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WP5.2 - Assessment of air emissions sources in the Port of Marseille and future scenario

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Assessment of air emissions sources in the Port of Marseille and future scenario

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Port of Marseille Fos – Dry Dock 10

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Description of the docks in Marseille port

The Port of Marseilles took advantage of its unique geographical position to develop a full range of specialized terminals and become the largest versatile port in southern Europe. In 1998, Marseilles was the first port to hold the ISO 9002 international certification for all the port's shipping service facilities. The "Marseilles Global Port" strategic project and the Marseilles Port Authority business plan for the 3rd millennium were adopted.

GPMM general information

- versatile GLOBAL PORT: 24 activities (VS, VL, Passengers, Oil products, cruises, RN, containers etc.)
- 1st port in France with a total of 83 million tons in 2009
- 3rd oil port worldwide after Rotterdam and Houston
- 4th European port after Rotterdam, Antwerp and Hamburg
- 1,000 employees for a turnover of 172 million euros
- it is a general purpose port given its 24 different activities distributed along its entire area stretching from Marseilles to Port Saint Louis du Rhône via Martigues:
    - East docks (city of Marseilles): 392 hectares (1000 hectares including water stretches)
    - West docks(spared on 3 mains cities): 10,000 hectares
        - more than 60 kilometers of quayside in all
        - distance of 45 km between the two docks
- 1,000,000 containers
- More than 2,4 million passengers including 890,000 cruise passengers
- More than 4 million roll-on/roll-off freight cargos
- More than 57 million tons of hydrocarbons are handled by the facilities
- One of the world's largest sectional dry docks - Form 10: 465 meters long, 85 meters wide, 11.5 meters draught

One of the strengths of the Port of Marseilles with its ideal geographical position for north/south and east/west trade is that all goods are conveyed by pipeline, gas line, land, rail or river.

As the No. 5 port in Europe, Marseille Fos Port affirms its position as a major player in the Euro-Mediterranean domain, with the adequate infrastructure and space to accommodate all

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types of traffic, including miscellaneous and container goods, dry bulk, liquid bulk, ro-ro, cars, conventional traffic, passenger traffic and cruise traffic. Marseille Fos port is constantly investing and innovating to satisfy the demand generated by international maritime transport development.

The port is working with its partners to implement projects firmly focused on the medium and long term, targeting niches of activity which are experiencing strong development (energy, logistics and combined transport) and promise to generate traffic, growth and employment (43,500 jobs linked to port activity). Conscious of its role as corporate citizen, the Port gives priority to initiatives which reconcile economic, social and environmental issues.

These powerful initiatives propel actions focused on mode transfer, promoting rail and inland waterway transport strictly bound to land management.

Marseille port's 10,000 hectares of land, unique in Europe, facilitate the growth and development of new industrial and logistics activities. Through its sustainable growth and development plan, the port has made major commitments to limit the impact of its facilities on air, water and land, and to respect local communities, protect biodiversity, promote energy conservation and guarantee efficient waste management.

Risk activities in terms of air emissions

Marseille port consists of an east and west basin. The eastern part, inside Marseille city, mainly handles passengers, general cargo, roll-on/roll-off activities and ship repairs. The western part is mainly used for oil chemicals and refined activities, crude oil and container-related activities. Also, a part of the container activities is located at the eastern part.

Figure 1 : Marseille port situation (source: Google Earth)

Methodology for air emission calculations

The methodology used to calculate and to locate emissions of maritime sector is based on the complete methodology MEET developed by Trozzi and Vaccaro (1998). A complete description is provided in a previous report[1] available on the APICE website.

Emissions from maritime sector are divided in three phases: hotelling, maneuvering and on-road. In maps of emissions, these phases are added on the same grid. Hotelling phase groups all emissions when ships are stopped in port (dock and harbor). Emissions reported in tables are related to the APICE area which is a 100x100km2 domain as represented in the following Figure 2.

In this report, each maritime activity is named according to the ship type used: transport of oil is associated with liquid bulk, transport of mineral with solid bulk … The category "other" refers to ship type not included in previous activities as tugs, fishing, pleasure boat, coastal navigation… The passenger activity is divided into two distinct activities: cruise and passenger transport not included in cruise activity, as transport to Corsica or Maghreb. As these activities use different ship types, passenger activity will only refer to cruise and passenger transport to Corsica or Maghreb will be a part of general cargo in this section.

For Marseille, the activities relevant with the presence of the port and presenting risks regarding air emissions are: Solid Bulk, Liquid bulk, Container, Cargo and passenger, Cruise, Inland and Other.

Emissions are reported for the main pollutants: carbon monoxide (CO), Nitrogen oxide (NOx), Sulfur oxide (SOx), non-methane volatile organic compounds (NMVOC), Particulate matter smaller than 10 microns (PM10) and 2.5 microns (PM2.5), carbon dioxide (CO2) and methane (CH4).

[1] Compilation of emission inventories for five large Mediterranean cities: Barcelona, Genoa, Marseille, Thessaloniki and Venice – APICE report (Emission_Inventory_Methodology_Description_Final_Report.pdf)

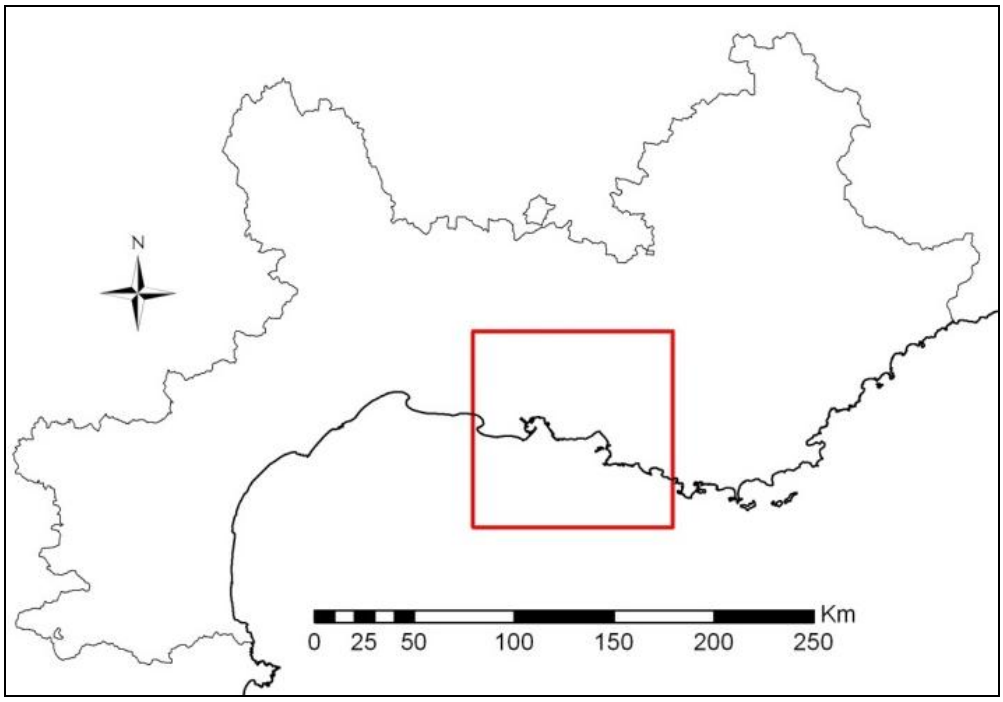

Figure 2 : APICE study area for Marseille (100km x 100km, resolution 1km x 1km)

Results of air emissions for Marseille port

Air emissions from activities relevant with the presence of the Marseille port for the reference year of 2007 are displayed in the Table II. Emissions are given for each activity and pollutant studied in this report according to the different phases.

To identify the most important phase in terms of pollutant emissions, Table III displays the sum of the whole activities for the different phases (hotelling, maneuvering and on-road). Except for the NOx emissions, the hotelling phase displays the major contribution of the annual emission over the APICE domain for the activities relevant with the presence of the Marseille port during the reference year of 2007. During this phase, the consumption of fuel is reduced by around 75% in comparison with the on-road consumption. However, the total time spent by ships at dock or in harbor during this phase leads to a total consumption higher than for the other phase. For the NOx, the difference is explained by a reduction of the emission factor by 60% between the on-road and the hotelling phases.

As emissions associated to the on-road phase depend on dimensions of the area, it is important to consider the extent of the domain before to compare the emission with the other phases or with different port. Even with a spatial extent similar to the APICE domain for Marseille, emission from the on-road phase would increase if the domain has be moved

towards the South. On the other hand, as the whole of both hotelling and maneuvering phase are inside the APICE domain, the comparison between these phases is independent from the spatial extent.

To compare the different activities, Table IV summarizes the total emissions from each activity over the APICE domain. So, three activities display a major contribution: liquid bulk, cargo-passenger and container with a different order according the pollutant.

Focus on NOx, SOx and PMx emissions

A focus is done for three pollutants displaying a major interest regarding to the air quality problematic: NOx, SOx and PM. These pollutants display some specificities in terms of emission factors according on different phases and activities.

NOx emissions

At the scale of the APICE domain, NOx emissions are dominated by the maneuvering phase. As explained in the previous part, emissions factors of this pollutant are higher during the movement phase, on-road and maneuvering phases, than during the hotelling phase. In terms of activities, NOx emissions are dominated by the liquid bulk. This activity is specific to the western part of the Marseille port. Cargo-passenger and container display a significant contribution also. These activities are split on western and eastern parts of Marseille port. More details on the repartition of these activities are given in the section about location of emissions.

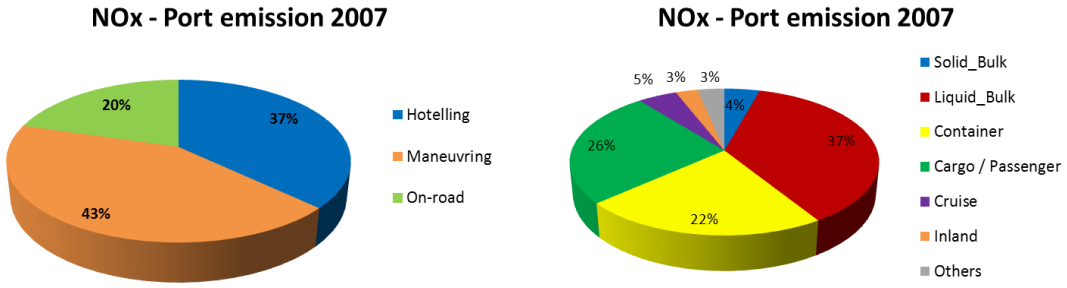

Figure 3 : Contribution of different phases and different activities for the total emission in Marseille port for NOx (reference year of 2007).

SOx emissions

At the scale of the APICE domain, SOx emissions are dominated by the hotelling phase as the emission factor is constant among the different phases and due to the long time spent at dock and inside the harbor during this phase. In terms of activities, SOx emissions are dominated by the liquid bulks with 45% of the total emissions over the domain. In comparison with NOx emission, the cargo-passengers display a lower contribution as passenger ships use a fuel with sulfur content lower than the other ships. For this pollutant, the second contribution is issue from the containers and the cargo-passenger activity displays the third contribution. More details on the repartition of these activities are given in the section about location of emissions.

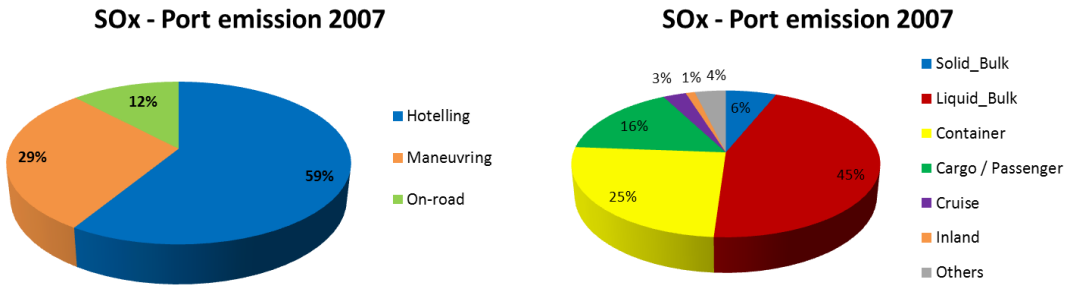

Figure 4 : Contribution of different phases and different activities for the total emission in Marseille port for SOx (reference year of 2007).

PM2.5 emissions

As PM emissions issue from the maritime sector are exclusively fine particles smaller than 2.5 microns (Table II), only PM2.5 emissions will be considered in the following sections to refer to particles emissions.

At the scale of the APICE domain, PM2.5 emissions are dominated by the hotelling phase with a repartition very close to the SOx emissions as emission factor are constant between the different phases and as this repartition in proportional to the fuel consumption. However, the distribution for the activities is different with a third of PM2.5 emissions issue from cargo-passenger and another third issue from liquid bulks. As the emission factors for this pollutant are similar for all ships, this ranking is directly associated to the numbers of ships and to the time spent by them inside the domain. More details on the repartition of these activities are given in the section about location of emissions.

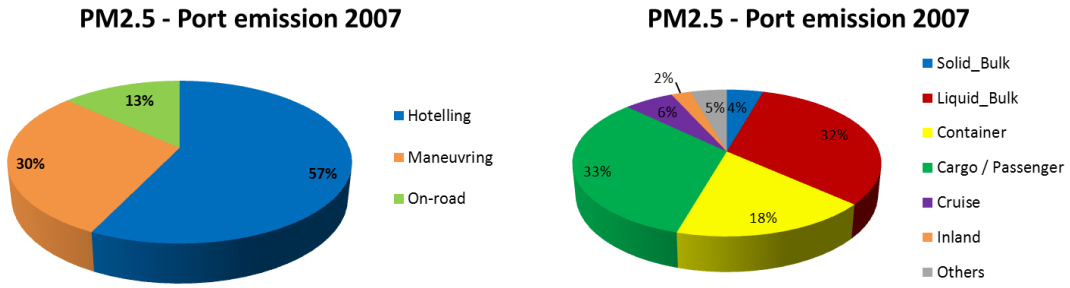

Figure 5 : Contribution of different phases and different activities for the total emission in Marseille port for PM2.5 (reference year of 2007).

Map of air emissions from Marseille port over APICE domain

To highlight the specificities of the western and eastern parts of Marseille port in terms of emissions, the Figure 6 and Figure 7 displays emissions maps for PM2.5 over a grid with a spatial resolution of 1km2 over the APICE domain for each activity. Emissions of liquid bulks are largely located in the western part of the port as this activity is mainly associated to transport of oil and used by petrochemical industry. For the container activity, a large part is located in the western part as a large specific terminal is dedicated for this activity and a minor part of this activity is treated inside the eastern part. The cargo-passenger ships are distributed inside both parts of the port with the passenger activity exclusively located inside the eastern part and a repartition for the cargo activity. This activity represents the major contribution for the eastern part of the Marseille port.

Port of Marseille Fos – Corse Terminal

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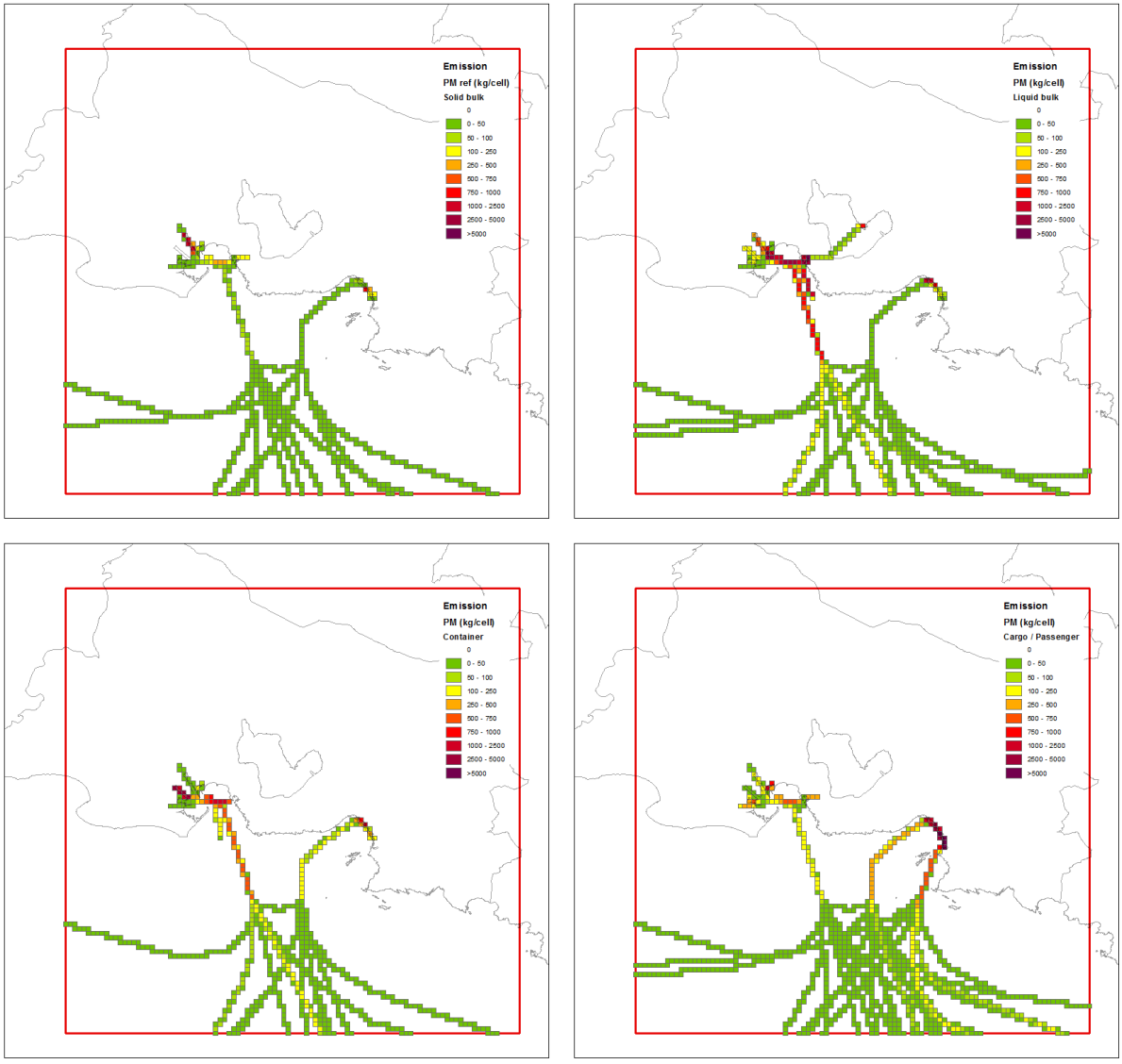

Figure 6: Total annual $PM_{2.5}$ emission (on-route, maneuvering and hotelling) for solid bulk, liquid bulk, container and cargo/passenger over the APICE domain (reference year 2007).

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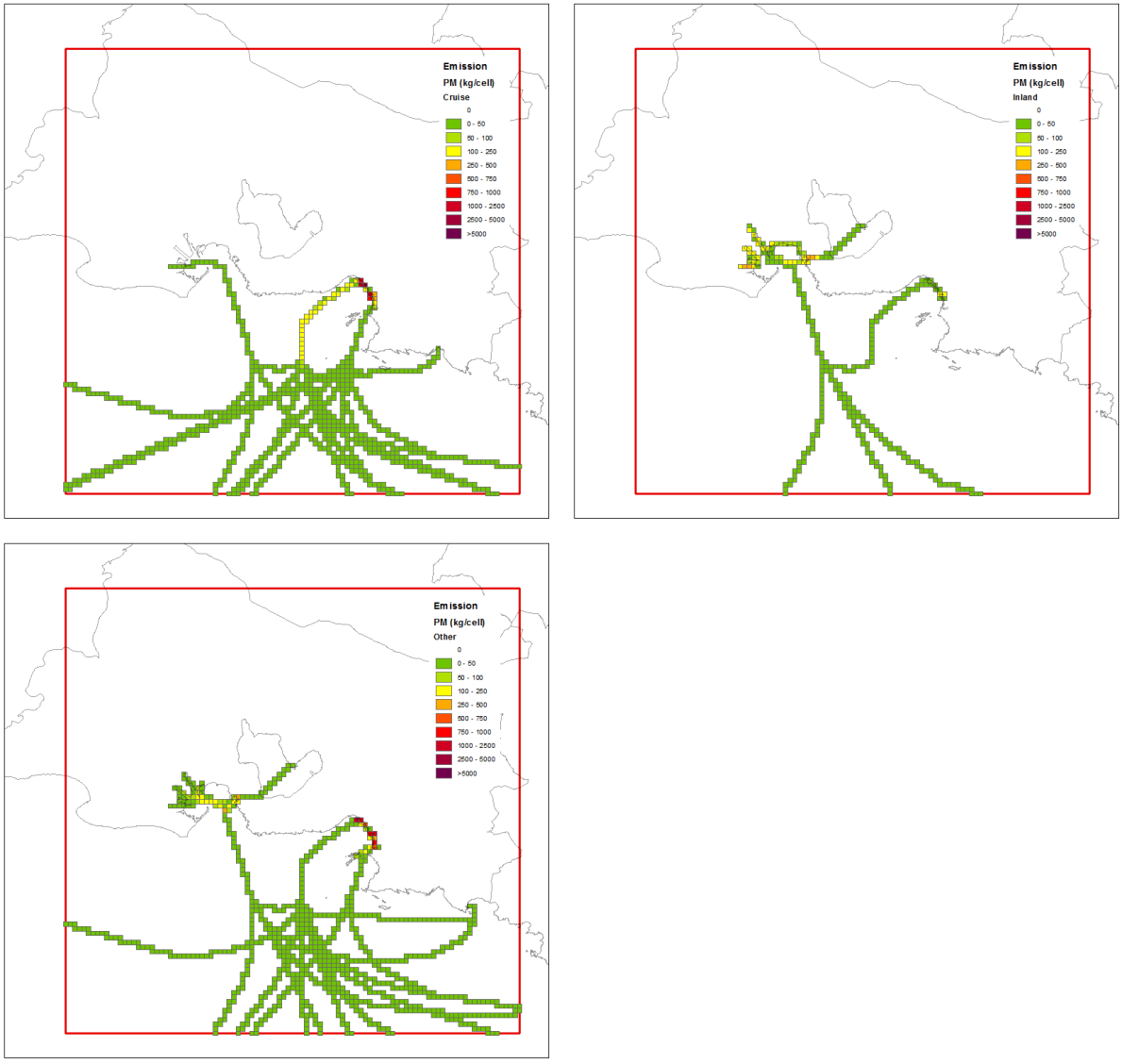

Figure 7 : Total annual $PM_{2.5}$ emission (on-route, maneuvering and hotelling) for cruise, inland and other ships over the APICE domain (reference year 2007).

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Time frame of the activities

The mean duration of the hotelling phase is calculated from the database of Marseille port. Table I considers a mean duration in the port for each large activity. This duration can be not representative for some sub-activities. The mean frequency is calculated by the number of total ships during the reference year divided by the number of day. Only passenger activity related to transport and cruise shows a seasonal variation with a significant increase during summer.

Table I : Time frame of the pollutant emitting activities relevant with the presence of the port in Marseille (reference year 2007)

IN-PORT ACTIVITIES OF SHIPS AND VESSELS		
	Mean hotelling duration	**Mean Frequency**
Cruise	48h	< 1 / day - mainly during summer
Cargo – passenger	12 – 24h	9 / day (east harbor) - mainly during summer 3 / day (west harbor)
Liquid bulk	20 – 30h	11 / day
Solid bulk	20 – 30h	< 1 / day
Inland waterways	< 24h	5 / day
Container	24h	1.5 / day (east harbor) 2.5 / day (west harbor)

Conclusion for the present time

Two activities display a major contribution: liquid bulk and cargo-passenger. Emissions of liquid bulks are mainly located in the western part of the port while emissions of cargo-passenger are mainly located in the eastern part. As discussed previously, cargo-passenger activity includes transport of passengers which is the major part of this category. Transport of passengers to Corsica and Maghreb includes regular rotations all along the year. However an increase of the activity during summer period is recorded. Container activity is the third pollutant activity at the port scale and is mainly located in the western basin. As for the liquid bulk activity, container activity does not show a seasonal variability. For the western basin,

container activity is the second contributor to PM emissions while the second contributor is the passenger activity including cruise activity for the eastern part.

Port of Marseille Fos – Seatrade Med 2012

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

Evolution of Marseille port traffic

To identify the future time risk activities in terms of emissions, the projections given by Marseille port are used. Data concern five activities: container, liquid bulk, solid bulk, cargo-passenger and cruise and are given for 2020 and 2030 (Figure 8). However, no data concern modification in engine type, emission factor or duration of hotelling phase. Also, no spatial data are given for additional ships. To map the future emissions, the following hypotheses are applied:

- same dimensions of ships (gross tonnage) and the same engines
- same fuel type
- same duration for each phase (on-road, maneuvering, hotelling)
- same provenance and destination
- same location at dock to load / unload

These hypotheses should lead to an overestimation of future emissions as some forecasts give an increase of ship dimension allowing a decrease of ship number, an improvement of engines consumption and additional restrictions about fuel composition. As the projection is given for the whole of each activity, the same projection factor is spatially applied for each activity. For activities without projections, the hypothesis is done that these activities are constant in the future time.

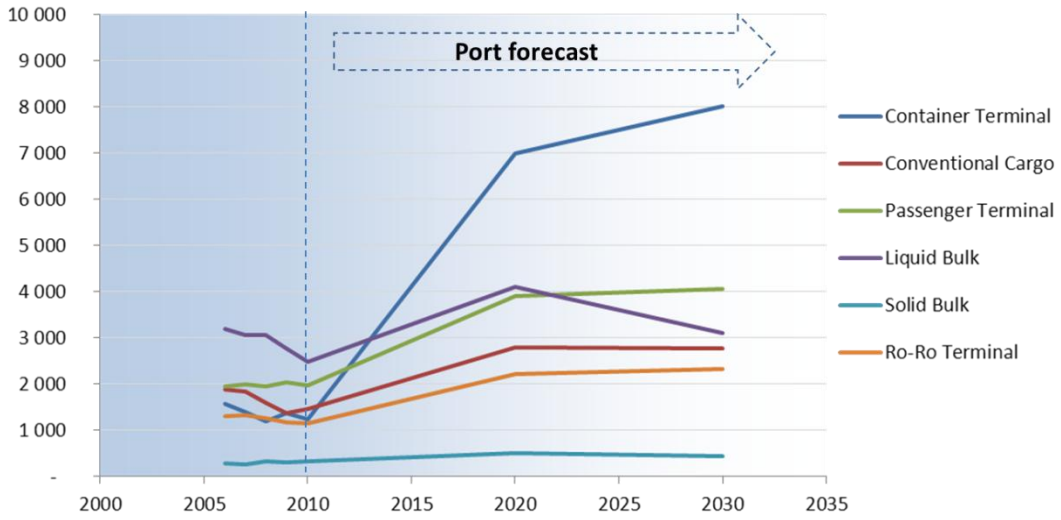


Figure 8 : Evolution of calls over the last and the future years

Risk activities in terms of air emissions

Results of air emissions for Marseille port

Pollutant emissions from the different activities relevant with the presence of the Marseille port for the future years of 2020 and 2030, calculated from projection given by Marseille port, are given in the Table V and Table VIII respectively.

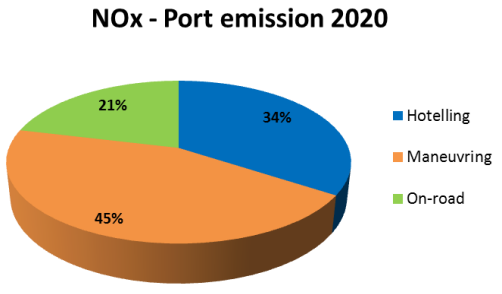
As for the present time, the hotelling phase will display the major contribution of the annual emission over the APICE domain for the activities relevant with the presence of the Marseille port during the future years of 2020 and 2030, except for the NOx emissions (Table VI and Table IX) as the assumptions for the future years considered no change for the engines and emission factors.

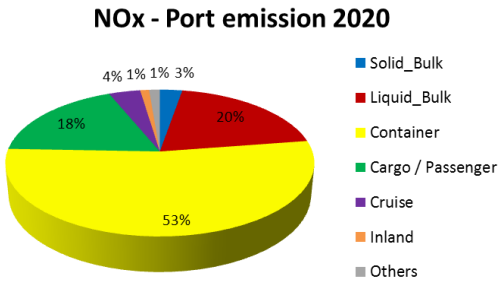
Due to a large development of the container activity for 2020 and 2030 in comparison to the others (Figure 8), this activity will become the main source of pollutant emission over the APICE domain with a total contribution around of 50%. The liquid bulk and cargo-passenger activities will become secondary in terms of emissions with 20-25% of pollutant emissions.

Focus on NOx, SOx and PMx emissions

NOx emissions

As the hypotheses used to calculate the future emissions assume a constant duration for each phase, their contribution is the same than for the present time and maneuvering phase is still the main phase in terms of NOx emissions. In terms of activities, NOx emissions are largely dominated by the container activity with more than half of the total emission over the APICE domain. For 2020, the second and the third activity are liquid bulk and cargo passenger respectively and inversely for 2030.





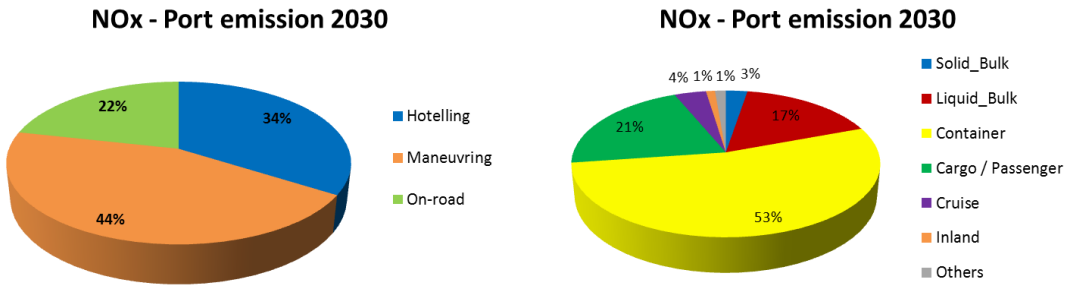


Figure 9 : Future contribution of different phases and different activities for the total emission in Marseille port for NOx.

SOx emissions

As for the present time, SOx emissions are dominated by the hotelling phase at the scale of the APICE domain. In terms of activities, SOx emissions are dominated by the containers with around 60% of emission. The second contribution is issue from the liquid bulks with a quarter of total emission and the cargo-passenger activity displays the third contribution.

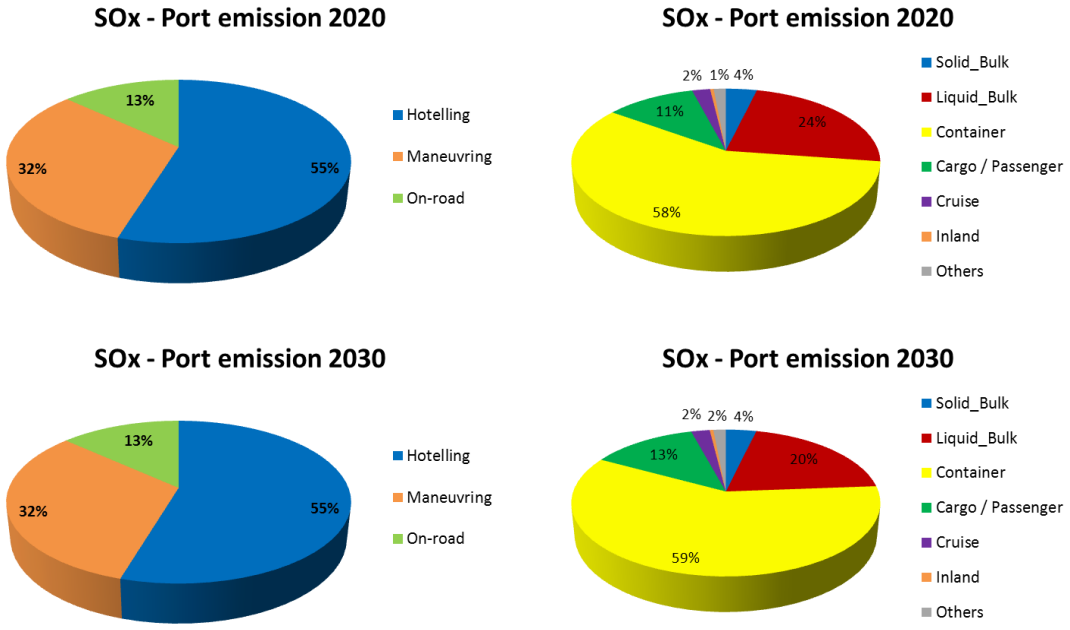


Figure 10 : Contribution of different phases and different activities for the total emission in Marseille port for SOx (reference year of 2007).

PM2.5 emissions

As for the present time, PM2.5 emissions are dominated by the hotelling phase at the scale of the APICE domain. In terms of activities, PM2.5 emissions are dominated by the containers with less than half of total emission. The second contribution is issue from the cargo-passenger and the third is issue from the liquid bulk.

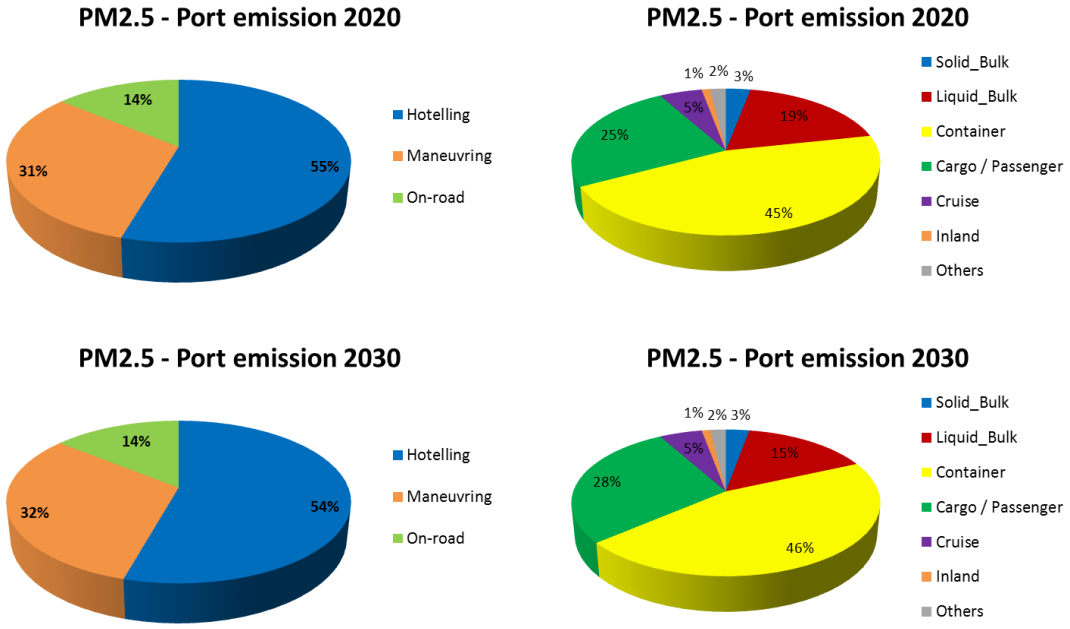


Figure 11 : Contribution of different phases and different activities for the total emission in Marseille port for PM2.5 (reference year of 2007).

Map of air emissions from Marseille port over APICE domain

Figure 12 displays emissions maps for PM2.5 over a grid with a spatial resolution of 1km2 over the APICE domain for each activity. As no modification for provenance/destination and location at dock have been assumed, the spatial distribution for the different activities is similar. However, due to the large increase of container traffic, this activity will become the major contributor for PM emissions in the western basin and liquid bulk will become the second contributor for 2020 and 2030. For the eastern port, cargo-passenger activity will still represent the major contribution with also a large contribution from container activity. Nevertheless, the evolution of the container activity inside the eastern part should be overestimated as the large increase of this activity will be located in the western part of

Marseille port where a new container terminal will be built. Also, the contribution of this activity should be more important for western part.

Port of Marseille Fos – Container Ternminals

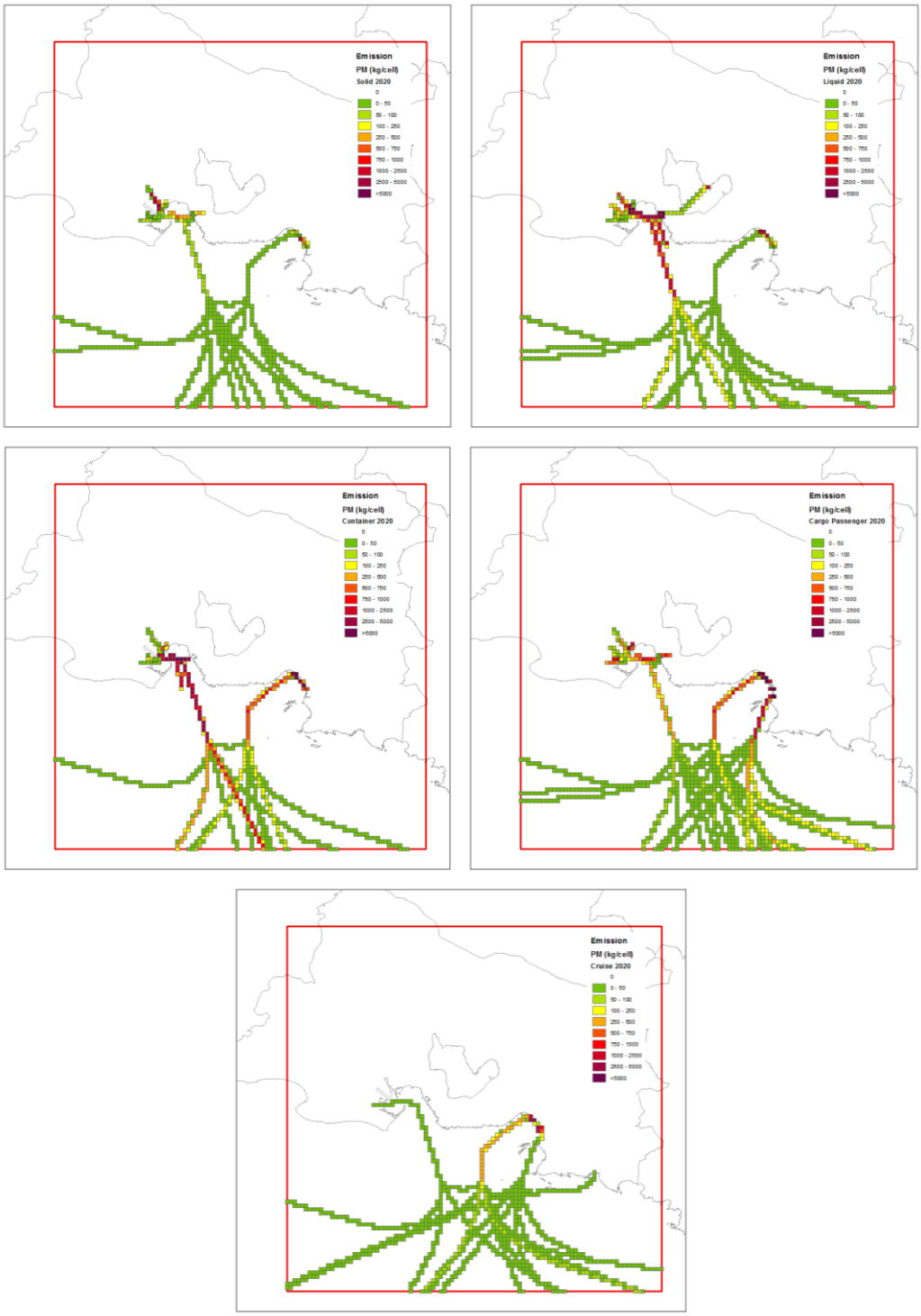


Figure 12: Total annual $PM_{2.5}$ emission (on-route, maneuvering and hotelling) for solid bulk, liquid bulk, container, cargo/passenger and cruise over the APICE domain (reference year 2007).

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Time frame of the activities

The hypotheses used to calculate the future emissions assume a constant duration for the hotelling phase.

Conclusion for the future time

The projections given by Marseille port are used to estimate emissions for 2020 and 2030 to identify the future risk activities for Marseille area. For the eastern part, cargo-passenger activity will still be the major contributor for PM emissions. For the western part, liquid bulk activity was the major contributor for PM emissions during the reference year 2007 and will be replaced by container activity for the future year 2020 and 2030.

Additional issues

This section introduces stakeholders and partners involved in the activities relevant with the presence of the port in Marseille. So, each activity is divided between the Port authority in charge of management of harbor area, the ship companies which operate with ships and vessels and the Maritime Operators which are in charge of connection between Port authority and ship companies.

To sign a possible agreement for the mitigation of emissions from the maritime sector, it needs to bring all stakeholders together. For example, if the Port authority introduces a new system to reduce emissions during hotelling phase, it will be necessary that the ship companies adapt their fleet to use this new system and that the Maritime Operators integer a staff able to use this new system.

Conclusions for Marseille

In the study about the identification of the present and future time risk activity and vulnerability systems in terms of air quality, several points have been highlighted for Marseille.

First, it has been shown that PM emissions are dominated by in-port vessel emissions. In addition of its major contribution in total emissions, this phase is located inside the port and directly impacts surrounding population.

From the present pollutant emissions two activities display a major contribution: liquid bulk and cargo-passenger. Emissions of liquid bulks are mainly located in the western part of the port while emissions of cargo-passenger are mainly located in the eastern part. As explained, cargo-passenger activity in the eastern part is dominated by transportation of passengers not included in cruise activity. This activity displays a seasonal variability with an increase during summer season. The third activity in terms of emissions is the container activity. For the western basin, this activity is the second contributor to PM emissions while the passenger activity including cruise activity is the second contributor for the eastern basin.

As projections at 2020 forecast a high increase of container activity, this sector will become the major contributor to PM emissions in the western basin. The cargo-passenger activity will still be the main contributor for PM emissions for the eastern basin. Liquid bulk activity will become the third activity at the port scale and will be still located in the western basin where it will be the second contributor to PM emissions. Cruise activity will become the third contributor in the eastern basin after cargo-passenger and container activities, according to assumptions applied. The same trends are obtained for projections at 2030.

All these results only consider emissions from maritime sector and not emissions from industrial, road transport and central heating which are the most important anthropogenic emission source sectors for PM2.5 as reported in a previous study[2] about local emission inventory.

[2] www.apice-project.eu/img_web/pagine/files/Results/Emission_Inventory_Marseille.xls

Table II : Pollutant emissions (in kg/year) from the activities relevant with the presence of the port in Marseille during the different phases (reference year 2007)

ACTIVITIES OF SHIPS AND VESSELS									
Emission (kg/y)		CO	NOx	SOx	NMVOC	PM10	PM2,5	CO2	CH4
Hotelling	Solid_Bulk	852 103	301 248	774 639	194 766	10 329	10 329	27 542 707	4 058
	Liquid_Bulk	4 816 397	1 702 767	4 378 543	1 100 891	58 381	58 381	155 681 535	22 935
	Container	2 238 934	791 542	2 035 394	511 756	27 139	27 139	72 369 572	10 662
	Cargo / Passenger	4 446 078	1 032 927	1 492 683	1 016 246	53 892	53 892	143 711 599	21 172
	Cruise	836 469	194 331	253 475	191 193	10 139	10 139	27 037 371	3 983
	Inland	372 257	131 606	112 805	85 087	4 512	4 512	12 032 552	1 773
	Others	678 720	157 682	470 769	155 136	8 227	8 227	21 938 409	3 232
Maneuvring	Solid_Bulk	50 989	142 042	163 894	6 422	2 185	2 185	5 827 351	134
	Liquid_Bulk	659 000	1 835 786	2 118 215	82 999	28 243	28 243	75 314 301	1 729
	Container	452 482	1 260 486	1 454 407	56 989	19 392	19 392	51 712 257	1 187
	Cargo / Passenger	646 227	1 177 056	692 386	81 391	27 695	27 695	73 854 472	1 696
	Cruise	115 247	209 915	123 479	14 515	4 939	4 939	13 171 134	302
	Inland	51 886	144 540	55 592	6 535	2 224	2 224	5 929 850	136
	Others	103 553	188 614	121 843	13 042	4 438	4 438	11 834 582	272
On-road (APICE)	Solid_Bulk	4 981	60 054	62 053	1 594	827	827	2 206 323	33
	Liquid_Bulk	62 783	746 898	772 229	20 008	10 296	10 296	27 457 028	296
	Container	47 397	558 499	577 694	15 065	7 702	7 702	20 540 233	314
	Cargo / Passenger	103 536	800 635	421 272	32 934	16 853	16 853	44 939 947	686
	Cruise	19 525	151 765	79 844	6 222	3 194	3 194	8 516 657	130
	Inland	3 244	38 582	13 298	1 035	532	532	1 418 377	21
	Others	4 138	32 278	20 057	1 320	679	679	1 811 070	27

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Table III: Total pollutant emissions (in kg/year) during the different phases (reference year 2007)

ACTIVITIES OF SHIPS AND VESSELS								
Emission (kg/y)	CO	NOx	SOx	NMVOC	PM10	PM2,5	CO2	CH4
Hotelling	14 240 958	4 312 103	9 518 308	3 255 075	172 619	172 619	460 313 745	67 815
Maneuvring	2 079 384	4 958 439	4 729 816	261 893	89 116	89 116	237 643 947	5 456
On-road	245 603	2 388 711	1 946 447	78 177	40 083	40 083	106 889 635	1 507

Table IV: Total Pollutant emissions (in kg/year) from the activities relevant with the presence of the port in Marseille (reference year 2007)

ACTIVITIES OF SHIPS AND VESSELS									
Emission (kg/y)		CO	NOx	SOx	NMVOC	PM10	PM2,5	CO2	CH4
Total	Solid_Bulk	908 073	503 344	1 000 586	202 782	13 341	13 341	35 576 381	4 225
	Liquid_Bulk	5 538 180	4 285 451	7 268 987	1 203 898	96 920	96 920	258 452 864	24 960
	Container	2 738 813	2 610 527	4 067 495	583 810	54 233	54 233	144 622 062	12 163
	Cargo / Passenger	5 195 841	3 010 618	2 606 341	1 130 571	98 440	98 440	262 506 018	23 554
	Cruise	971 241	556 011	456 798	211 930	18 272	18 272	48 725 162	4 415
	Inland	427 387	314 728	181 695	92 657	7 268	7 268	19 380 779	1 930
	Others	786 411	378 574	612 669	169 498	13 344	13 344	35 584 061	3 531

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Table V : Pollutant emissions (in kg/year) from the activities relevant with the presence of the port in Marseille during the different phases (reference year 2020)

ACTIVITIES OF SHIPS AND VESSELS									
Emission (kg/y)		CO	NOx	SOx	NMVOC	PM10	PM2,5	CO2	CH4
Hotelling	Solid_Bulk	1 339 019	473 390	1 217 290	306 061	16 231	16 231	43 281 397	6 377
	Liquid_Bulk	6 469 787	2 287 299	5 881 625	1 478 809	78 422	78 422	209 124 450	30 808
	Container	13 170 200	4 656 129	11 972 906	3 010 329	159 641	159 641	425 703 365	62 718
	Cargo / Passenger	7 780 637	1 807 622	2 612 195	1 778 431	94 311	94 311	251 495 298	37 051
	Cruise	1 672 938	388 662	506 950	382 386	20 278	20 278	54 074 742	7 966
	Inland	372 257	131 606	112 805	85 087	4 512	4 512	12 032 552	1 773
	Others	678 720	157 682	470 769	155 136	8 227	8 227	21 938 409	3 232
Maneuvring	Solid_Bulk	80 126	223 209	257 548	10 092	3 434	3 434	9 157 266	211
	Liquid_Bulk	885 224	2 465 981	2 845 363	111 491	37 938	37 938	101 168 464	2 323
	Container	2 661 659	7 414 624	8 555 335	335 229	114 071	114 071	304 189 747	6 982
	Cargo / Passenger	1 130 897	2 059 848	1 211 676	142 434	48 466	48 466	129 245 326	2 968
	Cruise	230 494	419 830	246 958	29 030	9 878	9 878	26 342 268	604
	Inland	51 886	144 540	55 592	6 535	2 224	2 224	5 929 850	136
	Others	103 553	188 614	121 843	13 042	4 438	4 438	11 834 582	272
On-road (APICE)	Solid_Bulk	7 827	94 370	97 511	2 505	1 300	1 300	3 467 078	51
	Liquid_Bulk	84 336	1 003 296	1 037 322	26 876	13 830	13 830	36 882 575	398
	Container	278 803	3 285 289	3 398 203	88 617	45 307	45 307	120 824 899	1 845
	Cargo / Passenger	181 188	1 401 111	737 226	57 634	29 492	29 492	78 644 907	1 200
	Cruise	39 050	303 530	159 689	12 444	6 388	6 388	17 033 315	260
	Inland	3 244	38 582	13 298	1 035	532	532	1 418 377	21
	Others	4 138	32 278	20 057	1 320	679	679	1 811 070	27

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Table VI: Total pollutant emissions (in kg/year) during the different phases (reference year 2020)

ACTIVITIES OF SHIPS AND VESSELS								
Emission (kg/y)	CO	NOx	SOx	NMVOC	PM10	PM2,5	CO2	CH4
Hotelling	31 483 558	9 902 390	22 774 540	7 196 239	381 623	381 623	1 017 650 213	149 925
Maneuvring	5 143 839	12 916 646	13 294 315	647 854	220 449	220 449	587 867 503	13 495
On-road	598 586	6 158 456	5 463 306	190 430	97 529	97 529	260 082 221	3 803

Table VII: Total Pollutant emissions (in kg/year) from the activities relevant with the presence of the port in Marseille (reference year 2020)

ACTIVITIES OF SHIPS AND VESSELS									
Emission (kg/y)		CO	NOx	SOx	NMVOC	PM10	PM2,5	CO2	CH4
Total	Solid_Bulk	1 426 971	790 969	1 572 349	318 657	20 965	20 965	55 905 741	6 639
	Liquid_Bulk	7 439 347	5 756 576	9 764 311	1 617 176	130 191	130 191	347 175 489	33 528
	Container	16 110 662	15 356 042	23 926 444	3 434 175	319 019	319 019	850 718 011	71 545
	Cargo / Passenger	9 092 722	5 268 581	4 561 097	1 978 499	172 270	172 270	459 385 531	41 219
	Cruise	1 942 482	1 112 022	913 597	423 860	36 544	36 544	97 450 325	8 830
	Inland	427 387	314 728	181 695	92 657	7 268	7 268	19 380 779	1 930
	Others	786 411	378 574	612 669	169 498	13 344	13 344	35 584 061	3 531

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Table VIII : Pollutant emissions (in kg/year) from the activities relevant with the presence of the port in Marseille during the different phases (reference year 2030)

ACTIVITIES OF SHIPS AND VESSELS									
Emission (kg/y)		CO	NOx	SOx	NMVOC	PM10	PM2,5	CO2	CH4
Hotelling	Solid_Bulk	1 278 155	451 872	1 161 959	292 149	15 494	15 494	41 314 061	6 087
	Liquid_Bulk	5 391 489	1 906 082	4 901 354	1 232 341	65 352	65 352	174 270 375	25 674
	Container	13 170 200	4 656 129	11 972 906	3 010 329	159 641	159 641	425 703 365	62 718
	Cargo / Passenger	8 892 156	2 065 854	2 985 366	2 032 492	107 784	107 784	287 423 198	42 344
	Cruise	1 672 938	388 662	506 950	382 386	20 278	20 278	54 074 742	7 966
	Inland	372 257	131 606	112 805	85 087	4 512	4 512	12 032 552	1 773
	Others	678 720	157 682	470 769	155 136	8 227	8 227	21 938 409	3 232
Maneuvring	Solid_Bulk	76 484	213 063	245 841	9 633	3 278	3 278	8 741 027	201
	Liquid_Bulk	737 687	2 054 984	2 371 136	92 909	31 615	31 615	84 307 053	1 935
	Container	2 661 659	7 414 624	8 555 335	335 229	114 071	114 071	304 189 747	6 982
	Cargo / Passenger	1 292 454	2 354 112	1 384 772	162 782	55 390	55 390	147 708 944	3 392
	Cruise	230 494	419 830	246 958	29 030	9 878	9 878	26 342 268	604
	Inland	51 886	144 540	55 592	6 535	2 224	2 224	5 929 850	136
	Others	103 553	188 614	121 843	13 042	4 438	4 438	11 834 582	272
On-road (APICE)	Solid_Bulk	7 471	90 080	93 079	2 391	1 241	1 241	3 309 484	49
	Liquid_Bulk	70 280	836 080	864 435	22 397	11 525	11 525	30 735 479	331
	Container	278 803	3 285 289	3 398 203	88 617	45 307	45 307	120 824 899	1 845
	Cargo / Passenger	207 072	1 601 270	842 544	65 867	33 706	33 706	89 879 894	1 371
	Cruise	39 050	303 530	159 689	12 444	6 388	6 388	17 033 315	260
	Inland	3 244	38 582	13 298	1 035	532	532	1 418 377	21
	Others	4 138	32 278	20 057	1 320	679	679	1 811 070	27

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Table IX: Total pollutant emissions (in kg/year) during the different phases (reference year 2030)

ACTIVITIES OF SHIPS AND VESSELS								
Emission (kg/y)	CO	NOx	SOx	NMVOC	PM10	PM2,5	CO2	CH4
Hotelling	31 455 915	9 757 888	22 112 108	7 189 920	381 288	381 288	1 016 756 701	149 793
Maneuvring	5 154 216	12 789 767	12 981 477	649 161	220 893	220 893	589 053 471	13 523
On-road	610 058	6 187 109	5 391 305	194 070	99 378	99 378	265 012 518	3 906

Table X: Total Pollutant emissions (in kg/year) from the activities relevant with the presence of the port in Marseille (reference year 2030)

ACTIVITIES OF SHIPS AND VESSELS									
Emission (kg/y)		CO	NOx	SOx	NMVOC	PM10	PM2,5	CO2	CH4
Total	Solid_Bulk	1 362 109	755 015	1 500 879	304 173	20 012	20 012	53 364 571	6 337
	Liquid_Bulk	6 199 455	4 797 146	8 136 926	1 347 647	108 492	108 492	289 312 907	27 940
	Container	16 110 662	15 356 042	23 926 444	3 434 175	319 019	319 019	850 718 011	71 545
	Cargo / Passenger	10 391 682	6 021 236	5 212 682	2 261 141	196 880	196 880	525 012 036	47 107
	Cruise	1 942 482	1 112 022	913 597	423 860	36 544	36 544	97 450 325	8 830
	Inland	427 387	314 728	181 695	92 657	7 268	7 268	19 380 779	1 930
	Others	786 411	378 574	612 669	169 498	13 344	13 344	35 584 061	3 531

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