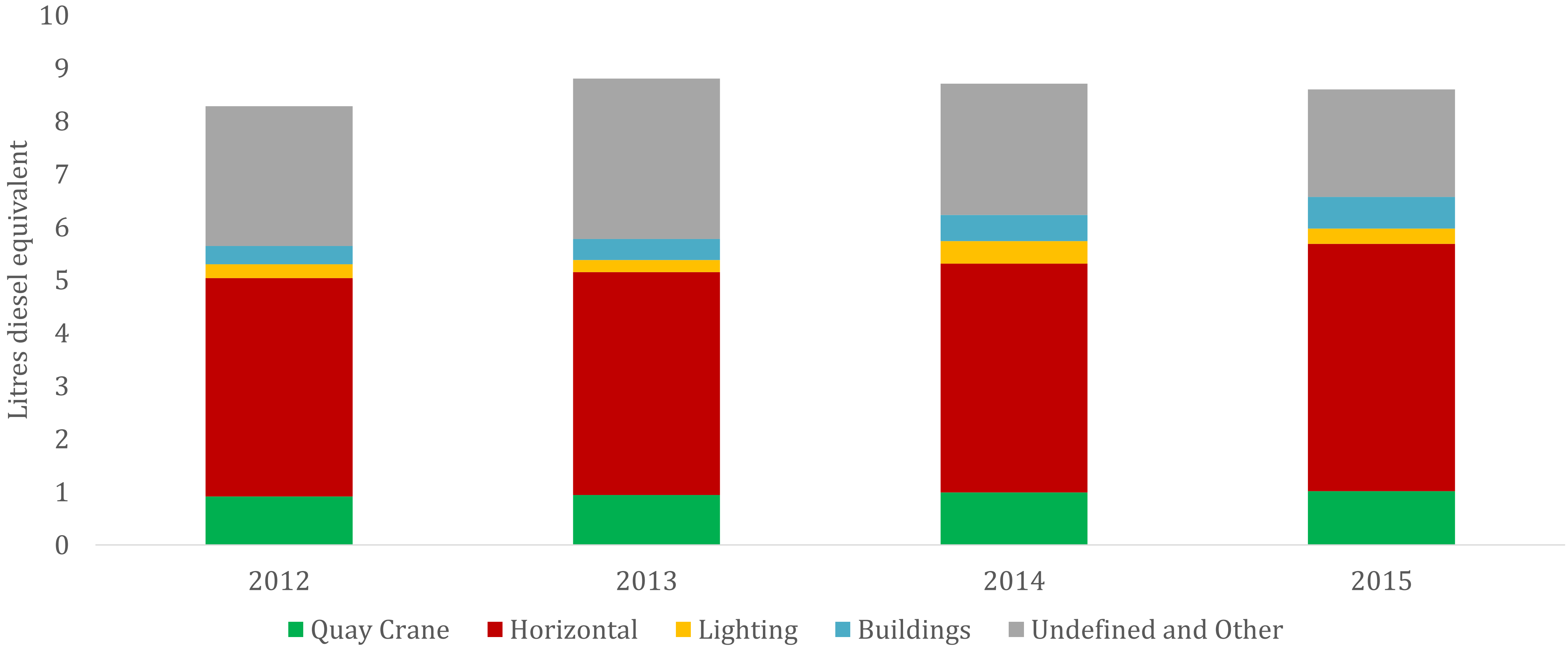
RESULTS

Median litres of diesel equivalent consumed for handling one dry box (excluding reefer consumption), by country, 2012-2015



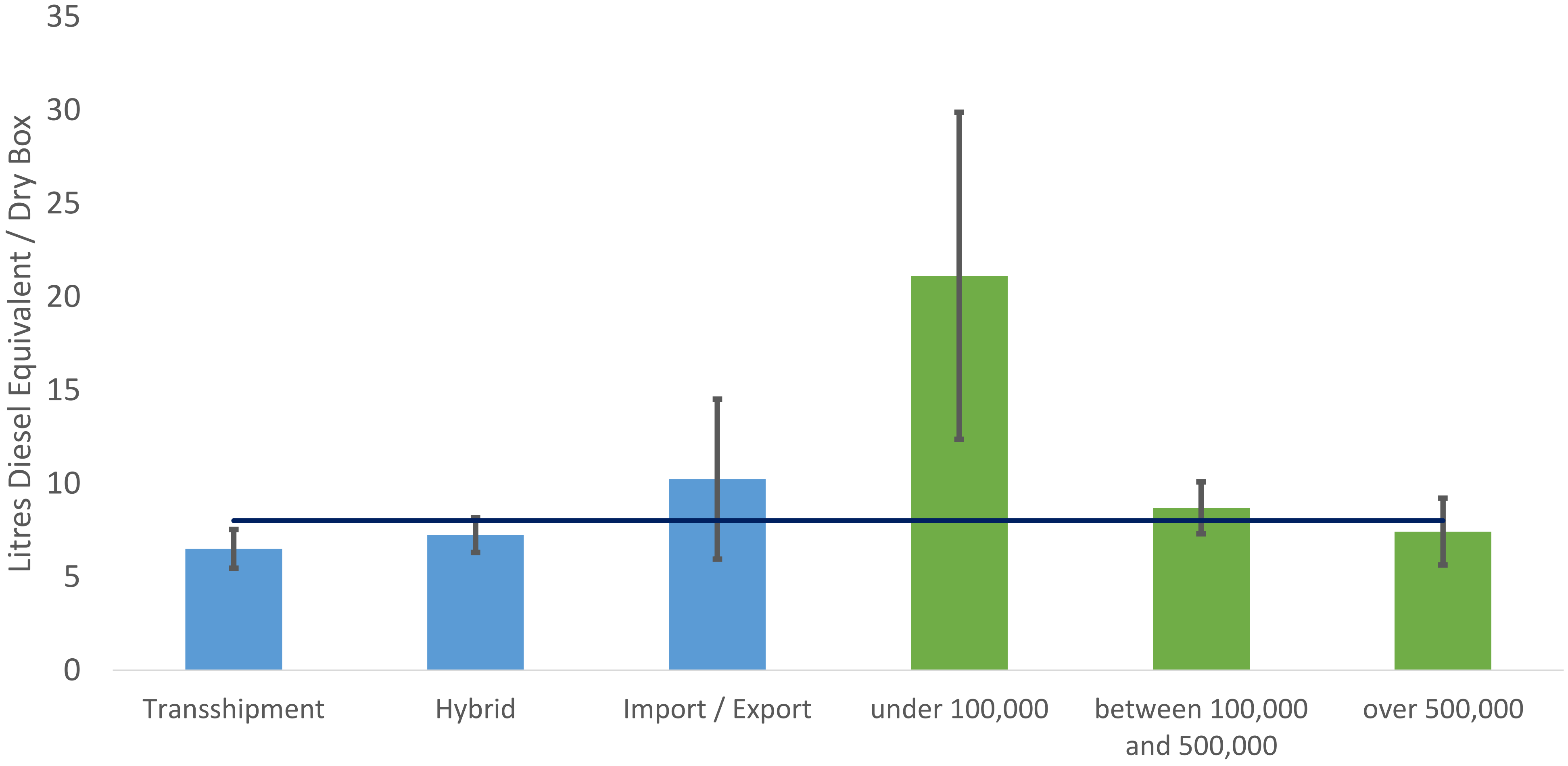
Source: Authors based on Wilmsmeier and Spengler (2016) and ECLAC Infrastructure Services Unit

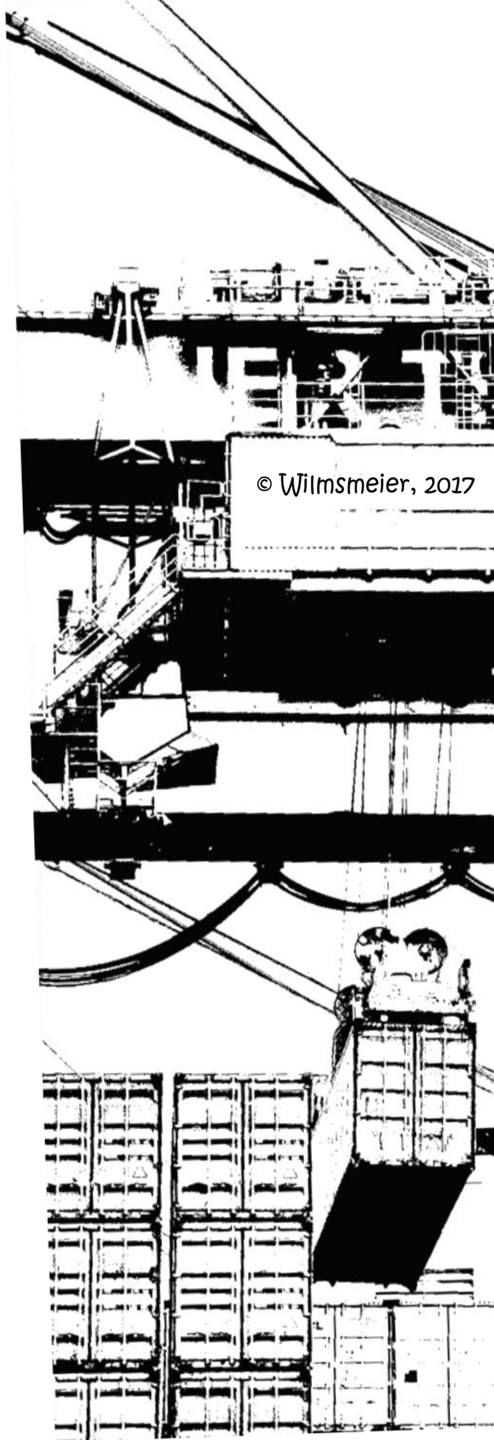
Median litres of diesel equivalent consumed per activity cluster (excluding reefer cooling), 2012-2015



Source: Authors based on Wilmsmeier and Spengler (2016) and ECLAC Infrastructure Services Unit
Note: The calculations are based on data for 31 terminals in 16 countries

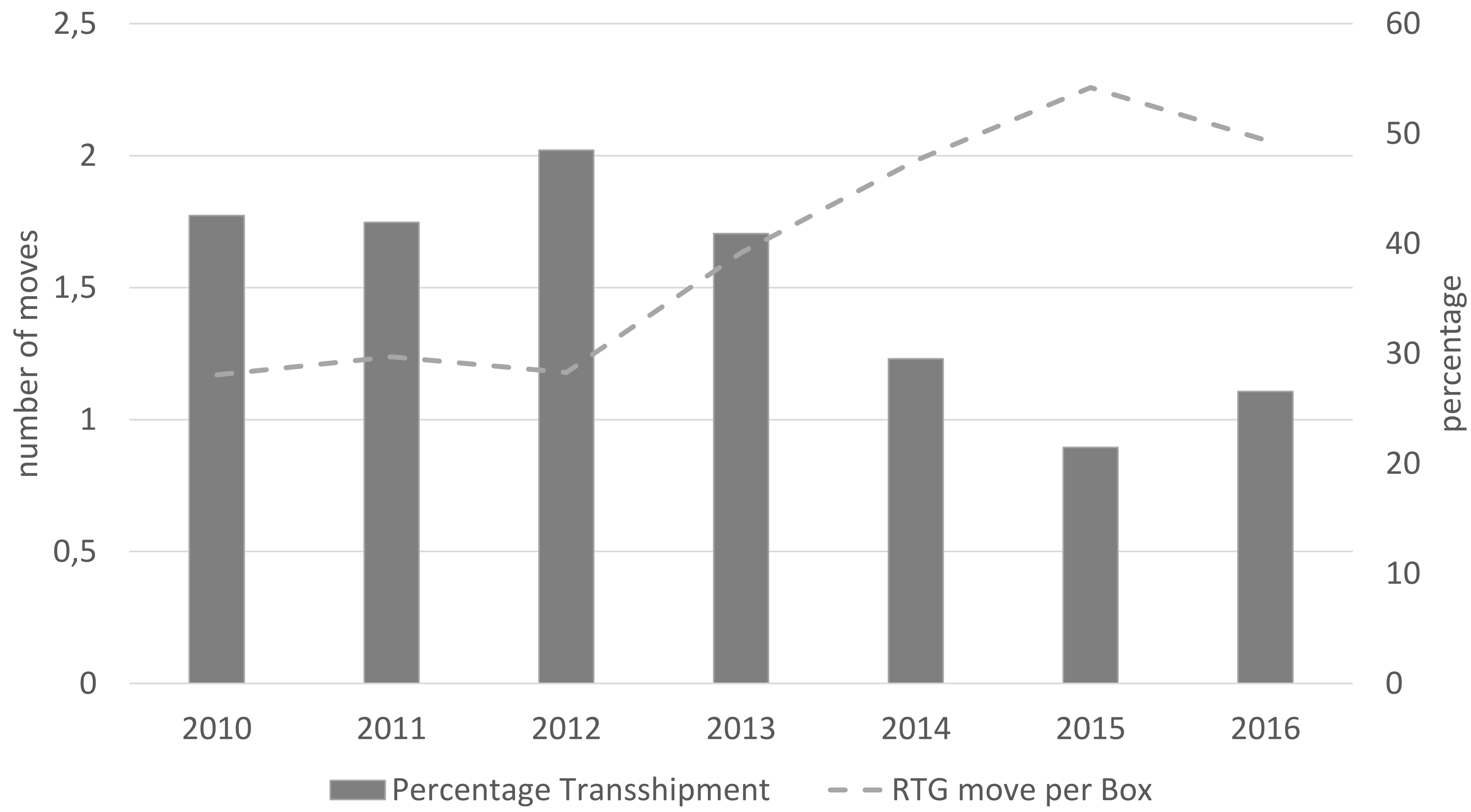
Median litres of diesel equivalent consumed for handling one dry box (excluding reefer consumption), by type and size of terminal, years 2012-2015

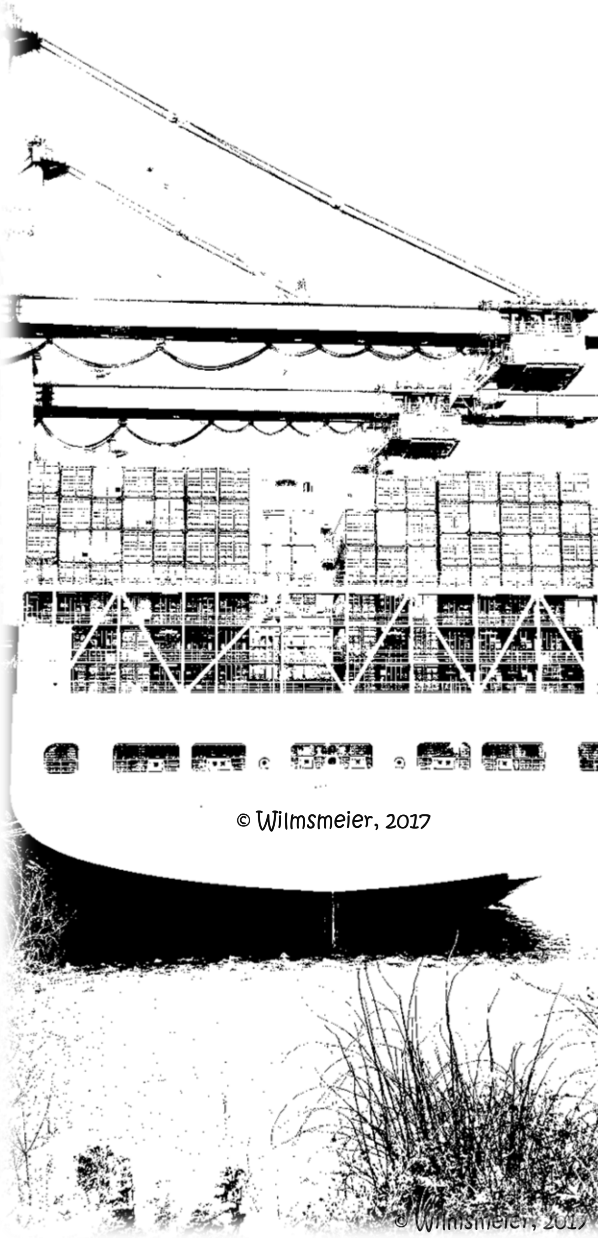




Source: Authors based on Wilmsmeier and Spengler (2016) and ECLAC Infrastructure Services Unit
Note: The calculations are based on data for 25 terminals in 8 countries

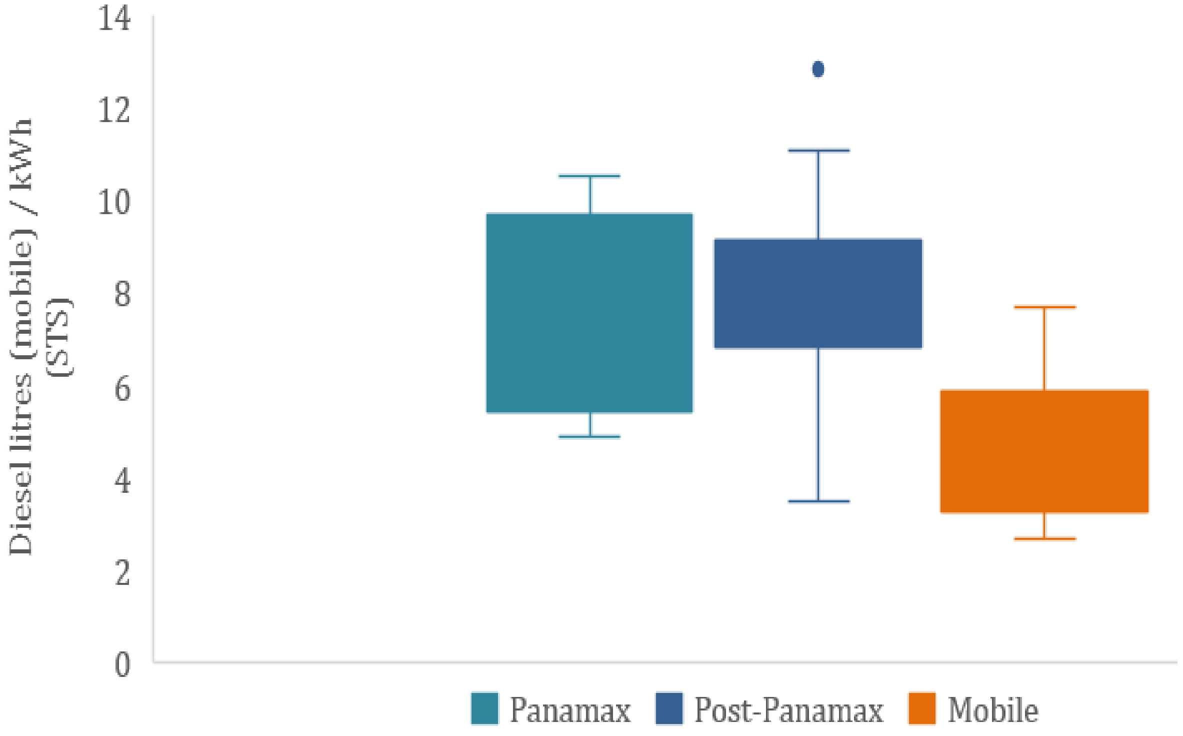
Example of the relationship between the share of transhipment cargo and RTG moves in Terminal B, 2010-2016

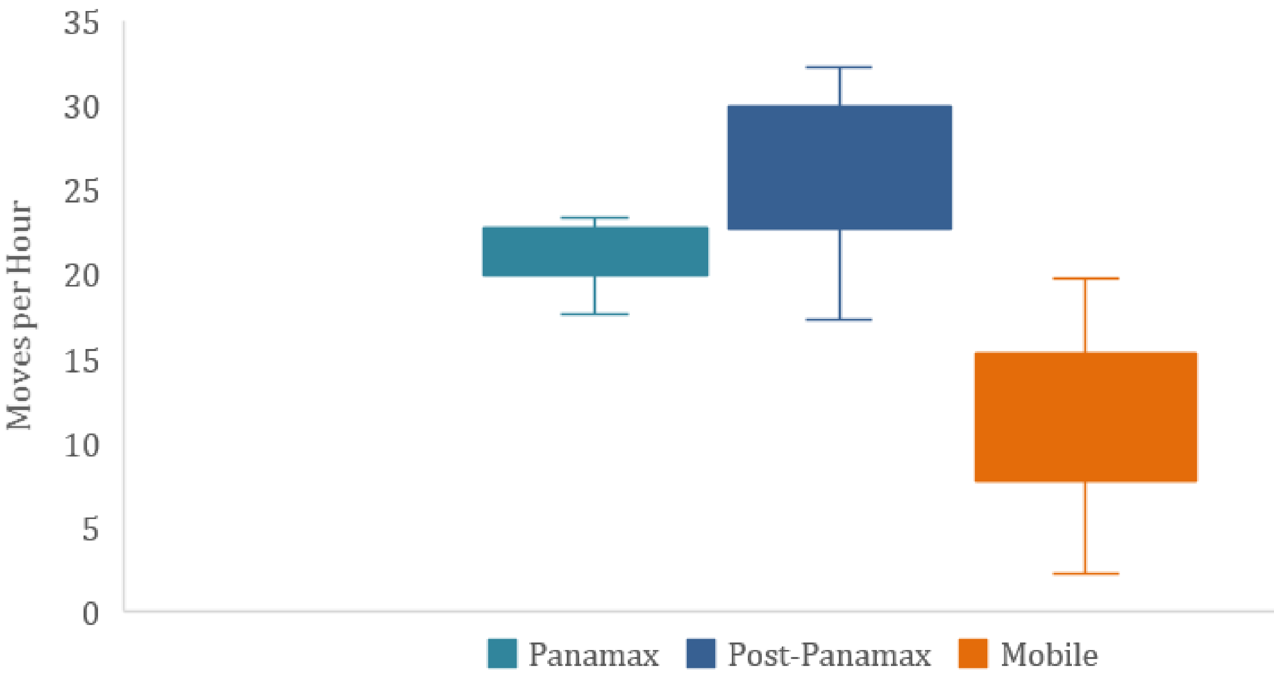


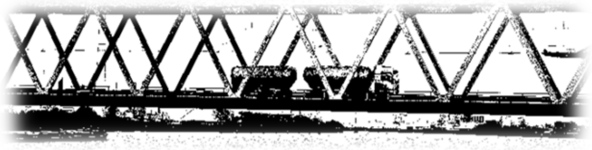


Source: Authors based on Wilmsmeier and Spengler (2016) and ECLAC Infrastructure Services Unit

Productivity and energy consumption by crane type, 2012-2015

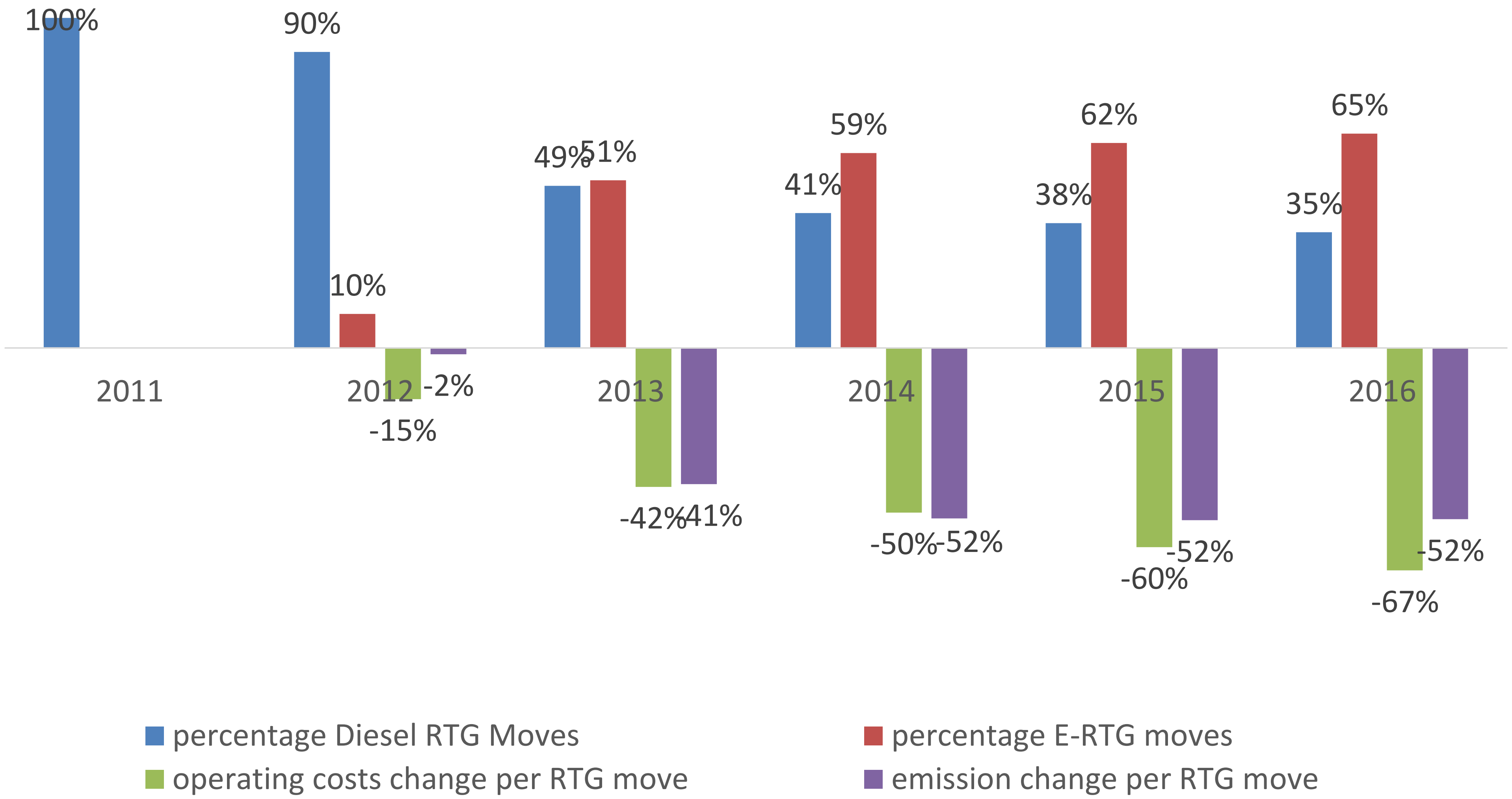


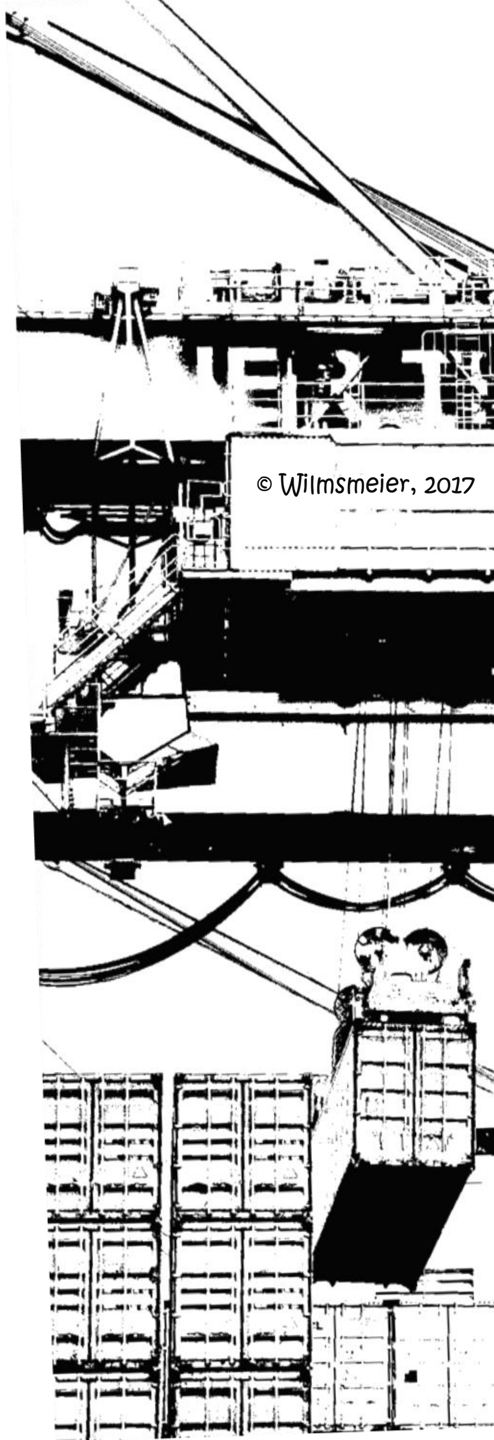




Source: Authors based on Wilmsmeier and Spengler (2016) and ECLAC Infrastructure Services Unit

Evolution of energy costs and emissions per RTG move in reference Terminal A

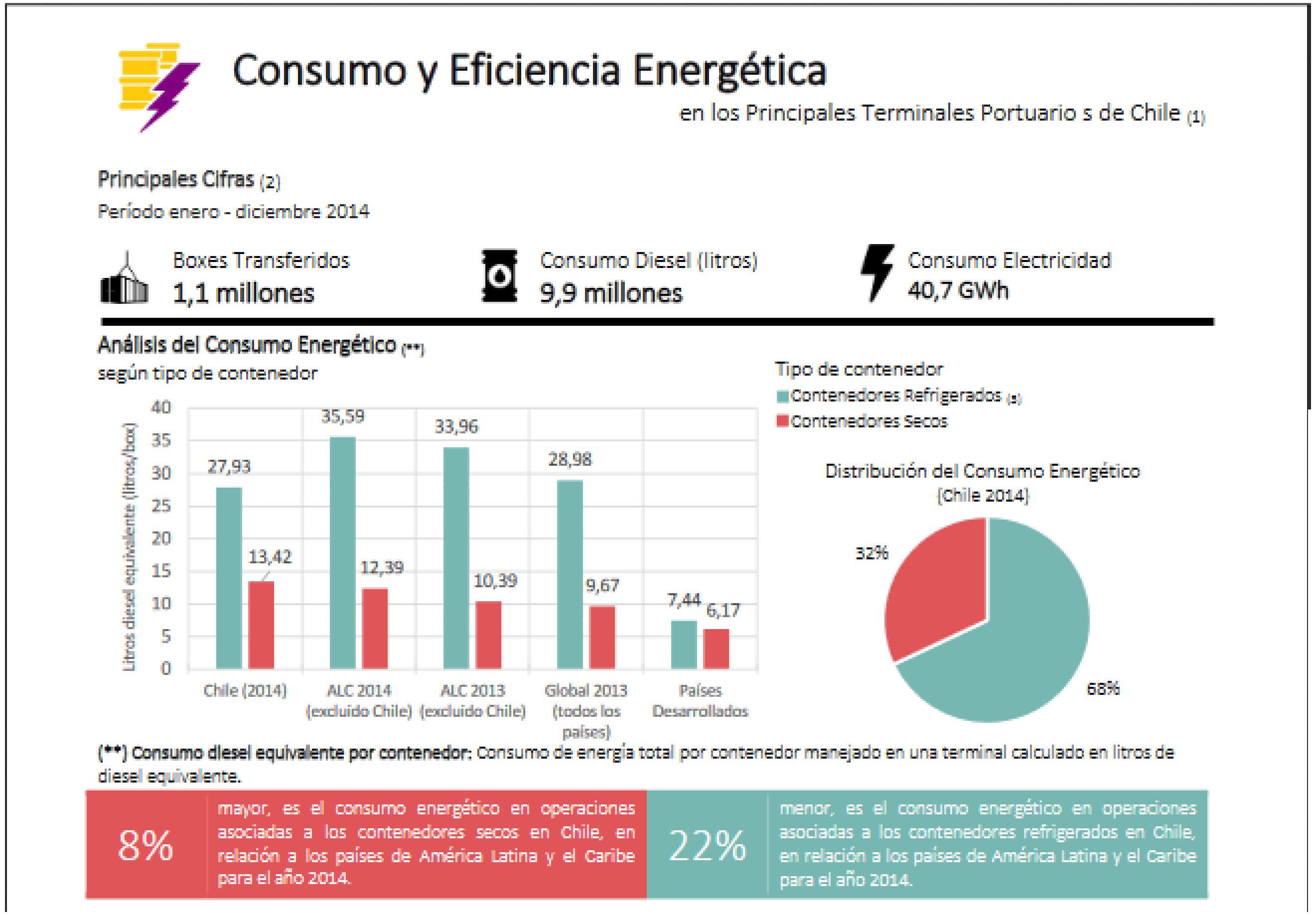


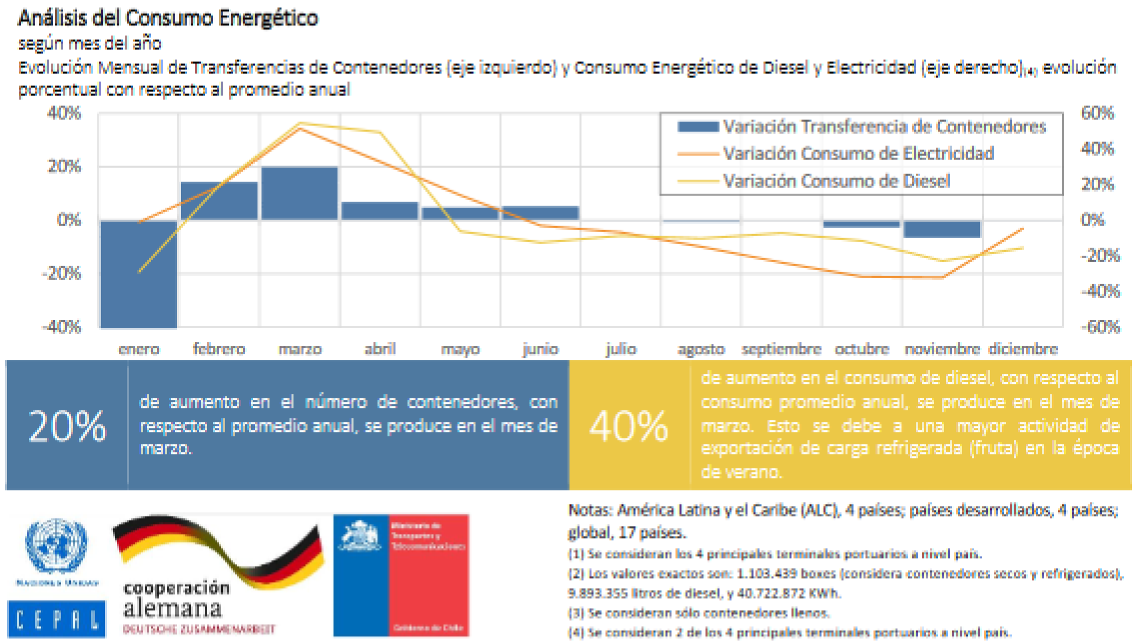


Source: Authors based on Wilmsmeier and Spengler (2016) and ECLAC Infrastructure Services Unit

COUNTRY SPECIFIC ANALYSIS

Example: new collaborations - Chile





Source: http://www.cepal.org/sites/default/files/events/files/boletin_ee-puertos-chile-cepal-mtt.pdf

Energy consumption in container terminals in Colombia 2015

Transferred TEU
3,8 million

Diesel consumption
17 million litres

Electricity consumption
106 GWh

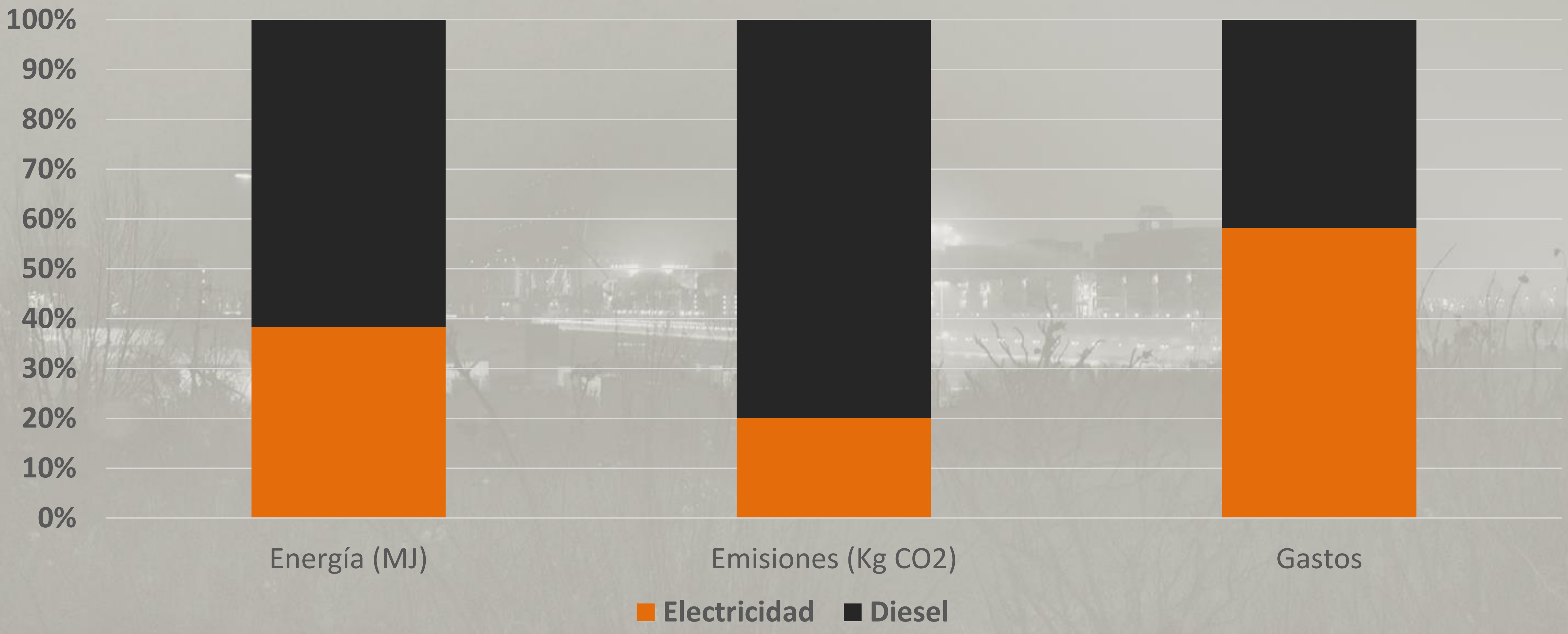
Energy expenses
26,2 million USD

Emissions
56,4 million kg CO_2 or 24 kg CO_2 / box

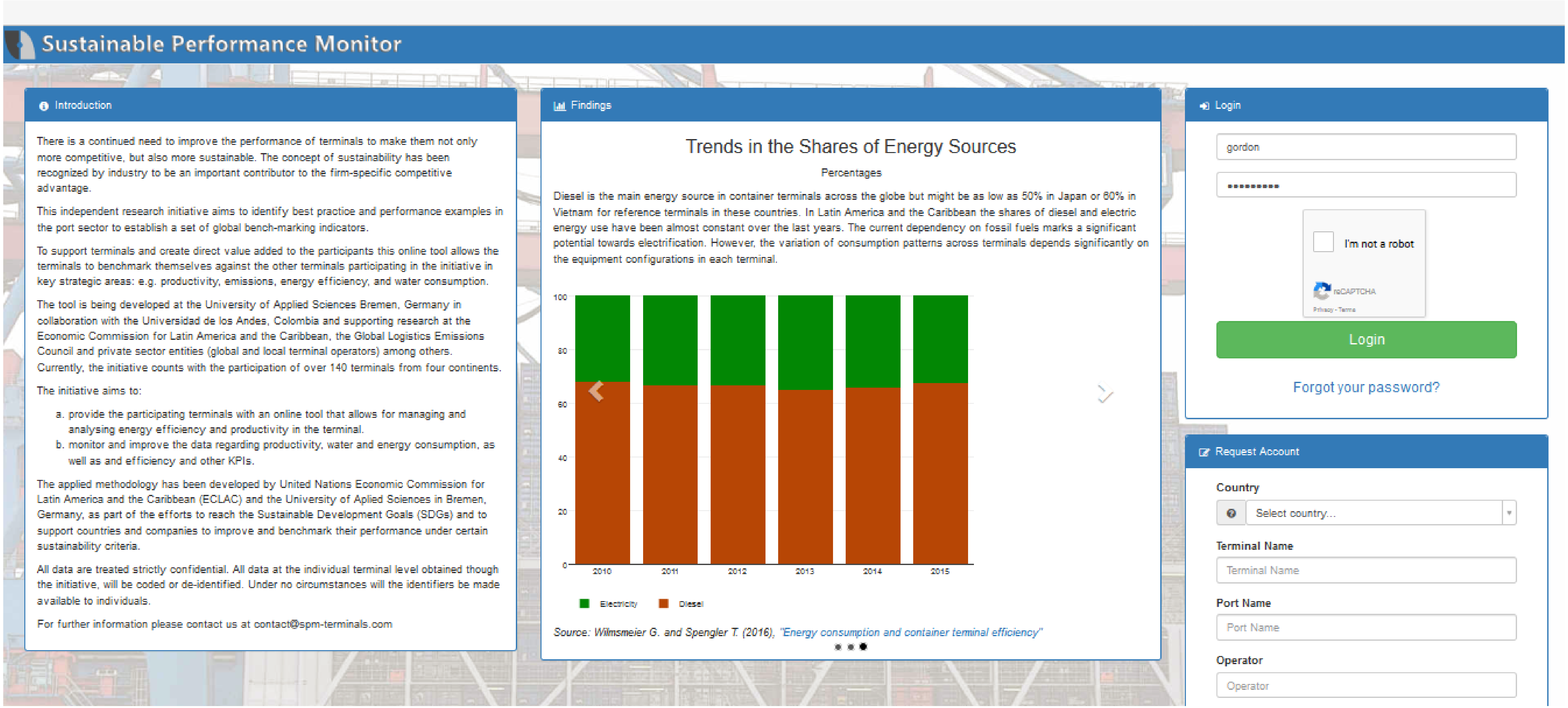
liters diesel equivalent per dry box

2014	2015
11,53	10,37

Clombia, comparison: energy, emissions, expenses, 2015

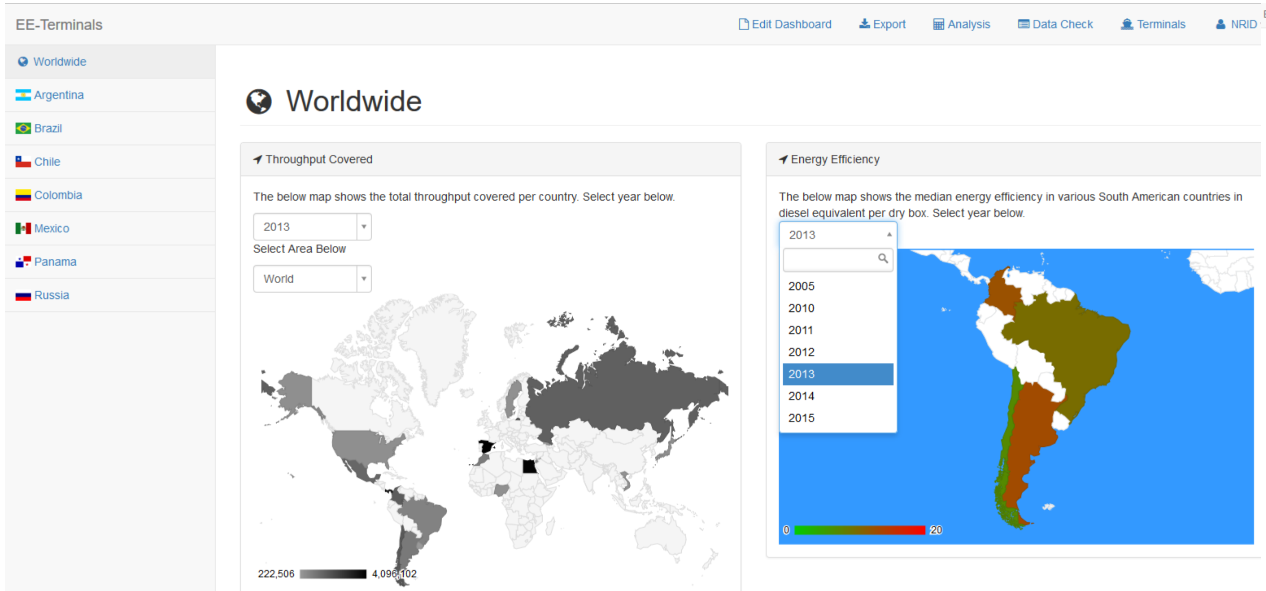


new tools

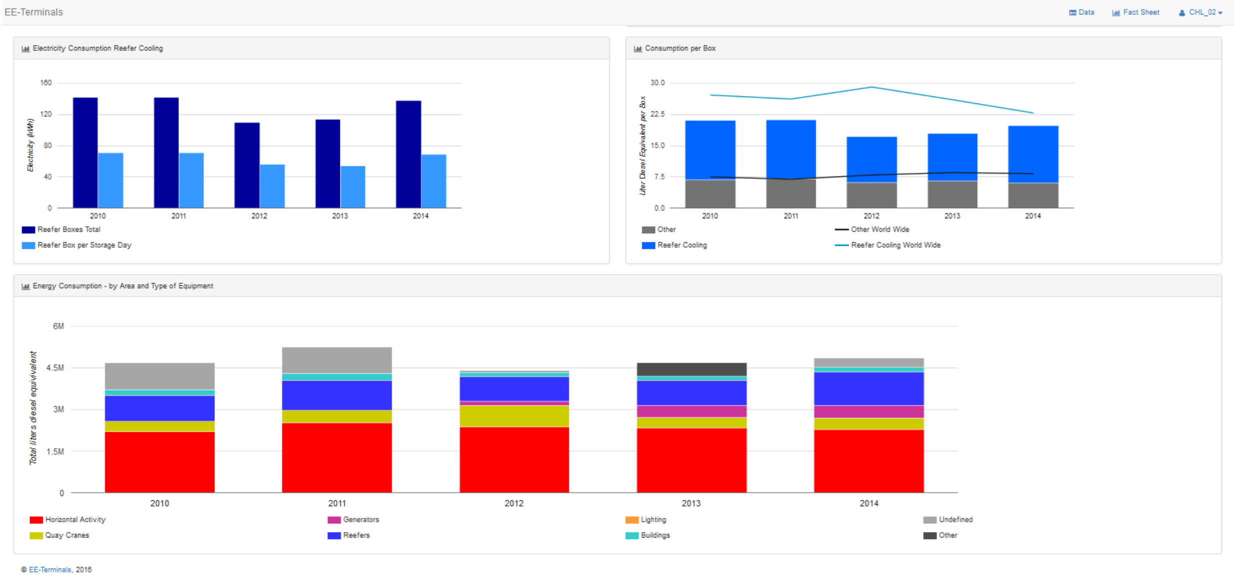


Visit: https://spm-terminals.com

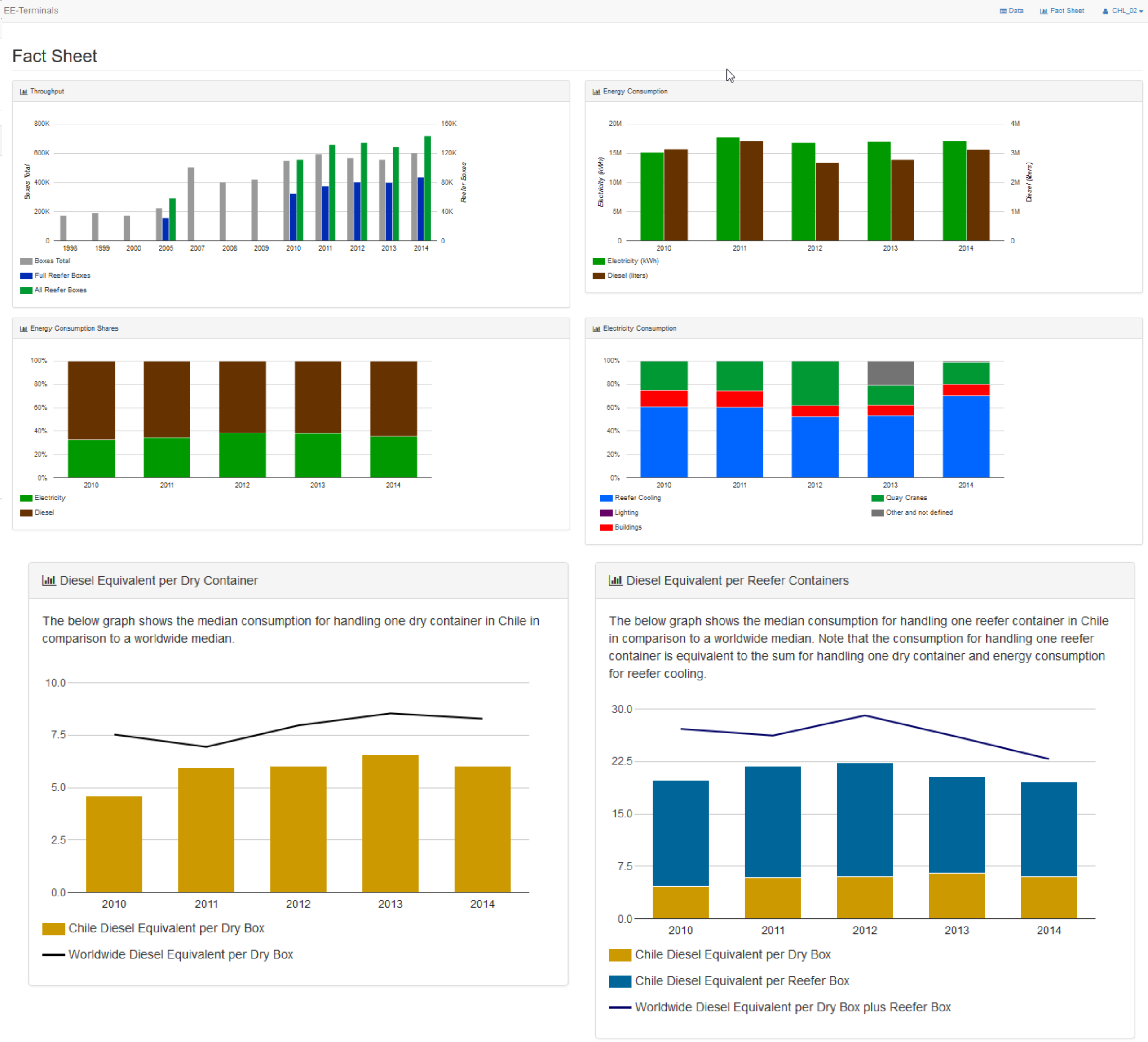
New tools



EE-Terminals
Edit Dashboard
Export
Analysis
Data Check
Terminals
NRID
Worldwide
Argentina
Brazil
Chile
Colombia
Mexico
Panama
Russia
Worldwide
Throughput Covered
The below map shows the total throughput covered per country. Select year below.
2013
Select Area Below
World
222,506
4,096,102
Energy Efficiency
The below map shows the median energy efficiency in various South American countries in diesel equivalent per dry box. Select year below.
2013
2005
2010
2011
2012
2013
2014
2015
0
20



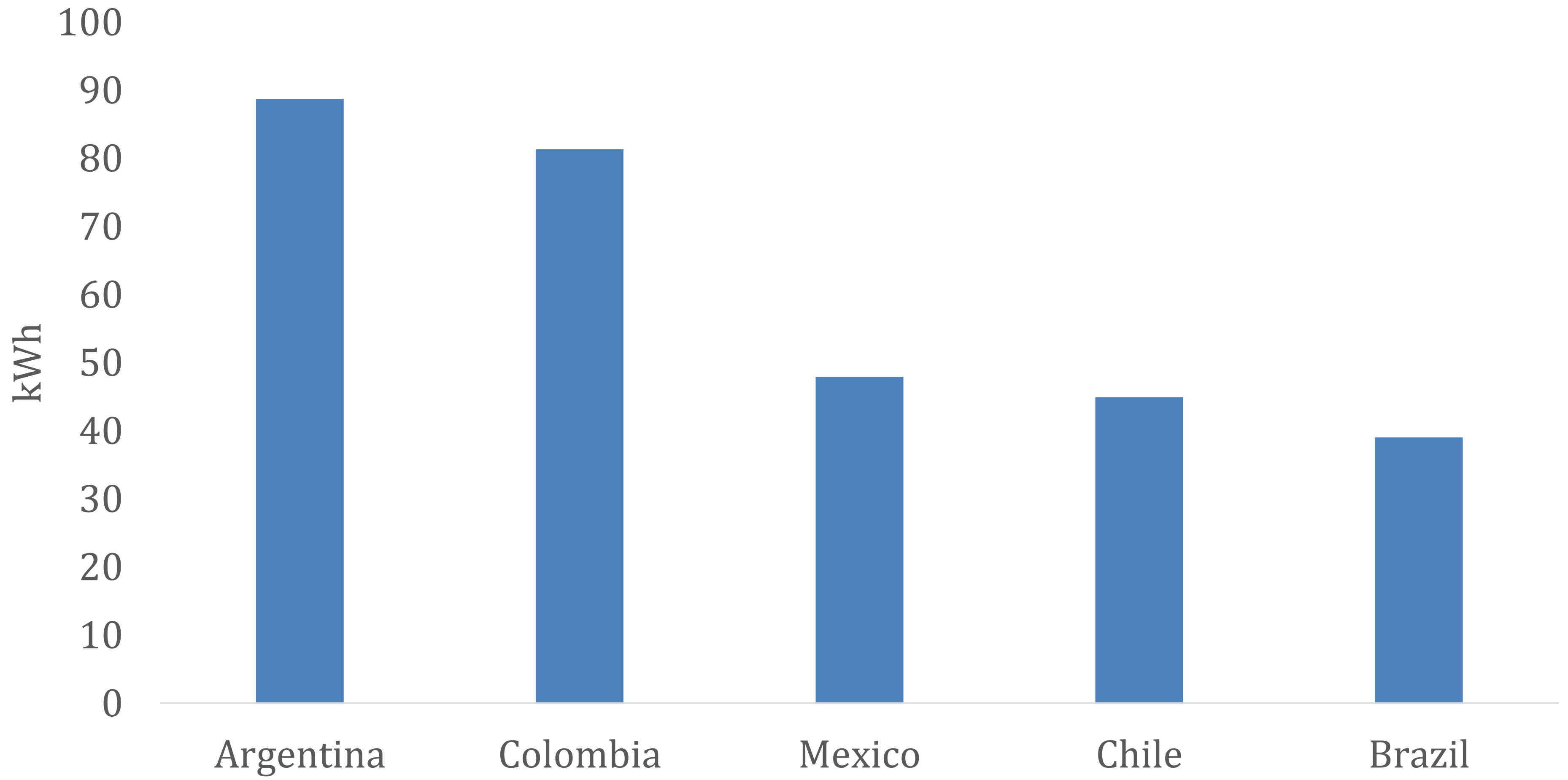
EE-Terminals
Data
Fact Sheet
CHL_02
Electricity Consumption Reefer Cooling
Reefer Boxes Total
Reefer Box per Storage Day
Consumption per Box
Other
Reefer Cooling
Other World Wide
Reefer Cooling World Wide
Energy Consumption - by Area and Type of Equipment
Horizontal Activity
Quay Cranes
Generators
Reefers
Lighting
Buildings
Undefined
Other
© EE-Terminals, 2016



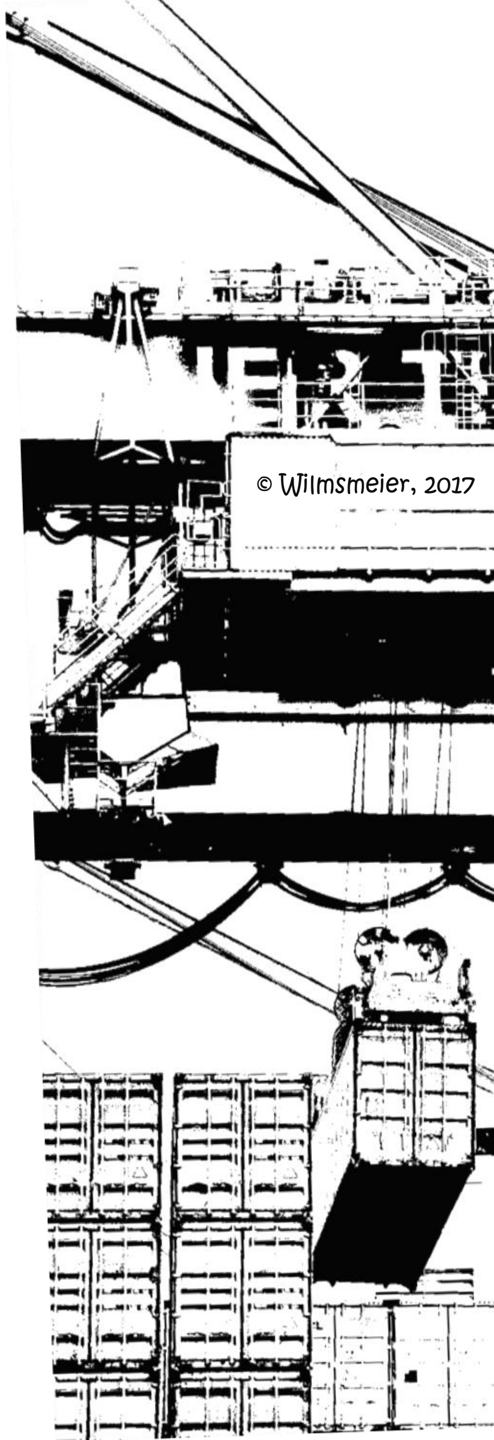
EE-Terminals
Data
Fact Sheet
CHL_02
Fact Sheet
Throughput
Boxes Total
Full Reefer Boxes
All Reefer Boxes
Energy Consumption
Electricity (kWh)
Diesel (liters)
Energy Consumption Shares
Electricity
Diesel
Electricity Consumption
Reefer Cooling
Lighting
Buildings
Quay Cranes
Other and not defined
Diesel Equivalent per Dry Container
The below graph shows the median consumption for handling one dry container in Chile in comparison to a worldwide median.
10.0
7.5
5.0
2.5
0.0
2010
2011
2012
2013
2014
Chile Diesel Equivalent per Dry Box
Worldwide Diesel Equivalent per Dry Box
Diesel Equivalent per Reefer Containers
The below graph shows the median consumption for handling one reefer container in Chile in comparison to a worldwide median. Note that the consumption for handling one reefer container is equivalent to the sum for handling one dry container and energy consumption for reefer cooling.
30.0
22.5
15.0
7.5
0.0
2010
2011
2012
2013
2014
Chile Diesel Equivalent per Dry Box
Chile Diesel Equivalent per Reefer Box
Worldwide Diesel Equivalent per Dry Box plus Reefer Box

THE REEFER CASE

Average energy consumption per storage day per full reefer container by country

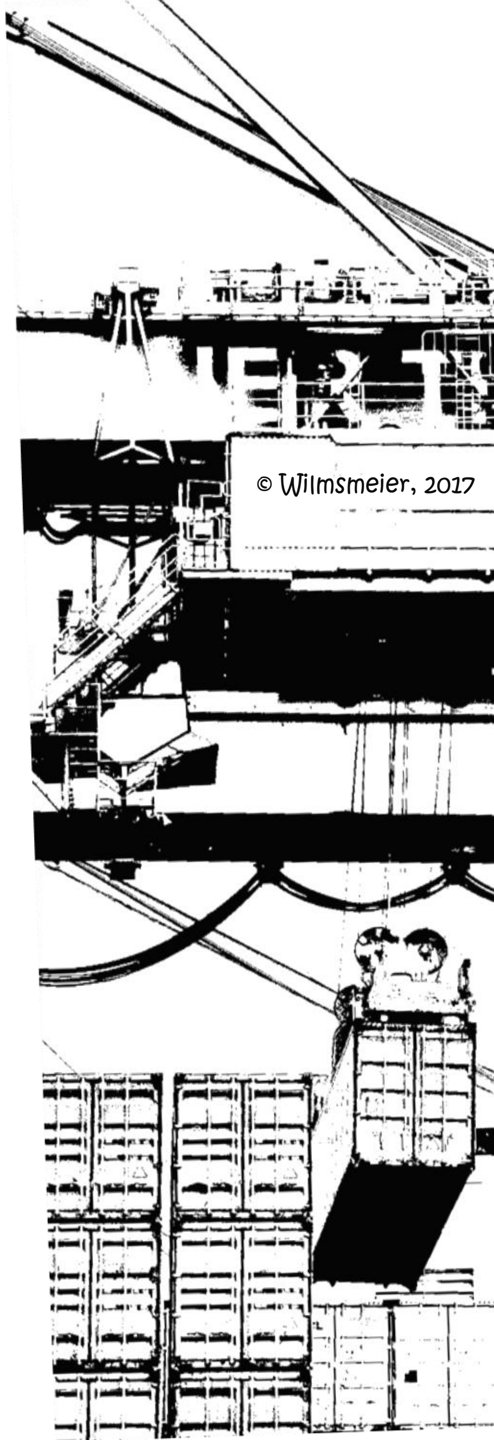


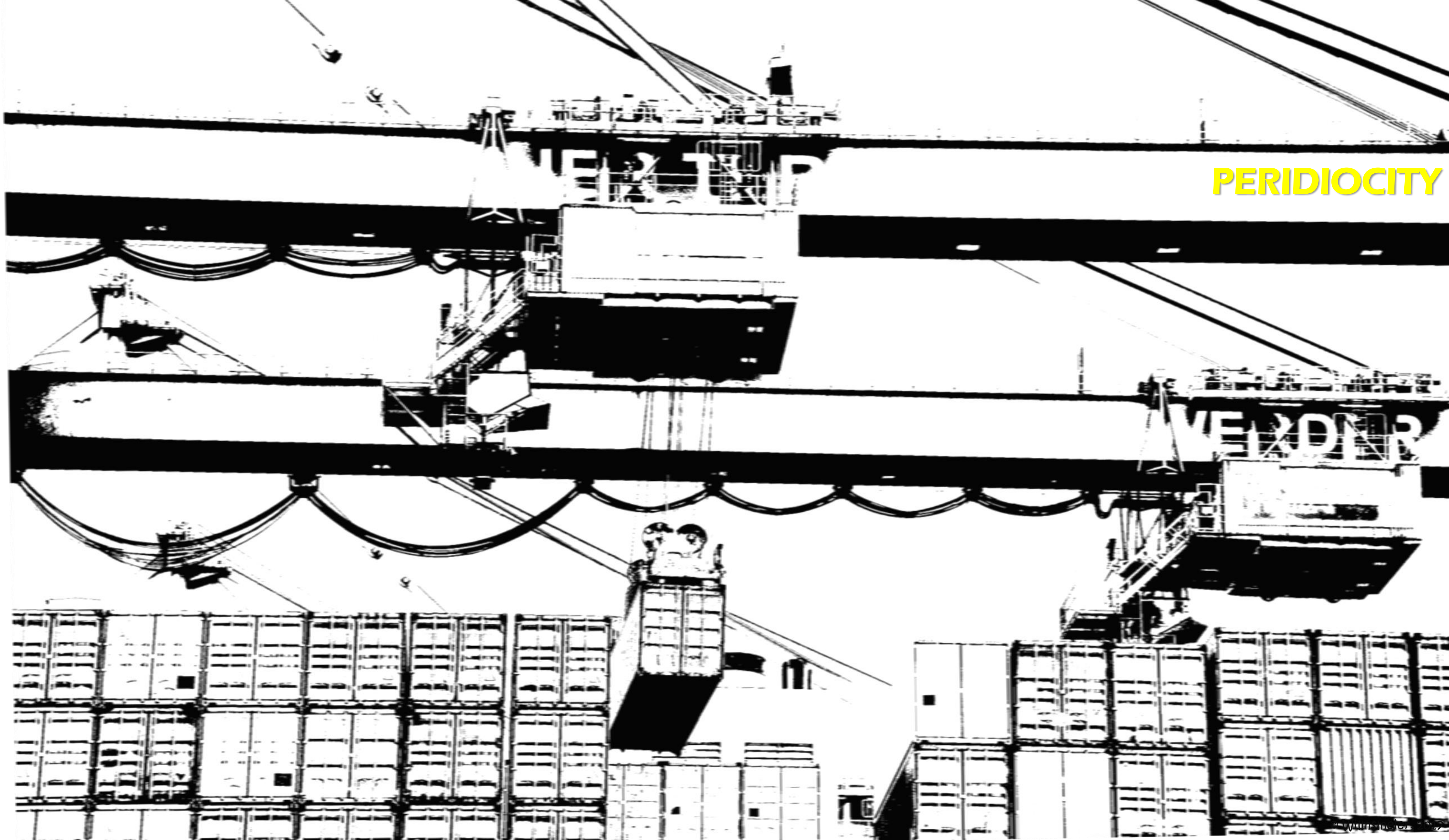
Source: The Authors based Wilmsmeier and Spengler (2016)



differentiating products effects on emissions

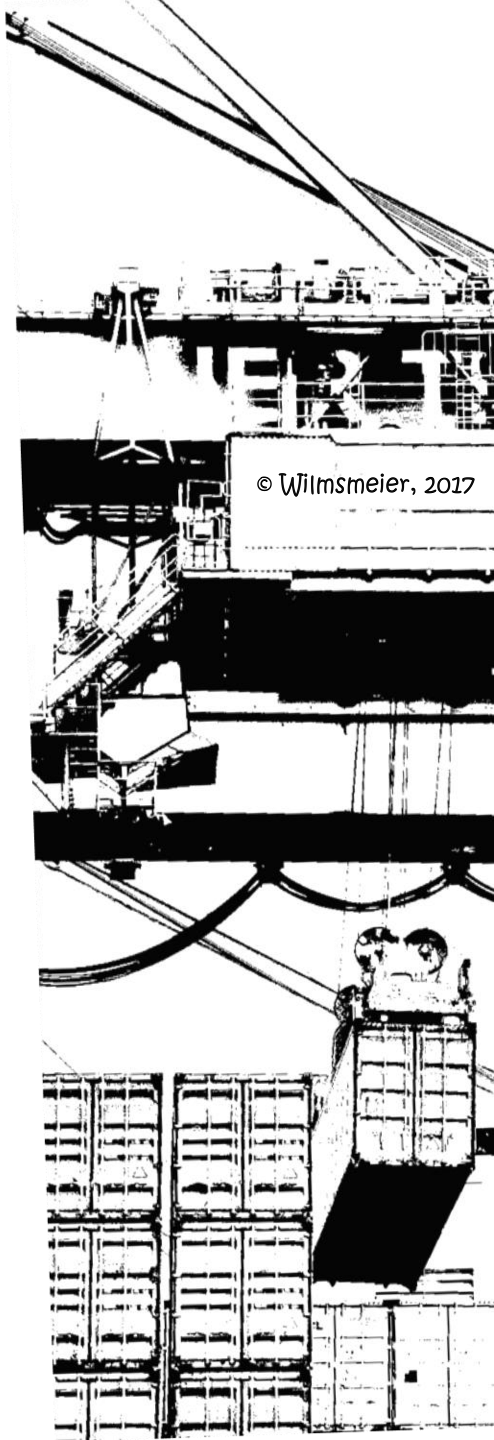
- reefer containers account for 10 to 20% of total box movements in Chile
- reefer cooling represents 60% of the electricity consumption in the terminals.
- dwell times are crucial factor in energy consumption
- the effect on emissions estimation
- Example:
  - Terminal A, in Chile, calculated emissions (without scope 3) to be 27.57 kg CO_2e per box (TPS, 2013) in 2013.
  - Applying the differentiation of container types based on the activity based approach:
  - CO_2 emissions:
    - per standard container are 19.32 kg
    - reefer container 66.18 kg CO_2




PERIDIOCITY

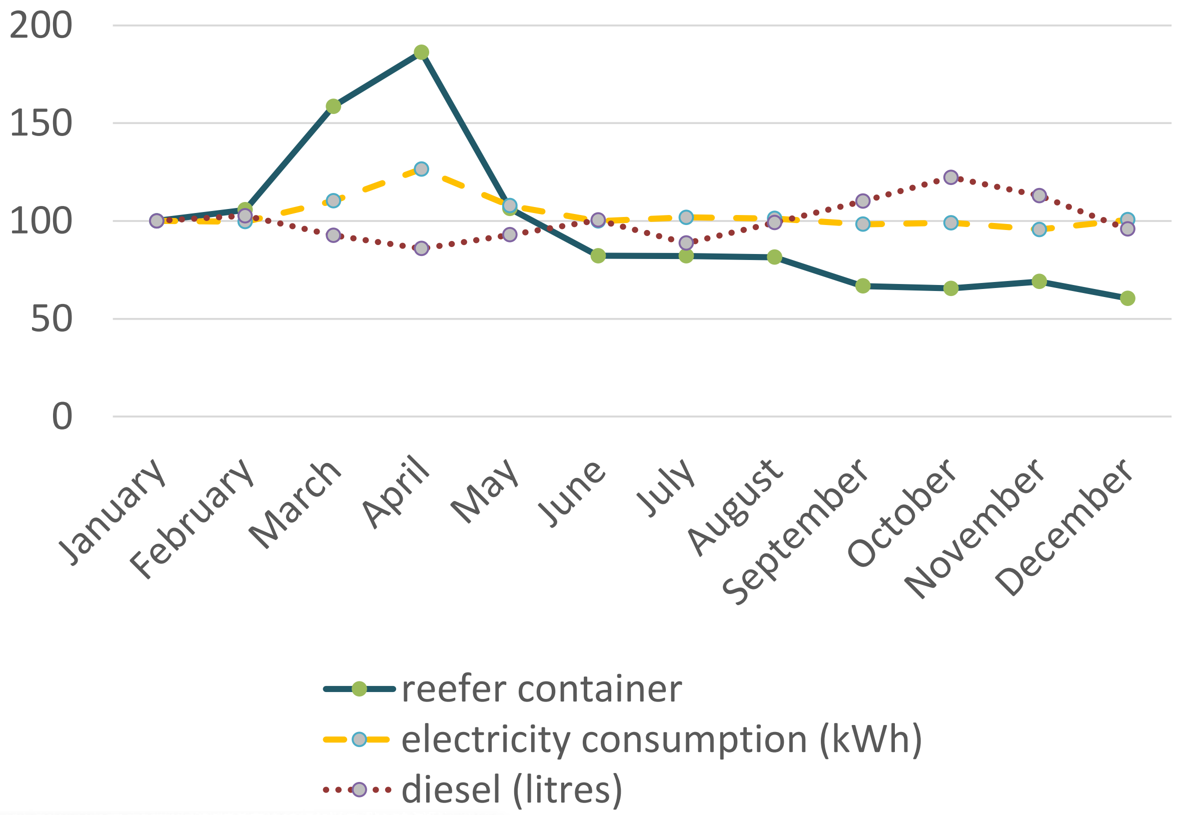
Periodicity of energy demand

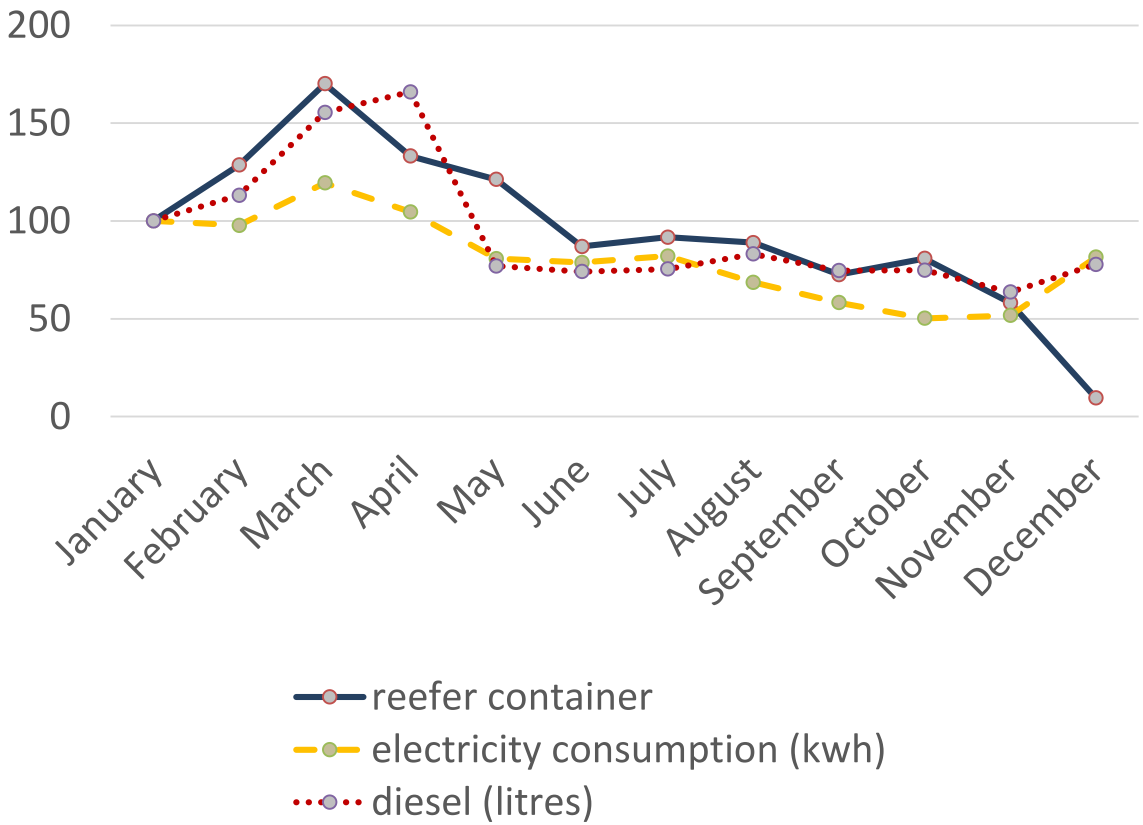
TIME	EXAMPLE/DRIVER
ANNUAL SEASONALITY	Harvesting season of fruit (e.g. apples in Chile)
MONTH	Vessel calling pattern
WEEK	Berth occupancy
DAY	Work shifts, delivery of reefer cargo

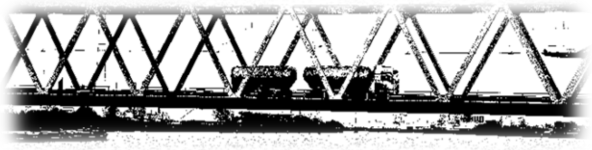


correlation between reefer activity and electricity consumption, percentage change (base month January = 100), year 2014

Terminal C	Terminal D







Next steps for moving ahead

- strengthen concerted effort of public and private sector
- further develop and use tools to gather new data
  - Water
  - Energy
  - Emissions, and
  - Social indicators
- Further evaluation of the effects of:
  - Technological change
  - Operational differences
  - Energy generation and security issues
- Tool development for
  - Bulk,
  - Roro
  - Passenger terminals

- collaborate towards a new standard of information

- can we walk the talk of a sustainable future?

questions?

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