Napoli – June 30, 2016

ELECTRIC SHORE POWER or LNG

to improve the quality of air in the port of Civitavecchia

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Environmental & Technological Development Division, Director

ELECTRIC SHORE POWER or LNG

Civitavecchia has decided its energetic policy according with the three pillars of sustainability.

This consists of at least the economic, social, and environmental pillars. If any one pillar is weak then the system as a whole is unsustainable.

The investigation started on 2005 and it is continuously updated.


CALLS 2013 2014 2015 Sub-tot
Ferry 1.518 1.411 1.352 4.281
Cruise 955 832 794 2.581
Cargo 717 513 591 1.821
Total 3.190 2.756 2.735 8.683

AVERAGE GROSS TONNAGE (TSL)

	2013	2014	2015
Ferry	38.556	38.638	39.941
Cruise	80.086	78.047	85.381
Cargo	23.476	24.089	27.244

The port of Civitavecchia is home of the largest passenger ships operating in the Med

DIRECTIVE 2014/94/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

22 October 2014

On the deployment of alternative fuels infrastructure

DIRECTIVE 2014/94/EU

Article 4 – p.5

ELECTRIC SHORE POWER

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.

European Commission

DIRECTIVE 2014/94/EU

Article 6 – p.1

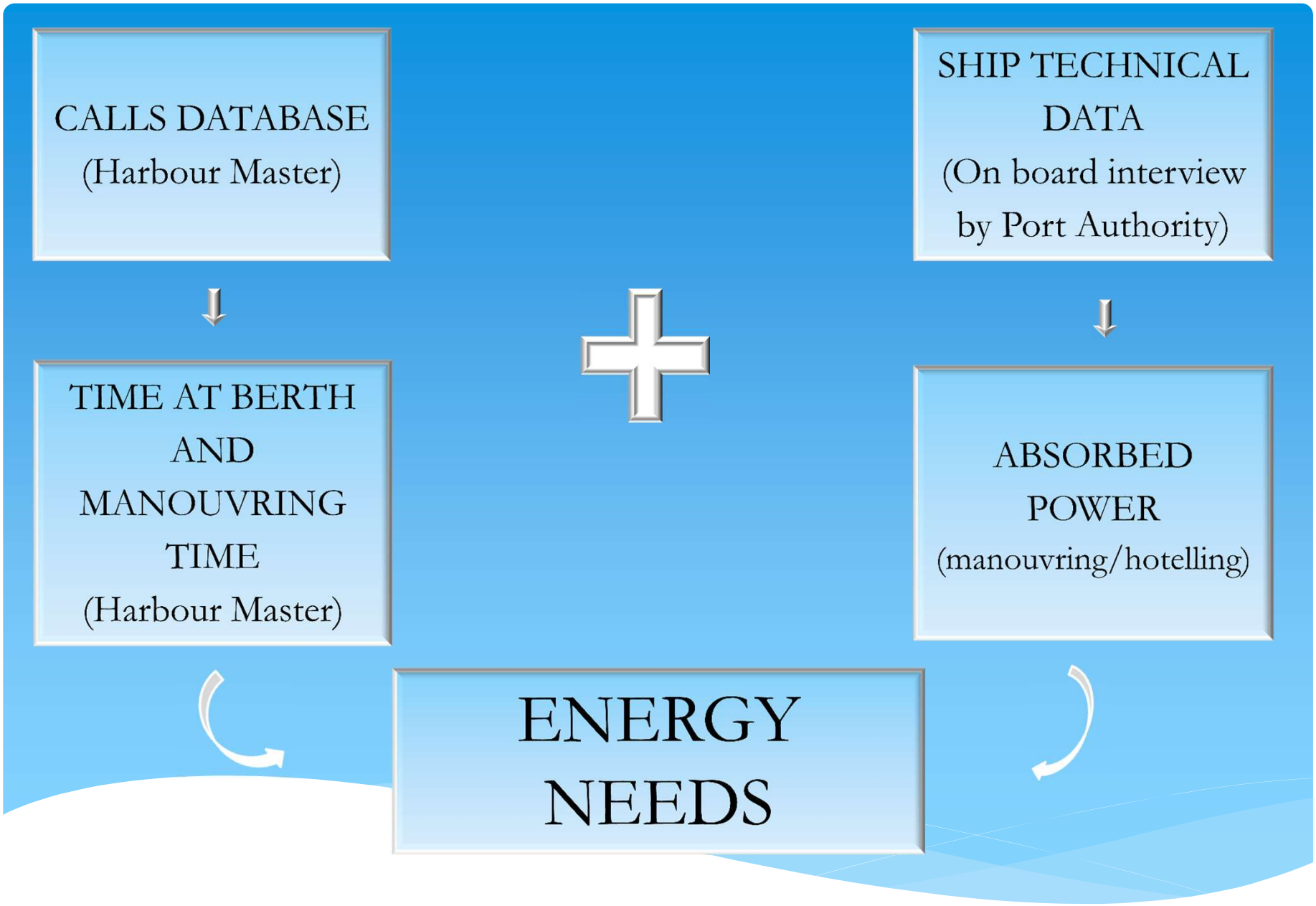
LIQUEFIED NATURAL GAS

Member States shall ensure, by means of their national policy frameworks, that an appropriate number of refuelling points for LNG are put in place at maritime ports, to enable LNG inland waterway vessels or seagoing ships to circulate throughout the TEN-T Core Network by 31 December 2025.

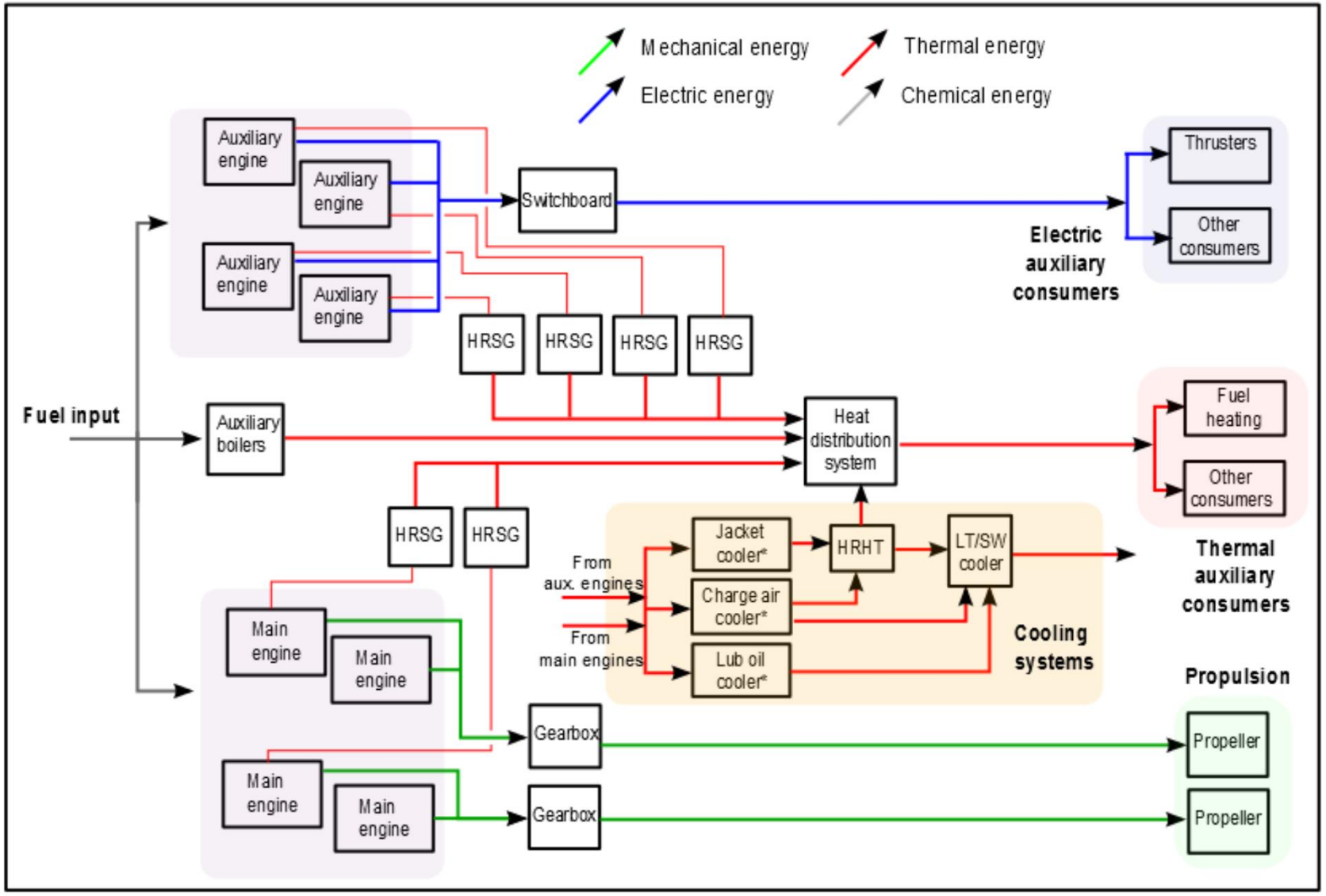
Member States shall cooperate with neighbouring Member States where necessary to ensure adequate coverage of the TEN-T Core Network.

European Commission

VESSELS
ENERGY NEEDS
in Civitavecchia


CALLS DATABASE
(Harbour Master)
SHIP TECHNICAL DATA
(On board interview by Port Authority)
TIME AT BERTH AND MANOUVRING TIME
(Harbour Master)
ABSORBED POWER
(manouvring/hotelling)
ENERGY NEEDS

schematic representation of ship energy systems



average electricity need of FERRIES

Calls (2013-2015)		Manouvring (2.5% S)	Hotelling (2.5-0.1% S)	Hotelling (0.1% S)	Total
Reliability	Time at berth (h)	Energy (kWh/y)	Energy (kWh/y)	Energy (kWh/y)	Energy (kWh/y)
Census	45.591	9.631.041	4.342.417	16.982.315	30.955.773
Sister	127	320.023	110.149	15.692	445.864
Estimated	2.053	742.470	480.521	1.022.599	2.245.589

ENERGY NEEDS RESUME (P_{Man}=14.763kW - P_{Hot}=1.365kW)

Calls	Hotelling (h/call)	Manouvring (kWh/call)	Hotelling (kWh/call)	Hotelling (kWh/call)	Total(kWh/call)
4.281	11h 10min	7.381	3.413	12.446	**23.240**

Average time to land and depart from the port is set 30 min
Average time to switch from RO to MGO, and vice versa is set 2h30min

average electricity need of CRUISES

Calls (2013-2015)		Manouvring (2.5% S)	Hotelling (2.5-0.1% S)	Hotelling (0.1% S)	Total
Reliability	Time at berth (h)	Energy (kWh/y)	Energy (kWh/y)	Energy (kWh/y)	Energy (kWh/y)
Census	28.674	5.792.202	10.431.664	42.837.519	59.061.385
Sister	2.090	576.291	1.030.047	4.627.462	6.233.800
Estimated	2.911	499.312	902.458	3.489.852	4.891.623

ENERGY NEEDS RESUME (P_{Man}=10.180kW - P_{Hot}=5.499kW)

Calls	Hotelling (h/call)	Manouvring (kWh/call)	Hotelling (kWh/call)	Hotelling (kWh/call)	Total(kWh/call)
2.581	13h 03min	7.635	13.748	56.519	**77.901**

Average time to land and depart from the port is set 45 min
Average time to switch from RO to MGO, and vice versa is set 2h30min

average electricity need of CARGOES

Calls (2013-2015)		Manouvring (2.5% S)	Hotelling (2.5-0.1% S)	Hotelling (0.1% S)	Total
Reliability	Time at berth (h)	Energy (kWh/y)	Energy (kWh/y)	Energy (kWh/y)	Energy (kWh/y)
Census	27.677	471.216	293.646	3.797.660	4.562.522
Sister	1.532	68.650	47.026	287.119	402.795
Estimated	57.316	587.875	305.945	5.985.785	6.879.605

ENERGY NEEDS RESUME (P_{Man}=3.401kW - P_{Hot}=390kW)

Calls	Hotelling (h/call)	Manouvring (kWh/call)	Hotelling (kWh/call)	Hotelling (kWh/call)	Total(kWh/call)
1.821	47h 31min	1.700	975	10.940	**13.615**

Average time to land and depart from the port is set 30 min
Average time to switch from RO to MGO, and vice versa is set 2h30min

average thermal energy need
(boilers)

Some of the thermal energy need of ships (about 30% of the total energy need of vessels) is recovered by heat recovery devices. By utilizing heat of exhaust gases, for cruise and ferry vessels the amount of energy needed by the auxiliary boilers is about 7% of total energy need of the ship (for some tankers more, we consider for cargoes calling Civitavecchia equal to 10%).
In port stay mode this percentage is over 10%.

Ship	Manouvring (1.5/2.5%)	Hotelling (1.5/2.5-0.1%)	Hotelling (0.1%)	Sub-tot
Ferry	748.547	493.309	1.802.061	3.043.917
Cruise	480.746	1.236.417	5.095.483	6.812.647
Cargo	112.774	64.662	1.007.056	1.184.492
TOT	**1.342.068**	**1.794.387**	**7.904.600**	**11.041.056**

AVERAGE ANNUAL ENERGY NEEDS

(electricity and heat)

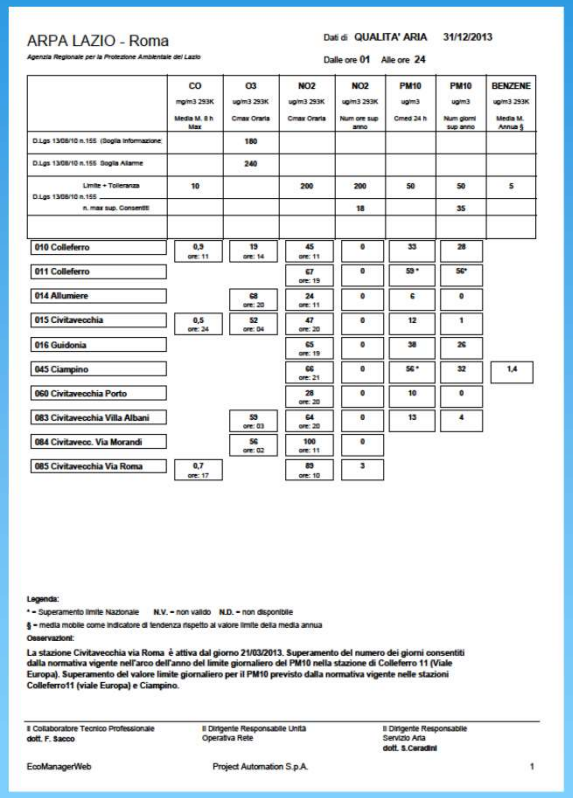
Average annual energy needs (referred to the period 01.01.2013 – 31.12.2015) are reported below.

Ship	Manouvring (1.5/2.5%)	Hotelling (1.5/2.5-0.1%)	Hotelling (0.1%)	Sub-tot
Ferry	10.693.534	4.933.087	18.020.605	33.647.226
Cruise	6.867.806	12.364.169	50.954.833	70.186.808
Cargo	1.127.742	646.617	10.070.564	11.844.923
Boilers	1.342.068	1.794.387	7.904.600	11.041.056
TOT	**20.031.150**	**19.738.260**	**86.950.602**	**126.720.013**

PARTICULATE MATTER (PM_{10}) FROM VESSELS

QUALITY OF AIR IN CIVITAVECCHIA

(2013 - 2015)



ARPA LAZIO - Roma

Agenzia Regionale per la Protezione Ambientale del Lazio

Dati di QUALITA' ARIA 31/12/2013

Dalle ore 01 Alle ore 24

	CO mg/m3 293K Media M. 8 h Max	O3 ug/m3 293K Cmax Oraria	NO2 ug/m3 293K Cmax Oraria	NO2 ug/m3 293K Num ore sup anno	PM10 ug/m3 Cmed 24 h	PM10 ug/m3 Num giorni sup anno	BENZENE ug/m3 293K Media M. Annua §
D.Lgs 13/08/10 n.155 (Soglia Informazione)		180					
D.Lgs 13/08/10 n.155 Soglia Allarme		240					
D.Lgs 13/08/10 n.155 Limite + Tolleranza	10		200	200	50	50	5
n. max sup. Consentiti				18		35	
010 Colleferro	0,9 ore: 11	19 ore: 14	45 ore: 11	0	33	28	
011 Colleferro			67 ore: 19	0	59 *	56*	
014 Allumiere		68 ore: 20	24 ore: 11	0	6	0	
015 Civitavecchia	0,5 ore: 24	52 ore: 04	47 ore: 20	0	12	1	
016 Guidonia			65 ore: 19	0	38	26	
045 Ciampino			66 ore: 21	0	56 *	32	1,4
060 Civitavecchia Porto			28 ore: 20	0	10	0	
083 Civitavecchia Villa Albani		33 ore: 03	64 ore: 20	0	13	4	
084 Civitavecc. Via Morandi		56 ore: 02	100 ore: 11	0			
085 Civitavecchia Via Roma	0,7 ore: 17		89 ore: 10	3			

Legenda:

* = Superamento limite Nazionale N.V. = non valido N.D. = non disponibile

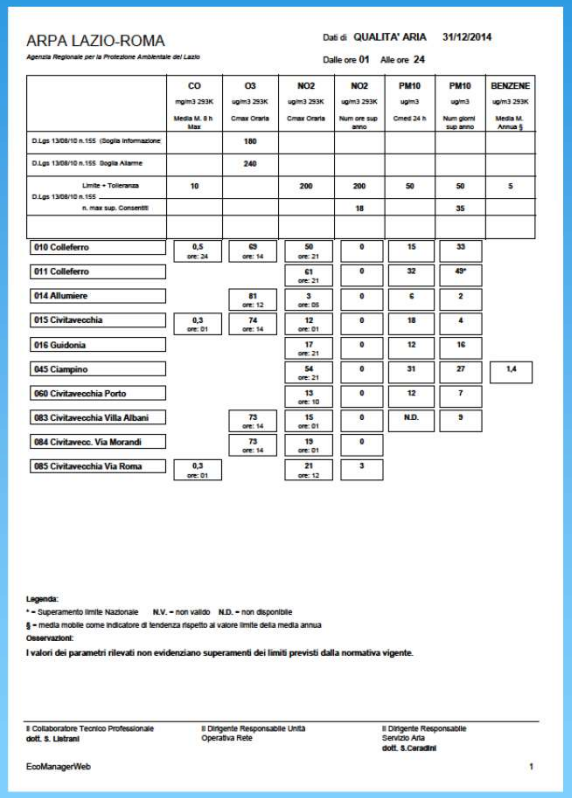
§ = media mobile come indicatore di tendenza rispetto al valore limite della media annua

Osservazioni:

La stazione Civitavecchia via Roma è attiva dal giorno 21/03/2013. Superamento del numero dei giorni consentiti dalla normativa vigente nell'arco dell'anno del limite giornaliero del PM10 nella stazione di Colleferro 11 (Viale Europa). Superamento del valore limite giornaliero per il PM10 previsto dalla normativa vigente nelle stazioni Colleferro11 (viale Europa) e Ciampino.

Il Collaboratore Tecnico Professionale dott. F. Sacco | Il Dirigente Responsabile Unità Operativa Rete | Il Dirigente Responsabile Servizio Aria dott. S.Ceradini

EcoManagerWeb Project Automation S.p.A. 1



ARPA LAZIO-ROMA

Agenzia Regionale per la Protezione Ambientale del Lazio

Dati di QUALITA' ARIA 31/12/2014

Dalle ore 01 Alle ore 24

	CO mg/m3 293K Media M. 8 h Max	O3 ug/m3 293K Cmax Oraria	NO2 ug/m3 293K Cmax Oraria	NO2 ug/m3 293K Num ore sup anno	PM10 ug/m3 Cmed 24 h	PM10 ug/m3 Num giorni sup anno	BENZENE ug/m3 293K Media M. Annua §
D.Lgs 13/08/10 n.155 (Soglia Informazione)		180					
D.Lgs 13/08/10 n.155 Soglia Allarme		240					
D.Lgs 13/08/10 n.155 Limite + Tolleranza	10		200	200	50	50	5
n. max sup. Consentiti				18		35	
010 Colleferro	0,5 ore: 24	69 ore: 14	50 ore: 21	0	15	33	
011 Colleferro			61 ore: 21	0	32	40*	
014 Allumiere		81 ore: 12	3 ore: 08	0	6	2	
015 Civitavecchia	0,3 ore: 01	74 ore: 14	12 ore: 01	0	18	4	
016 Guidonia			17 ore: 21	0	12	16	
045 Ciampino			54 ore: 21	0	31	27	1,4
060 Civitavecchia Porto			13 ore: 10	0	12	7	
083 Civitavecchia Villa Albani		73 ore: 14	15 ore: 01	0	N.D.	9	
084 Civitavecc. Via Morandi		73 ore: 14	19 ore: 01	0			
085 Civitavecchia Via Roma	0,3 ore: 01		21 ore: 12	3			

Legenda:

* = Superamento limite Nazionale N.V. = non valido N.D. = non disponibile

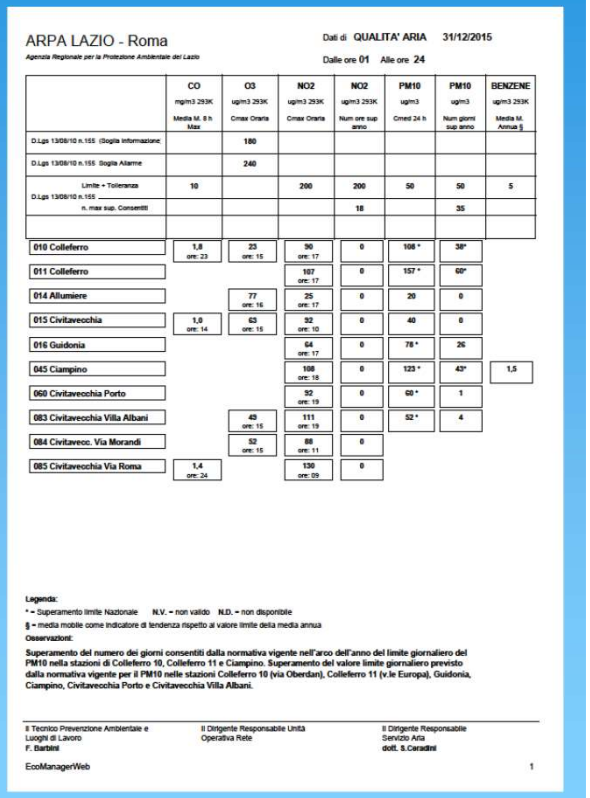
§ = media mobile come indicatore di tendenza rispetto al valore limite della media annua

Osservazioni:

I valori dei parametri rilevati non evidenziano superamenti dei limiti previsti dalla normativa vigente.

Il Collaboratore Tecnico Professionale dott. S. Liabrani | Il Dirigente Responsabile Unità Operativa Rete | Il Dirigente Responsabile Servizio Aria dott. S.Ceradini

EcoManagerWeb 1



ARPA LAZIO - Roma

Agenzia Regionale per la Protezione Ambientale del Lazio

Dati di QUALITA' ARIA 31/12/2015

Dalle ore 01 Alle ore 24

	CO mg/m3 293K Media M. 8 h Max	O3 ug/m3 293K Cmax Oraria	NO2 ug/m3 293K Cmax Oraria	NO2 ug/m3 293K Num ore sup anno	PM10 ug/m3 Cmed 24 h	PM10 ug/m3 Num giorni sup anno	BENZENE ug/m3 293K Media M. Annua §
D.Lgs 13/08/10 n.155 (Soglia Informazione)		180					
D.Lgs 13/08/10 n.155 Soglia Allarme		240					
D.Lgs 13/08/10 n.155 Limite + Tolleranza	10		200	200	50	50	5
n. max sup. Consentiti				18		35	
010 Colleferro	1,8 ore: 23	23 ore: 15	90 ore: 17	0	108 *	38*	
011 Colleferro			107 ore: 17	0	157 *	60*	
014 Allumiere		77 ore: 16	25 ore: 17	0	20	0	
015 Civitavecchia	1,8 ore: 14	63 ore: 15	32 ore: 10	0	40	8	
016 Guidonia			64 ore: 17	0	78 *	26	
045 Ciampino			108 ore: 18	0	123 *	43*	1,5
060 Civitavecchia Porto			52 ore: 19	0	68 *	1	
083 Civitavecchia Villa Albani		49 ore: 15	111 ore: 19	0	52 *	4	
084 Civitavecc. Via Morandi		52 ore: 15	88 ore: 11	0			
085 Civitavecchia Via Roma	1,4 ore: 24		130 ore: 09	0			

Legenda:

* = Superamento limite Nazionale N.V. = non valido N.D. = non disponibile

§ = media mobile come indicatore di tendenza rispetto al valore limite della media annua

Osservazioni:

Superamento del numero dei giorni consentiti dalla normativa vigente nell'arco dell'anno del limite giornaliero del PM10 nella stazioni di Colleferro 10, Colleferro 11 e Ciampino. Superamento del valore limite giornaliero previsto dalla normativa vigente per il PM10 nelle stazioni Colleferro 10 (via Oberdan), Colleferro 11 (v.le Europa), Guidonia, Ciampino, Civitavecchia Porto e Civitavecchia Villa Albani.

Il Tecnico Prevenzione Ambientale e Luoghi di Lavoro F. Barbini | Il Dirigente Responsabile Unità Operativa Rete | Il Dirigente Responsabile Servizio Aria dott. S.Ceradini

EcoManagerWeb 1

According with data certified by Regional Agency for the Environmental Protection (ARPA Lazio), in the period 01.01.2013 – 31.12.2015 quality of air in Civitavecchia has been always in compliance with Decree 155/2010 (Directive 2008/50/CE).

Only few days in a year (less than allowed) PM_{10} is over the limit.

Avaible emission factors (g/kWh)

All emission factors (except for LNG) are desumed from California Air Resourse Borard (**CARB**) document on May 2008, concerning with emissions of ocean-going vessels. Emission factor of PM_{10} from LNG powered ships is assumed equal to 0.01 g/kWh.

VESSEL TYPE	GENERATOR	FUEL	PM10
ALL	Boiler	MGO 0.1	0.13
PASSENGERS	Boiler	RO 1.5	0.48
CARGO	Boiler	RO 2.5	0.80
ALL	Boiler	LNG	0.01
ALL	Main	MGO 0.1	0.25
PASSENGERS	Main	RO 1.5	0.90
CARGO	Main	RO 2.5	1.50
ALL	Main	LNG	0.01
ALL	Auxiliary	MGO 0.1	0.25
PASSENGERS	Auxiliary	RO 1.5	0.90
CARGO	Auxiliary	RO 2.5	1.50
ALL	Auxiliary	LNG	0.01

According with **DNV-GL** document on January 2014, concernign with LNG as fuel, compared to RO, LNG reduces particle emissions by 95% and more.

According with **WPCI** website compared to RO, LNG reduces particle emissions by 100%.

According with Norwegian Insitute for Air Research (**NILU)** document on June 2015, emission factor of PM_{10} from LNG powered ships is equal to 0.00036 g/kWh.

AVERAGE ANNUAL PM_{10} EMISSIONS

(Residual Oil and Marine Gas Oil)

According with p.8, of art.295 of D.lgs. 152/2006, ships at berth are obliged to use low sulphur fuels (<0.1%). Ships are allowed to switch from RO (1.5/2.5%) to MGO (0.1%) within 2 hr (Circolare MATTM 10023/2010).
Emissions are expressed in ton.

Ship	Manouvring (1.5/2.5%)	Hotelling (1.5/2.5-0.1%)	Hotelling (0.1%)	Sub-tot
Ferry	9,62	2,84	4,51	16,97
Cruise	6,18	7,11	12,74	26,03
Cargo	1,69	0,57	2,52	4,78
Boilers	0,54	0,37	1,03	1,94
TOT	18,03	10,88	20,79	**49,71**

Average annual production of PM_{10}, using traditional fuels (RO or MGO), is estimated in **49,71 ton**.

ELECTRIC SHORE POWER (HVSC)
in Civitavecchia

ELECRTIC SHORE POWER (HVSC)
in Civitavecchia

HVSC WORKING GROUP

Port Authority of Civitavecchia has conducted and promoted studies involving different subjects:

- ✓ Institutions (Ministero delle Infrastrutture e Trasporti, Ministero dell'Ambiente, Regione Lazio, GSE Spa);
- ✓ Electricity producers (Enel Produzione Spa);
- ✓ Electricity distributors (Enel Distribuzione Spa);
- ✓ Shipyards (Fincantieri Spa ed STX Europe AS);
- ✓ Electrical engineering components manufacturer (Nidec ASI Spa, ABB Spa, Siemens spa, Schneider Electric Spa, Eaton Industry Srl, Cavotec SA);
- ✓ Shipping companies (Carnival Corporation & PLC, Royal Caribbean Cruise Ltd., MSC Crociere Spa, Norwegian Cruise Line Ltd., Grimaldi Spa),
- ✓ Ports (Venezia, Genova, Bari, Savona, Barcellona, Nizza, Amsterdam, Goteborg).

ELECRTIC SHORE POWER (HVSC)
in Civitavecchia

PILOT PLANT FOR CRUISE VESSELS AT BERTH 12bis

ENEL S.p.A., 29.01.2009.

First purchasing technical specification drawn up in Italy for a pilot plant, designed to provide 20MVA to one cruise ship moored at the dock 12bis.

Basic cost of the pilot plant (without connection to national grid):

- €.8.230.460,00 (system with static converter),
- €.9.431.440,00 (system with rotary converter).

The plant was designed to be used by ships belonging to different owners.

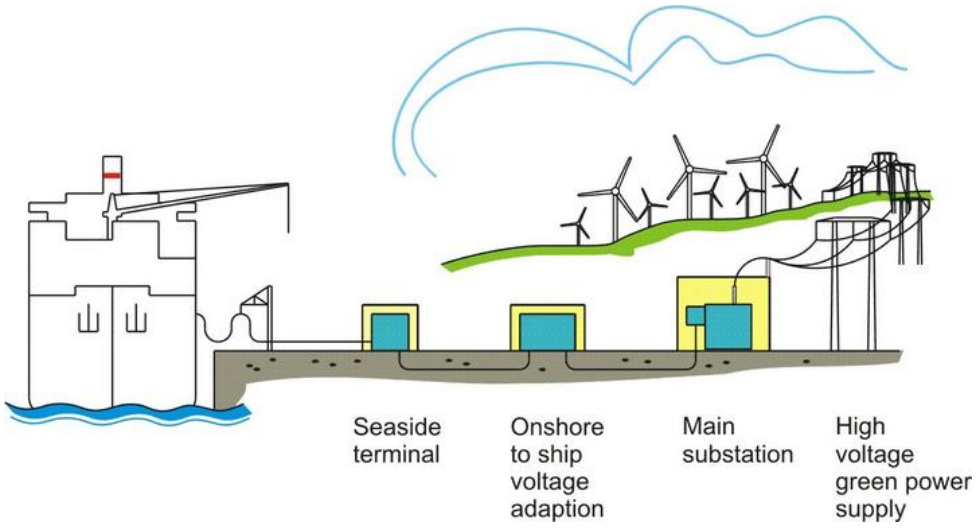
ELECRTIC SHORE POWER (HVSC)
in Civitavecchia

SHORE POWER PLANT FOR ONE CRUISE AND ONE FERRY CALLING DARSENA SANT'EGIDIO

Basic cost for a system having a total power of 20MVA (16MVA for cruises + 4MVA for ferries) connected to the national grid, €.18.100.000,00:

- €.4.100.000,00: connection to national grid,
- €.14.000.000,00: system with static converter.

The plant was designed to be used by ships belonging to different owners.



Nota prot. assunta in data 14.12.2012 con n.17571

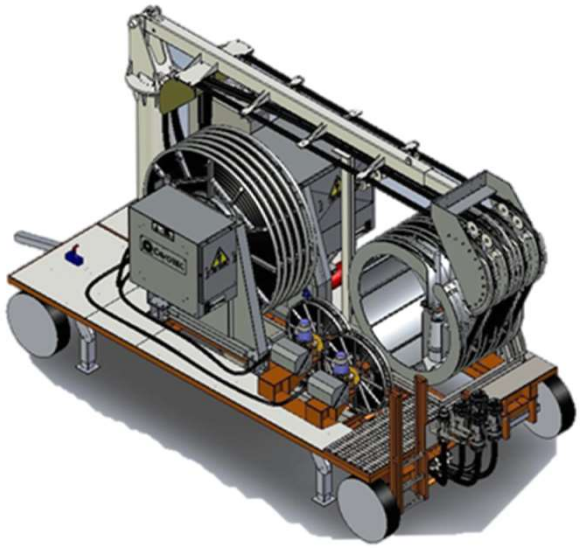
ELECRTIC SHORE POWER (HVSC)
in Civitavecchia

SHORE POWER PLANT FOR ONE FERRY CALLING DARSENA SANT'EGIDIO

Basic cost for a system having a power of 4MVA (only for ferries), without connection to the national grid, €.4.665.000,00:

- €.3.340.000,00: system with static converter,
- €.1.225.000,00: cables delivery system.

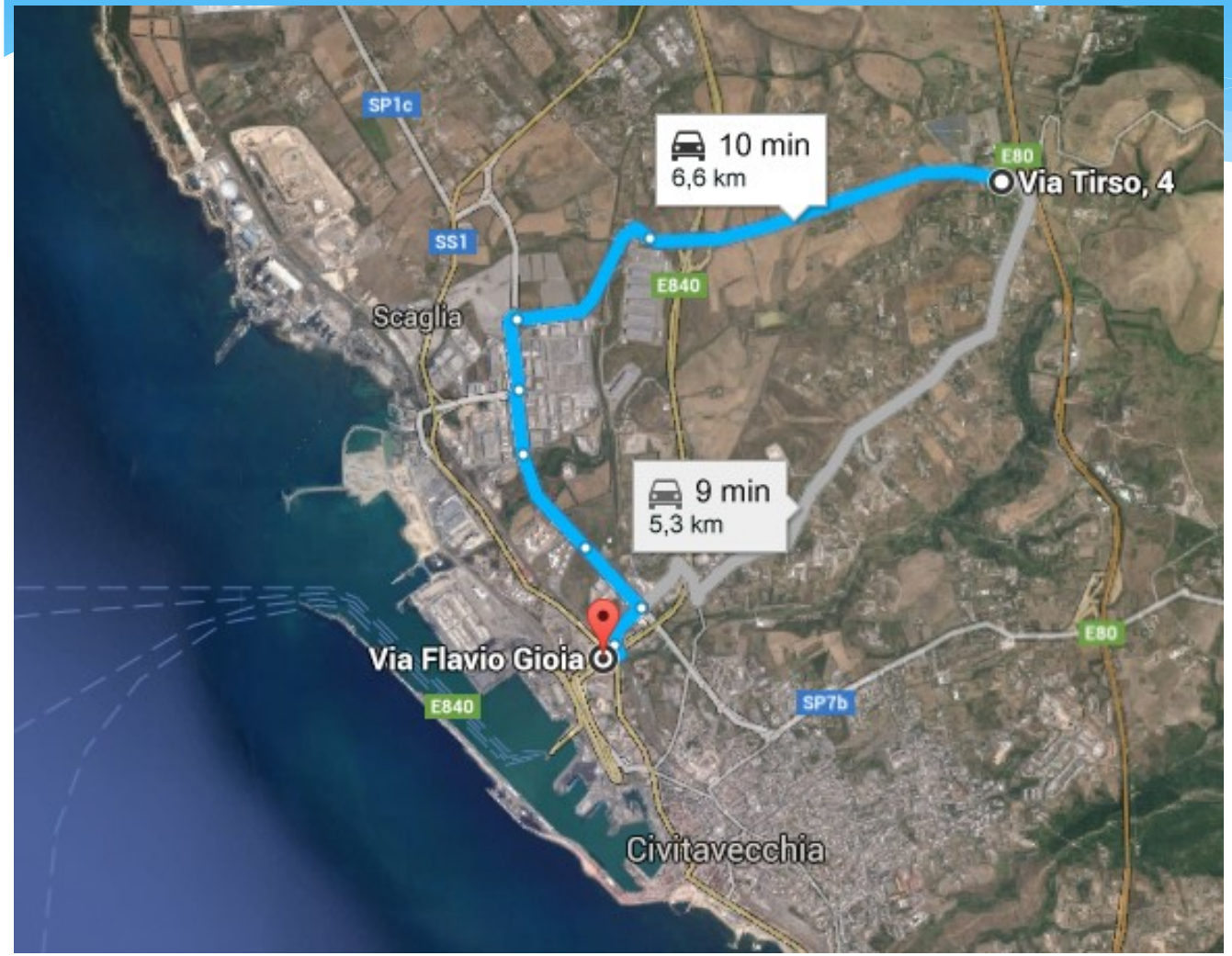
The plant was designed to be used by ships belonging to different owners.



Nota prot. assunta in data 08,09,2014 con n.11668

ELECRTIC SHORE POWER (HVSC)
in Civitavecchia

CONNECTION TO NATIONAL GRID



Point of connection to National Grid is located 6.6 km far from the point of delivery.
Connection could be realized in HV – 132kV (cost borne by P.A.), or MV – 20kV (cost borne by utility company).

ANNUAL PM_{10} EMISSIONS

(Electric Shore Power)

Connection/Disconnection operations take 45minutes (at least).
During the onshore connection (with engines and genset off) thermal energy needs (from boilers) is considered double.
According with p.9, of art.295 of D.lgs. 152/2006, ships using electric shore power are not obliged to use low suplhur fuels at berth.

Ship	Manouvring (1.5/2.5%)	Hotelling (1.5/2.5%)	Hotelling (HVSC)	Sub-tot
Cruise	9,62	0,85	0,00	10,47
Ferry	6,18	2,13	0,00	8,31
Cargo	1,69	0,17	0,00	1,86
Boilers	0,54	0,11	2,58	3,23
TOT	18,03	3,26	2,58	**23,87**

Average annual reduction of PM_{10}, compared to the use of traditional fuels (RO or MGO), is estimated in **25,84 ton** (49,71 – 23,87 = 25,84): 52,0%.

RATES OF ELECTRICITY FROM NATIONAL GRID

(Power and Energy)

Enel

L'ENERGIA CHE TI ASCOLTA.

(Tariffe in vigore per l'anno 2015)

Tariffa per usi diversi MTA3

Questa tariffa si applica a forniture di energia elettrica in media tensione con **potenza disponibile superiore a 500 kW**, con contratto di durata annuale o inferiore all'anno.

Componenti della tariffa	Unità di misura	Prezzo
Quota fissa	€/anno	673,4177
Corrispettivo di potenza impegnata	€/kW/anno	28,8830
Prezzo dell'energia utilizzata	€/kWh	0,00693

La potenza impegnata è pari alla potenza prelevata massima in ciascun mese.
L'importo complessivo si calcola sommando le componenti della tariffa dopo averle moltiplicate per i fattori corrispondenti.

Ai prezzi della tabella vanno aggiunti: le componenti A, UC e MCT, i corrispettivi per l'energia reattiva e le imposte.

www.eneldistribuzione.enel.it

The electricity tariff (energy component) in the port of Civitavecchia is 188,00 €/MWh.

Enel

L'ENERGIA CHE TI ASCOLTA.

(Tariffe in vigore per l'anno 2015)

Tariffe Usi diversi Alta

Questa tariffa si applica a forniture di energia elettrica in **alta tensione** con **tensione fino a 220 kV**

	Unità di misura	Prezzo
Quota fissa	€/anno	22.417,9133
Corrispettivo di potenza impegnata	€/kW/anno	18,3360
Prezzo dell'energia utilizzata	€/kWh	0,00126

L'importo complessivo si calcola sommando le componenti della tariffa dopo averle moltiplicate per i fattori corrispondenti.

Ai prezzi della tabella vanno aggiunte le componenti A, UC e MCT generali, i corrispettivi per l'energia reattiva e le imposte.

Electric Shore Power system

	large ships
Cost to provide Shore Power to the port (30 piers)	> €. 200.000.000,00
Regulation	IEC/ISO/IEEE 80005
Total power of the system (30 piers)	264MVA
Power of the system (12 cruises, 8 ferries, 2 cargoes)	185MWe
Annual cost (power, maintenance and personnel)	> 8.000.000,00 €./y
Energy delivered to ships	91.607 MWh/y
Electric energy tariff in the port of Civitavecchia	188,00 €./MWh
Cost of power, maintenance and personnel	> 87,00 €./MWh
Reduction of PM_{10} emissions	52,0%

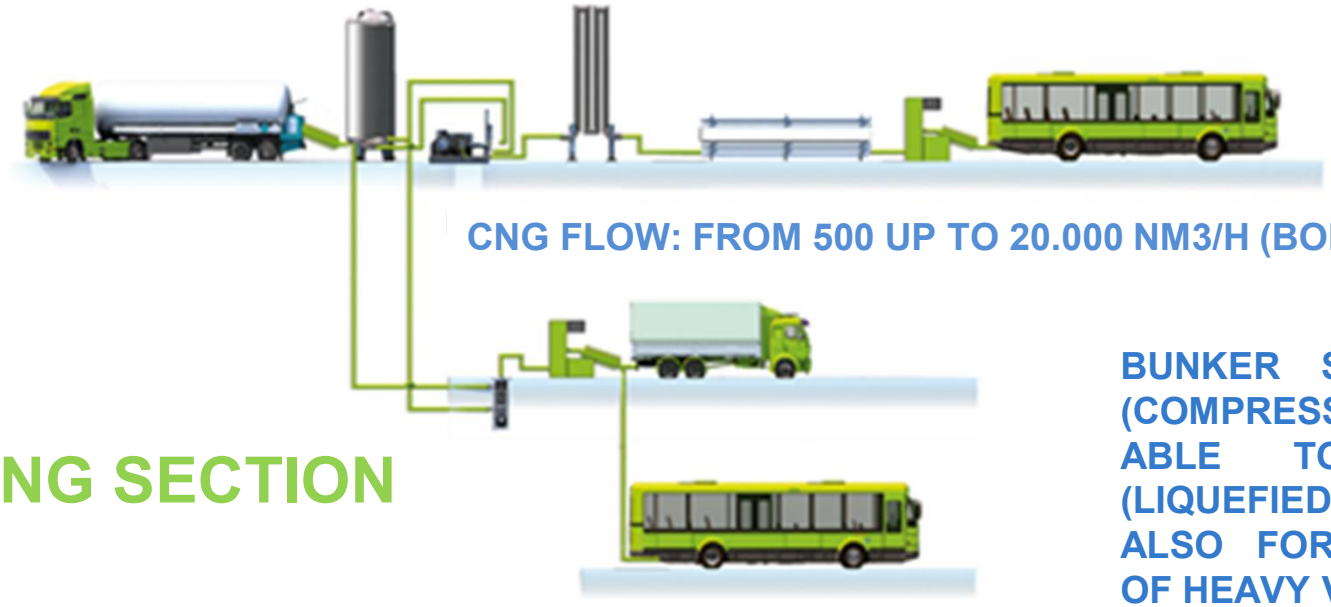
Cost are referred to infrastructures necessary to provide each berth of the port with a shore connection (total 264MVA, 50/60Hz, 6.6/11.0kV), and they also consider the connection cost to the national grid (185MWe, 50Hz, 20 or 132kV).

LNG
in Civitavecchia

First LNG bunkering operation in Italy

Civitavecchia, 16 may 2014

M/T BOKN – (15 c.m. of LNG in 2 hours)

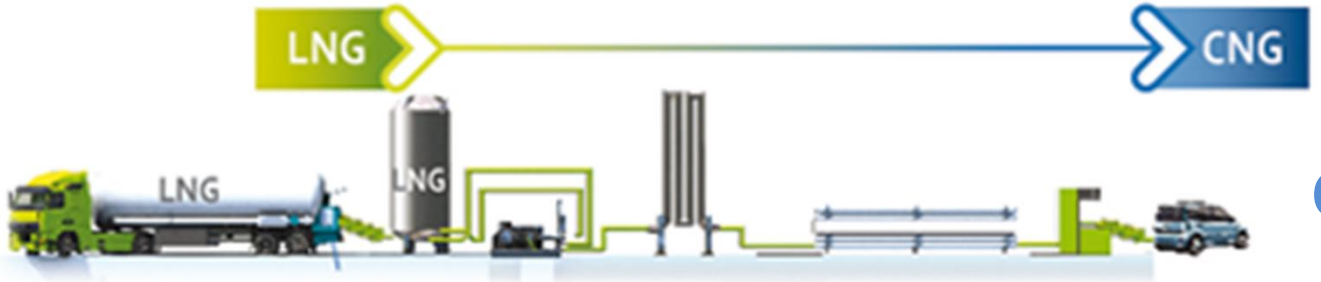


CNG FLOW: FROM 500 UP TO 20.000 NM3/H (BOIL-OFF RECOVERY)

LNG SECTION

BUNKER STATION FOR CNG (COMPRESSED NATURAL GAS) ABLE TO DELIVER LNG (LIQUEFIED NATURAL GAS) ALSO FOR NEXT-GENERATION OF HEAVY VEHICLES

LNG FLOW: FROM 80 UP TO 350 LITER/MINUTE



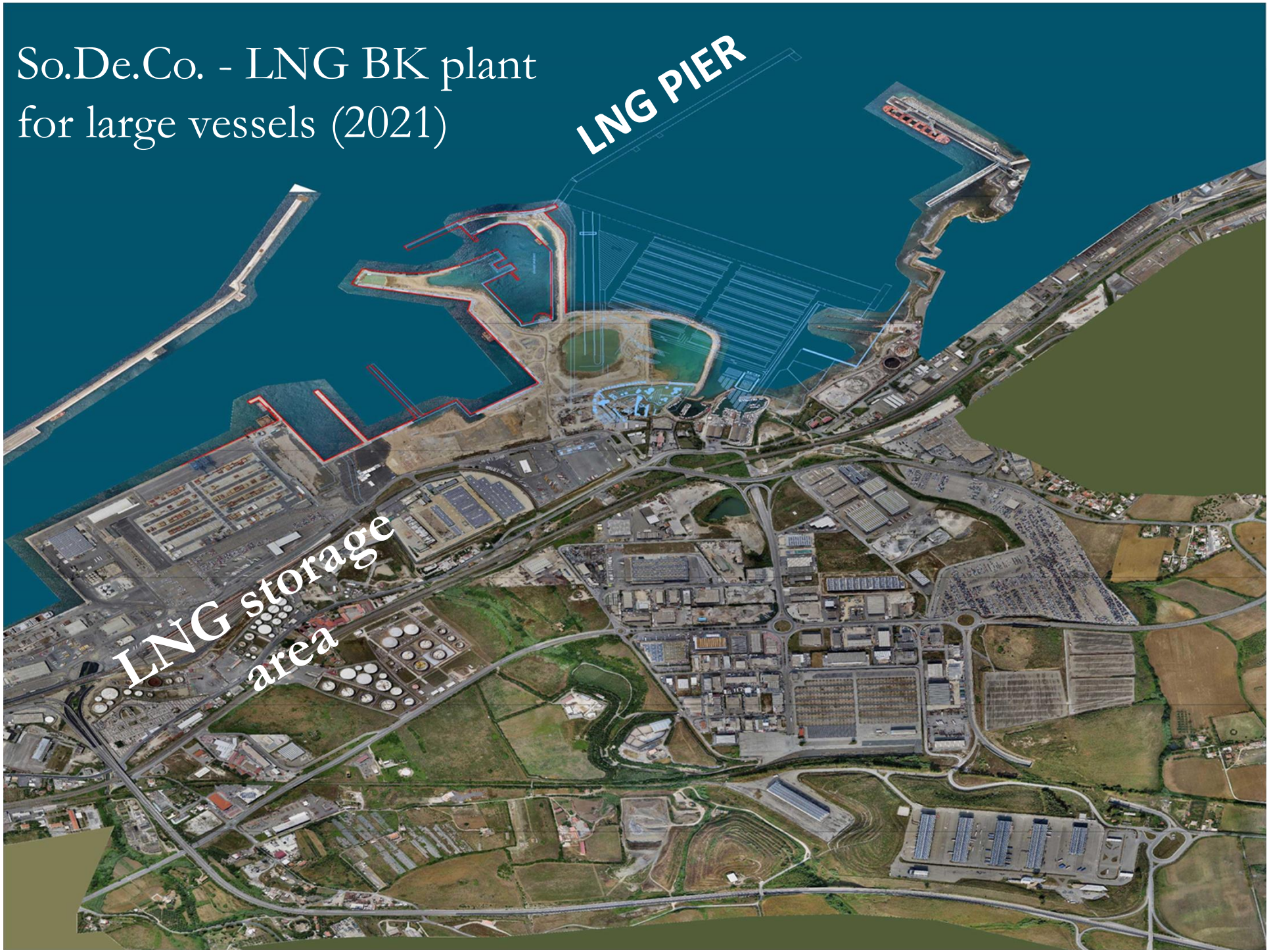
CNG SECTION

CNG FLOW: FROM 500 UP TO 20.000 NM3/H

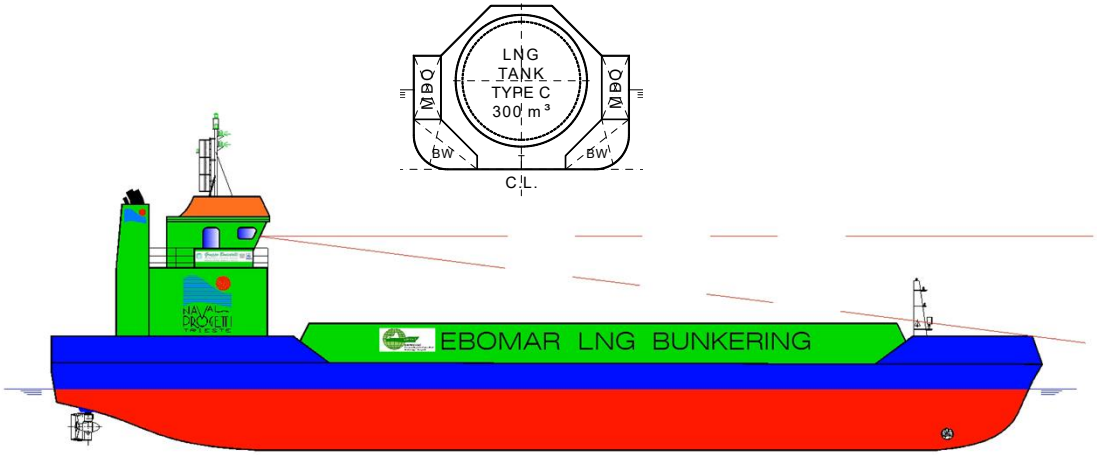
LNG Bunkering plant for small vessels (2018)

BUNKER STATION FOR CNG (COMPRESSED NATURAL GAS) ALSO SUITABLE FOR PRIVATE FLEETS WHO WANT TO SUPPLY THEIR OWN VEHICLES POWERED BY NATURAL GAS

Logistic chain for small LNG BK plant (2018)


So.De.Co. - LNG BK plant
for large vessels (2021)
LNG PIER
LNG storage
area

EBOMAR ~ LNG BUNKERING BOAT
FOR LARGE VESSELS (2021)



LNG BUNKERING BOAT

Principal dimensions:

L_{oa}	=	55.0 m
B	=	9.5 m
D	=	5.0 m
T	=	3.5 m

Cargo Tanks:

LNG Tanks:	600 m³
MDO/MGO:	500 m³

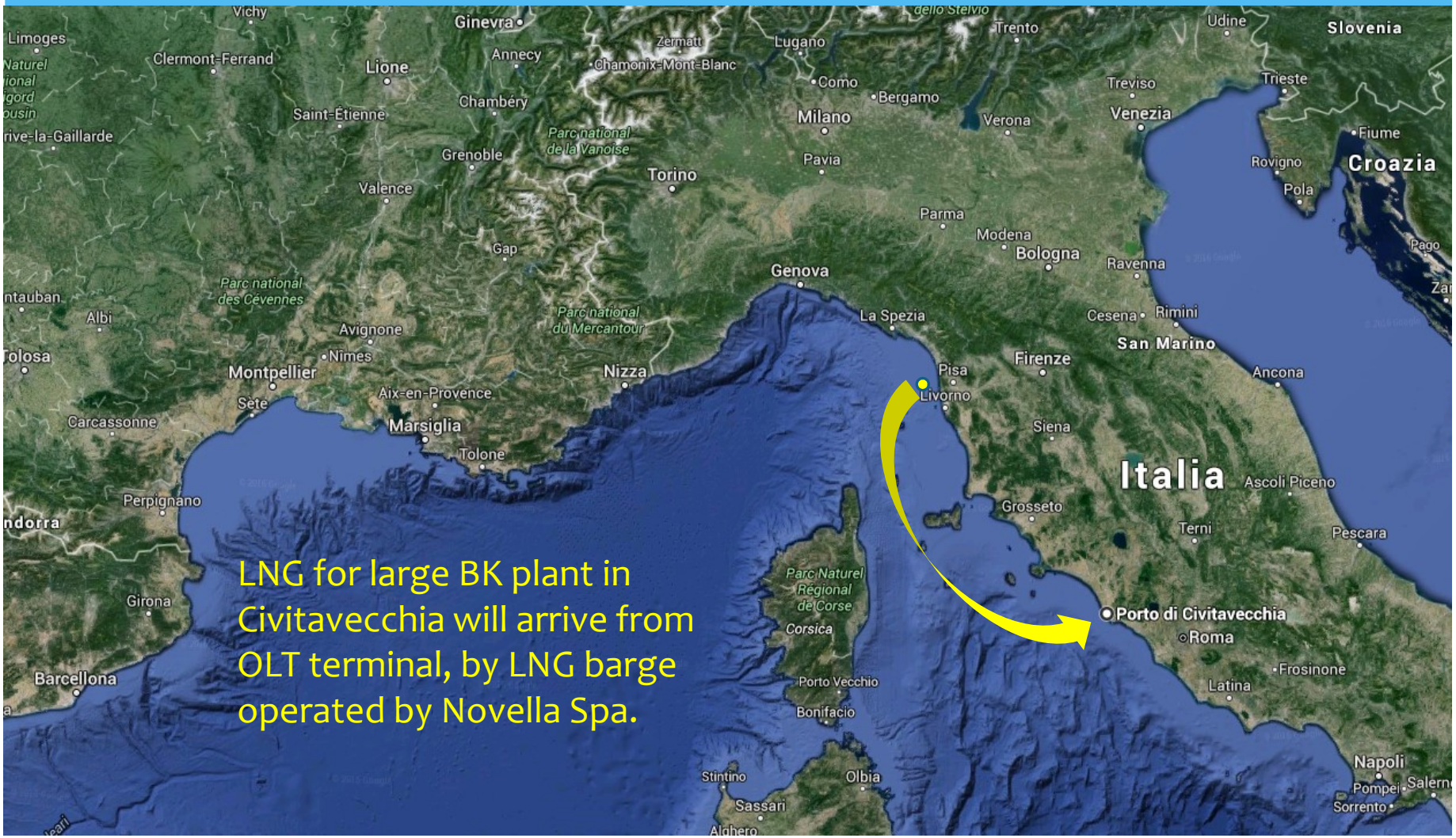
Service Speed: 10 knots

Gruppo Bonistalli
SHIPPING AGENCY - CHARTERING - BUNKERING
BONISTALLI SHIPPING - EBOMAR S.r.l. - M & C S.r.l.

NAVAL PROGETTI TRIESTE

EBOMAR
EBOMAR s.r.l
Commercio prodotti petroliferi
Bunkeraggi - Trasporti

Logistic chain for large LNG BK plant (2021)



ANNUAL PM_{10} EMISSIONS

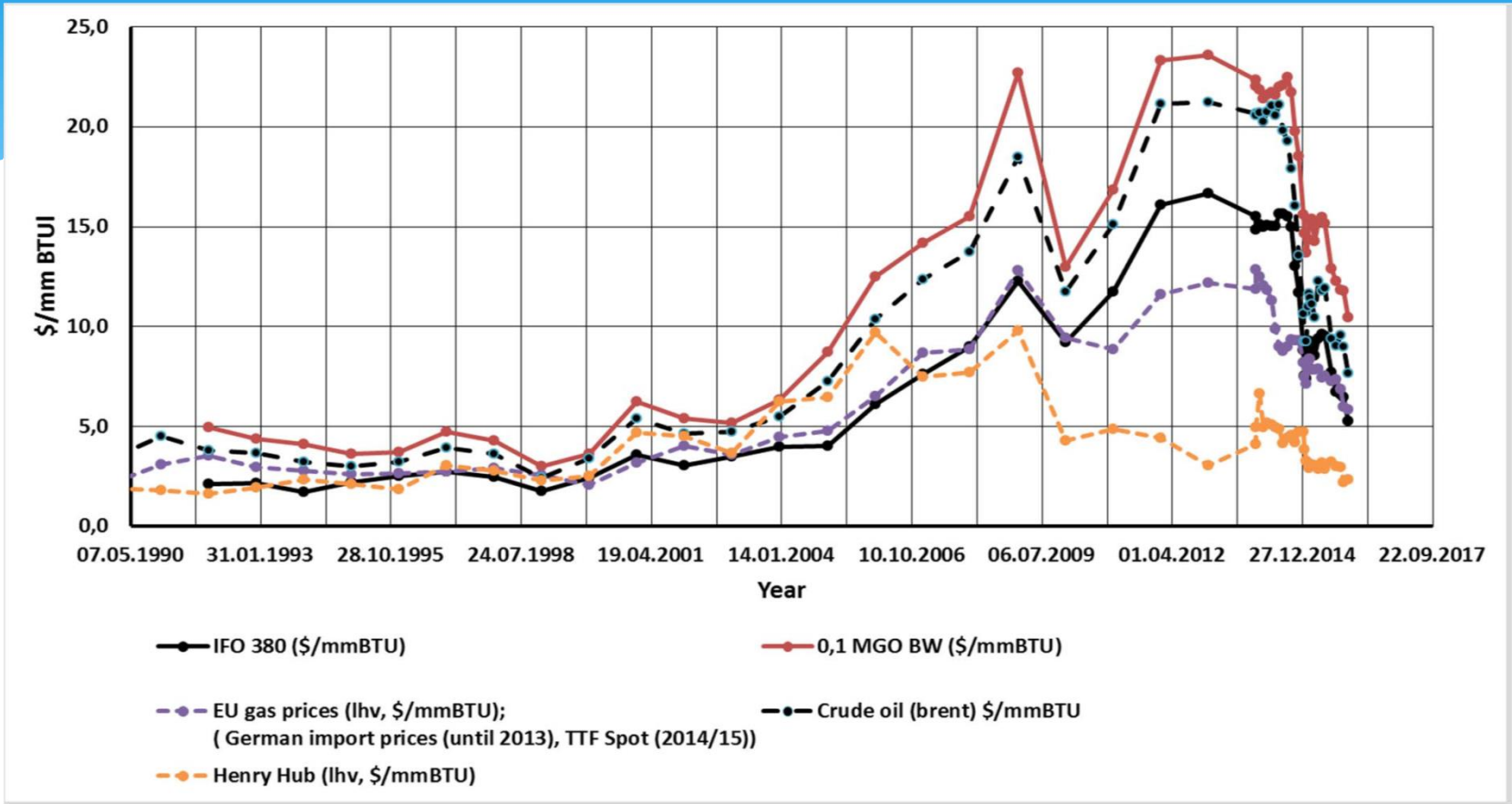
(Liquefied Natural Gas)

LNG can be used in each operational phase (navigation, manouvring and hotelling, to produce steam).

Ship	Manouvring (LNG)	Hotelling (LNG)	Hotelling (LNG)	Sub-tot
Ferry	0,11	0,05	0,18	0,34
Cruise	0,07	0,12	0,51	0,70
Cargo	0,01	0,01	0,10	0,12
Boilers	0,01	0,02	0,08	0,11
TOTALE	0,20	0,20	0,87	**1,27**

Average annual reduction of PM_{10}, compared to the use of traditional fuels (RO or MGO), is estimated in **48,44 ton** (49,71 – 1,27 = 48,44): 97,4%.

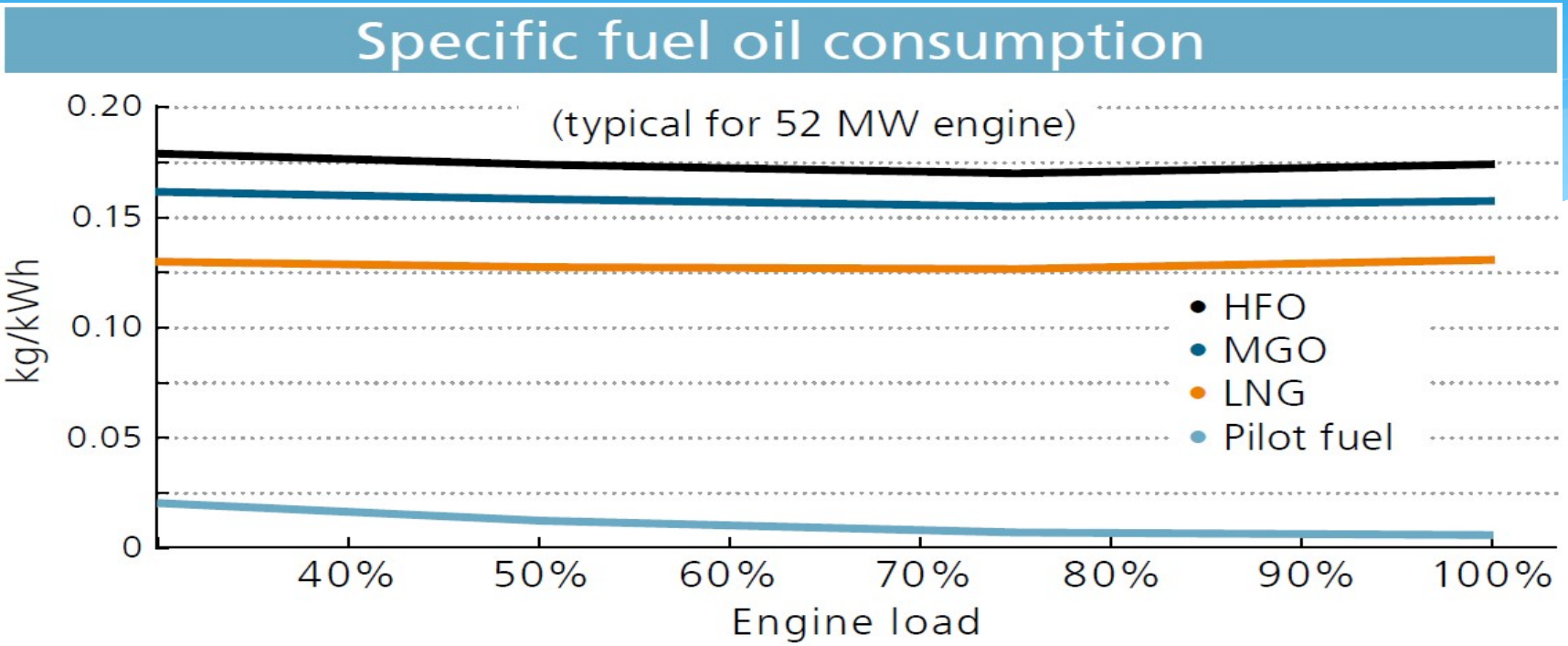
PRICE DEVELOPMENT OF MARINE FUELS



Data are referred to prices registred on 09th December 2015

MGO 0,1% S: 10,45 $/mmBTU = 423 $/t (384 €/t)
IFO 180: 5,99 $/mmBTU = 230 $/t (209 €/t)
LNG EU (lhv): 5,87 $/mmBTU = 272 $/t (247 €/t)
IFO 380: 5,25 $/mmBTU = 202 $/t (183 €/t)

COST OF SELF-PRODUCTION OF ELECTRICITY ON BOARD



Cost of self-production is mainly given by (Price of fuel) x Sfc; specific fuel consumption (Sfc) changes according with different engine sizes, fuels and engine loads. At this cost must be added the cost of personnel, lubricant, maintenance, etc.

Average cost of fuel for self-production

MGO 0,1% S: 60 €/MWh
IFO 180: 40 €/MWh
LNG EU (lhv): 39 €/MWh
IFO 380: 35 €/MWh

LNG Bunkering program

	2018 (small ships)	2021 (large ships)
Cost of the system (storage plant with truck or barge)	€. 1.600.000,00 (included cost of the truck)	€. 50.000.000,00 (included cost of the barge)
Regulation	Circolare VV.F. 3819/13	D.lgs.152/06 – D.lgs.105/15
Storage volume (m^3)	100	8.000
Surface of the storage plant (m^2)	2.000	30.000
Boil off management	CNG for cars	CNG for cars
LNG pier	no	DEGM
Cryogenic pipeline	no	yes
Refilling of storage plant way	cryogenic truck	LNG carrier
Bunkering method	cryogenic truck	LNG bunker boat
Reduction of PM_{10} emissions (%)	n.a.	97,4%

LNG bunkering program of Civitavecchia has been approved by Italian Ministry of Transport, and it has been included in the *PoseidonGainn* project.

ELECTRIC SHORE POWER vs LNG in Civitavecchia

SUSTAINABILITY ANALYSIS

	HVSC	LNG
Basic cost of contruction for Port Authority (€.)	> 200.000.000,00	0,00
Cost of energy for ships	+ 300%	- 20%
Demand from ships	no	yes
Elegible for EU funding (CEF program)	no	yes
Economic sustainability	**NO**	**YES**
PM_{10} reduction	52%	97%
Environmental sustainability	**YES**	**YES**
Social sustainability	**YES**	**YES**
SUSTAINABLE	**NO**	**YES**

According with this study, reduction of PM_{10} emission from large vessels by HVSC is bearable, but only by LNG is sustainable.

ENERGETIC POLICY

of the Port Authority of Civitavecchia

End User	Technology
Ferry	LNG
Cruise	LNG
Cargo	LNG
Pleasure boats and maxi-yacht	HVSC
Resident boats	LNG
Road/Heavy duty vehicles	LNG
Cars	CNG/electric
Energy from National Grid	Photovoltaic/Waves

Any questions?

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