

H2 and Fuel Cells

Perspectives in Ports.



Mercedes de Juan
Project Manager



Figures



58 COUNTRIES

Detailed description: A world map is shown in a light pink color. The countries of North and South America, Europe, and parts of Africa and Asia are highlighted in a darker shade of pink. The number 58 is prominently displayed in red over the North American continent.

426 PARTNERS

199 MILLION €
of POTENTIAL SAVINGS
derived from the implementation of the PROJECTS
TOP TEN

Main project topics and completed courses

INTERNATIONAL INSTITUTIONS

19 PROJECTS
 - SSS and Motorways of the sea
 - Logistics, intermodality
 - International trade and competitiveness
 44 COURSES

GOVERNMENT AND GOVERNMENT INSTITUTIONS

87 PROJECTS
 - Logistics, intermodality
 - Port planning
 - SSS and Motorways of the sea
 29 COURSES

RO-RO TERMINALS

20 PROJECTS
 - PCS, Single Window, e-maritime
 - International trade and competitiveness
 - SSS and Motorways of the sea
 75 COURSES

EXPORTERS AND IMPORTERS

21 PROJECTS
 - Logistics, intermodality
 - International trade and competitiveness
 - SSS and Motorways of the sea
 54 COURSES

LOGISTICS OPERATORS AND CARRIERS

80 PROJECTS
 - Logistics, intermodality
 - International trade and competitiveness
 - SSS and Motorways of the sea
 104 COURSES

CUSTOMS AND BORDER INSPECTION POSTS

22 PROJECTS
 - PCS, Single Window, e-maritime
 - Technological industry applications (RFID, automated gateways, GPS,...)
 - Safety and security
 48 COURSES

PORT AUTHORITIES

154 PROJECTS
 - Port planning
 - International trade and competitiveness
 - Logistics, intermodality
 117 COURSES

DEPOTS

3 PROJECTS
 - Logistics, intermodality
 - Terminal automation
 25 COURSES

CRUISES

4 PROJECTS
 - SSS and Motorways of the sea
 - Port-City Integration
 - Port planning
 26 COURSES

MARINAS

2 PROJECTS
 - Port planning
 25 COURSES

BULK AND MULTIPURPOSE TERMINALS

10 PROJECTS
 - Port planning
 - Productivity and port capacity
 - Logistics, intermodality
 24 COURSES

PORT TECHNICAL SERVICES

5 PROJECTS
 - Energy efficiency
 - Safety and security
 - PCS, Single Window, e-maritime
 29 COURSES

SEA CARRIERS AND MARITIME AGENTS

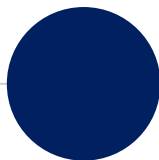
54 PROJECTS
 - International trade and competitiveness
 - SSS and Motorways of the sea
 - PCS, Single Window, e-maritime
 123 COURSES

CONTAINER TERMINALS

51 PROJECTS
 - PCS, Single Window, e-maritime
 - Port planning
 - Energy efficiency
 84 COURSES

RAILWAY OPERATORS AND SERVICES

14 PROJECTS
 - Logistics, intermodality
 - Railway transport
 - Management tools and technologies
 25 COURSES



The context

Regulatory framework.

Integration of H2 and Fuel Cells within Port Operation

The market in figures



ValenciaPort in figures



71 M Ton. Total Traffic



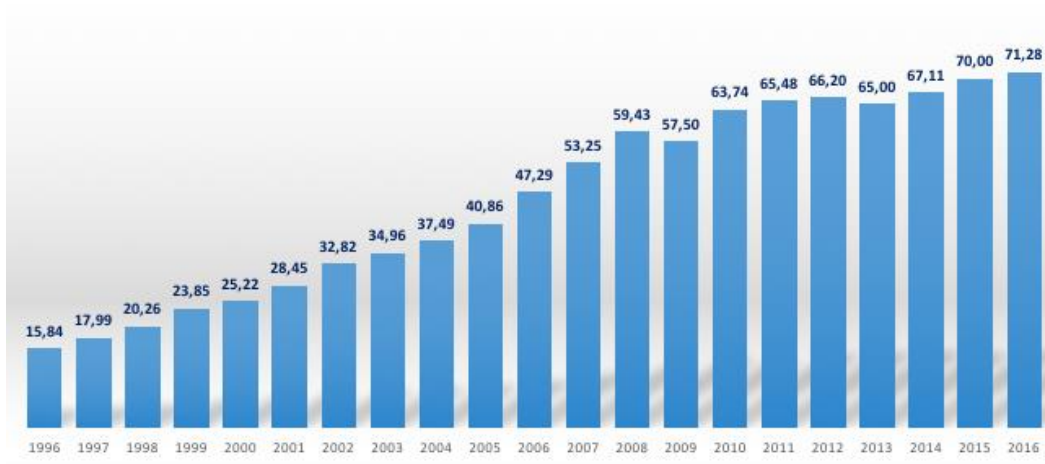
4,7 M TEU Containers Traffic



19.800 direct or indirect jobs

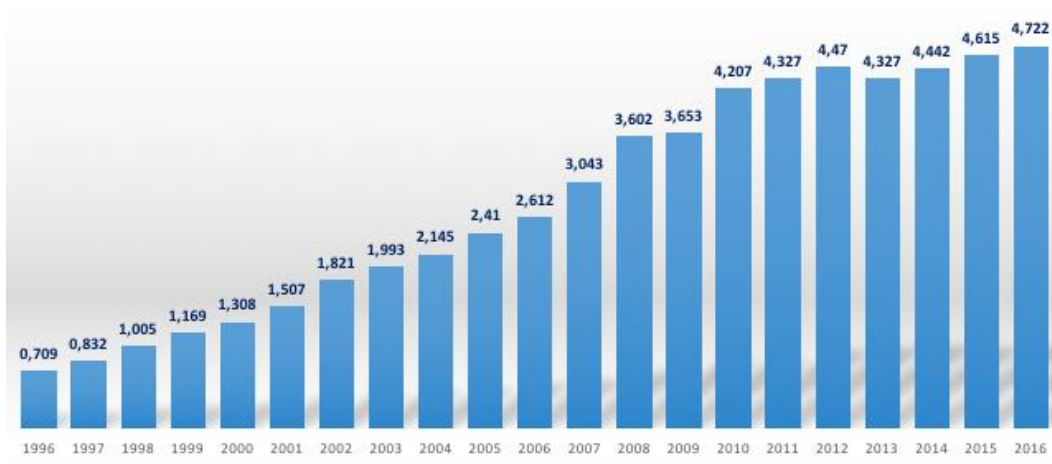


Indirect or related role in the generation of over **1.74 billion euros** in production



Total traffic Evolution

1996-2016 (Mio. Tons)



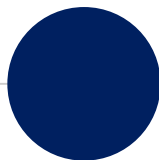
Container traffic Evolution

1996-2016 (Mio. TEUs)



Total emissions

Description	Power consumption in kWh	CO2 emissions in kg	CH4 emissions in Kg	N2O emissions in Kg	CO2e emissions in Kg	% Total
Total emissions associated to electrical consumptions	52.938.537,00	14.966.656,44	132,42	26,84	14.977.759,06	9,48
Total emissions associated to fuel consumptions	117.493.588,09	31.265.829,53	1.625,19	1.596,13	31.794.758,86	20,13
Total emissions associated to transport	69.415.324,38	18.502.429,99	973,81	973,81	18.824.761,79	11,92
Total emissions associated to vessel stops	155.143.634,55	90.989.516,52	1.465,25	4.202,96	92.323.202,96	58,46
Total emissions associated to port activity	394.991.084,02	155.724.432,48	4.196,67	6.799,74	157.920.482,67	100,00



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The market in figures





DIRECTIVE 2014/94/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 October 2014 on the deployment of alternative fuels infrastructure

Article 4

Electricity supply for transport

5. Member States shall ensure that the need for shore-side electricity supply for inland waterway vessels and seagoing ships in maritime and inland ports is assessed in their national policy frameworks. Such shore-side electricity supply shall be installed as a priority in ports of the TEN-T Core Network, and in other ports, **by 31 December 2025**, unless there is no demand and the costs are disproportionate to the benefits, including environmental benefits.

Article 5

Hydrogen supply for road transport

1. Member States which decide to include hydrogen refuelling points accessible to the public in their national policy frameworks shall ensure that, **by 31 December 2025**, an appropriate number of such points are available, to ensure the circulation of hydrogen-powered motor vehicles, including fuel cell vehicles, within networks determined by those Member States, including, where appropriate, cross-border links.



Regulation, Guidelines and Standards

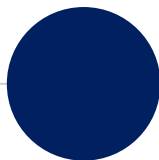
Regulations

- **IGF Code: International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels, 2016 Edition**
- **Regulation (EC) No 79/2009 of the European Parliament and of the Council of 14 January 2009 on type-approval of hydrogen-powered motor vehicles, and amending Directive 2007/46/EC**

Guidelines and Standards

- ISO/TS 19880-1:2016 Preview
Gaseous hydrogen -- Fuelling stations -- Part 1: General requirements.
- NFPA 50 A: Standard for gaseous hydrogen systems at consumer sites.
- EIGA IGC Doc 121/04/E Hydrogen transportation pipelines.
- SAE J2601 – Fueling Protocols for Light Duty Gaseous Hydrogen Surface Vehicles.
- CSA HGV 4.3-2012 – Test Methods for Hydrogen Fueling Parameter Evaluation.
- Classification Societies Rules and Standards





The context

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The market in figures

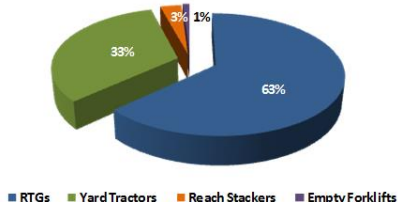


Port Container Terminals Energy Profile

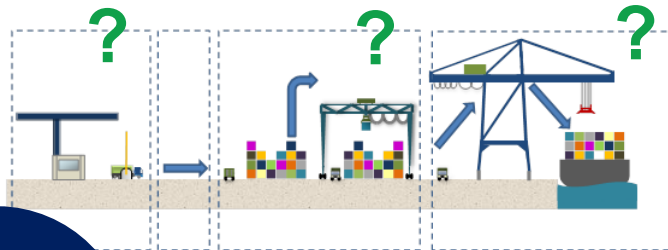
Port Container Terminals have been studied with the aim of obtaining their energy profiles and the global carbon footprint produced, taking into account the activities carried out by the whole group of machinery and equipment involved.

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?



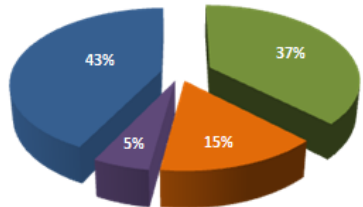
Where is the energy consumed?



How Much Energy? Electrical Consumption

NCTV Electrical Consumption

2012 (kWh)



■ STS Cranes ■ Yard Lighting ■ Offices ■ Container Reefers

80%



12,522,629 kWh
(43%)



11,006,280 kWh
(37%)



4,801,013 kWh
(15%)

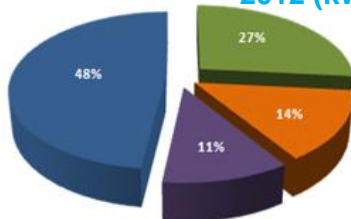


1,815,477 kWh
(5%)

30,1 GWh

NCTV Electrical Consumption

2012 (kWh)

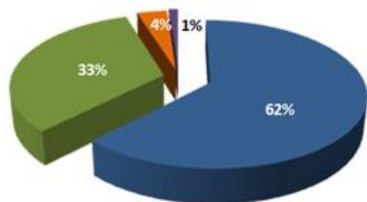


■ STS Cranes ■ Terminal Lighting ■ Offices ■ Reefer Containers

Carbon Footprint (Electricity)
4.15 Kg CO₂eq / TEU

How Much Energy? Fuel Consumption

NCTV Yard Machinery Total Fuel Consumption 2012



■ RTGs ■ Yard Tractors ■ Reach Stackers ■ Empty Forklifts

90%



4,049,138 L
(58%)



2,245,147 L
(32%)



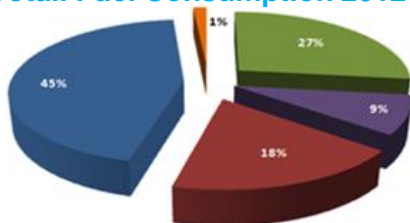
611,460 L
(9%)



80,819 L
(1%)

6,986,564 L

Livorno TDT Yard Machinery Total Fuel Consumption 2012



■ RTGs ■ Internal Tractors ■ External Tractors ■ Reach Stackers ■ ForkLifts

Carbon Footprint (Fuel)
7.57 Kg CO₂eq / TEU

**1st European Terminal Tractor powered by LNG
piloted at Valenciaport/Noatum Container Terminal**





LNG tractors for new Turkish terminal

08 Jul 2014

Netherlands-based Terberg Benschop is to supply 40 LNG tractors for Asyaport's new container terminal, being built in Turkey on the Marmara Sea.

The YT222 tractors with 170kW Mercedes engines are powerful enough to handle two trailers carrying 20 inch containers.

Asyaport says it chose LNG as a fuel for its environmental properties and the fact that it's considerably cheaper in Turkey than diesel. There is also an LNG filling station near the terminal, so maintenance is easy.

Terberg's Turkish distributor Portunus, based in Istanbul, will provide service and support. Delivery will begin in January 2015.

Asyaport's new deep-water container terminal is strategically located as a transshipment hub for containers destined for the Black Sea via the Bosphorus. It will handle vessels carrying up to 18,000 teu and will have an annual capacity of around two million teu.

Investors in the terminal include Terminal Investment Ltd SA (TIL), the terminal operating subsidiary of Mediterranean Shipping Company (MSC), and the Soyuer Group in Turkey.

Following this order, Terberg will also supply 28 tractors to TIL's terminal at Lomé in Togo, West Africa.

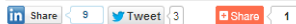


Terberg will supply 40 LNG tractors for Asyaport's new container terminal



Terberg to supply LNG tractors to Turkish terminal

04 Jul 2014 - Terminal Handling



Netherlands-based specialist vehicle manufacturer Terberg Benschop has been chosen to supply 40 LNG-powered tractors for a new, sophisticated container terminal in Turkey.

The Terberg YT222 tractor has a 170kW Mercedes engine, claimed to be powerful enough to handle two trailers carrying 20ft containers.

Servicing and support for the tractors will be provided by Portunus – Terberg Benschop's Istanbul-based Turkish distributor.

LNG was chosen to power all tractors at the terminal as it eliminates particulate emissions and leads to much lower NOx emissions than diesel. Furthermore, LNG is considerably cheaper in Turkey than diesel and there is an LNG filling station close to the terminal. Delivery of the tractors will commence in January 2015.

To be built by Asyaport on a deep water site, the new terminal will be located around 135km from Istanbul on the Sea of Marmara. The proposed port will be strategically located as a trans-shipment hub for containers destined for the Black Sea via the Bosphorus, and will handle 18,000 TEU vessels; it will have an annual capacity of around two million TEU.

For further information on Terberg Benschop, [click here](#)



Proposed site of Asyaport's new terminal. Image: Terberg Benschop

BENCOMO EXPRESS: AN LNG DUAL-FUEL RETROFITTED ROPAX HSC



Distance: 36 nm
Transit time: 1 hour
Round trips: 3/day

Year of construction: 1999

Speed: 38 Knots

Capacity



871 passengers 330 line metres

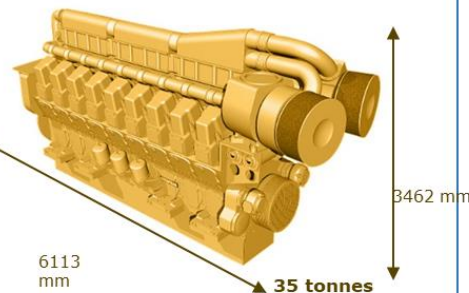


**Main engines: 4 x CAT
3618**

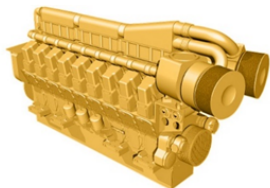
(4 x 7200 kW)

Auxiliary engines: 4 x CAT 3406

Waterjets: 4 x Wartsila LIPS LJ 150D



E
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Second-hand sister engine
CAT 3618



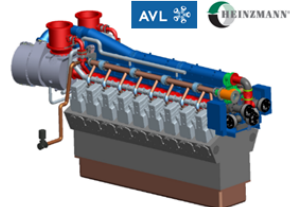
Barloworld
Finanzauto

Engine overhaul for
allowing testing

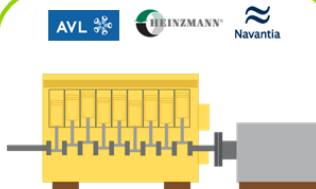


Simulation of dual-fuel
engine & transition modes

R
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Dual-fuel system
installation



Dual-fuel engine
validation at test bench

New DNVGL Rules
January 2016
Gas Fuelled
Ship Installations

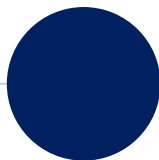


Approval of FO 3618 DF

Challenges for the implantation 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





The context

Regulatory framework.

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The market in figures





The market at a glance

- In 2014, global containerized trade is **increased by 5.3** per cent and reached **171 million TEUs**.
- The total mainlane container trade is **grown by 9.0 per cent** between 2007 and 2014 while trade volumes on the non- mainlane trades are expanded by **45 per cent** during the same period. (Source UNCTAD)

The existing fleet of **RTG cranes** worldwide in **4500 units**, representing **9 €bn**. (Source: Paceco)

The surveys conducted by the Port Equipment Manufacturers Association show the following figures in 2015.

- The **global yard cranes** deliveries was **678 units**, representing **1,35 €bn**
- **Reach stacker** deliveries were **1403 units** accounting for a **9% growth**
- **Laden FLTs** deliveries in 2015 were **204**, while empty FLT's showed an increase of **3%** with **698 units**
- A total amount of **2191 terminal tractors** were delivered in 2015, where terminal tractors 4x4x representing **7% increase**



The Knowledge Centre of the Leading Port Cluster in the Mediterranean

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