Measuring sustainability in ports

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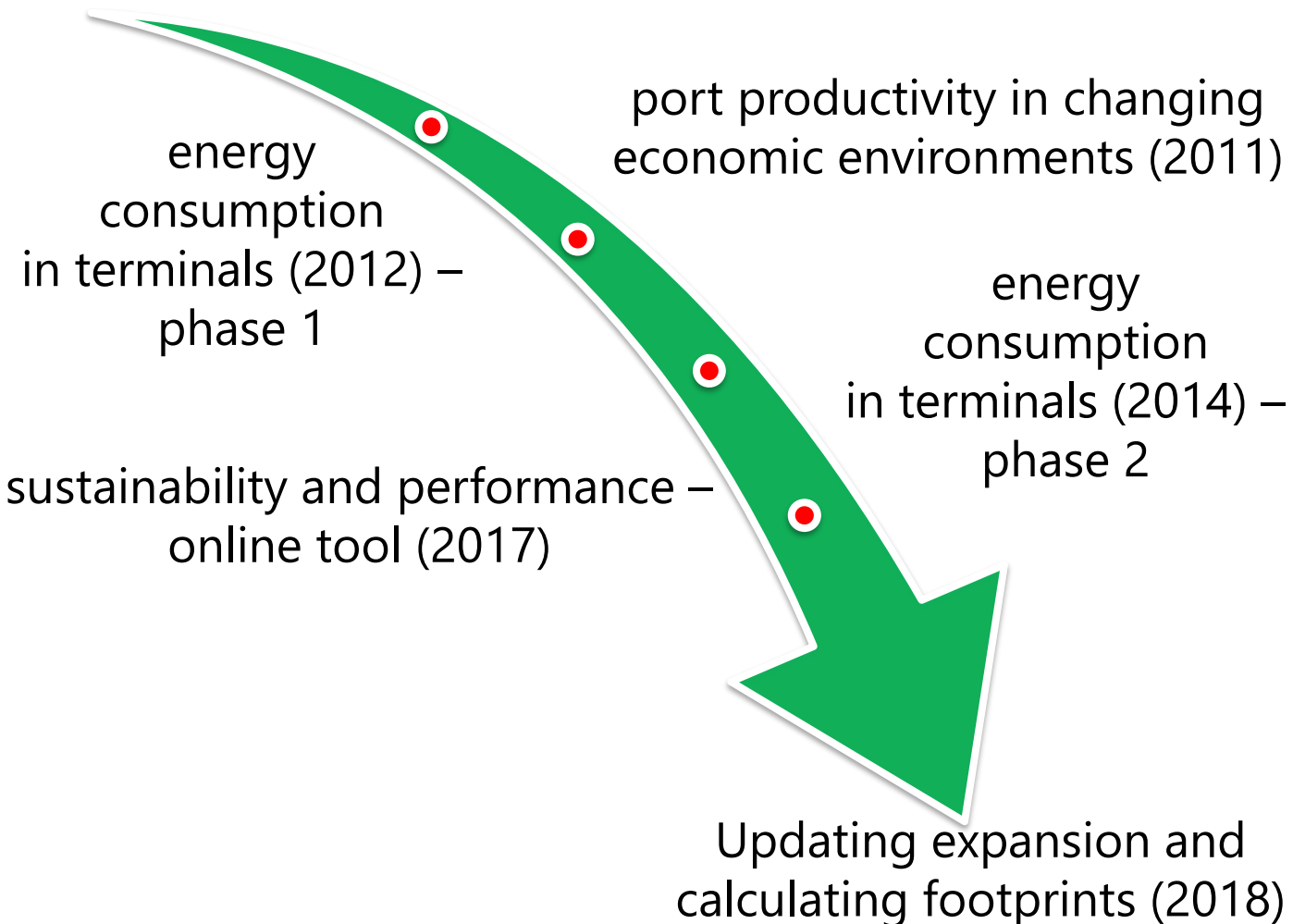April, 2018

What is a sustainable port?

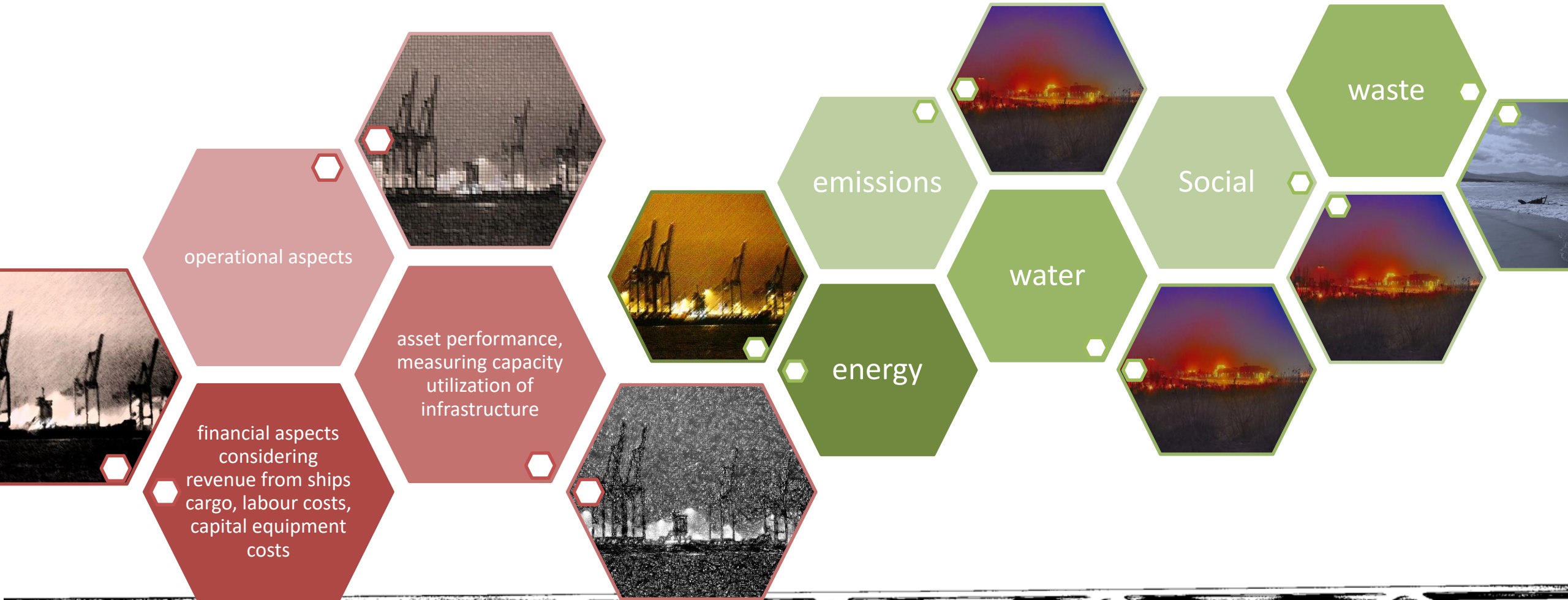# The role of ports when calculating footprints in logistics chains

$$? \; + \; ? \; = \; ?$$

A timeline of resaerch
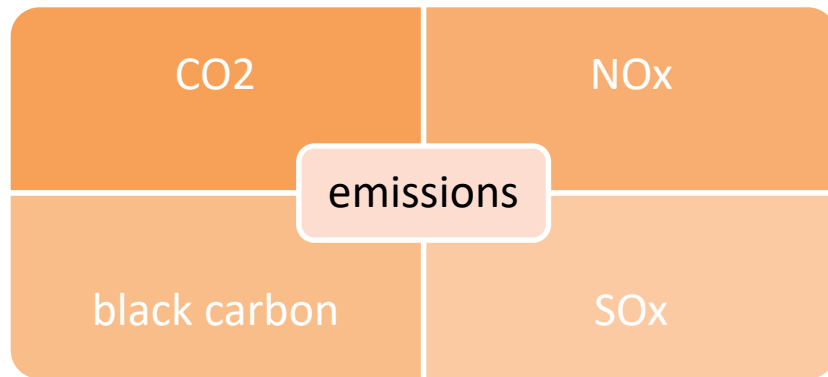
port productivity and efficiency in LAC (2001/2002)

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)

Updating expansion and calculating footprints (2018)

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A wider set of measures of performance is necessary?

operational aspects

asset performance, measuring capacity utilization of infrastructure

financial aspects considering revenue from ships cargo, labour costs, capital equipment costs

emissions

energy

water

Social

waste

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New data and measures are not simple

energy	
LNG	diesel
LPG	electricity

water	
blue water	green water
grey water	virtual water

emissions	
CO2	NOx
black carbon	SOx

waste	
(non)toxic	dry/liquid
recycling	origin
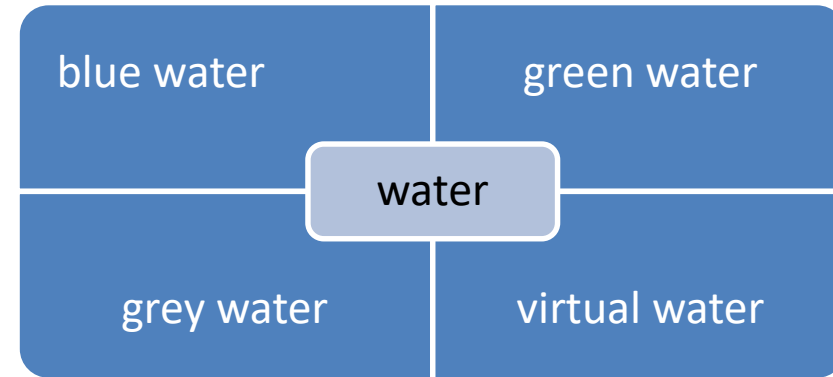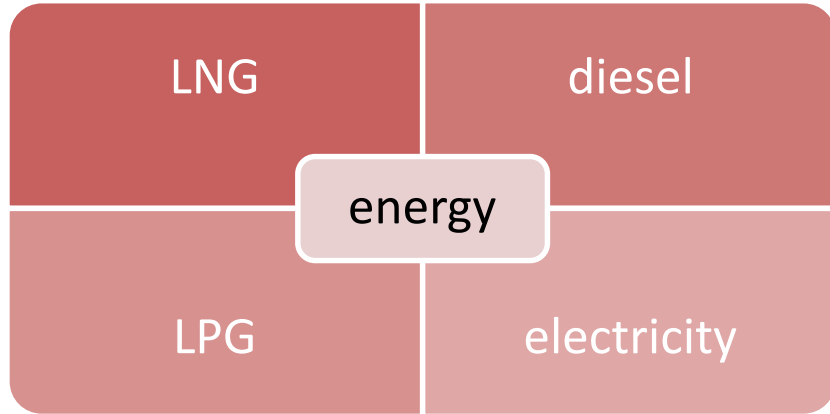
Current activities

- Reviewing updating processes and agreements with collaborators
- Testing and reviewing questionnaires by terminal type: esp. dry and liquid bulk
- Updating data for:
  - Colombia
  - Chile
  - Mexico
  - Panama and Caribbean
- New agreements with terminals in
  - Spain
  - Kenya

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The formula

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

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
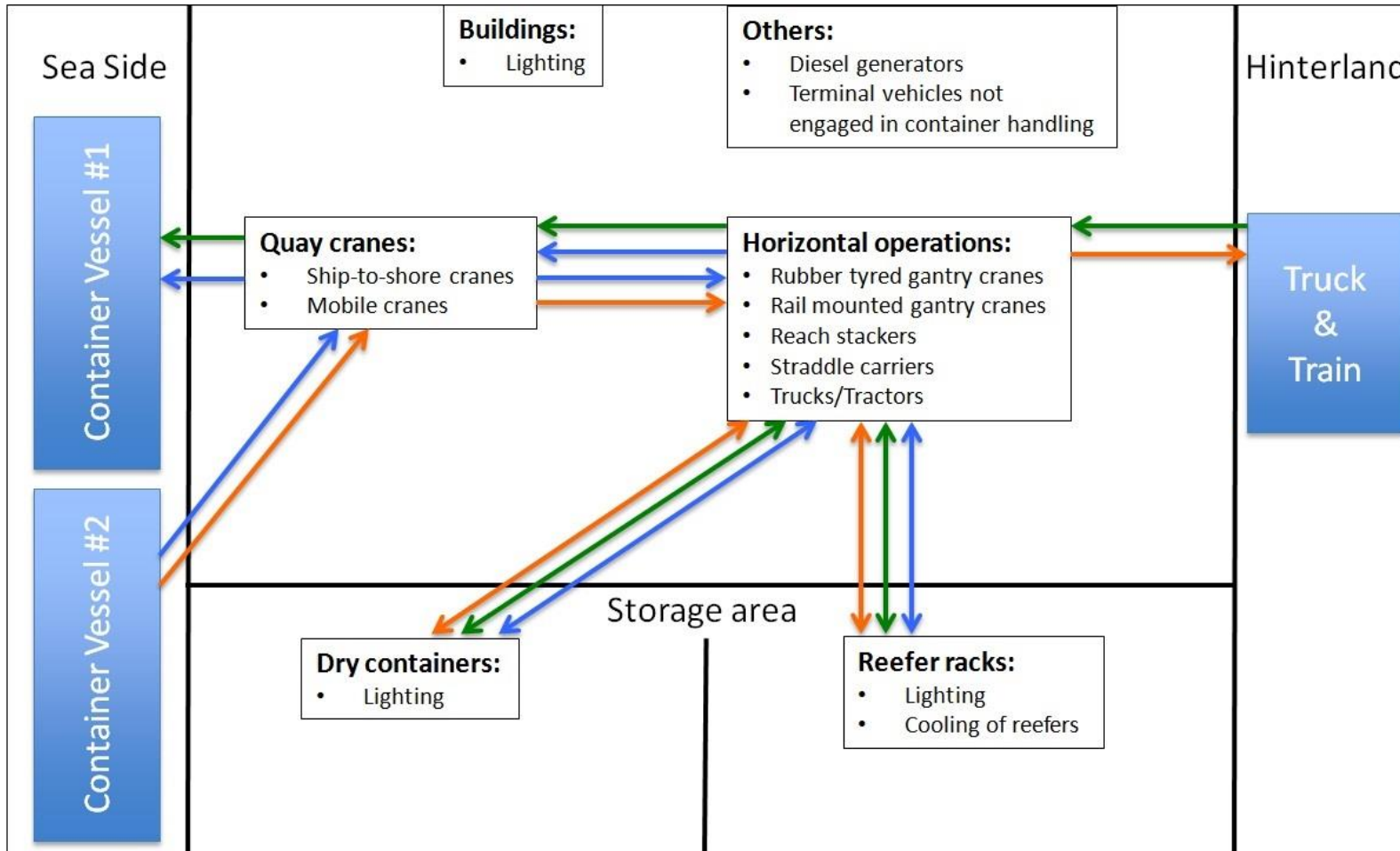
container terminals are multi product operations

- differentiation necessary between:
  - container types (i.e. dry, reefer)
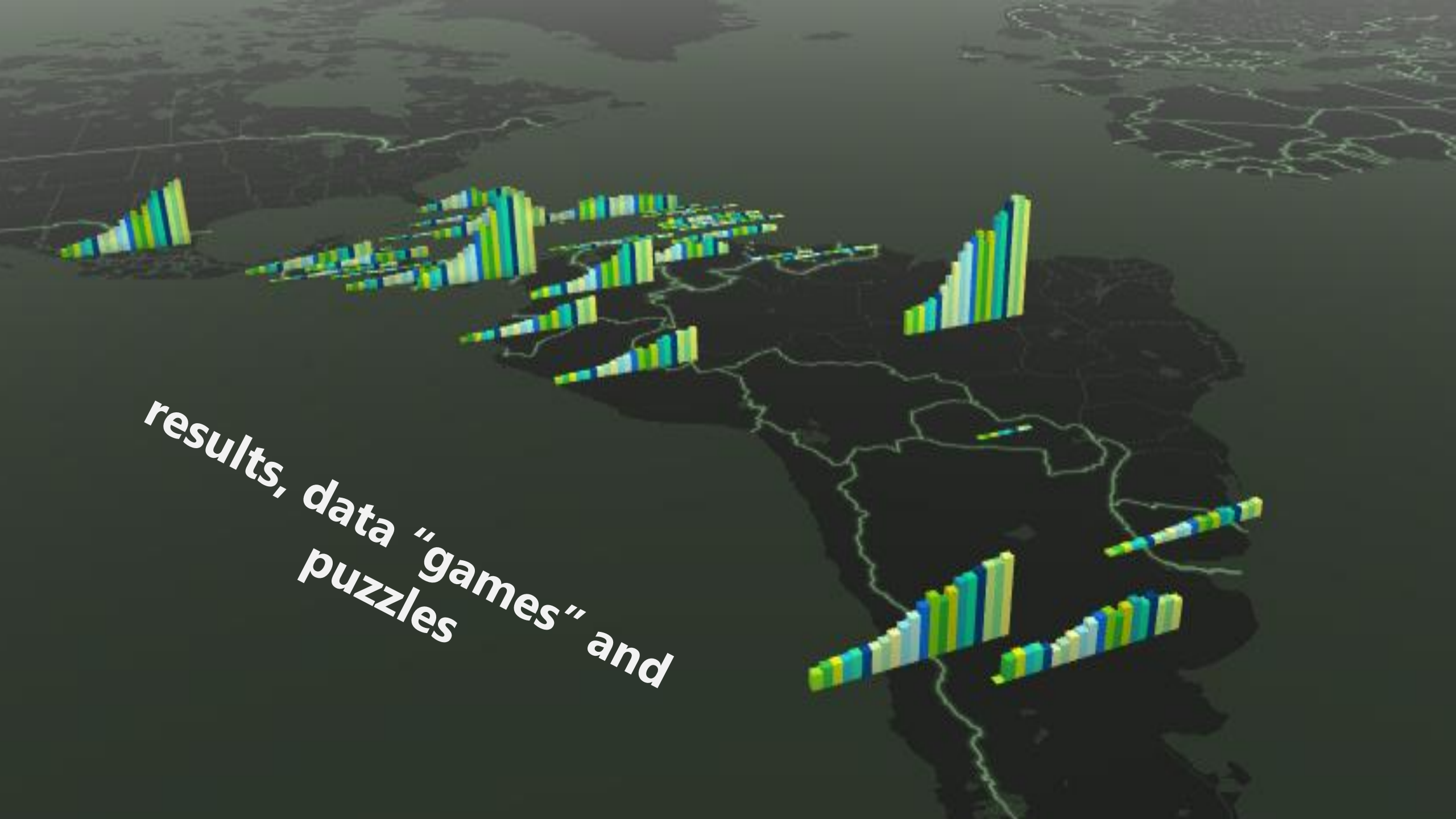 - transhipment and impo/expo cargo
  - full and empty
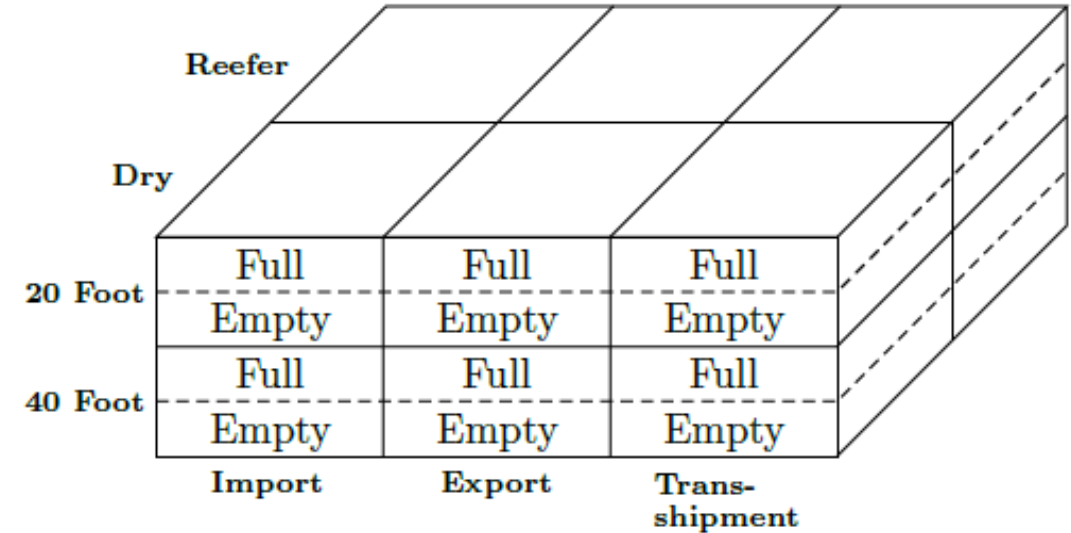
Thus, different products
have different requirements
and performance

Container terminal example:
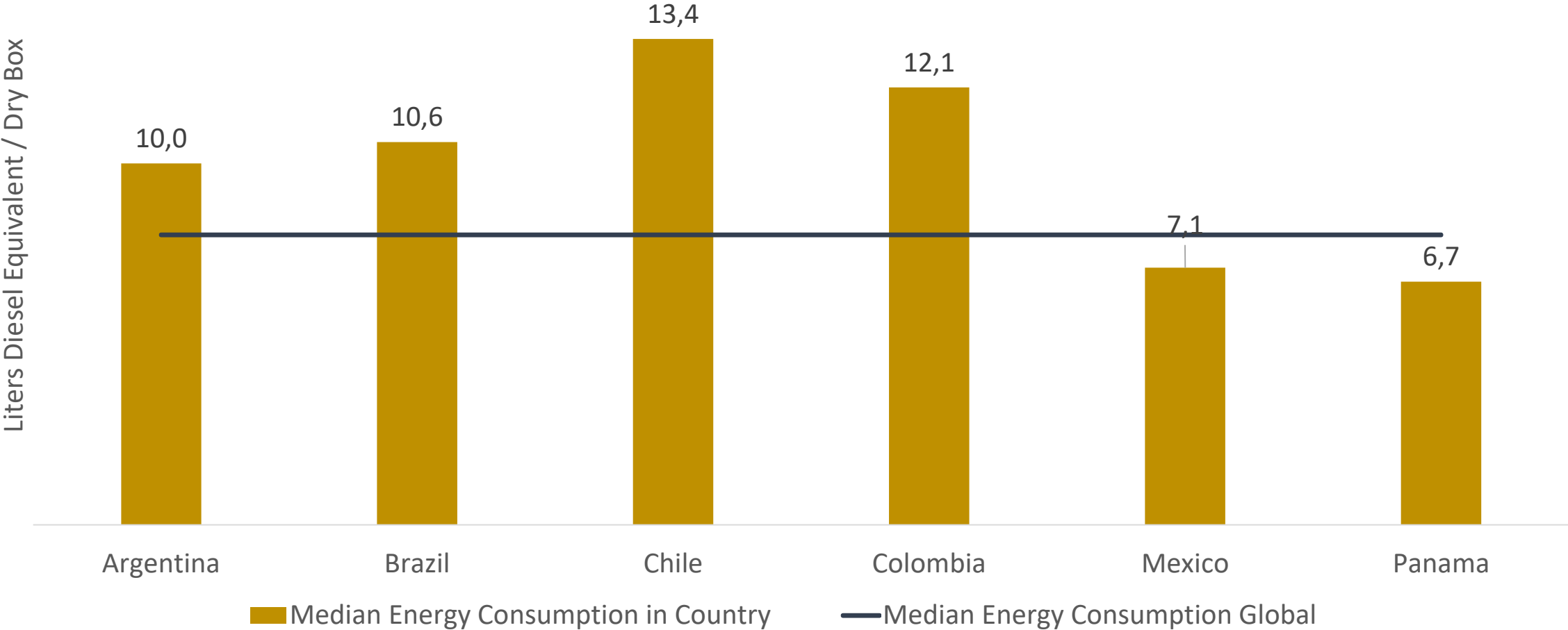## an activity based approach to allocate energy consumption
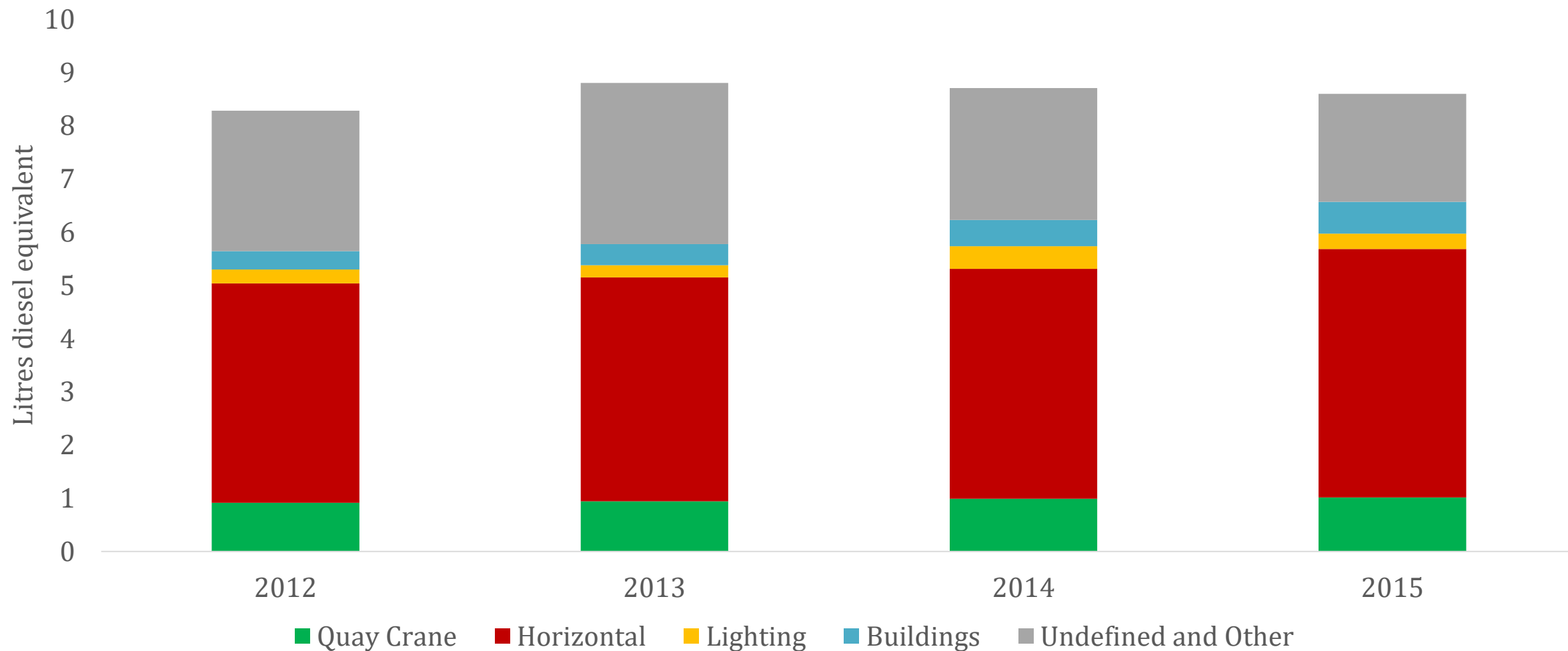

Source: Spengler 2015

results, data "games" and puzzles

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

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

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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 CO2 or 24 kg CO2 / box

liters diesel equivalent per dry box

2014	2015
11,53	10,37

Reachstacker (diesel) operating hours and consumption

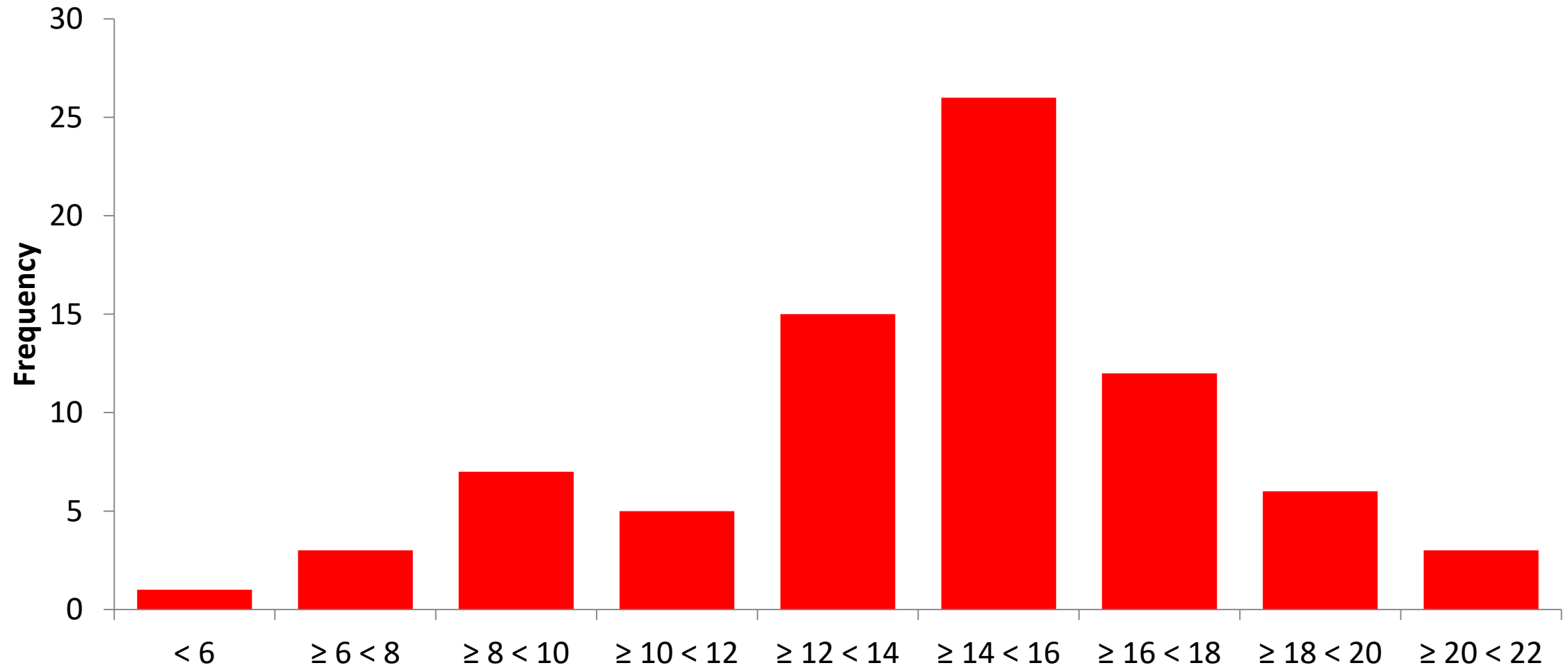Consumption diesel litres vs operating hours
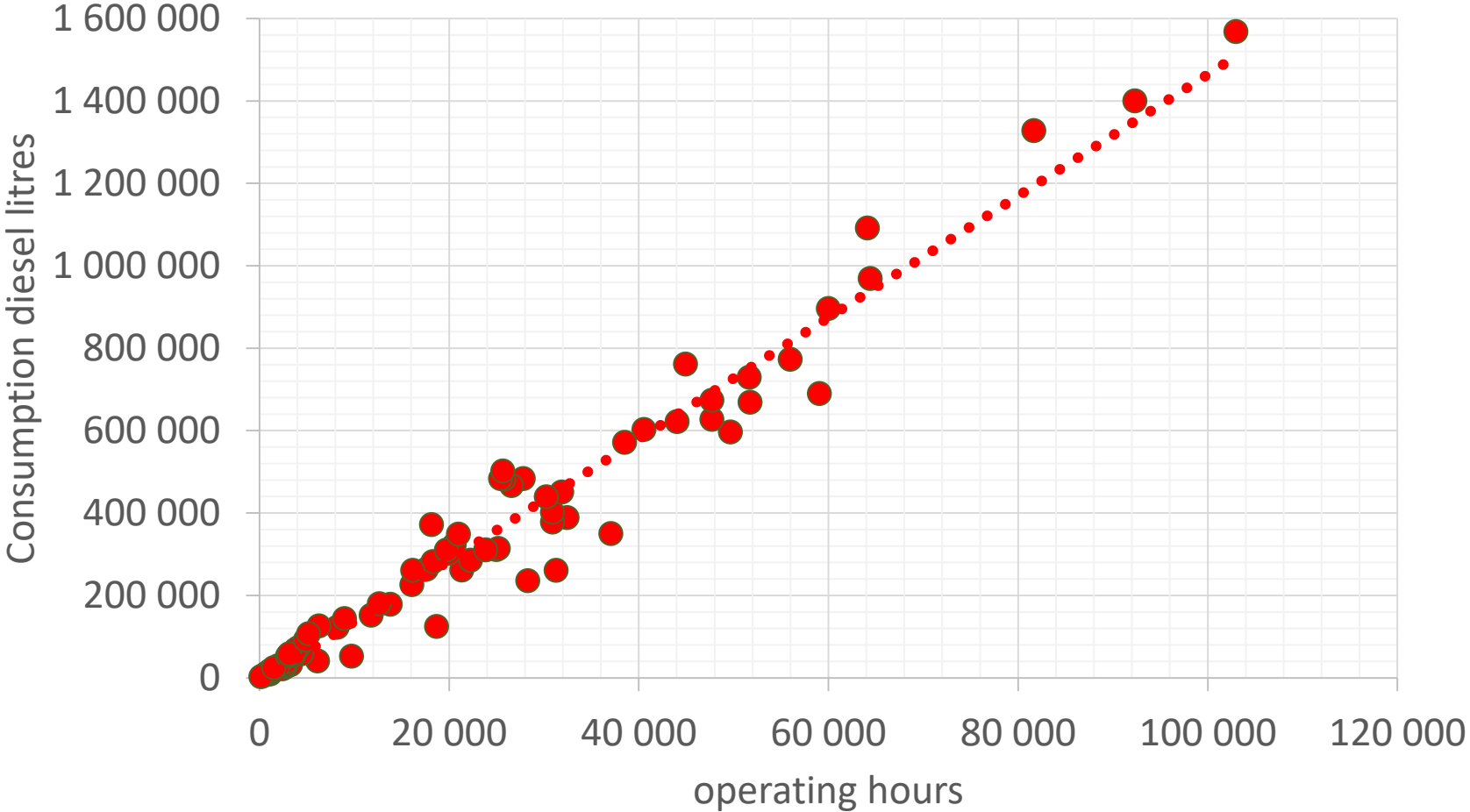
consumption   Linear (consumption)

Note: 78 observations, 8 countries

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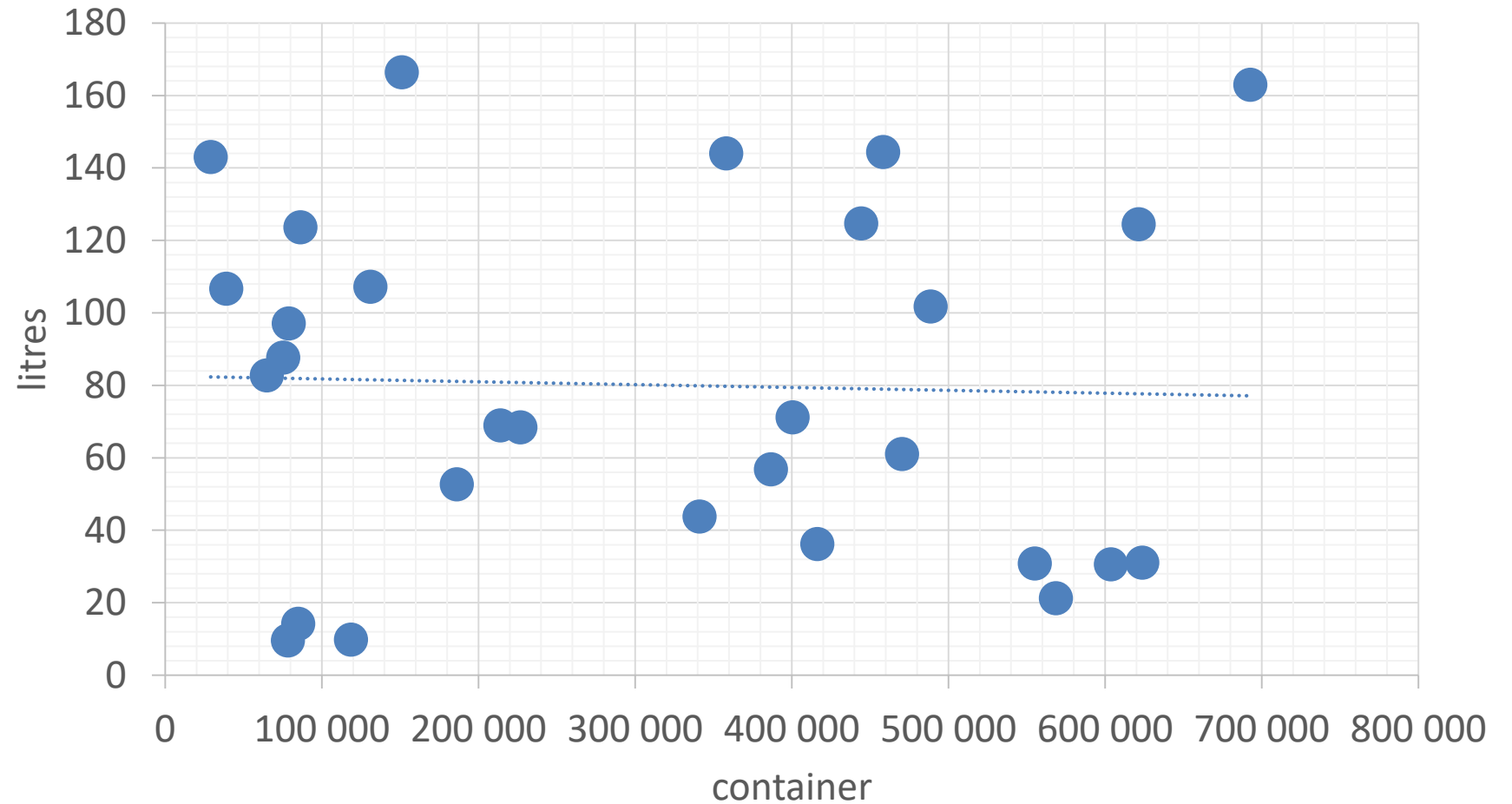# Reachstacker (diesel) diesel consumption per hour

Note: 78 observations, 8 countries

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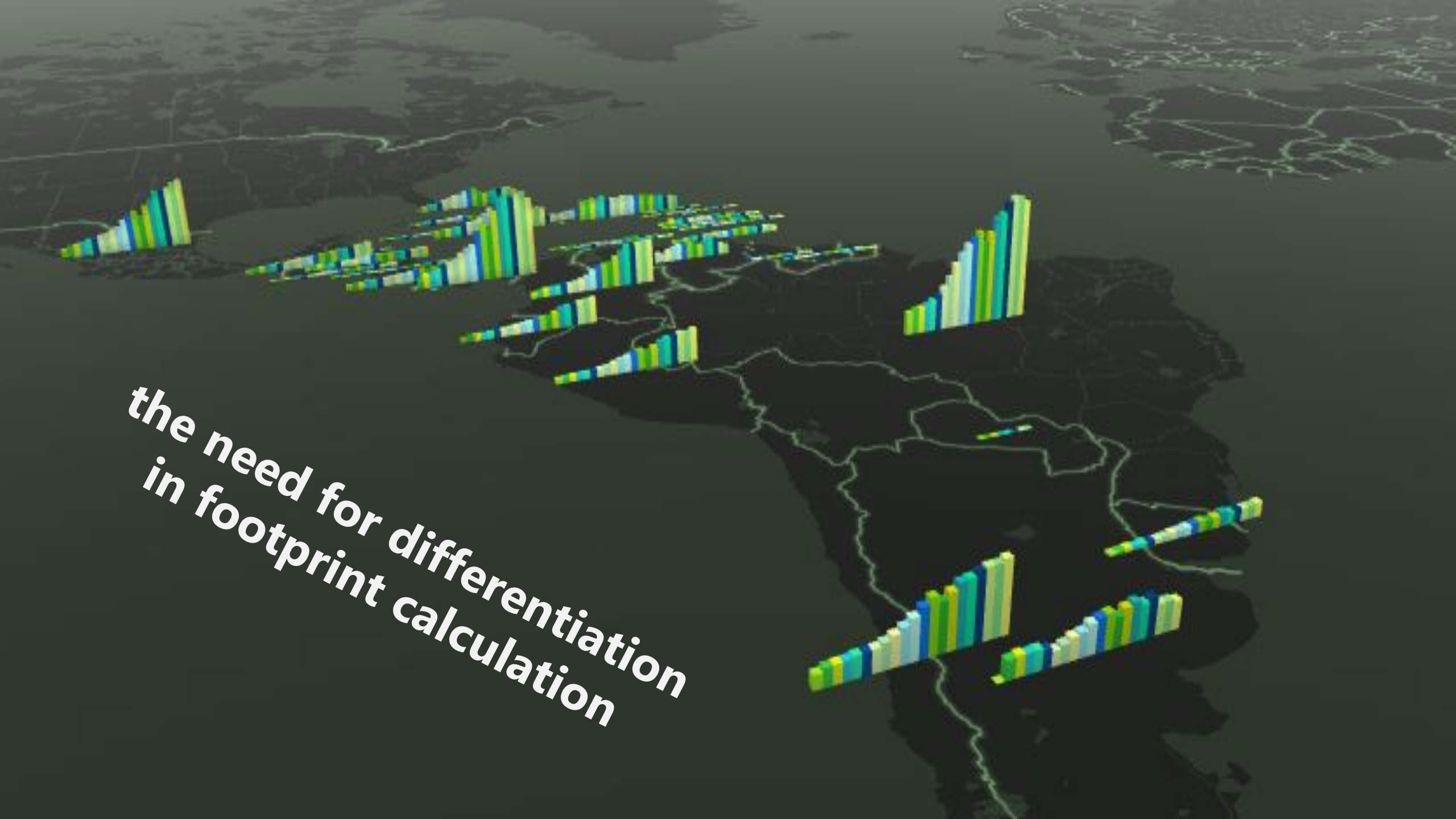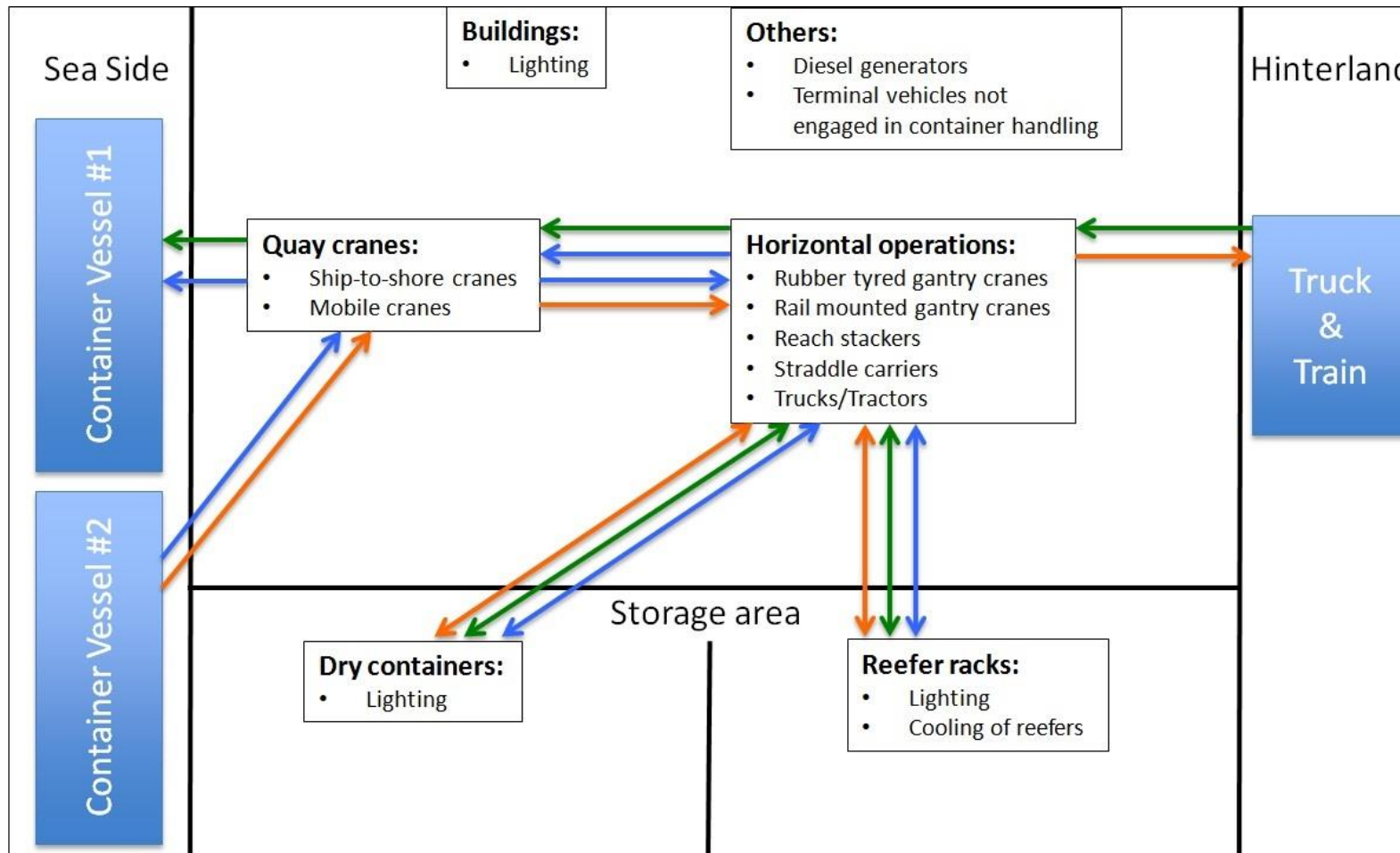
another puzzle
net water consumption per Box, litres

Note: 30observations, 4 countries

the need for differentiation in footprint calculation

Container terminal example:
an activity based approach to allocate energy consumption

Source: Spengler 2015

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Carbon footprint differentiation example
Terminal X

Unidad	CO2e (KG)/TEUS		
Año	**2012**	**2013**	**12vs13**
Alcance I	8.9	9.51	7%
Alcance II	7.36	7.43	1%
Alcance III	36.53	32.27	-12%
Total	**52.79**	**49.21**	**-7%**

CO2e (KG)/Container

* 1.64 = 14.60

* 1.64 = 12.07

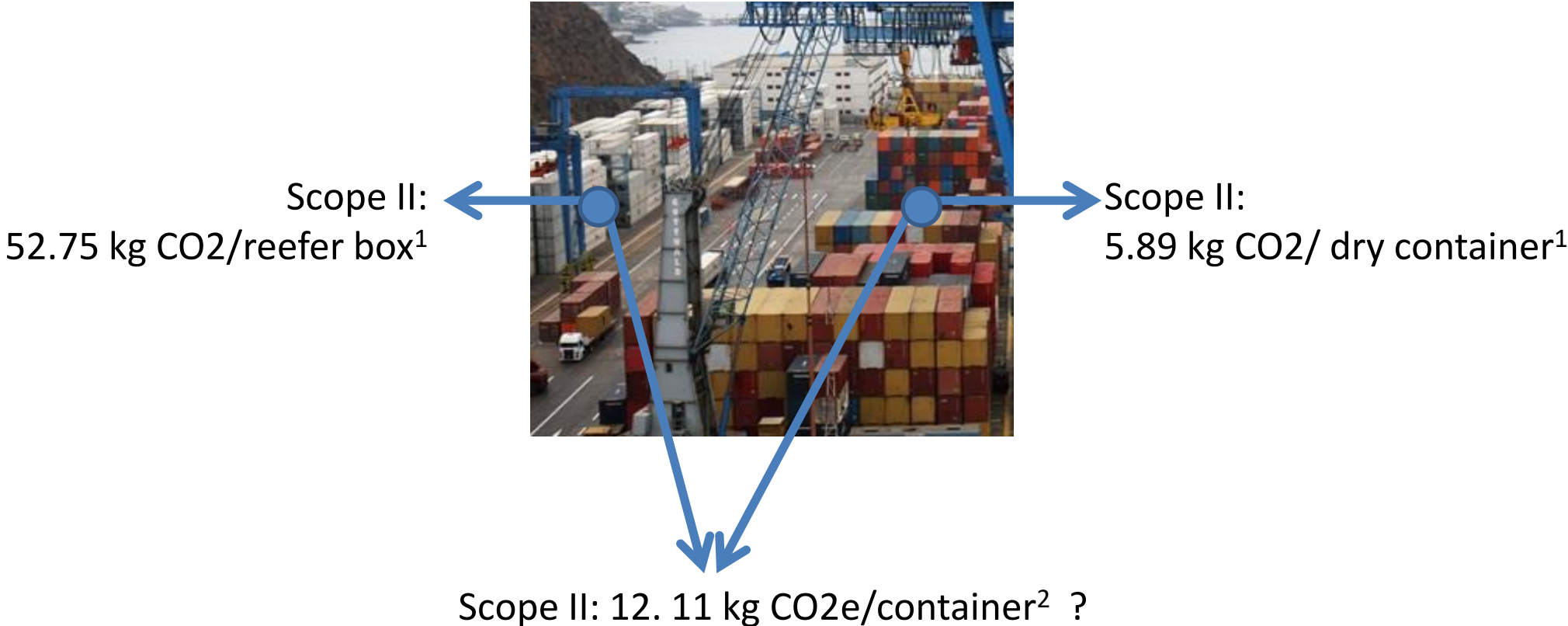* 1.63 = 15.50

* 1.63 = 12.11

Note: * TEU factor in year y

Emissions Scope I
Terminal X

	2012	2013
Terminal x (kg C02e/container)	14.60	15.50
Authors (kg CO2/container)	12.61	13.43

Emissions Scope II
Terminal X

Scope II:
52.75 kg CO2/reefer box[1]

Scope II:
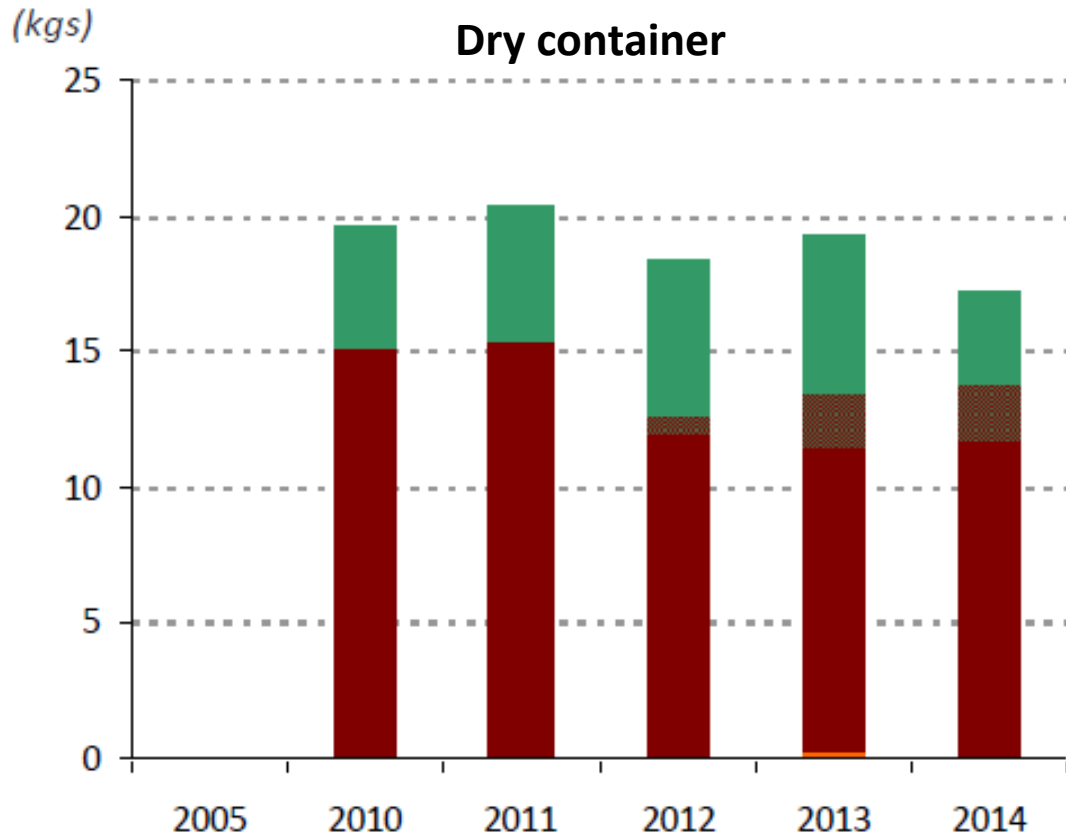5.89 kg CO2/ dry container[1]

Scope II: 12. 11 kg CO2e/container[2] ?

[1] Calculated by authors
[2] Teminal X, Carbon footprint 2013

Emissions
Kg CO2 per container Terminal X

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peso/litre

peso/kw/h

Note: information on 4 years

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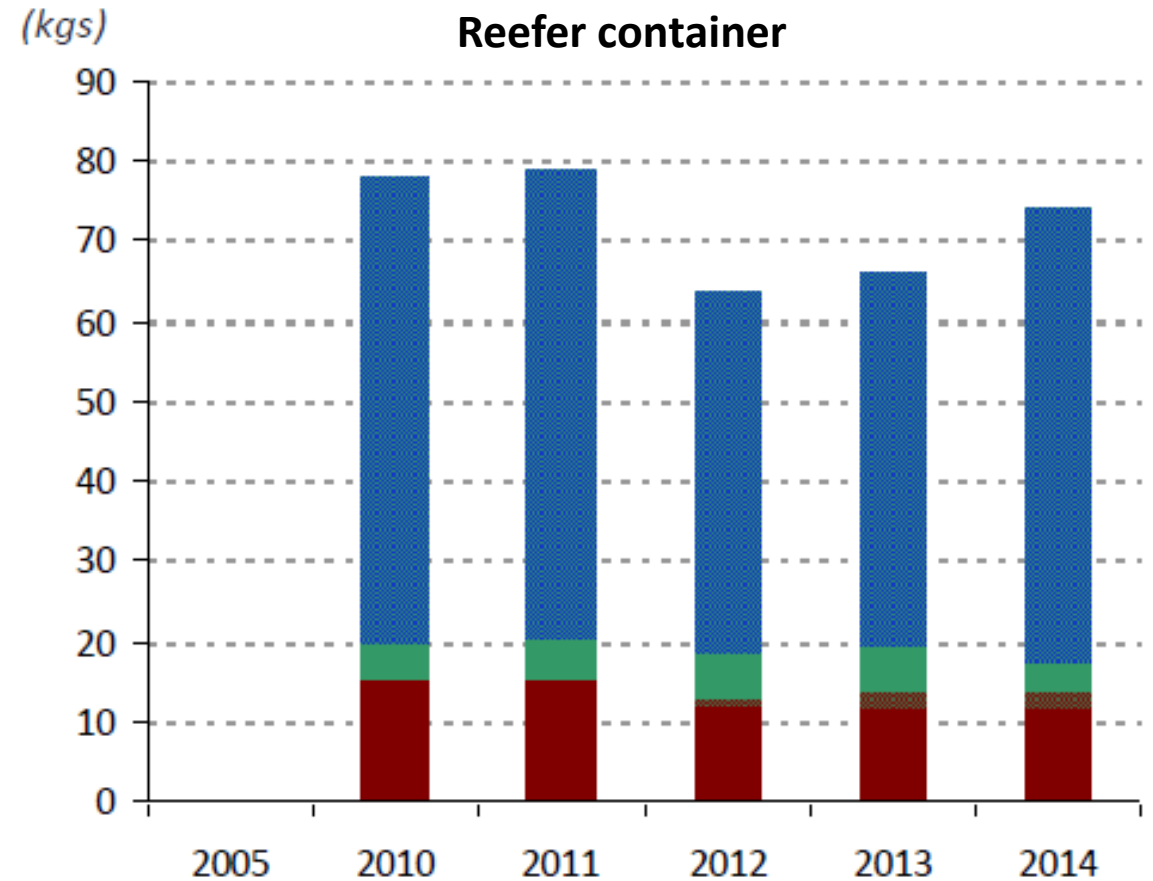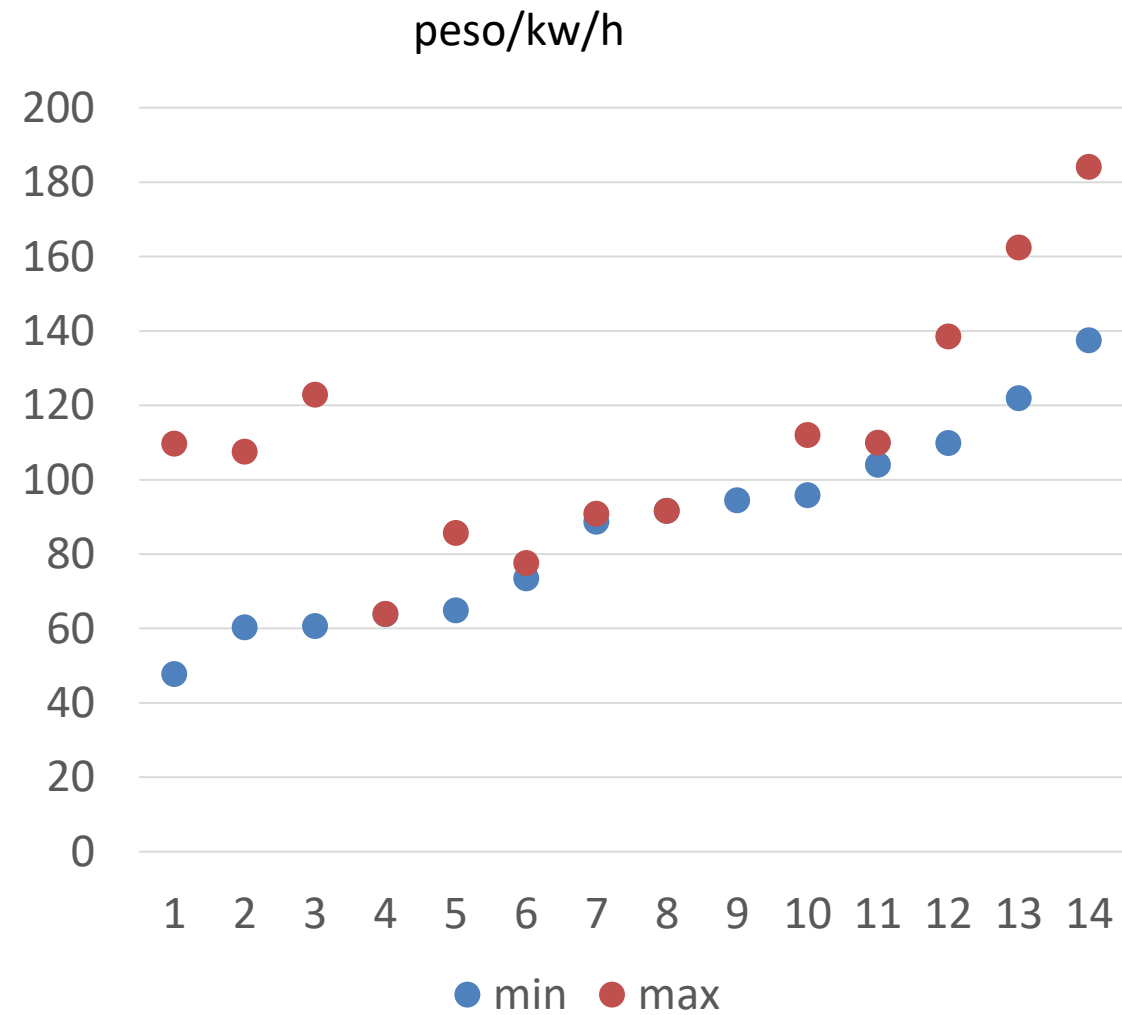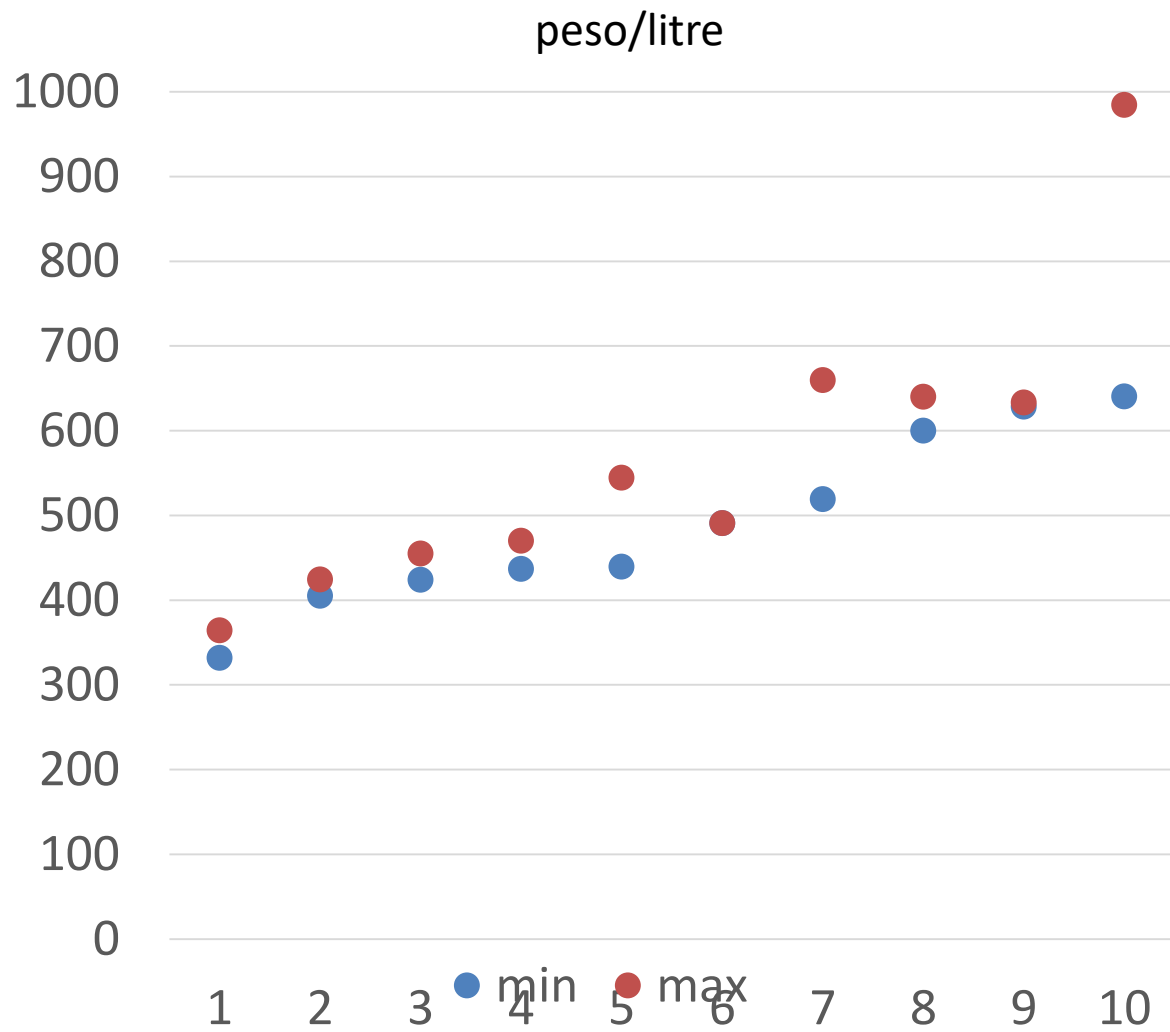
Energy expenses differences by type in country X
peso

Legend:
- peso/kwh (with kwh adjusted for energy content)
- peso/liter

X-axis categories: average, min, max

Note: information on 4 years

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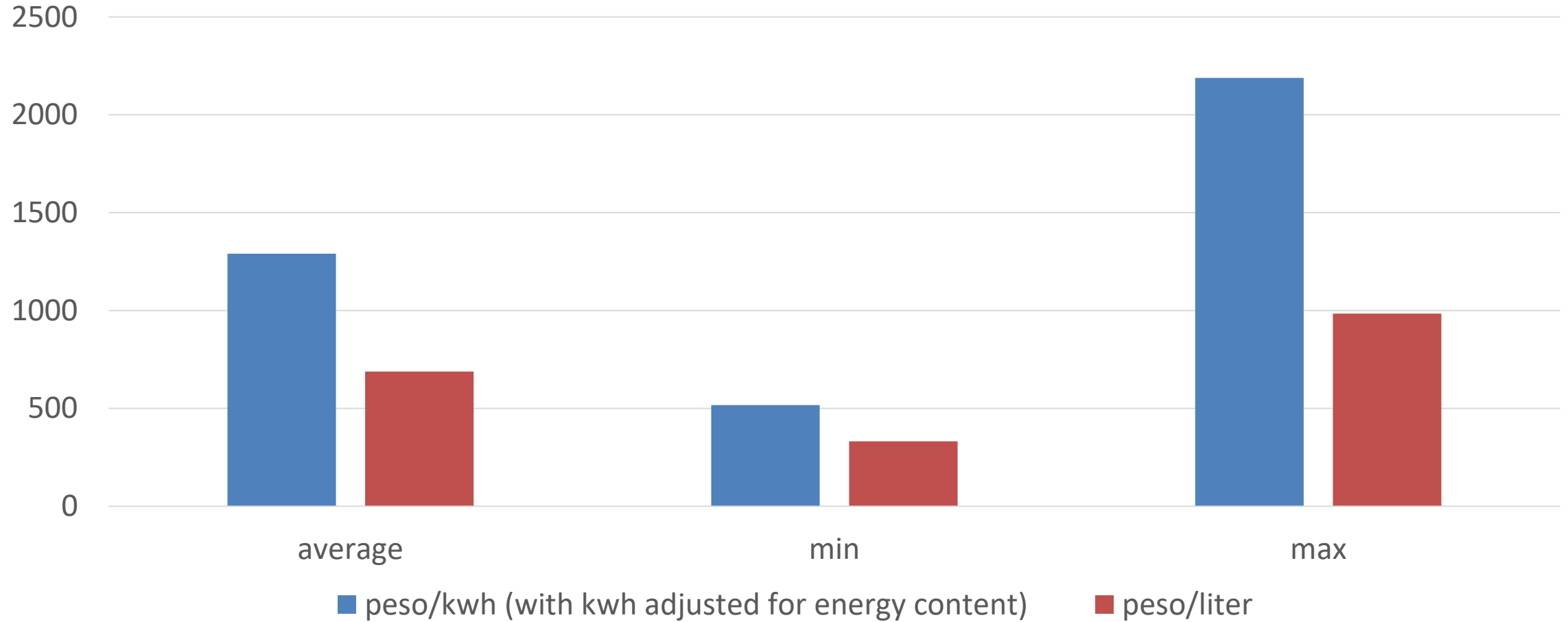
Next steps for moving ahead

- further develop and use tools to expand data sets
  - Water
  - Energy
  - Emissions,
  - Waste, and
  - Social indicators
- Further evaluation of the effects of:
  - Technological change
  - Operational differences
  - Energy generation and security issues
  - Simulation and projection of performance indicators
- Tool development for
  - Bulk,
  - Roro
  - Passenger terminals

- collaborate towards a new standard of information

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questions?

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