H2Ports
Implementing Fuel Cells and Hydrogen Technologies in Ports

Fundación Valenciaport

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Figures

- **209** Projects
- **15** Industrial Prototypes
- **87** Planning and Management Software Solutions
- **199** Million € of Potential Savings (derived from the implementation of the Projects)
- **58** Countries
- **426** Partners
- **8** Databases and Simulators

TOP TEN
Main project topics and completed courses
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ValenciaPort in figures

76.4 M Ton. Total Traffic in 2018

5.2 M TEU Containers Traffic in 2018

19,800 direct or indirect jobs in 2016

Indirect or related role in the generation of over 1.74 billion euros in production in 2016
Container traffic Evolution

1996-2016 (Mio. TEUs)
Total Emissions in 2014

**CO₂e emissions in kg**
- 58% Total emissions associated to electrical consumptions
- 20% Total emissions associated to fuel consumptions
- 12% Total emissions associated to transport
- 10% Total emissions associated to vessel stops

**NO₂ emissions in kg**
- 62% Total emissions associated to electrical consumptions
- 24% Total emissions associated to fuel consumptions
- 14% Total emissions associated to transport
- 0% Total emissions associated to vessel stops

Source: Own elaboration based on Valenciaport Carbon Footprint
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Port Container Terminals. Energy Profile

Port Container Terminals have been studied with the aim of obtaining their energy profiles and the global carbon footprint produced, taking into account the activities carried out by the whole group of machinery and equipment involved.

The aim is to characterise PCTs energy profiles by means of the evaluation of the energy performance of their activities and processes, thus quantifying their impact in terms of GHG emissions.

How much energy is consumed?

Where is the energy consumed?
How Much Energy? Fuel Consumption

**NCTV Yard Machinery**
Total Fuel Consumption 2012

- 4,049,138 L (58%)
- 2,245,147 L (32%)
- 611,460 L (9%)
- 80,819 L (1%)

**Livorno TDT Yard Machinery**
Total Fuel Consumption 2012

Carbon Footprint (Fuel)
7.57 kg CO$_2$eq / TEU
Decarbonization in Port Container Operation

1. Decarbonisation Experiences in Port Container Operations
   - Liquefied Natural Gas
   - Electrification

2. Next Step: Hydrogen
LNG Terminal Tractor Prototype
LNG Terminal Tractor. Design Requirements

This side free to install the 323 liters LNG tank

\[ 3.500 \text{ mm wheelbase} \]
Instead 3.300 mm standard

Hydraulic tank, battery and air compressor moved to the same side
Decarbonization in Port Container Operation

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Full Electrical Tractor

**Batteries**
Traction battery capacity 206[kWh]
Traction battery type Lithium Iron Phosphate
Nominal voltage 299 [V] (260-380 Volt)
Current 700Ah

**Driveline**
Power/torque 160/180 hp @ 1800-2800 RPM
633/712 Nm @0-1800 RPM

**Autonomy**
6 hours (1 operational shift)

**Recharging Time**
Between 3-5 hours (depending on plug type)
LNG vs Electrification

LNG Terminal Truck
- Refuelling time similar to Diesel
- Equipment cost similar to Diesel
- LNG availability
- Less Autonomy than Diesel
- Not Zero-Emission solution

Full Electric Terminal Truck
- Zero-Emission solution
- Electricity price lower than Diesel
- Charging time higher than Diesel refuelling
- Low autonomy (less than 6 hours)
- Equipment cost much higher than Diesel
Decarbonization in Port Container Operation

1. Decarbonisation Experiences in Port Container Operations
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   - Electrification

2. Next Step: Hydrogen
Towards Zero-Emissions Operations in Ports
General Overview

First application of hydrogen technologies in port handling equipment in Europe

Reach Stacker in MSC Terminal
- FC: 90-120 kW
- 2 years / 5000 h of operation

Mobile HRS
- Hydrogen supply logistics at ports
- Port regulatory framework
- Safety procedures

Yard Tractor in Valencia Terminal Europa
- FC: 85 kW
- 2 years / 5000 h of operation
Challenges for the Implementation of H2 in Ports

- Certification of the equipment
- Hydrogen distribution model according our particularities
- Suitable location inside/outside the terminal?
- Protection against fire
- Training staff
- Emergency protocols
- Permitting
- City Perception
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Conclusions

- Port container operations can (and must) be decarbonised: electrification and low carbon / zero-emission fuels;
- This task is challenging: not all port operators are prepared for making the transition towards zero-emission solutions;
- There are knowledge and awareness gaps in the port industry about zero-emission alternatives. Need to bridge the gaps with successful stories;
- Need for cooperative innovation among technology providers and end users;
- Financial feasibility and short pay-backs are critical factors for real implementation of disruptive technologies (like Hydrogen).
Thank you!

Mercedes de Juan
mdejuan@fundacion.valenciaport.com