Project confinancé parte Fonds Européen de Développement Régional

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Identification of the risk activities and vulnerability systems in terms of present and future emissions in the Port of Venice (WP5.2. Report)

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WP5.2 APICE Project Task Report

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1. Identification of the present time risk activities and vulnerability systems in terms of emissions

The analysis of the present time risk activities has been developed for the Port of Venice considering the following emissions:

- activities of ships and vessels in different phase of trip (cruise, hotelling, manoeuvring)
- harbor craft: tug boats
- loading and unloading of ships
- in port traffic load induced by port activities (as road and as railway transport).

The methodologies applied for the emission estimations are the following:

- for load/unload of ships: AP42 - Aggregate Handling And Storage Piles (EPA, 2006) , that calculates the emission of particles of material (PM10 and PM2.5) starting from the quantities of material in operations of loading, unloading and storage. The emission factors are expressed in mass of pollutant per mass of material handled, and it is a function of the relative humidity of the material. The calculation for the port of Venice has been applied on the total amount of dried bulk materials arriving to and departing from the port in a year, included the coal for the Coal-fired power plant;
- for road transport: the Italian Fleet COOPERT IV Emission Factors (ISPRA, 2012), applied on the mileages driven by the total amount of vehicles (duty vehicles and passenger ones) arriving and leaving from the port in a year, as estimated by the Venice Port Authority;
- for railway transport: the EMEP/CORINAIR Guidebook (chapter - 1.A.3.c Railways) emission factors, applied on the number trains arriving and leaving form the port in a year, as estimated by the Venice Port Authority;
- for ship emissions: the Tier 3 Ship movement methodology of the EMEP/EEA CORINAIR Guidebook (EEA, 2009 update March 201) applied on the Venice Port Authority (APV) database, recording the arrivals and the departures of ships and vessels during the whole year 2011. Since the APV database doesn't contain information on the type of fuel used by each ship, the estimation has been performed using the statistical distribution of the 2010 world fleet reported for the different typologies of ships into the two groups of fuel: Bunker Fuel Oil (BFO) and Marine Diesel Oil /Marine Gas Oil (MDO/MGO), as suggested on the EMEP/EEA Guidebook itself.

Moreover for SO_2 estimation by ship emissions, the assumption on fuel Sulphur content are:

- 0,1% for hotelling phase (Directive 2005/33/EC)
- 1.5% for passenger ships inside territorial waters (Directive 2005/33/EC)
- 2,7 % for BFO and 1% per MDO/MGO (not distinguished by EMEP/EEA Tier 3 approach) (ENTEC, 2002).

The emission calculation has been developed and discussed for the 100 x 100 km^2 scale, chosen as domain to be analyzed in APICE since the previous emission inventory task. The kilometers travelled in cruise phase by the ships outside the lagoon are almost 44-47 km, depending on the lagoon inlet (Lido or Malamocco), of which 22 km inside territorial seas.

The emissions due to the local traffic of boats and water buses (*vaporetti*) in the city of Venice and in the surrounding lagoon has been considered, too. The calculation has been based on the total amount of gasoline and marine gas oil sold by the fuel stations operating in the area and the fuel consumed by the public water service (consumption data referred to year 2008).

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On the following table (Tab 1.1), ship emissions are reported by ship categories (EMEP/EEA ship categories classification) and phase of trip for the whole traffic of the Port of Venice.

Tab 1.1 Pollutant emissions (in tn/year) by ship activities in the port in Venice (year 2011)

ACTIVITIES OF SHIPS AND VESSELS								
Hotelling	**CO**	**NOx**	**SO2**	**NMVOC**	**NH3**	**PM10**	**PM2.5**	**Duration (hours)**
Container	50	423	14	17	Not estimated in EMEP/EEA guidebook	11	11	18,705
Dry bulk carriers	25	209	7	8		5	5	19,913
General cargo	23	188	6	7		5	5	42,147
Liquid bulk ships	69	559	19	48		27	27	22,553
Others	12	90	3	3		2	2	9,504
Passenger	64	503	17	21		15	15	35,930
Ro Ro Cargo	7	53	2	2		1	1	3,677
Tugs								
Total	**249**	**2025**	**67**	**106**		**67**	**67**	**152,428**
ACTIVITIES OF SHIPS AND VESSELS								
Manouvering	**CO**	**NOx**	**SO2**	**NMVOC**	**NH3**	**PM10**	**PM2.5**	**Duration (hours)**
Container	18	153	129	14	Not estimated in EMEP/EEA guidebook	19	19	2,524
Dry bulk carriers	4	31	26	3		4	4	1,151
General cargo	5	37	32	3		5	5	3,013
Liquid bulk ships	7	60	50	5		7	7	2,571
Others	1	11	7	1		1	1	552
Passenger	50	322	193	32		50	50	4,071
Ro Ro Cargo	3	23	21	2		3	3	521
Tugs	39	233	10	23		20	20	11,459
Total	**127**	**870**	**468**	**82**		**109**	**109**	**25,863**
Cruise	**CO**	**NOx**	**SO2**	**NMVOC**	**NH3**	**PM10**	**PM2.5**	**Duration (hours)**
Container	31	363	227	7	Not estimated in EMEP/EEA guidebook	20	20	1,765
Dry bulk carriers	8	88	55	2		5	5	1,002
General cargo	14	141	95	3		6	6	3,547
Liquid bulk ships	16	173	112	3		9	9	2,274
Others	4	40	22	1		1	1	748
Passenger	106	845	552	18		29	29	3,653
Ro Ro Cargo	9	77	56	2		3	3	525
Total	**188**	**1727**	**1119**	**36**		**73**	**73**	**13,514**
Hotelling+Manouvering+Cruise	**CO**	**NOx**	**SO2**	**NMVOC**	**NH3**	**PM10**	**PM2.5**	**Duration (hours)**
Container	100	940	370	38	Not estimated in EMEP/EEA guidebook	50	50	22,995
Dry bulk carriers	36	328	88	12		14	14	22,066
General cargo	42	365	133	14		16	16	48,707
Liquid bulk ships	92	792	181	56		43	43	27,398
Others	17	142	32	5		5	5	10,803
Passenger	219	1671	763	71		94	94	43,654
Ro Ro Cargo	18	153	78	6		7	7	4,723
Tugs	39	233	10	23		20	20	11,459
Total	**564**	**4622**	**1655**	**224**		**249**	**249**	**191,805**

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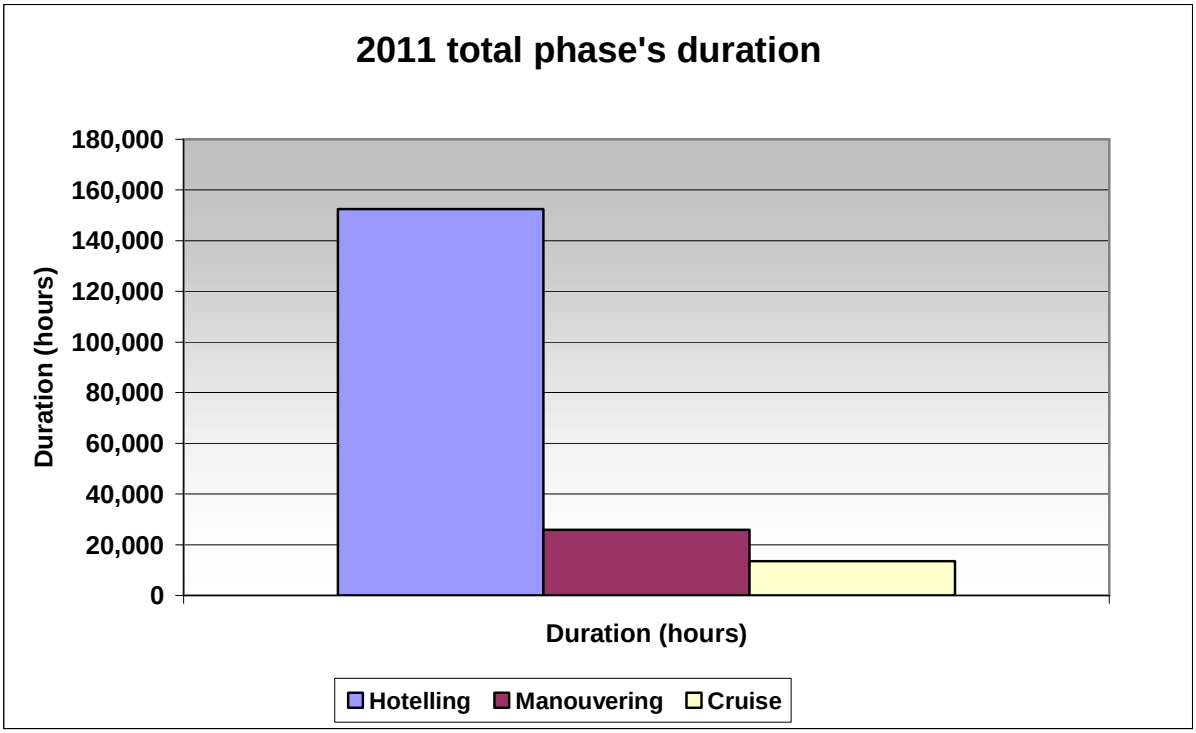
Beside the total amount of emissions (in Mg or tons) for the various pollutants, the duration (in hours) of the activities is reported also in term of sum of hours spent by all the ships of a certain category. The duration is presented as an useful metric in comparing emissions with other ports and in comparing emissions within the same port for the different contribution given by the different phases of navigation, as shown in the following graph (Fig 1.1).

Fig 1.1. Total time spent by all the ships on the different phases in year 2011 in the Port of Venice.



The emissions data presented in table 1.1 are summarized, on the following graph (Fig 1.2), for the two simple classes of passenger ships and cargo ships, considering into this latter class all the ships and vessels carrying other then passengers (Container, Dry Bulk carriers, General Cargo, Liquid bulk ships, RoRo Cargo, Others). The emissions considered are those emitted during the three phases of navigation inside the 100x100 studied domain: hotelling, maneuvering and cruise.

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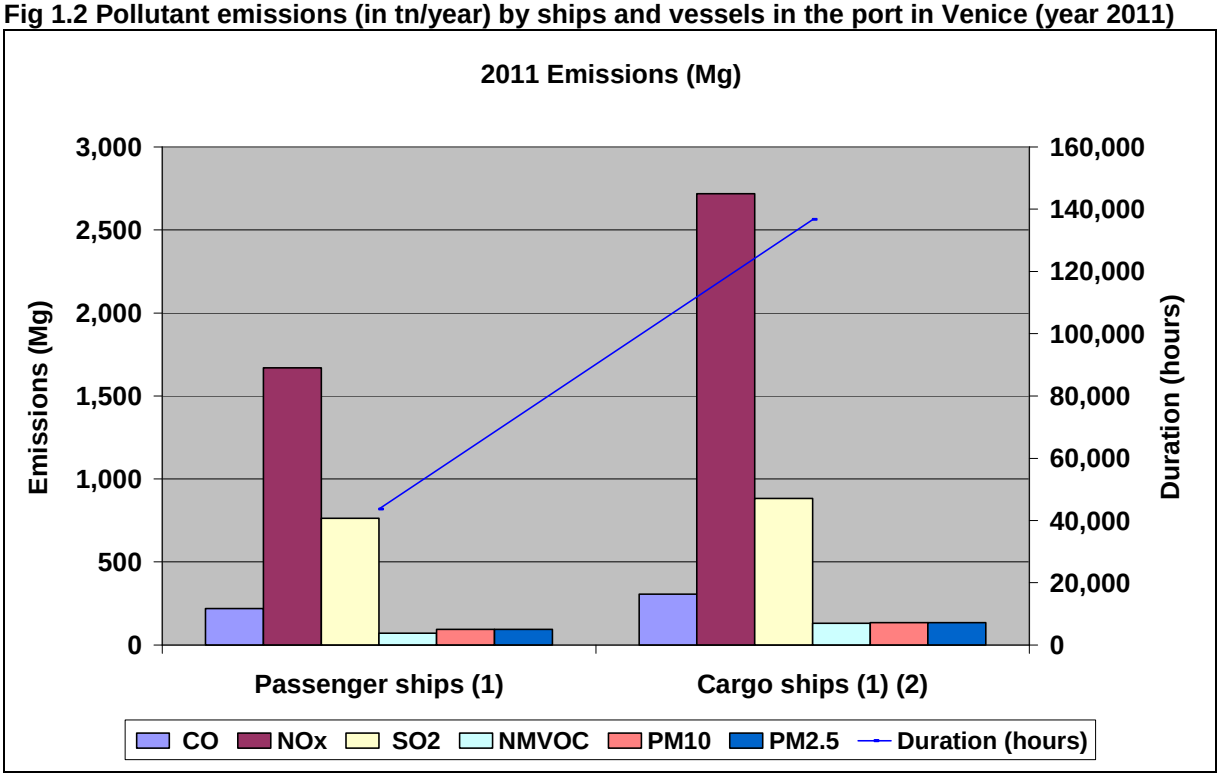
Fig 1.2 Pollutant emissions (in tn/year) by ships and vessels in the port in Venice (year 2011)



(1) Hotelling+ Manouvering+Cruise

(2) Container+Dry Bulk carriers+General Cargo+Liquid bulk ships+RoRo Cargo+Others

The following table (Tab 1.2) compares ship emissions of the port of Venice to the Venetian water traffic inside the lagoon and the particulate matter emissions due to operations of loading, unloading and storage of dry bulks.
The huge emissions of CO (and of NMVOC) for the Venetian water traffic is due to the consumption of gasoline by many of the boats circulating inside the lagoon.

Tab 1.2 Pollutant emissions (in tn/year) by ship activities for the port of Venice (year 2011) and Venice water traffic (year 2008).

Hotelling+Manouvering+Cruise	CO	NOx	SO2	NMVOC	NH3	PM10	PM2.5	Duration (hours)
Passenger ships (1)	219	1671	763	71		94	94	43,654
Cargo ships (1) (2)	306	2719	882	130		135	135	136,691
Passenger + cargo ships + tugs (1)	**564**	**4622**	**1655**	**224**		**249**	**249**	**191,805**
Venice water traffic inside the Lagoon	2095	525	1	678	0.1	85	85	
Load/unload ships						4	1	
(1) Hotelling+ Manouvering+Cruise								
(2) Container+Dry Bulk carriers+General Cargo+Liquid bulk ships+RoRo Cargo+Others								

The traffic emissions induced on roads and railways by the total amount of vehicles arriving to and departing from the port of Venice is presented on the following table (Tab 1.3). The induced traffic emission estimation has been calculated for the studied domain of 100 x 100 Km^2, as previously explained.

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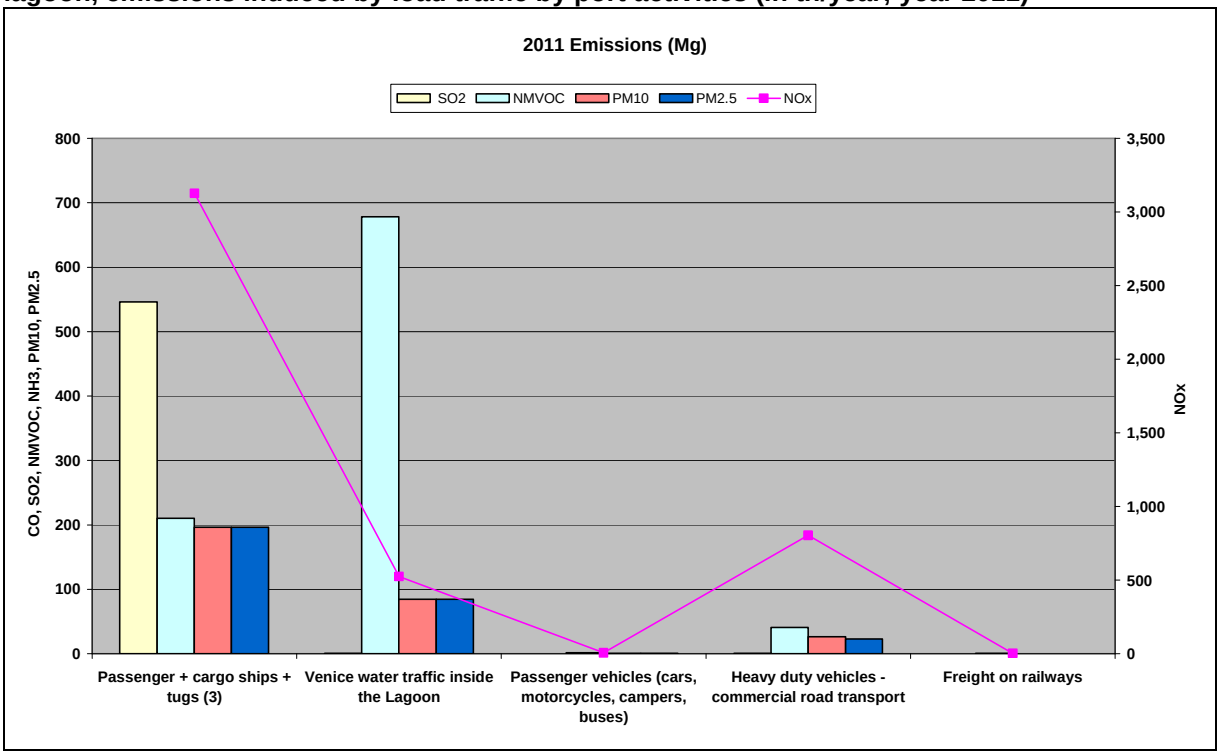
Tab 1.3 In port traffic load induced by port activities (in tn/year) (year 2011)

IN-PORT TRAFFIC LOAD INDUCED BY PORT ACTIVITIES							
	CO	**NOx**	**SOx**	**NMVOCs**	**NH3**	**PM10**	**PM2.5**
Passenger vehicles (cars, motorcycles, campers, buses)	10	5	0.005	1	0.1	0.4	0.3
Heavy duty vehicles - commercial road transport	190	804	0.38	41	0.4	26	23
Freight on railways	1	3	0.0	0.23	0.00	0.10	0.10
Total	**200**	**811**	**0**	**42**	**1**	**27**	**24**

The following graph (Fig 1.3) compares ship emissions, as sum of passenger and cargo ships, with the emissions by the water traffic inside the lagoon, the road traffic induced by port activities, split in passenger vehicles and duty vehicles, and lastly the emissions due to transport of freight by trains. For ship emissions only hotelling and maneuvering phases are considered.

Fig 1.3 Comparison among ship emissions (hotelling+ manouvering), water traffic inside the lagoon, emissions induced by load traffic by port activities (in tn/year; year 2011)



(3) Hotelling+ Manouvering

The timeframe of the ships activities in the port in Venice is discussed, once again, splitting the ships in the various categories and the two main classes of passenger and cargo ships. The analysis has been based on the arrivals and departures records of the year 2011.
The variation within the year is shown in terms of monthly percentage of the total movements in the year of the single category (Fig 1.4).
The seasonal variation is a clear pattern for the passenger categories (Fig 1.5), whereas for the commercial cargo there's not an important seasonal pattern (Fig 1.6).

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Fig 1.4 Time frame of the ships and vessels arrival and departures (year 2011)

HOTELLING AND MANOUVERING OF SHIPS AND VESSELS																
		Hotelling	Manouvering	Monthly variation (% of total arrivals in a year)												
Ship category	Type of ship	Mean Duration (h)	Mean Duration of a single arrival or departure (hh.dec)	gen	feb	mar	apr	mag	giu	lug	ago	set	ott	nov	dic
Passenger ship	Cruise ships	18	2	0%	1%	1%	4%	10%	14%	18%	20%	15%	12%	5%	1%
	Ro-ro passenger vessels	6	1.4	6%	6%	7%	7%	8%	10%	10%	10%	10%	9%	8%	8%
	Yacht - charter class	67	1	0%	0%	0%	0%	4%	18%	30%	34%	12%	1%	0%	0%
	Yacht - pleasure crafts	97	1	0%	1%	1%	3%	8%	21%	30%	21%	11%	2%	1%	1%
	High speed passenger crafts	5	1	0%	0%	0%	0%	2%	7%	25%	44%	22%	0%	0%	0%
General cargo	General dry cargo ship	44	1.6	6%	8%	7%	7%	7%	10%	11%	8%	10%	9%	10%	8%
	High speed cargo craft	7	0.7	0%	0%	0%	0%	0%	20%	31%	29%	16%	4%	0%	0%
Ro Ro Cargo	Ro-ro cargo ship	22	1.6	5%	7%	6%	6%	8%	12%	12%	8%	8%	10%	10%	8%
Container	Containership	26	1.7	7%	7%	7%	7%	7%	9%	10%	9%	9%	10%	10%	9%
Dry bulk carriers	Bulk carrier	63	2	7%	8%	8%	7%	8%	11%	10%	8%	7%	8%	10%	8%
	Heavy load carrier	76	1.8	10%	7%	4%	5%	1%	13%	9%	14%	11%	9%	7%	11%
Liquid bulk ships	Tankship	37	1.9	8%	8%	9%	5%	6%	7%	10%	13%	10%	10%	8%	6%
	Gas carrier	26	1.9	7%	6%	8%	7%	7%	9%	11%	10%	9%	11%	8%	7%
	Chemical tankship	33	1.9	7%	7%	6%	6%	7%	9%	9%	11%	9%	9%	10%	10%
	Oil tankship	36	1.9	7%	6%	7%	8%	9%	9%	8%	9%	8%	10%	10%	9%

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Fig 1.5 Seasonal variation for the passenger ship movements in the Port of Venice.

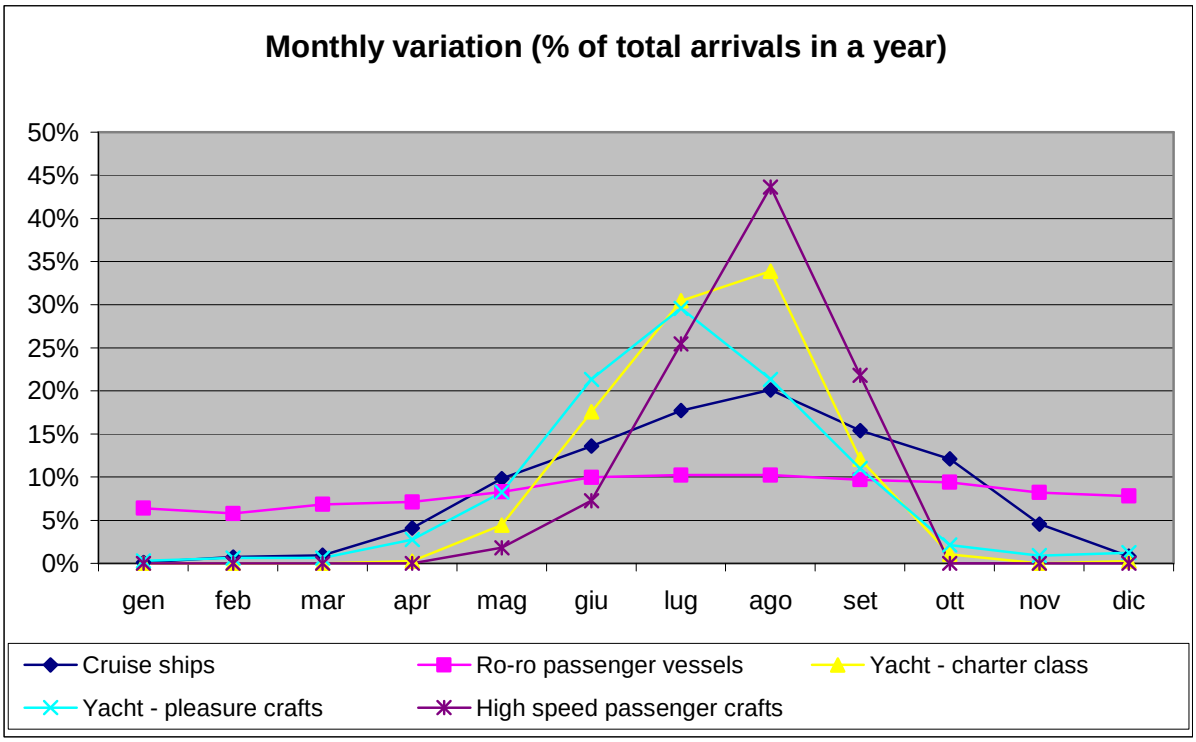
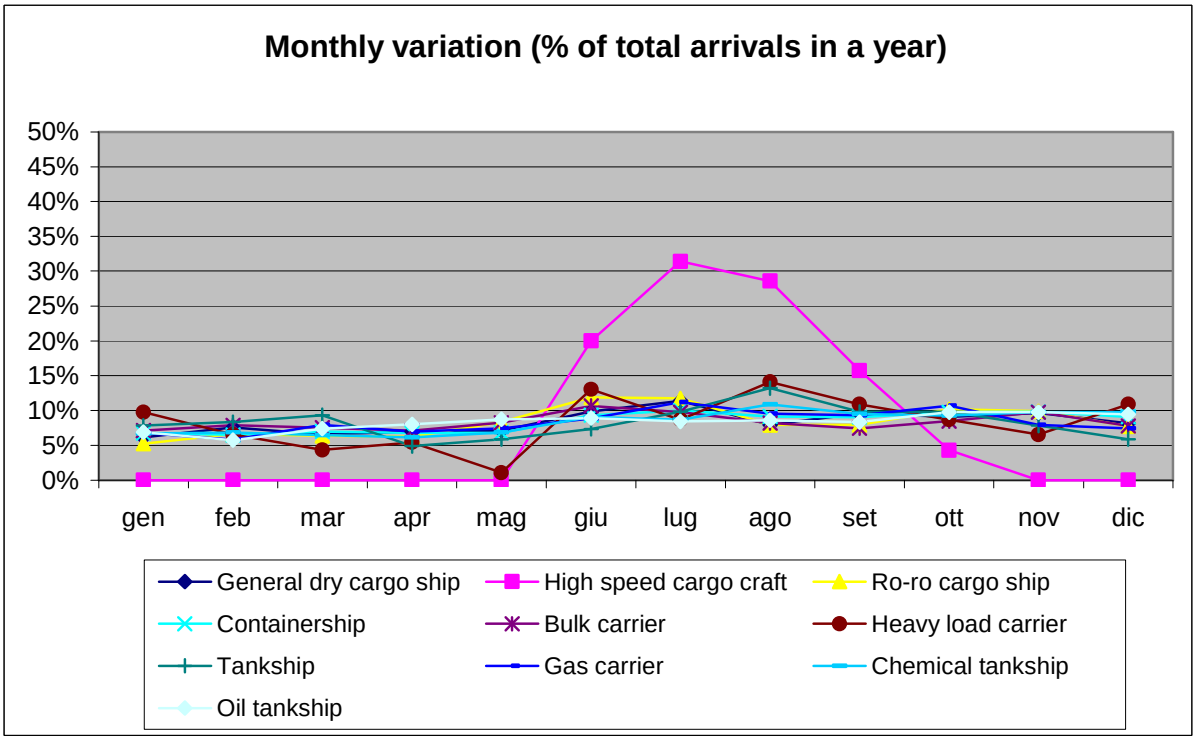


Fig 1.6 Seasonal variation for the cargo ship movements in the Port of Venice



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For the risk activity assessment the emission estimation has been discussed not only for the total amount of traffic of the Port of Venice, but also splitting the emissions between the two different routes of entry into the lagoon: Lido inlet and Malamocco inlet.
The first route brings the ships and vessels to the various berths inside the historical city of Venice and most of them, through the Giudecca Chanel to the Venice Passenger Terminal in Marittima, whereas the Marghera-Malamocco channel brings mainly cargo ships to the various berths of the Commercial and Industrial Terminals in Porto Marghera (on the inner border of the lagoon) or southward to the Oil Terminal in San Leonardo (see Fig 1.7).

Fig 1.7 Location of the Venice Port Terminals and nautical access to the various berths

Provided by Venice Port Authority (APV; APICE Venice conference January 2012)

On the following table (routes of arrival to the Terminals. The emissions are, once again, referring to the 100x100 Km^2 studied domain, and thus considering the 3 different trip phases: hotelling, manouvering and cruise outside the lagoon.

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Tab 1.4) and the related graph (Fig 1.8), the same emissions discussed for the whole Port of Venice (Tab 1.1) are presented split into the two routes of arrival to the Terminals. The emissions are, once again, referring to the 100x100 Km^2 studied domain, and thus considering the 3 different trip phases: hotelling, manouvering and cruise outside the lagoon.

Tab 1.4 Pollutant emissions (in tn/year) by ship activities in the port in Venice, divided by the two inlets into the Lagoon and the location in Venice and in Porto Marghera-San Leonardo (year 2011)

ACTIVITIES OF SHIPS AND VESSELS								
	Mg	CO	NOx	SO2	NMVOC	NH3	PM10	PM2.5
Lido entrance and Terminals in the city of Venice	Hotelling Passenger Ships	59	470	16	20	Not estimated in EMEP/EEA guidebook	14	14
	Hotelling Cargo Ships	9	72	2	4		2	2
	Manouvering Passenger Ships	47	301	181	29		47	47
	Manouvering Cargo Ships	2	15	13	1		2	2
	Tugs	19	112	5	11		10	10
	Cruise Passenger ships	99	790	516	17		27	27
	Cruise Cargo Ships	4	42	27	1		2	2
	total emissions	238	1802	760	83		104	104
Malamocco entrance and Terminals in Porto Marghera and San Leonardo	Hotelling Passenger Ships	4	33	1	1	Not estimated in EMEP/EEA guidebook	1	1
	Hotelling Cargo Ships	176	1450	48	81		50	50
	Manouvering Passenger Ships	3	21	13	2		3	3
	Manouvering Cargo Ships	37	300	252	26		37	37
	Tugs	20	120	5	12		10	10
	Cruise Passenger ships	7	55	36	1		2	2
	Cruise Cargo Ships	78	840	541	17		41	41
	total emissions	326	2820	896	141		145	145

Fig 1.8 Pollutant emissions (in tn/year) by ship activities in the port in Venice, divided by the two inlets into the Lagoon and the location in Venice and in Porto Marghera-San Leonardo (year 2011)

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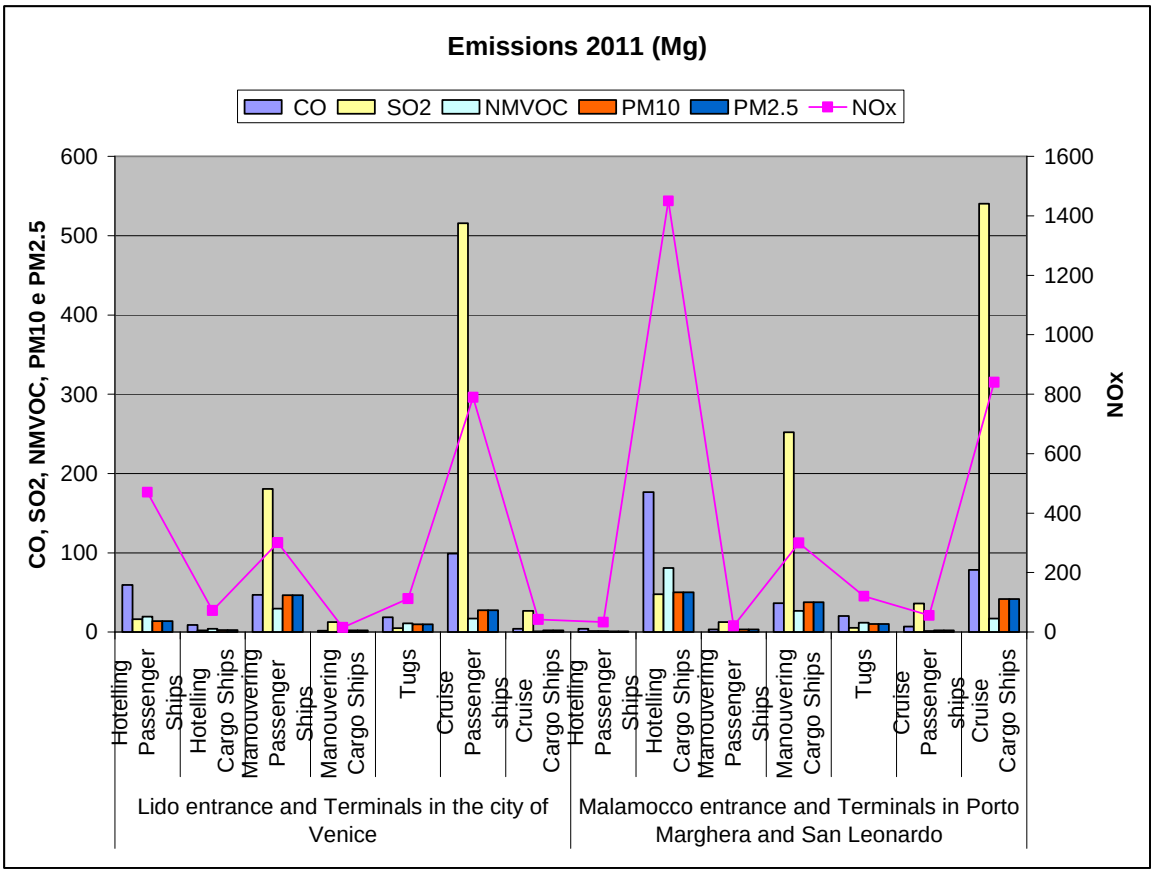

2. Identification of the future risk activities and vulnerability systems in terms of emissions

The future time emissions at 2020 in Venice has been calculated considering the two main Port development projects with a realistic realisation within 2020: the Venice Motorways of the Sea Terminal and the new Container Terminal. Moreover, for the port emission projection an yearly rate increase of 2% for the cruise movements has been considered, as shown by trend on this sector in the last years.

The increase of ship traffic volumes of the development scenarios foreseen for 2020 year is that reported on the following table (Tab 2.1)

Tab 2.1 Traffic increase of the 2020 Port development scenario

Traffic increase:	(2020-2011)/2011
Containership	18%
Passenger ship	17%
Ro-ro cargo ship	11%
Ro-ro passenger vessel	77%
All other typologies	0%
Total arrivals	26%

The Venice Motorways of the Sea Terminal (APV, Fig 2.1) will be constructed in Fusina at the junction between the southern industrial channel and the Malamocco-Marghera channel, equipped with 4 quays to berth simultaneously up to 4 ships. It will serve rolling stock traffic, i.e. ferries transporting trucks or their trailers (Ro-Ro) and ferries carrying cars and

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passengers (Ro-Pax). It will be linked to the rail network, with its own logistics platform, serving up to 1,200 ferries.
The new terminal project foresees, at its maximum development, the ability to cater for 1800 Ro-ro cargo ships and Ro-ro passenger vessels a year. Both Ro-Ro and Ro-Pax ships will spend an average of about six hours in the terminal. The average time for mooring, dismoring and manouvering will be about two hours between entrance and exit by the Malamocco inlet.

For the future emissions estimation at 2020 the following data of the Venice Motorways has been considered:

- 1800 Ro-Ro and Ro-Pax vessels
- 6 hours of hotelling for each one
- almost 2 hours of manouvering for each arrival or departure
- location in the Commercial Port of Porto Marghera (Fusina area)

The emission calculation has been applied considering that the 1800 Ro-ro cargo ships and Ro-ro passenger vessels substitute the current around 500 ro-ro and ro-pax ships, the latter almost all mooring now in the terminals inside the historical city of Venice.

The new Container Terminal will be erected in the site of former industrial facilities in Porto Marghera (formerly Syndial and Montefibre). The traffic volumes increase foreseen by APV for 2020 year is of 155 containership arrivals per year, that is the 21% of the 2011 containerships movements. This is only a first development of the containership terminal for which a much more important growth is foreseen after 2020 with the realisation of the off – shore Terminal outside the Venice Lagoon.

Fig 2.1 Location of the future Venice Motorways of the Sea Terminal

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Provided by APV.

Beside the emissions by ships, also for the development scenario the traffic emissions induced on roads and railways by the total amount of vehicles arriving to and departing from the port of Venice has been considered. The induced traffic emission estimation has been calculated starting from the forecast of duty and passenger vehicles on road, as well on

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railway provided by APV for the two projects. The estimation refers to the studied domain of 100 x 100 Km^2, as previously done for the present time scenario.

For the SOx estimation, the 2020 scenario has considered the following limit on sulphur content:

- % S in hotelling phase for all ships, as the present time scenario (this sulphur limit implies a total shift from BFO to MDO/MGO)
- 0.5% S in manouvering and cruising phases for all ships (since this sulphur limit doesn't imply a shift from BFO to MGO/MDO, the same proportion between BFO and MDO/MGO of the EMEP/EEA methodology has been considered; moreover for BFO an emission reduction of 20% for PM10 and PM2.5 has been applied as suggested in EC, 2008).

On the following table (Tab 2.2), ship emissions are reported by ship categories (EMEP/EEA ship categories classification) and phase of trip for the whole traffic of the Port of Venice for the 2020 scenario.

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Tab 2.2 Pollutant emissions (in tn/year) by ship activities in the port in Venice for the future development scenario (year 2020)

Hotelling	CO	NOx	SO2	NMVOC	NH3	PM10	PM2.5	Duration (hours)
Container	61	514	17	20	Not estimated in EMEP/EEA guidebook	14	14	22,721
Dry bulk carriers	25	209	7	8		5	5	19,913
General cargo	23	188	6	7		5	5	42,147
Liquid bulk ships	69	559	19	48		27	27	22,553
Others	12	90	3	3		2	2	9,504
Passenger	87	686	23	28		20	20	41,405
Ro Ro Cargo	76	59	2	2		2	2	4,110
Tugs								
Total	**352**	**2,305**	**77**	**117**		**75**	**75**	**162,353**
ACTIVITIES OF SHIPS AND VESSELS								
Manouvering	**CO**	**NOx**	**SO2**	**NMVOC**	**NH3**	**PM10**	**PM2.5**	**Duration (hours)**
Container	22	186	29	17	Not estimated in EMEP/EEA guidebook	19	19	3,066
Dry bulk carriers	4	31	5	3		3	3	1,151
General cargo	5	37	7	3		4	4	3,013
Liquid bulk ships	7	60	10	5		6	6	2,571
Others	1	11	2	1		1	1	552
Passenger	119	769	161	75		96	96	9,260
Ro Ro Cargo	4	25	5	2		3	3	583
Tugs	60	359	16	35		31	31	17,667
Total	**222**	**1,478**	**235**	**141**		**162**	**162**	**37,863**
Cruise	**CO**	**NOx**	**SO2**	**NMVOC**	**NH3**	**PM10**	**PM2.5**	**Duration (hours)**
Container	38	442	52	9	Not estimated in EMEP/EEA guidebook	20	20	2,290
Dry bulk carriers	8	88	10	2		4	4	1,070
General cargo	14	141	19	3		5	5	3,758
Liquid bulk ships	16	173	22	3		7	7	2,429
Others	4	40	6	1		1	1	798
Passenger	240	1,919	324	57		82	82	8,312
Ro Ro Cargo	10	86	13	2		3	3	626
Total	**330**	**2,888**	**446**	**77**		**122**	**122**	**19,284**
Hotelling+Manouvering+Cruise	**CO**	**NOx**	**SO2**	**NMVOC**	**NH3**	**PM10**	**PM2.5**	**Duration (hours)**
Container	121	1,141	98	46	Not estimated in EMEP/EEA guidebook	53	53	28,077
Dry bulk carriers	36	328	22	12		12	12	22,135
General cargo	42	365	32	14		14	14	48,918
Liquid bulk ships	92	792	50	56		40	40	27,552
Others	17	142	11	5		4	4	10,854
Passenger	446	3,374	509	161		198	198	58,978
Ro Ro Cargo	90	171	20	6		7	7	5,320
Tugs	60	359	16	35		31	31	17,667
Total	**904**	**6,671**	**757**	**335**		**359**	**359**	**219,500**

The future development emissions data presented in Tab 2.2 are summarized, on the following graph (Fig 2.2), for the two simple classes of passenger ships and cargo ships, considering into this latter class all the ships and vessels carrying other then passengers (Container, Dry Bulk carriers, General Cargo, Liquid bulk ships, Ro-Ro Cargo, Others). The

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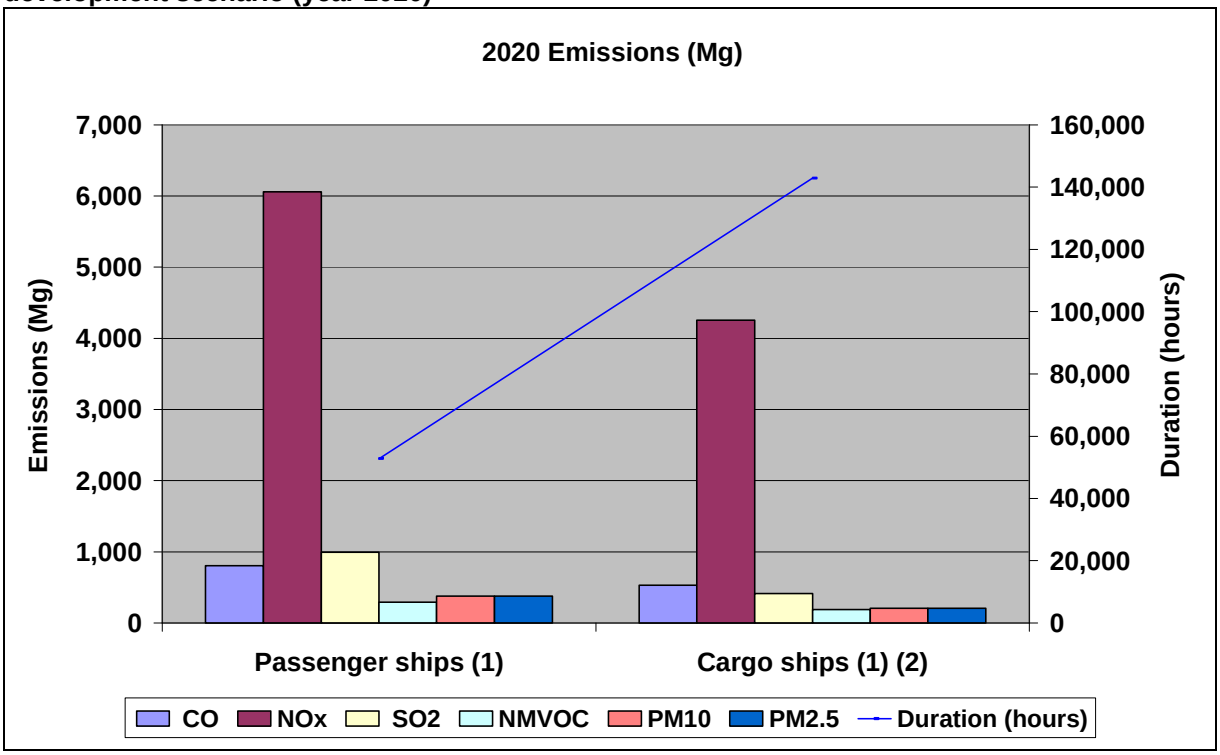
emissions considered are those emitted during the three trip phases inside the 100x100 Km^2 studied domain: hotelling, manouvering and cruise.

Fig 2.2 Pollutant emissions (in tn/year) by ships and vessels in the port in Venice for the future development scenario (year 2020)



(1) Hotelling+ Manouvering+Cruise

(2) Container+Dry Bulk carriers+General Cargo+Liquid bulk ships+RoRo Cargo+Others

Differently to the 2011 emissions, on the 2020 scenario the grater emission contribution is by passenger ships and this is mainly due to the Ro-ro passenger vessel traffic increase of the new Motorways of the Sea Terminal.

With the unique exception for SO_2 emissions, for which the limitation of 0.5% in sulphur content for the manouvering and cruising phases brings to an important decrease, all the other pollutants record an increase between 40% to 60%, considering the whole Port of Venice and the three phases of navigation The percentage are different considering separately the Commercial/industrial terminals in Porto Marghera and the other terminals in the historical city of Venice and considering only the hotelling and the manouvering phases, as reported on the following graph (Fig 2.3).

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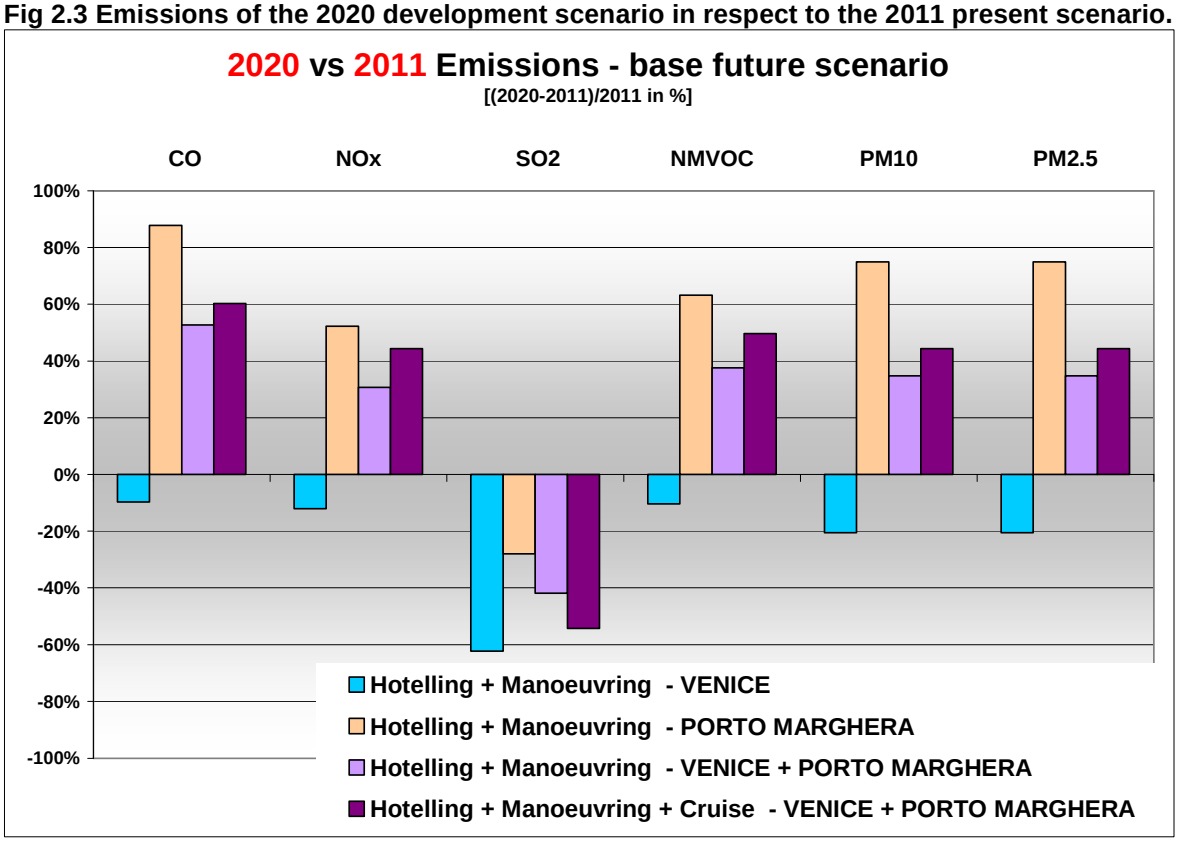
Fig 2.3 Emissions of the 2020 development scenario in respect to the 2011 present scenario.



On the following table (Tab 2.3) and the related graph (Fig 2.4), the same emissions discussed for the whole Port of Venice for the 2020 scenario (Tab 2.2) are presented split into the two routes of arrival to the Terminals. The emissions are, once again, referring to the 100x100 Km^2 studied domain, and thus considering the 3 different trip phases: hotelling, manouvering and cruise outside the lagoon.

Tab 2.3 Pollutant emissions (in tn/year) by ship activities in the port in Venice, divided by the two inlets into the Lagoon and the location in Venice and in Porto Marghera-San Leonardo (year 2020)

	Mg	CO	NOx	SO2	NMVOC	NH3	PM10	PM2.5
Lido entrance and Terminals in the city of Venice	Hotelling Passenger Ships	49	388	13	16		11	11
	Hotelling Cargo Ships	11	68	2	4		2	2
	Manouvering Passenger Ships	44	284	60	28		36	36
	Manouvering Cargo Ships	2	15	2	1		1	1
	Tugs	16	98	4	9		8	8
	Cruise Passenger ships	93	745	126	16		22	22
	Cruise Cargo Ships	4	41	5	1		2	2
	total emissions Venezia	**219**	**1,639**	**213**	**75**		**82**	**82**
Malamocco entrance and Terminals in Porto Marghera and San Leonardo	Hotelling Passenger Ships	38	298	10	12		9	9
	Hotelling Cargo Ships	255	1,551	51	85		53	53
	Manouvering Passenger Ships	75	485	102	47		61	61
	Manouvering Cargo Ships	41	335	55	30		34	34
	Tugs	43	261	12	25		22	22
	Cruise Passenger ships	147	1,174	198	41		60	60
	Cruise Cargo Ships	86	928	117	19		39	39
	total emissions Porto Marghera	**685**	**5,032**	**544**	**259**		**277**	**277**

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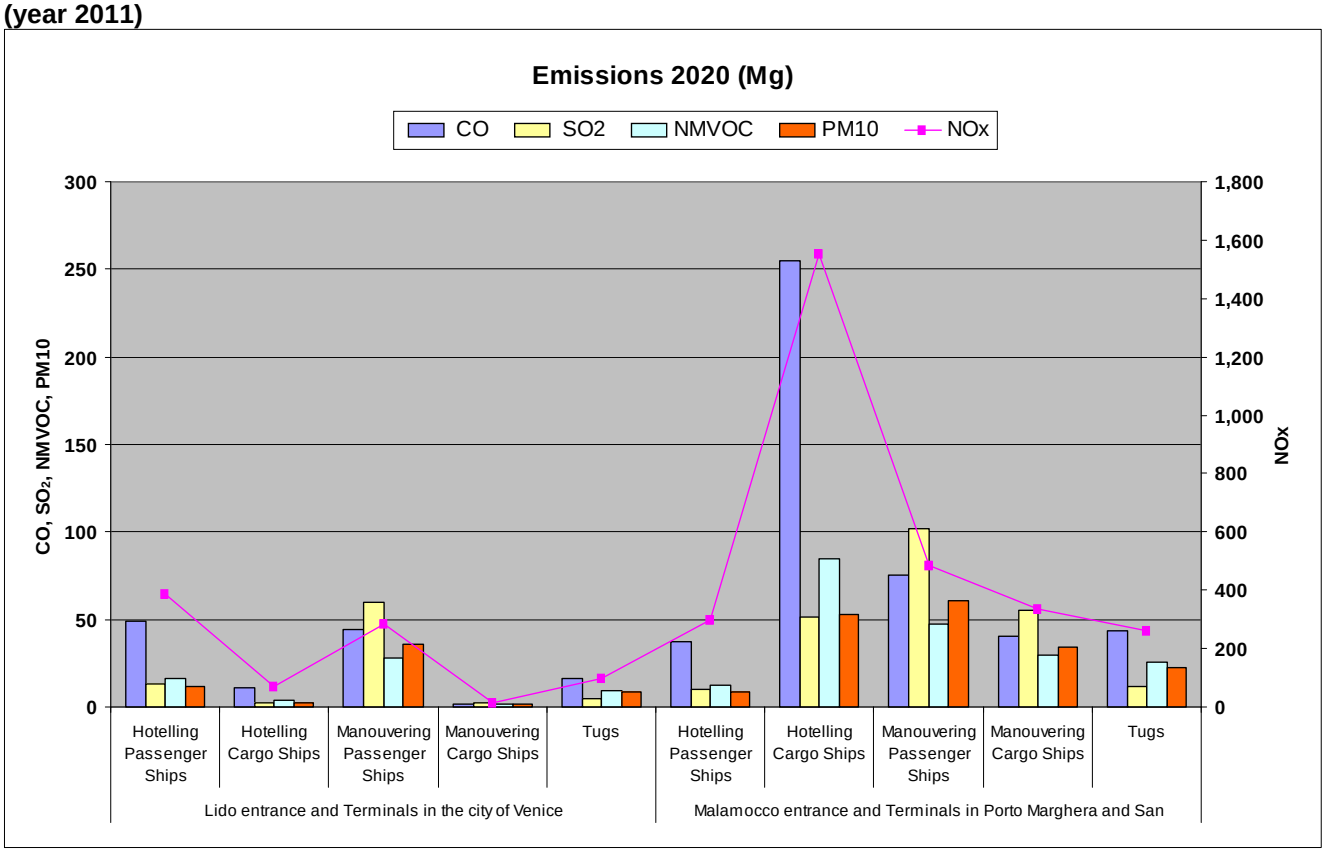
Fig 2.4 Pollutant emissions (in tn/year) by ship activities in the port in Venice, divided by the two inlets into the Lagoon and the location in Venice and in Porto Marghera-San Leonardo (year 2011)



The emissions estimated for the traffic load induced by the port activities on the 2020 scenario are reported on the following table (Tab 2.4).

Tab 2.4 In port traffic load induced by port activities (in tn/year) (year 2020)

IN-PORT TRAFFIC LOAD INDUCED BY PORT ACTIVITIES (Mg)							
	CO	**NOx**	**SOx**	**NMVOCs**	**NH3**	**PM10**	**PM2.5**
Passenger vehicles (cars, motorcycles, campers, buses)	12	6	0.01	2	0	0.5	0.4
Heavy duty vehicles - commercial road transport	332	1,406	1	71	1	46	41
Freight on railways	1	7	0	1	0	0	0
Total	**346**	**1,419**	**1**	**73**	**1**	**47**	**41**

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3. Involvement of stakeholders in the activities relevant with the presence of the port in Venice

As one of the most important objective of APICE project is to promote the decision-making approach and the related set of mitigation measures, designed by the project and contained in the Local Action Plan, across the policy-makers and private operators, a stable and proactive exchange scheme between the key public and private players was an outstanding phase of the project implementation in the Venice area.

The consensus-building process adopted in the Venetian pilot area was mainly based upon bilateral and larger round tables between the local partners - Veneto Region and the Regional Agency for the Environmental Protection - and those governmental and economic actors that play a role in addressing solutions to reduce emissions and improve the air-quality. Among the others, the Port Authority of Venice, the Municipality of Venice, the Venice Passengers Terminal, the Venice Harbourmaster, the Customs Agency and the Consortium for Researches for the Venice Lagoon were involved in the mainstreaming process since the beginning of the project operation, then stretched throughout the project life.

This kind of approach focused mainly on the organization of technical workshops during which Veneto Region and ARPAV transfer to the above mentioned local networks the APICE scientific findings related to the emission sources and risk factors, with the final purpose of shaping a common analytic frame, getting feedbacks on potential mitigation strategies and pave the way towards agreements between economic operators, ship-owners and PAs.

Veneto Region and ARPAV organized the first round-table on 27th March 2012 at the premises of the Venice Port Authority. After having explained the project performances so far - above all the scientific results obtained during the air monitoring campaign - the discussion delivered some useful indication by the Venice Port Authority and the Municipality of Venice on the most relevant topics to be included in the APICE Action Plan for the Venetian area. In specific, a better knowledge on the air pollution mitigation measures implemented by the other APICE 's cities and the necessity to analyze the forthcoming scenarios were raised by the key-stakeholders. A broad availability to consider any contribution coming from APICE (in line with the legislation in force and not affecting the growth perspectives of the Port) to improve the air conditions in the Venetian area was confirmed by all participants.
The analysis of potential risks and mitigation actions concerning the most relevant economic and urban port and coastal areas, carried out by the Veneto Region, and based on the modelling elaborated by ARPAV for the Venice lagoon, was the topic of the second round-table held again at the premises of the Venice Port Authority on the 25th of September 2012. The stakeholders were asked to provide a feedback over a wide given list of possible mitigation actions - ranging from wise spatial planning measures to the electrification of the quays – to identify the most fitting ones for the Venetian case, in line with the main European and International legislation (in specific, MARPOL). The stakeholders were invited to implement the analysis presented by Veneto Region with comments and insights, as well as to increase the analysis with materials, data or their knowledge as “experts” in the sector. As result of the discussion, the stakeholders agreed on a common approach to the strategy for the Local Adaptation Plan, and established a ranking with the most suitable actions according to the criteria of evaluation that were implemented by the APICE Partnership. They also compromised themselves in preparing the base for a voluntary agreement related to the adoption of low sulphur fuel for cruise ships while manoeuvring inside the Venice Lagoon, to anticipate the entry into force of the MARPOL ANNEX VI, foreseen for the 2020, as a robust

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action to reduce emissions at source and to mitigate the risk of exposure of the Venice Historical Islands.
Further bilateral meetings between APICE Venice partners (Veneto Region and ARPAV) and Venice Port Authority were organized in the final part of the project to gather information and to emphasize the importance of reaching voluntary agreements with the ship owners to testing and adopting abatement technologies to curb emissions.
Beside the workshops, the mainstreaming strategy was applied also at a larger regional scale, to inform policymakers, planners, environmentalists economists, ship and port managers and the civil society through a targeted dissemination actions consisting in the delivery of international and local newsletters, the project website and press releases. A crucial milestone in the communication strategy was represented by the international final conference organized in Venice on the 8th November 2012, with the presence of the European Commission - Directorate-General for Maritime Affairs and Fisheries and the European Cruise Council, together with local and international maritime operators. The conference reaffirmed the centrality of the Mediterranean Sea and its port-cities in driving economic recovery after the downturn and stresses the need of concrete strategies for the reduction of emissions and to increase the energy efficiency in port areas.

4. Conclusions

In the present time emissions scenario, considering the two simple categories of passenger ships versus not passenger ships (sum of Container, Dry Bulk carriers, General Cargo, Liquid bulk ships, RoRo Cargo, Others) this latter category is responsible of a greater contribution for all pollutants.
Considering every ship category separately (passenger ships, Container, Dry Bulk carriers, General Cargo, Liquid bulk ships, RoRo Cargo, Others.), the most important emission source for all pollutants is the passenger ships. The second larger contributor to total maritime emissions is the containers for all pollutants except NMVOC for which the second most important source is the liquid bulk ships.
As regards comparison among emissions in the three different phases of a trip (hotelling, manouvering and cruise), taking into consideration that the emission calculation has been developed for the 100 x 100 km^2 scale, in which the kilometers travelled in cruise phase by the ships outside the lagoon are almost 44-47 km, depending on the lagoon inlet (Lido or Malamocco), of which 22 km inside territorial seas, passenger ships, emissions are highest during the cruising mode for all pollutants except for NMVOC emissions which are highest during the hotelling phase. Emissions from liquid bulk ships are highest during hotelling mode for all pollutants except SO_2 for which emissions are highest on-cruise.
Differently to the 2011 emissions, on the 2020 development scenario, considering the two simple categories of passenger ships versus not passenger ships, the grater emission contribution is by passenger ships and this is mainly due to the Ro-ro passenger vessel traffic increase of the new Motorways of the Sea Terminal.
Making a comparison between the 2020 development scenario toward the present time 2011 emissions scenario, with the unique exception for SO_2 emissions, for which the limitation of 0.5% in sulphur content for the manouvering and cruising phases brings to an important decrease, all the other pollutants record an increase between 40% to 60%, considering the whole Port of Venice and the three phases of navigation. The percentage are different considering separately the Commercial/industrial terminals in Porto Marghera and the other terminals in the historical city of Venice and considering only the hotelling and the manouvering phases.

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