

# I progetti futuri per il GNL nell'area di cooperazione

09.06.2021

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# Agenda

I progetti futuri per il GNL  
nell'area di cooperazione

- I. The Interreg LNG Cluster
- II. TDI RETE-GNL 2.0
- III. Observatory on green technologies for shipping & ports
- IV. Further opportunities

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- I. **The Interreg LNG Cluster**
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# The INTERREG LNG Cluster experience

## Partnering & Networking

Partners: 5  
Budget: 749.042,16 €



Partners: 6  
Budget: 1.613.514,63 €

**Research design & theoretical framework**  
Demand & supply; Localization & Sizing; Economic & financial feasibility; Environmental issues; Technologies & procedures

**Modelling and optimizing the LNG maritime network**



INTERREG LNG Cluster



Partners: 5  
Budget: 2.345.655 €

Partners: 7  
Budget: 749.069,31 €



**Promotion  
Stakeholder engagement**

**Developing the physical infrastructure  
Piloting & Demo days**



# The INTERREG LNG Cluster experience

## Networks, competences & Know how

- **Oltre 20 consulenti tecnici** esperti di GNL attivati.



- **4 Università italiane** (UNIGE, UNICA, UNIPI, UNIUD) coinvolte nel progetto, con la partecipazione di oltre 20 professori universitari di dipartimenti di economia e di ingegneria.



- **Oltre 10 «young researchers»** finanziati/coINVOLTI nelle attività di progetto sui temi del GNL (assegnisti di ricerca, borsisti di ricerca, dottorati di ricerca)

- **Sviluppo della rete** con tutte le grandi **associazioni di categoria**



CONFITARMA  
Federazione Italiana Armatori

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# TDI RETE-GNL 2.0

## Conceptual Framework

- **Background:** within the ITA-FRA INTERREG Maritime Projects labelled «LNG Cluster» several managerial integrated tools for planning and developing LNG bunkering and storage facilities in the maritime-port domain have been designed.
- **Aims:**
  - ✓ Disseminate/capitalise the technical output of LNG cluster's project
  - ✓ Further develop the managerial and operational tools designed during research activities
  - ✓ Integrate North and South Mediterranean Countries
- **Potential partners:** Public Entities, Port Authorities, LNG bunkering terminal operators, shipping companies investing in LNG-propelled ships; Universities & Research centres
- **Working packages**
  1. Governance settings & networking
  2. Managerial and technical tools
  3. ICT platform development

# TDI RETE-GNL 2.0

## Governance settings & Networking

### ➤ **Partner typologies:**

- ✓ Public Entities,
- ✓ Port Authorities,
- ✓ LNG bunkering terminal operators,
- ✓ shipping companies investing in LNG-propelled ships;
- ✓ Universities & Research centres.

### ➤ **Country coverage:** North and South Mediterranean countries.

### ➤ **Governance settings:** for planning and monitoring project activities an ad-hoc Scientific & Technical committee will be nominated, including all partner typologies and covering all “geographic” regions involved in the project.

### ➤ **Technical procedure for networking, sharing and integrating tasks, data, information and planning activities:** rules related to data gathering and data protection will be set at the beginning of the project in order to avoid governance concerns during the development of the project.





# TDI RETE-GNL 2.0

## Managerial & Technical Tools: main typologies

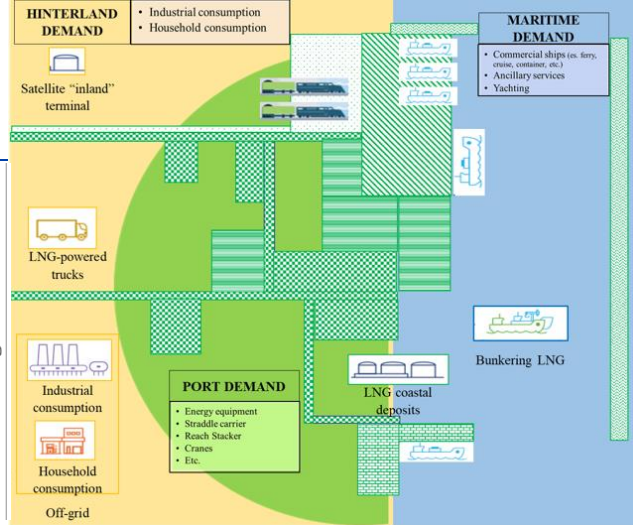
- 1. Market analysis**
- 2. Supply chain mapping**
- 3. Localization and sizing of facilities and infrastructures**
- 4. Economic and financial evaluation**
- 5. Environmental assessment + safety & security issues**

# Managerial tools

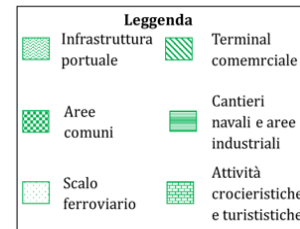
## Market analysis

- Market segmentation
- Fleet geo-localization
- Qualitative market analysis
- Quantitative market analysis
- Market forecasts
- BI insights

LNG market analysis  
Market segmentation

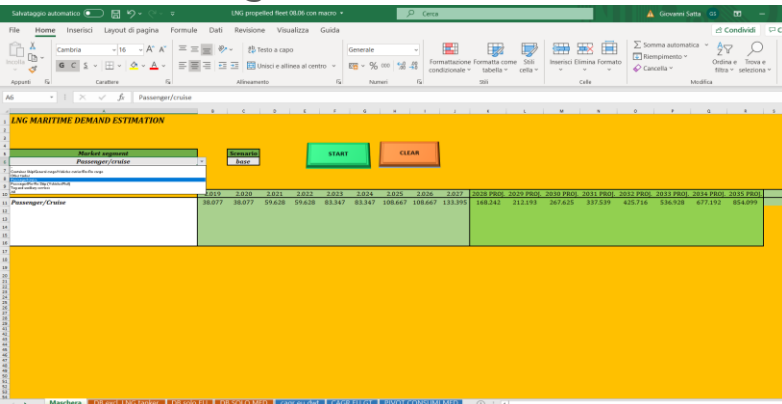


## LNG demand segmentation



LNG market analysis  
Features & functionalities

- The TDI RETE-GNL methodological framework for **assessing LNG demand in maritime and port domain** belonging to target ITA-FRA regions will be capitalized for developing customized managerial tools capable to:
  - ✓ predict LNG demand in broader geographical regions (e.g. Mediterranean Sea)
  - ✓ disentangling maritime, port and inland LNG demand
  - ✓ map LNG-propelled ships in the target area (grounding on the TDI RETE-GNL project)
  - ✓ quantify LNG bunkering maritime demand (grounding on SIGNAL project)
  - ✓ estimate LNG port demand (grounding on the TDI RETE-GNL project)
  - ✓ forecast LNG inland demand (grounding on the TDI RETE-GNL project)
  - ✓ integrate LNG demand forecasts from multiple sources
  - ✓ develop scenario analysis & sensitive analysis



## 2. TDI RETE-GNL 2.0

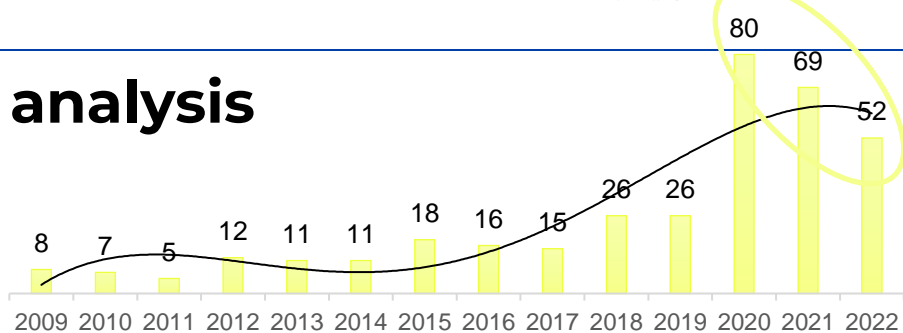
# Maritime LNG demand: data analysis

## LNG-propelled ships, Worldwide

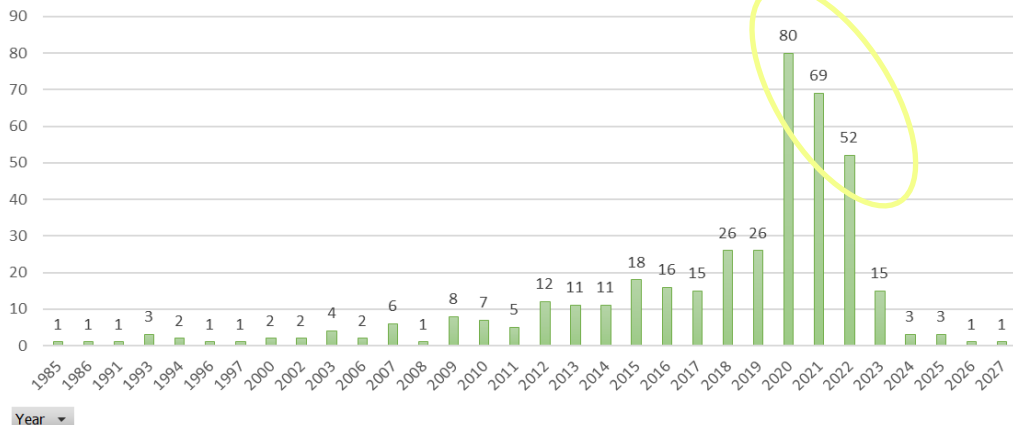
LNG-propelled ships worldwide at 2027 (data 2019)

excluding LNG tanker (BOG)

**406 LNG-propelled ships**



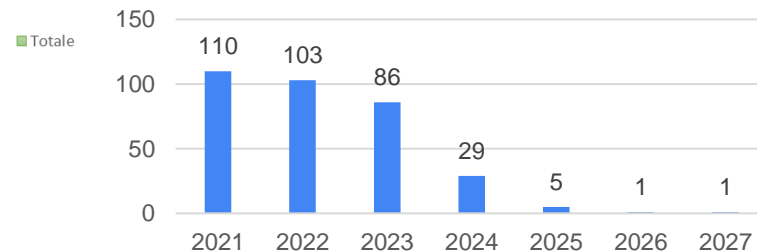
Conteggio di Name of Ship



LNG-propelled ships worldwide at 2027 (data 06.2021)

excluding LNG tanker (BOG)

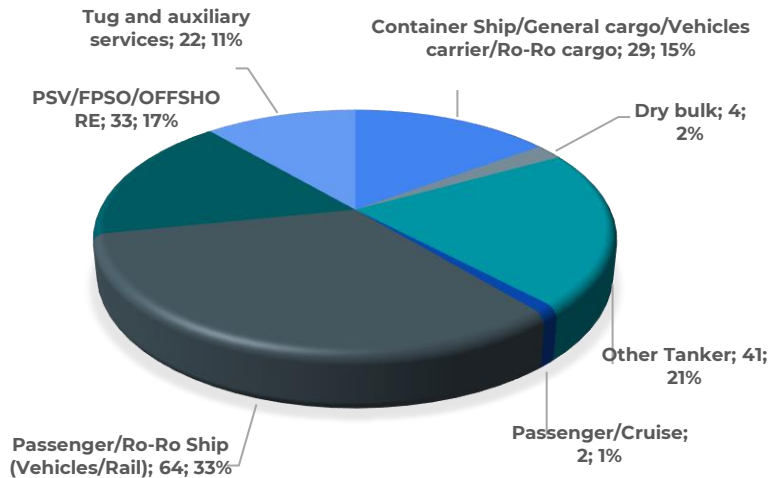
**552 LNG-propelled ships** (+146 ships; +35,96%)



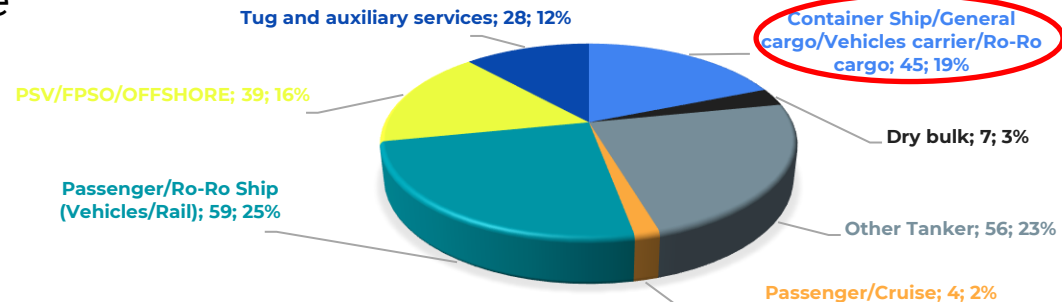
# Maritime LNG demand: data analysis

## LNG-propelled ships, Worldwide

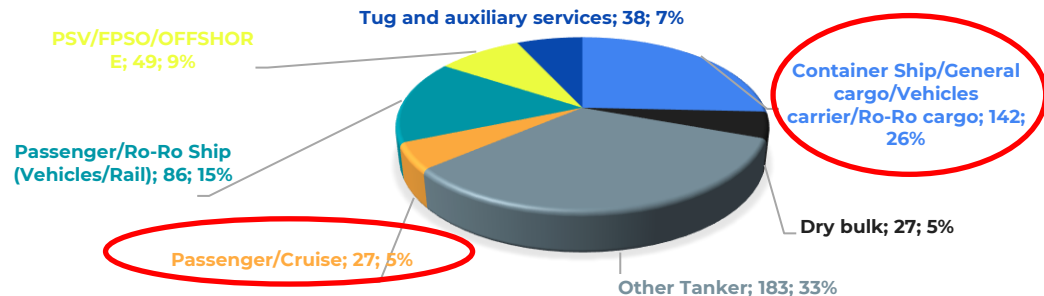
### 195 LNG-propelled ships worldwide at 2020



### 238 LNG-propelled ships worldwide at 2021



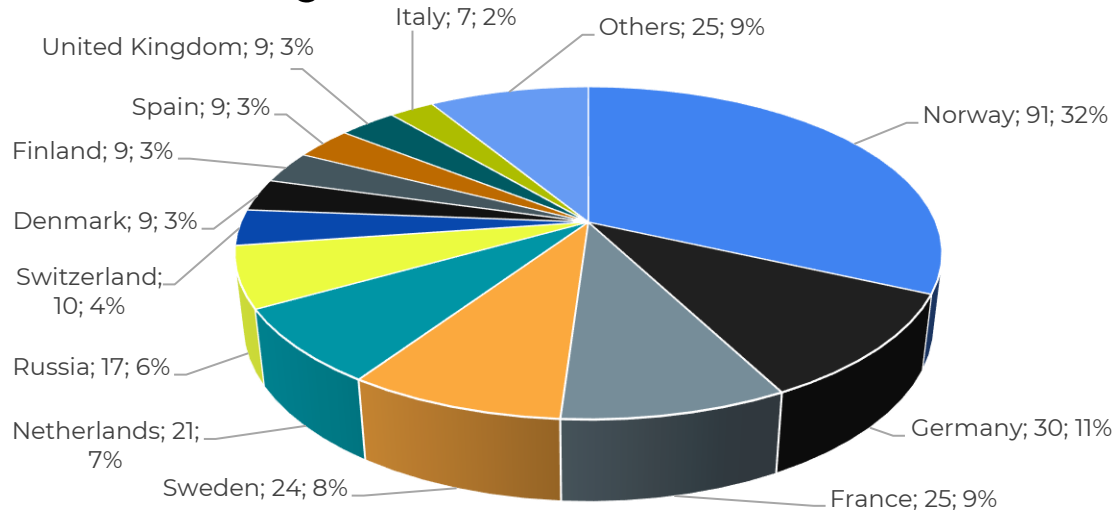
### 552 LNG-propelled ships worldwide at 2027



# Maritime LNG demand: data analysis

## LNG-propelled ships, Europe

- Geographical mapping of the demand can be done by adopting different approaches:
  - ✓ Nationality of **group owners**
  - ✓ Nationality of **registered owners**
  - ✓ Fleet **asset deployment**
- The first 2 profiles, taking into account the international nature of the sector and the mobility of assets, appear to be of little significance to investigate the actual commercial use of the LNG fleet.
- However, examining the ownership of LNG fleet ships helps to understand which countries are focusing on this technology and where there will be greater attention in the coming years in terms of investment and regulation.
- Examination of the most relevant countries in terms of “group owners” by 2027



# Maritime LNG demand: data analysis

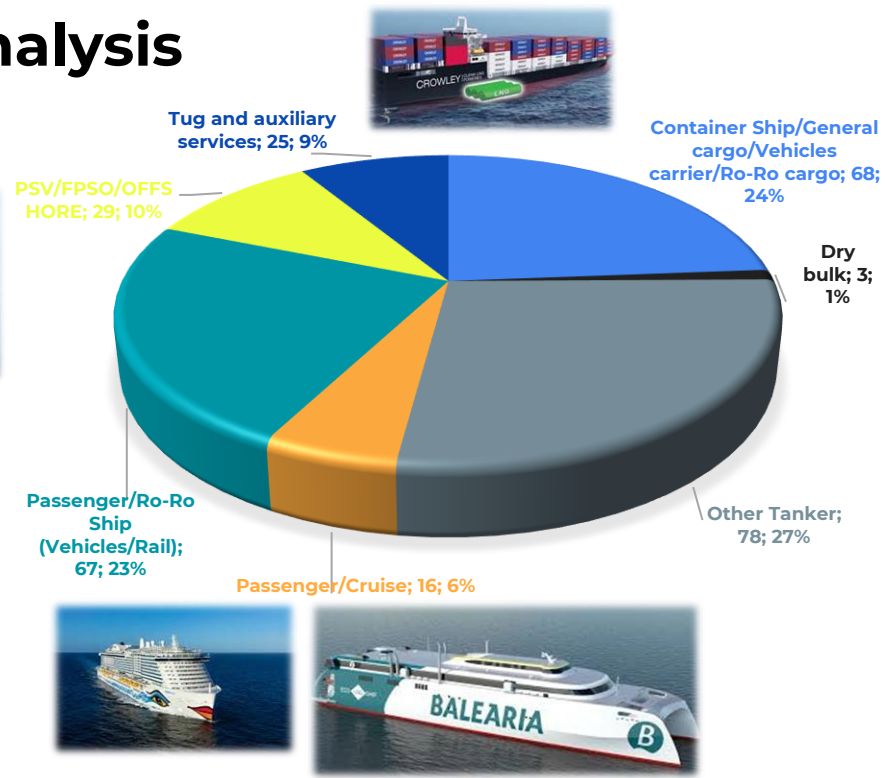
## LNG-propelled ships, Europe

**286 LNG-propelled ships – European shipowner at 2027**

(Estimation on data available 06.2021)



Ship type	LNG-propelled ships
Container Ship/General cargo/Vehicles carrier/Ro-Ro cargo	68
Dry bulk	3
Other Tanker	78
Passenger/Cruise	16
Passenger/Ro-Ro Ship (Vehicles/Rail)	67
PSV/FPSO/OFFSHORE	29
Tug and auxiliary services	25
<b>Totale</b>	<b>286</b>





Economic and financial analysis  
Features & functionalities

- The tool for economic and financial analysis will support public entities, Port Authorities, as well private parties involved in LNG infrastructure planning/authorization process in:
  - ✓ Assessing the **quality and validity of data included in business plans** (BPs) presented by private partners.
  - ✓ Evaluating the consistency of **CAPEX** estimated in BPs.
  - ✓ Evaluating the consistency of **OPEX** estimated in BPs.
  - ✓ Including potential **cross-countries synergies or overlaps/risks** in LNG infrastructures development (estimation of potential competitive or cooperative effects between investments developed by different countries involved)
  - ✓ Estimating **port concession fees** related to port areas committed to LNG infrastructures.
  - ✓ Defining the **duration of the concession** offered to private parties investing in LNG infrastructures, consistent with the **pay back period** (PBP) of the investment.
  - ✓ Supporting the **economic and financial analysis** of the LNG infrastructure (NPV, IRR, etc.).
  - ✓ Considering **public-private-partnership** (PPP) opportunities for the development of LNG infrastructure in the port domain.

# Managerial tools

## Economic & financial evaluation

- CAPEX and OPEX analysis
- Supply chain costs analysis
- Assessment of potential synergies or overlaps in investment strategies from different countries
- Preliminary econ./financial evaluation of projects related to green technologies (NPV, IRR, etc.).
- Tools for supporting public authorities involved in port concession procedures

### Economic and financial analysis

Assessment of CAPEX and OPEX related to LNG bunkering/storage facilities

TECHNOLOGY	T-T-S	P-T-S	S-T-S
ISO-CONTAINER ON TRUCK		PORT TERMINAL "SMALL BULLETS" 8 BAR	BUNKERING SHIP VERY SMALL SIZE 150-300m <sup>3</sup>
BUNKERING WITH TRUCK		PORT TERMINAL "MID-SIZE BULLETS" 8 BAR	BUNKERING BARGE «SMALL SIZE» 1,000-3,000m <sup>3</sup>
ISO-CONTAINER ON SKID		PORT TERMINAL "LONG-BULLETS" 8 BAR	BUNKERING SHIP «SMALL SIZE» 1,000-5,000m <sup>3</sup>
TANKER ON SKID		PORT TERMINAL "SATELLITE" PRESSIONE ATM.	BUNKERING SHIP «MID SIZE» 6,000-10,000m <sup>3</sup>
ISO CONTAINER/ MULTI-RACK		PORT TERMINAL "HUB" PRESSIONE ATM.	BUNKERING SHIP «LARGE SIZE» 15,000-30,000m <sup>3</sup>

### Economic and financial analysis

Assessment of CAPEX and OPEX related to LNG bunkering/storage facilities

LNG - BUNKERING MODE	T-T-S				P-T-S				S-T-S							
	ISO-cont	Tanker	ISO-cont	Tank	ISO-cont	Tanker	ISO-cont	Tank	ISO-cont	Tanker	ISO-cont	Tank				
LNG Storage net capacity	m <sup>3</sup>	40	52	40	60	200	500	5,000	20,000	20,000	50,000	200	2,000	5,000	7,500	30,000
tank external diameter	m	2,50	2,40	2,50	2,75	6x7,5	2x4,0	6x10	18x6,0	36x0	48,0	4,00	2x4,0	2x12	2x13,5	2x13,5
tank length/height	m	32,2	34,5	32,2	35,0	33,2	30,0	7x4,5	6x0	30,0	43,0	24,0	38,0	37,4	45,6	45,6
operating pressure	MPa	800	800	800	800	800	800	300	300	15	15	800	800	800	800	800
LNG Send-Out Capacity	m <sup>3</sup> /d	40	52	40	60	200	500	5,000	15,000	15,000	23,000	150	500	600	700	800
land safety/area req. required	m <sup>2</sup>	500	500	500	500	1,000	2,500	15,000	50,000	15,000	20,000	n.a.	n.a.	n.a.	n.a.	n.a.
DWT	t	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	220	2400	4320	6030	6030
LOA	m	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	49,7	64,6	107,6	117,6	117,6
BEAM	m	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	11,3	14,6	18,4	18,6	18,6
DWT	m	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	31	2,6	5,0	5,8	5,8
LNG supply each truck/ship load	m <sup>3</sup>	40	52	40	60	200	500	5,000	15,000	15,000	30,000	200	2,000	5,000	7,500	30,000
number of truck/ship load per week	n°	36	36	36	42	144	392	2	2	2	2	7	3	3	3	3
LNG "Hub" capacity	m <sup>3</sup> /y	76,000	97,000	76,000	114,000	300,000	133,000	780,000	1,540,000	1,540,000	4,680,000	73,000	343,000	790,000	1,070,000	4,680,000
specific capacity: m <sup>3</sup> /sendout/m <sup>3</sup> storage		1,875	1,865	1,875	1,900	1,500	1,038	87	78	62	365	156	156	156	156	156
LNG feed supply chain	m <sup>3</sup> /y	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0
each truck/ship load	m <sup>3</sup> /y	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0
number of truck/ship load per week		13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0

LNG - BUNKERING TYPE	
OPERATION COSTS - OPEX	
a) LNG supply chain	€ / y
b) LNG storage IN/OUT	€ / y
c) LNG send out to bunkering	€ / y
d) LNG infrastructure general services	€ / y
Supervision	€ / y
ship-work	€ / y
day-work (adm & tec)	€ / y
Maintenance	€ / y
Energy & other utilities	€ / y
GSA&Assurances	€ / y
TOTAL OPEX	€ / y
OPEX UNIT/SENDOUT COST	€ / m <sup>3</sup> y
	€ / mmbtu

**ASSOCOSTIERI SERVIZI**  
 Gestionale ambientale ed autorizzato  
 Servizi in campo strategico



# TDI RETE-GNL 2.0

## ICT platform development

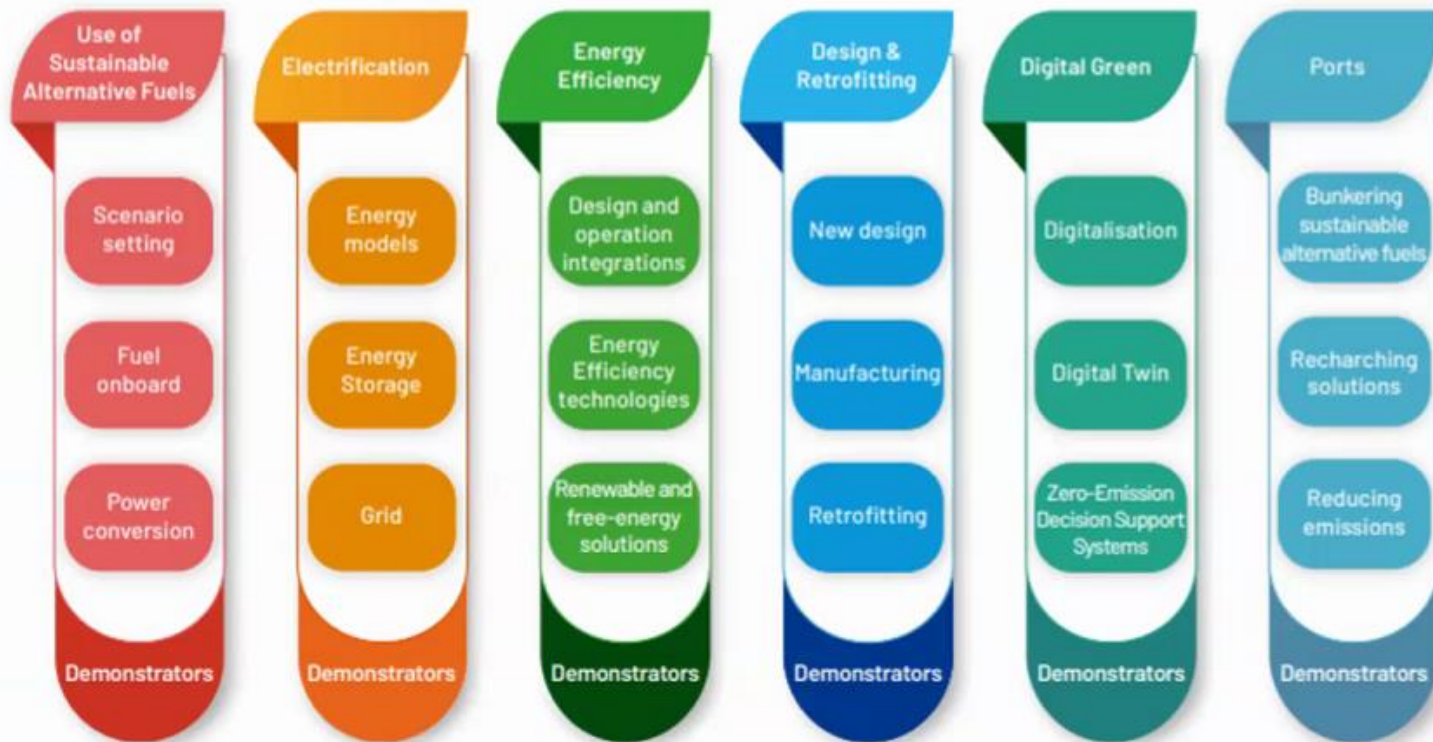
1. Goals
2. Architecture
3. Data gathering & data sharing
4. Outcomes & available services
5. Business model & revenue model development



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### **3. Observatory on green technologies for shipping & ports**

La coopération au cœur de la Méditerranée  
La cooperazione al cuore del Mediterraneo

## Westmed Technical Group (TG) on Green Shipping

### Observatory on green technologies for shipping and ports

Authors:

*Prof. Giovanni Satta (University of Genoa; CIELI & DIEC)*

*Dott.ssa Giorgia Morchio (University of Genoa; CIELI)*

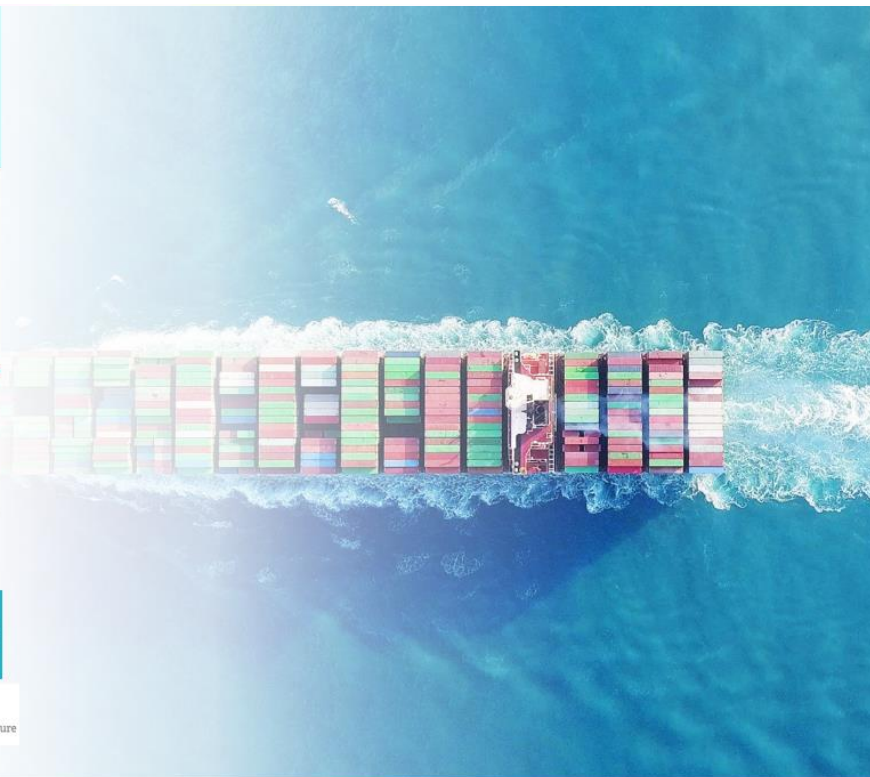
*Dott.ssa Marta Giannoni (University of Genoa; CIELI)*

26.05.2021

**WESTMED**  
blue economy initiative



 **Università di Genova** | **CIELI**  
Centro Italiano di Eccellenza sulla Logistica i Trasporti e le Infrastrutture



# Strategic goals

- I. Establishing a **regional observatory** on innovative and sustainable **technologies** for **green shipping** and **green ports** (strong focus on **energy efficient technologies**).
- II. Assessing the **state of the art** and **future potentials** in research and innovation for technological solutions aimed at fostering sustainable energy for Mediterranean green shipping.
- III. Providing **managerial tools** for supporting the decision-making process related to investments in new technologies from both private and public stakeholders as well as co-funding programs opportunities selected by policy makers involved in the shipping and port domain



## Main project outcomes

1. Observatory for green technologies in shipping & ports
2. Managerial tools for stakeholders and policy makers



## 3. Observatory on green technologies for shipping & ports

La coopération au cœur de la Méditerranée  
 La cooperazione al cuore del Mediterraneo

# Observatory for green tech in shipping & ports

## Conceptual framework

Ship propulsion systems & alternative fuels	Tech. solutions for energy & environ. efficiency	Waste treatment systems	Water treatment systems	Automation & digital technologies
Integrated Electric Prop. (IEP)/Battery	Exhaust Gas Cleaning System (scrubber)	Adv. wastewater purif. systems (AWWPS)	Waste reduction policies	Autonomous shipping
Diesel-Electric engines	Hull air lubrication ("bubble technology")	Ballast water Exchange	Unsorted/separated waste compactors	Digital technologies
Wind assisted propulsion	Fuel saving propeller attach. & ship design	Onboard treatment	Wet waste compactor (Converter NV)	Etc.
VLSFO/ULSFO	New bulbous bow (nose job)	Etc.	Hazardous chemical waste management	
LNG/LPG	Heating, Ventilation and Air Conditioning			
Hydrogen/Fuel Cell (FC) systems	Solar power			
Biofuels	Cold ironing			

- 5 clusters of green technologies
- Main focus:
  - ✓ Ship propulsion systems & alternative fuels
  - ✓ Technological solutions for energy and environmental efficiency

# Observatory for green tech in shipping & ports

## Tasks & Pillars

### 1. Technological assessment

- ✓ Technology description
- ✓ State of the art
- ✓ Technical issues
- ✓ Environmental impacts
- ✓ etc.



### 2. Methodological issues

- ✓ Research design
- ✓ Development of ad hoc indexes and KPIs for comparing technological solutions considering both economic and environmental performances



### 3. Data gathering

- ✓ Technology related data
- ✓ Market data
- ✓ Supply chain data
- ✓ Localization and sizing of infrastructures
- ✓ Economic and financial data
- ✓ Environmental data

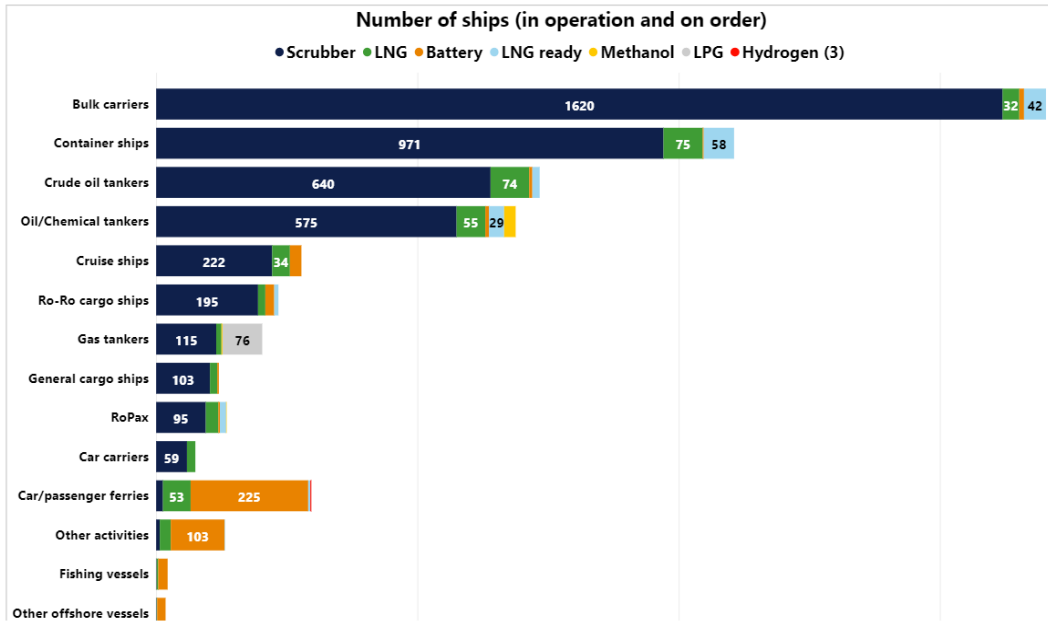
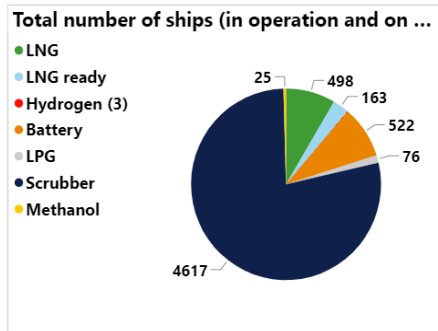


### 4. Main outcomes

- ✓ set of innovative and settled KPIs for making more efficient public support to energy transition in the transport domain
- ✓ development of ad hoc **dashboard system** for supporting public and private stakeholders and policy makers involved in the shipping and port industry

# Technological assessment

## Current uptake of alternative fuels and propulsion technologies in shipping

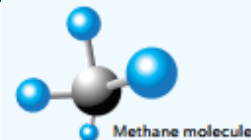




# Technological assessment

## LNG: state of the art

- 195 LNG-propelled ships worldwide at 2020 (excluding LNG tanker)
- 406 LNG-propelled ships worldwide at 2027 (excluding LNG tanker)



### LNG

Liquefied natural gas (LNG) has more or less the same composition as natural gas used for households and power generation, and in the industry. Its main component is methane (CH<sub>4</sub>), the hydrocarbon fuel with the lowest carbon content.

ENVIRONMENTAL REGULATIONS					
Emission component	Emission reduction with LNG as fuel			Comments	
SO <sub>x</sub>	100%			Complies with ECA and global sulphur cap	
NO <sub>x</sub> , low-pressure engines (Otto cycle)	85%			Complies ECA 2016 Tier III regulations	
NO <sub>x</sub> , high-pressure engines (Diesel cycle)	40%			Need EGR/SCR to comply with ECA 2016 Tier III regulations	
CO <sub>2</sub>	25-30%			Benefit for the EEDI requirement, no other regulations (yet)	
Particulate matter	95-100%			No regulations (yet)	
COMPARISON OF EMISSIONS FROM DIFFERENT FUELS					
Data from DNV No. 2011-1449, Rev. 1 (Tab 16 mainly); DNV NO 2012-0719	CO <sub>2</sub> equivalent [g/MJ] (Tab 3, DNV-2012-0719)			% CO <sub>2</sub> (HFO = 100%)	
	Well-to-tank CO <sub>2</sub> emissions (WTT)	Tank To Propeller CO <sub>2</sub> emissions (TTP)	Total CO <sub>2</sub> emissions	% total	% Tank To Propeller
Oil fuel (HFO)	9.80	77.70	87.50	100.00	100.00
Oil fuel (MGO)	12.70	74.40	87.10	99.54	95.75
LNG (from Qatar used in Europe)	10.70	69.50	80.20	91.66	89.45
LNG (from Qatar used in Qatar)	7.70	69.50	77.20	88.23	89.45

Source: DNV-GL, «Assessment of selected alternative fuels and technologies» - April 2019



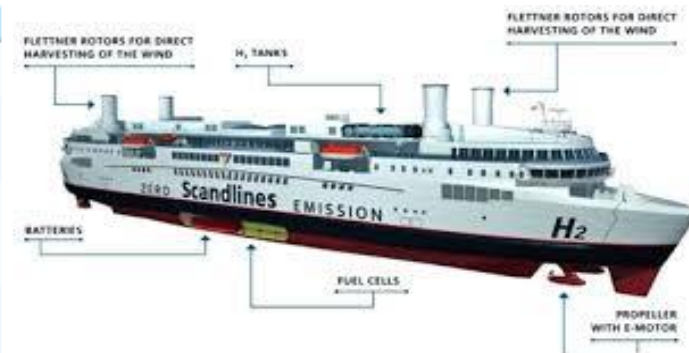
# Technological assessment

## LNG: state of the art



- The use of hydrogen-powered fuel cells for ship propulsion, by contrast, is still at an early design or trial phase – with applications in smaller passenger ships, ferries or recreational craft.
- The low- and high-temperature fuel cell (PEMFC) and the solid oxide fuel cell (SOFC) are seen as the most promising fuel cell types for nautical applications (EMSA 2017).
- 23 projects identified in 2017 by EMSA

Project	Concept	Main partners	Year	Fuel Cell	Capacity	Fuel
FellowSHIP	320 kW MCFC system for auxiliary power of Offshore Supply Vessel	Eidesvik Offshore, Wärtsilä, DNV	2003-2011	MCFC	320 kW	LNG
Viking Lady METHAPU Undine	20 kW SOFC tested for the evaluation of 250 kW SOFC solution for marine APU.	Wallenius Maritime, Wärtsilä, DNV	2006-2010	SOFC	20 kW	Methanol
E4Ships - Pa-X-ell MS MARI- ELLA	60 kW modularized HT-PEM fuel cell system developed and tested for the decentralized auxiliary power supply onboard passenger vessel MS MARIELLA.	Meyer Werft, DNVGL, Lürssen Werft, etc	Phase 1: 2009-2017 Phase 2: 2017-2022	HTPEM	60 kW (each stack is 30 kW)	Methanol
E4Ships - SchIBZ MS Forester	100 kW containerized SOFC system developed and tested for the auxiliary power supply of commercial ships. Scalable up to 500 kW units.	Thyssen Krupp Marine Systems, DNVGL, Leibniz University Hannover, OWI, Reederei Röd Braren, Sunfire	Phase 1: 2009-2017 Phase 2: 2017-2022	SOFC	100 kW	Diesel



### 3. Observatory on green technologies for shipping & ports

La coopération au cœur de la Méditerranée  
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# Technological assessment

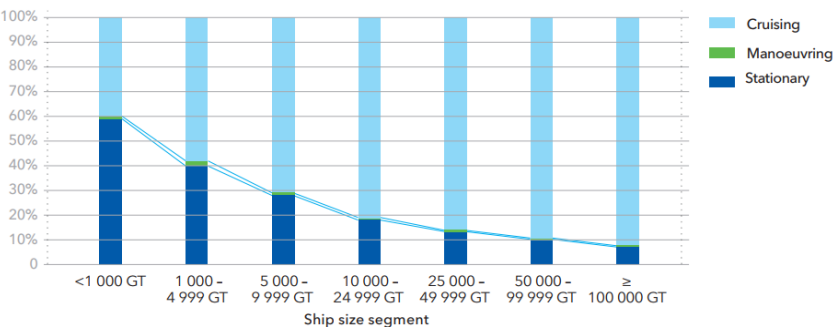
## Cold ironing: state of the art

### ➤ Environmental benefits

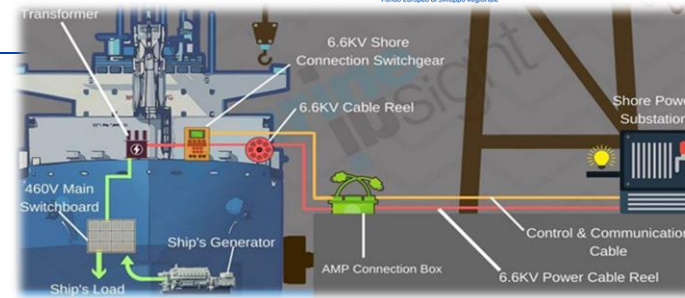
- ✓ 30% reduction in CO2 emissions
- ✓ 97% reduction in NOx emissions
- ✓ 95% reduction in sulphur (SOx) emissions

Share of fuel used in each operational mode in 2017 by ship size segment

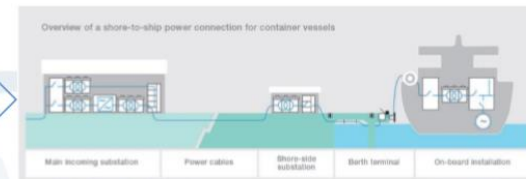
Units: Percentages



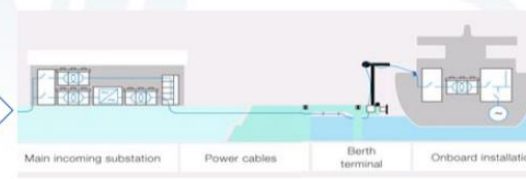
Source: DNV GL, 2018a



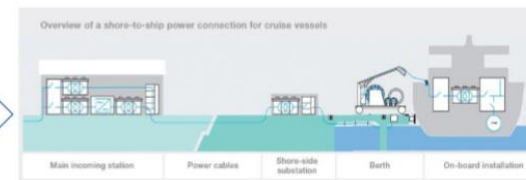
Container terminals



Traghetti & Ro-ro



Nave da crociera



### 3. Observatory on green technologies for shipping & ports

La coopération au cœur de la Méditerranée  
La cooperazione al cuore del Mediterraneo

# Agenda

I progetti futuri per il GNL  
nell'area di cooperazione

- I. The Interreg LNG Cluster
- II. TDI RETE-GNL 2.0
- III. Observatory on green technologies for shipping & ports
- IV. Further opportunities**

# Further opportunities

1. **Recovery plan** & PNRR (PIANO NAZIONALE DI RIPRESA E RESILIENZA)
2. Funding LNG infrastructures in the maritime and port domain: **scouting** new funding schemes
3. **Green Deal innovations** for Economic Recovery (16.06.2021 & 06.10.2021)
4. Updating the National **Strategic Plan** for LNG
5. Developing new opportunities for **LNG inland demand** and LNG network integration
6. Observatory on **LNG pricing** in the port domain (DIEC-CIELI-CCIAA di Genova e Riviera)
7. **Networking** & **cooperation** with other entities (e.g., ConferenzaGNL)