WP3.2 – REPORT FROM THESSALONIKI REGION

THE CURRENT REPORT IS A COLLABORATION OF UNIVERSITY OF WESTERN MACEDONIA
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SUMMARY

University of West Macedonia redacted five reports for each region which participates in APICE project: Barcelona, Marseille, Venice, Genoa and Thessaloniki. In each report, there is a brief presentation of each region and port area. An analysis of the air quality in each area for the last years follows and the interest is focused on PM10. Meteorological conditions influence is also examined. With the scope of the study of the port's contribution to the air quality of each city, these reports prepare the next steps of an inter-comparison campaign and an air long monitoring campaign for a source apportionment study as also for modeling activities and socio-economic trends. The present report refers to the port of Thessaloniki.

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INTRODUCTION

The current report has been redacted in lines of APICE program (Common Mediterranean strategy and local practical Actions for the mitigation of Port, Industries and Cities Emissions). APICE project develops its actions within 5 study areas of 4 MED space Countries belonging to the regions of Veneto and Liguria (Italy), Provence-Alpes-Côte d'Azur (France), Cataluña (Spain) and Central Macedonia (Greece) and involve some of the most important port-cities of Mediterranean space. The project areas show common features related to the port-areas systems (in terms of harbor-industrial district organization) and present the same problems of air-pollution affecting seriously not only the populated urban centers but also the whole natural ecosystems and the cultural heritage (the project territories count several Sites of Community Importance & Special Protection Areas in their surroundings, as well as UNESCO sites).

The report includes a description of the air quality and meteorology network in Thessaloniki's region. Furthermore, a brief analysis of the air quality during the last years is included. The interest is focused on the Port of Thessaloniki area. PM10 particles monthly, daily and hourly variation was examined for the year 2009. A discussion about PM10 limit values excesses as well as the effect of meteorological parameters to PM10 levels is also included. Finally, a description of the national and international framework follows.

1. PARTNERS PRESENTATION

University of west Macedonia (UOWM)

The Department of Mechanical Engineering, former Department of Engineering and Management of Energy Resources, was first established in 1999 as one of the three new departments of the Aristotle University of Thessaloniki (AUTH), in the framework of expanding the scope of higher education. The foundation of the Department and its rules of operation are determined by Presidential Decree 179/6.1999 t.a. The department is one of the founding departments of the University of Western Macedonia which was established in 2004. The Department of Mechanical Engineering is located in the city of Kozani which is the heart of energy production in the country. Nearly 70% of the electricity is produced in the power plants located in the broader area of Kozani.

Aristotle University of Thessaloniki (A.U.Th.)

Aristotle University of Thessaloniki (A.U.Th.) undertakes extensive research activities, with excellent participation in European projects, international collaboration schemes and with acclaimed researchers. Each year, 600-700 new research projects are initiated, while the average duration of a project is three years. Sectors in which research projects are currently implemented are: the environment (natural and structured), new materials, IT and communications, agricultural research, biotechnology, medical research, architectural research, new technologies and nanotechnology, research in social and economic sciences, research in issues of language and culture, etc. A.U.Th. cooperates closely with Universities, research centres, organisations and companies in Greece and abroad. Thanks to its high number of Faculties and Schools, as well as its 250 laboratories, it has the capacity to implement research, technological, educational and training projects, as well as Service Provision Projects. The Research Committee is the University institution for the management of research and related activities. It was created in order to meet the special needs of research activities and, specifically, in order to facilitate the distinction between research and teaching and to provide external financing.

The Laboratory of Atmospheric Physics (LAP) is part of the Physics Department, in the Faculty of Sciences of Aristotle University of Thessaloniki (AUTH). The main research activities fall in the domain of Atmospheric and Environmental Physics. Research topics of current interest include the tropospheric chemistry and dispersion of air pollutants, the transmission of solar radiation through the atmosphere, climate modeling and atmospheric effects of climate change, the variations and physics of the ozone layer, the distribution and optical properties of atmospheric constituents using both ground-based and satellite measurements and the instrument characterization and quality control. These topics are investigated using both experimental data and theoretical calculations. The modeling capabilities of LAP include deterministic 3D models, statistical model development, sensitivity and uncertainty analysis of model output, regional climate models, coupled climate-chemistry models and radiative transfer models. The scientific infrastructure of LAP-AUTH comprises a lidar system for aerosol and ozone measurements, spectroradiometers for UV and visible solar radiation measurements and remote sensing of atmospheric constituents, a nation-wide network of UV and visible solar radiation radiometers and facilities for absolute calibration and radiometric characterization of radiation instruments. Since 1991 LAP-AUTH hosts the Total Ozone Mapping Center of the World Meteorological Organization. During the 28 years of its lifetime and in the frame of scientific research programs, its members have collaborated with many Universities and Research Institutes all over the world, as well as with international organizations, such as WMO, DLR, ESA, EUMETSAT, NCAR, NASA, JRC Ispra, IFU, ECMWF, RIVM, MPI at Hamburg and Mainz, Riso National Laboratory, Universities of Cambridge, Uppsala, Oslo, Munich, Manchester, Innsbruck, Hannover, etc. Members of LAP-AUTH have participated in international assessments (e.g. of UNEP, WMO and IPCC) and are active members of committees and workgroups for the depletion of the ozone layer, the variations and effects of solar ultraviolet radiation and the global climate change.

LAP-AUTH research activities that are related to the objectives of the APICE project and focus on numerical regional and urban scale modeling (chemical and meteorological), boundary layer meteorology, data analysis and coupling between model results and observations, sensitivity analysis of model results, compilation of anthropogenic and natural emission inventories.

Region of Central Macedonia (RCM)

The Region of Central Macedonia (RCM), one of the thirteen administrative regions of Greece, is situated in the centre of Northern Greece and includes seven prefectures (Thessalonica, Imathia, Kilkis, Pella, Pieria, Serres and Chalkidiki). Covering a surface of 19.147 km2 (14,51% of the country's total), is considered to be the first in size, region of the country. It shares borders with two Balkan countries to the north (F.Y.R.O.M. and Bulgaria). Central Macedonia is bounded by the region of Western Macedonia to the West, the region of Eastern Macedonia – Thrace to the East and by the region of Thessaly and the Aegean Sea to the South. The region is characterized by rich physical, terrestrial and aquatic resources and also rich subsoil, that are partly exploited but further infrastructures' modernization and research activities are still needed. The Region of C. Macedonia is very favourably located in the crossroads of the national road axis of PATHE (connecting Patra, Athens, Thessalonica, Evzoni – borders with FYROM) and EGNATIA. This central position together with the port of Thessalonica will be further consolidated with EGNATIA's completion and the connection to Adriatic Sea. RCM's geographical position given its cross regional, cross Balkans and European operation, forms a "field" for significant initiatives development.

The Region of Central Macedonia (RCM) is a decentralized Regional Administration unit (under the L 2503/1997) that is responsible for a number of competencies and resources transferred from the Central Administration. The perspectives of the Region of Central Macedonia in the European and international environment are defined based on the activity of its production system for adaptation and restructuring. A basic element for both, confronting the challenges and seizing opportunities, within the frame of knowledge technology, is the development of a regional strategy for innovation, is the development of a regional strategy and competitiveness.

During the 2000-2006 Programming Period, the Region of Central Macedonia, implemented successfully the Regional Operational Programme of 1,5 bn € with an absorption of 100%. In the current Programming Period it operates a budget of 4,1 bn €.
The organizational structure of the Region consists of 43 Directorates and a series of thematic administrative fields fall under its responsibilities (ie Environment, Spatial Planning, Civil Protection and Immigration) and is also involved in the wider social and economic policy. The Directorate of Civil Protection occupies a rich experience in tackling emergency events

(fires, floods, earthquakes, etc) while prevention is a key element when drafting the Regional Action Plans. Prevention is subject to consultation and cooperation with the local and wider area involved authorities and stakeholders. The Region of Central Macedonia, as the Body responsible to implement these Action Plans disseminates information to the citizens on how they should react in the case of natural risks but also coordinates the actions of all involved entities and invests in training groups of volunteers and targeted groups of citizens (ie. School children,etc).
The region has, in the framework of environmental and social assurance as well as economic growth, adopted an open and active policy of cooperation under many initiatives, actions and projects involving local actors and other regions and countries throughout Europe for the creation and exchange of expertise and identification and diffusion of innovative best practices

2. PORT PRESENTATION

Considering the geopolitical form of the broader area, the city of Thessaloniki is the central pole for implementing a national development strategy. It is co-capital of Greece, the second largest city of the country and the capital of the administrative Region of Central Macedonia (RCM). With a population of over 1,000,000 people, it constitutes a modern European commercial and cultural metropolis, and one of the most important trade and communication centres, situated in the heart of the Balkans.

Thessaloniki is the gateway to the Balkans and the hub of a new trading network within South-East Europe and the wider east Mediterranean area, capable of regaining its former importance as the second city in the Roman, Byzantine, and Ottoman Empire. Thessaloniki is being hailed as the new metropolitan centre of the entire Balkan Peninsula, as well as the centre for information and coordination in several European and international initiatives for Balkan reconstruction. The city has a long history as a centre of regional trade and finance and this continues in modern times. Since 1995, Thessaloniki has its own Stock Exchange, whose mission is to become a major stock market in southeastern Europe and the Balkan region. The impact of globalisation and the realisation that only through trade can smaller Balkan countries achieve competitiveness, both contribute to Thessaloniki’s reemergence. Except for being a major port city, Thessaloniki is Greece's second major economic, industrial, commercial and political centre, as well as a major transportation hub for the rest of southeastern Europe. The city's industries mainly produce refined oil, steel, petrochemicals, textile, machinery, flour, cement, pharmaceuticals. A considerable percentage of the city's working people are employed in small and medium sized businesses and in the service and the public sector. In recent years, the city has begun a process of deindustrialization and a move towards a service based economy.

The Port of Thessaloniki is one of the largest Greek seaports and one of the largest ports in the East Mediterranean basin, with a total annual traffic capacity of 16 million tones (7 million tones dry bulk and 9 million tones liquid bulk). It is also the second largest Greek container port after the Port of Piraeus.

Thessaloniki's port is a European port and the natural gateway for economic activities between Eastern Europe, Black Sea and Middle East areas. It serves the growing needs of those countries for the import and export of raw material, consumer products and capital equipment. The port is a vital element of the country's economy while it also plays a substantial role in the effort of Northern Greece and its centre city to be established as the economic centre of the Eastern Mediterranean. The port enjoys a privileged position being located at the crossroad of land transportation networks. Moreover, the port is at a driving distance of 16 kilometers from the International "Makedonia" Airport and at a mere kilometer from the Railway Station.

Thessaloniki's port has a total quay length of 6,200m and a sea depth down to 12 meters. It has 600,000 m2 of indoor and open storage area and modern mechanical equipment for the secure and prompt handling of all kinds of cargo, general, bulk and containers. Thessaloniki Port Authority S.A. is currently one of the major employers of Northern Greece with a workforce of more than 600 people while over 2,000 people work daily on its premises.

The container terminal has a storage area of 350,000 m^2 and a storage capacity of 4,696 TEU's in ground slots and is currently being expanded by 36 hectares.

The cargo terminal has a storage area of 1,000,000 m^2 specializes in the handling of wide cargoes: metal products, ore, chemical products (chloroform, asphalt, chemicals, mineral oils), general cargoes, timber, bulk cargoes and food products. The cargo terminal also serves as a major transshipment hub in the Aegean — Black Sea area being used by other Balkan countries like Serbia, FYROM, Albania and Montenegro.

The oil and gas terminal has a total storage capacity of 500,000 m^2 and an annual traffic capacity of 9,000,000 tonnes per year.

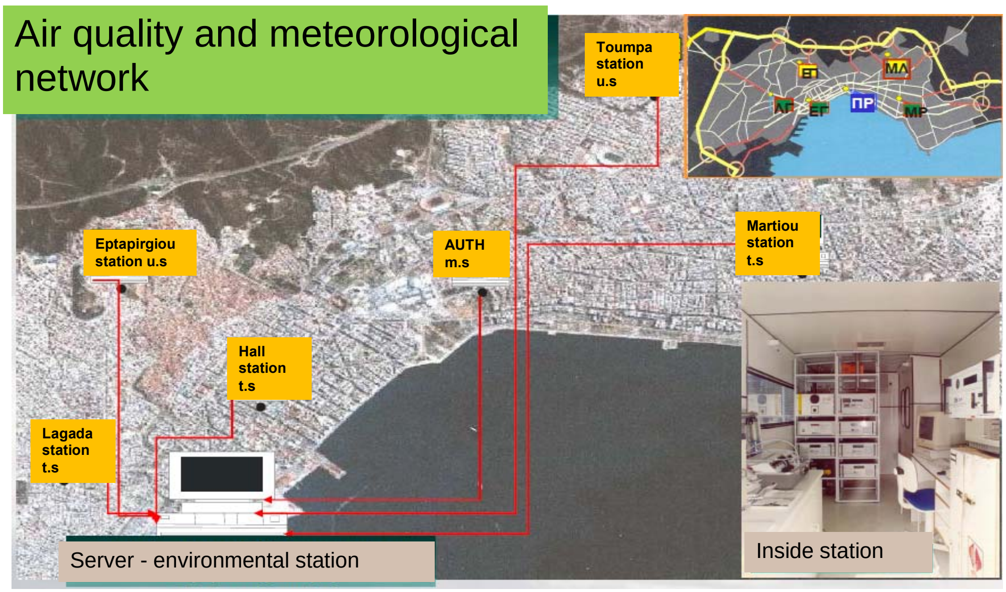
Finally, the Port of Thessaloniki has one of the largest passenger terminals in the East Mediterranean Sea basin, which handles around 200,000 passengers per year.

4. MONITORING NETWORKS

4.1 AIR QUALITY AND METEOROLOGICAL NETWORK

The air quality network in Thessaloniki region includes 8 stations while the nearest to the port station is Aghia Sophia’s station.

CODE	*STATION*
Σ1	SINDOS
Σ2	NEOXOROUDA
Σ3	KORDELIO
Σ4	PL.DIMOKRATIAS
Σ5	AG.SOFIAS
Σ6	AUTH
Σ7	PANORAMA
Σ8	KALAMARIA



u.s – ***urban station***
t.s – ***traffic station***
m.s – ***meteorological station***

The following Table presents the monitored pollutants in each station of the network. Meteorological data (wind speed, wind direction, temperature, relative humidity) are recorded in all stations except for Agia Sofia and Pl. Dimokratias stations.

POLLUTANT	**STATION**							
	AUTH (University) station urban	KORDELIO station urban/ industrial	KALAMARIA station suburban	NEOXOROUDA station agricultural	PANORAMA station suburban	**AGIA SOFIA (near the port station) urban**	PL. DIMOKRATIAS station urban	SINDOS station Agricultural/ industrial
SO_2	✓	✓	✓			✓		✓
NOx	✓	✓	✓	✓	✓	✓	✓	✓
O_3	✓	✓	✓	✓	✓	✓		✓
CO		✓	✓			✓	✓	✓
PM10		✓			✓	✓		✓

The monitoring is continuous and automatic, with a time interval of 1 minute. Pollutants' data are concentrated in a central computing system and hourly average values are calculated. A frequent instruments calibration provides monitoring accuracy.

5. MEASUREMENTS

5.1 POLLUTANTS

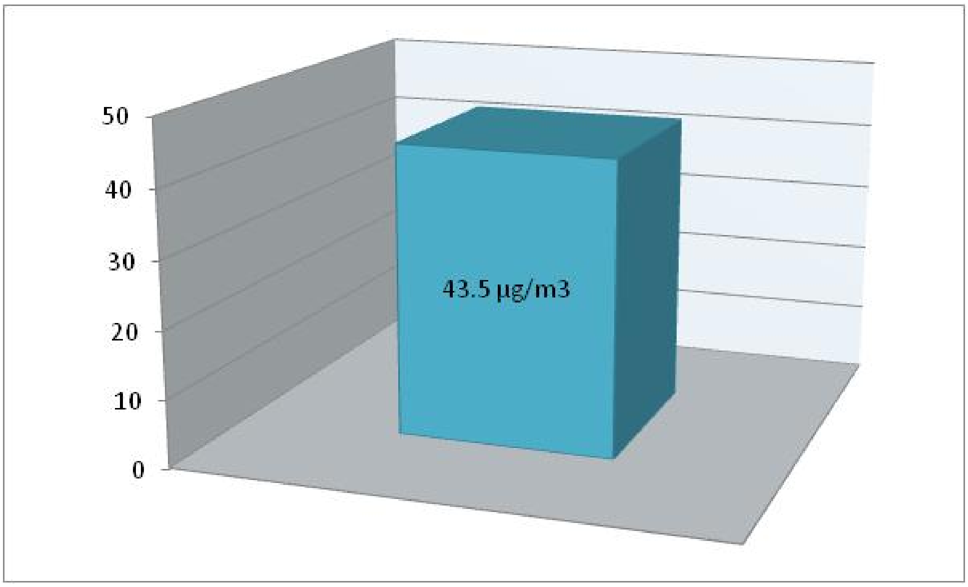
6. ANALYSIS OF PM10 FOR YEAR 2009 FOR NEAR THE PORT STATION

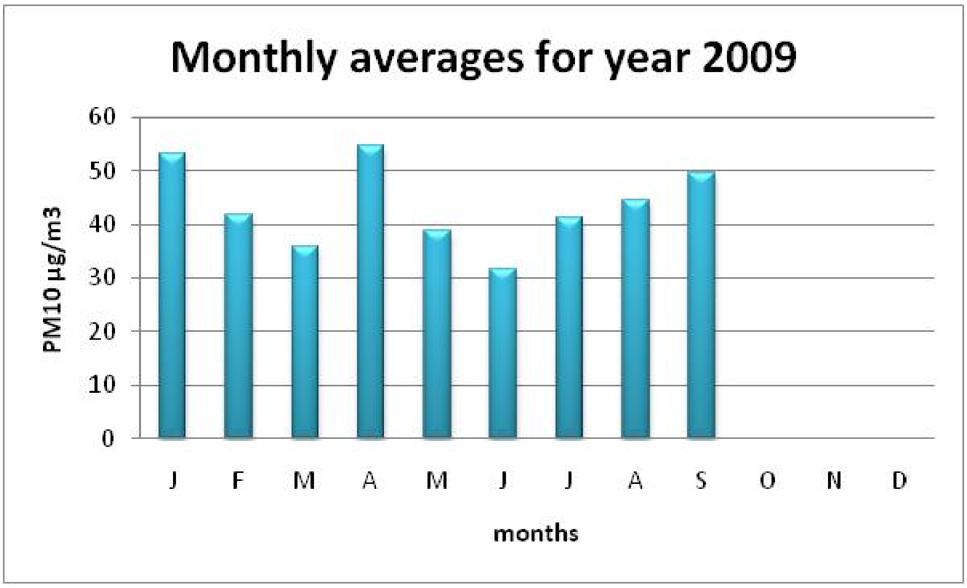
In this section, PM10 levels at “Aghia Sofia” station for the year 2009 is presented. This station was selected because of its vicinity and direct affection from the port air pollution and due to the immediate access to data. The analysis is focused on PM10 particles which is one of the major pollutants that attract the scientific interest, as there is a proven connection with adverse health problems. *Data for October, November and December from this year were not available.*

The average annual PM10 concentration at Aghia Sofia’s station is 43,5μg/m^3 that is slightly higher than the annual limit value (40μg/m^3). Regarding monthly averages, the highest values correspond to April, January and September. The lowest monthly value was recorded during June. Among daily average values during the year 2009 (where data were available), peaks are recorded all over the year, as extended emissions under specific meteorological patterns can lead to high particles concentrations.

Regarding the average value per each day of the week for the same year, it is noticed that particles’ levels are slightly lower on Sundays, possibly due to the reduced vehicles circulation and human activity in the center of Thessaloniki.

Finally, the exceeded days (limit value 50μg/m^3) were …. For this year and were noticed mainly during winter and autumn.


50
40
30
20
10
0
43.5 µg/m3


Monthly averages for year 2009
PM10 µg/m3
60
50
40
30
20
10
0
J
F
M
A
M
J
J
A
S
O
N
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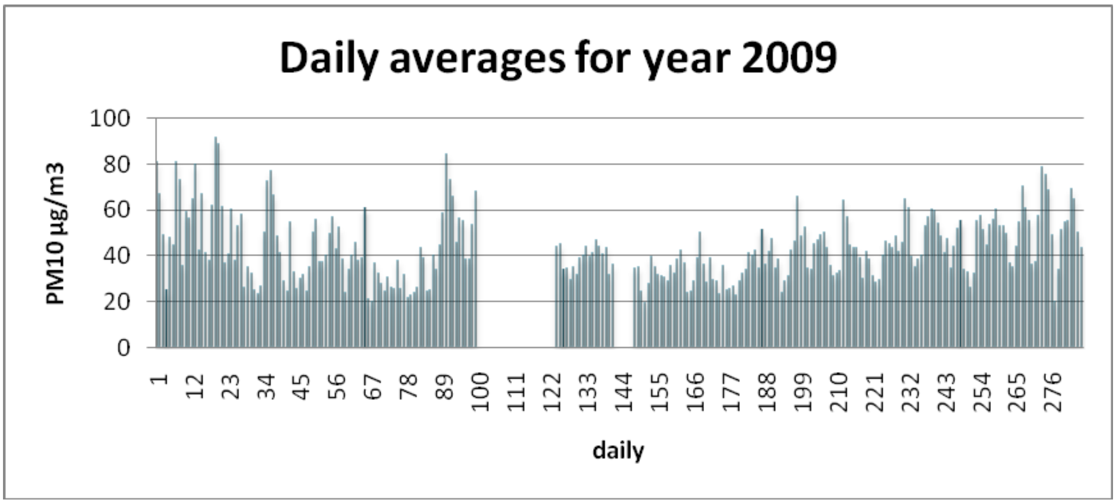
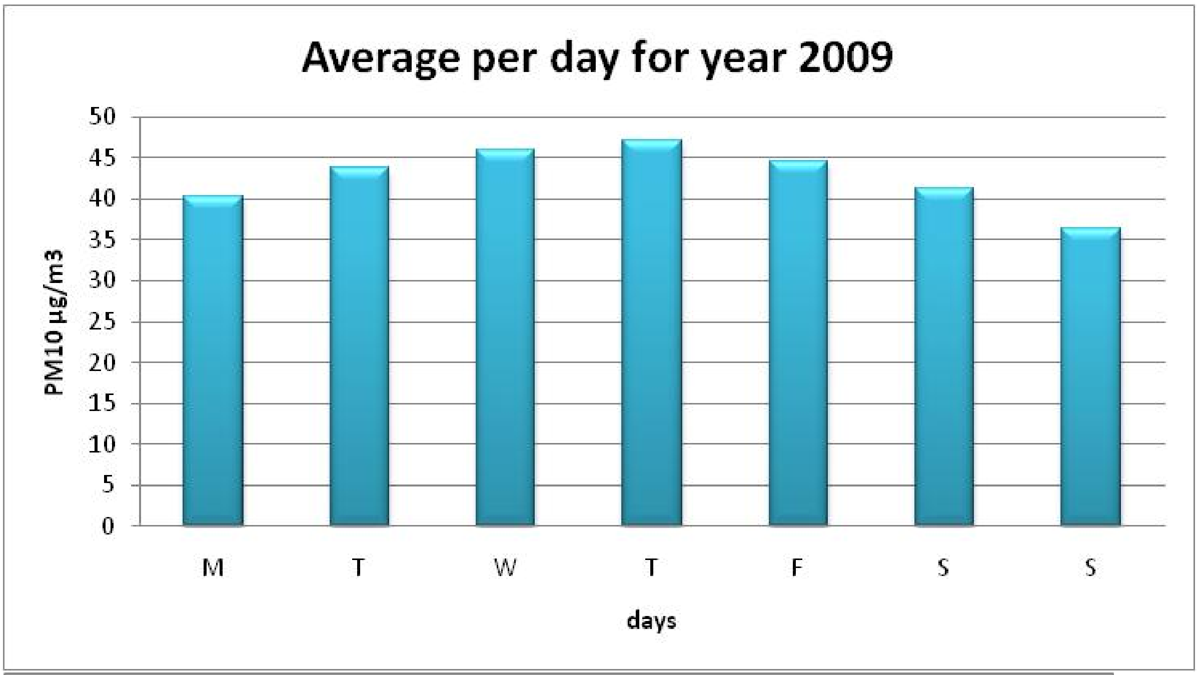
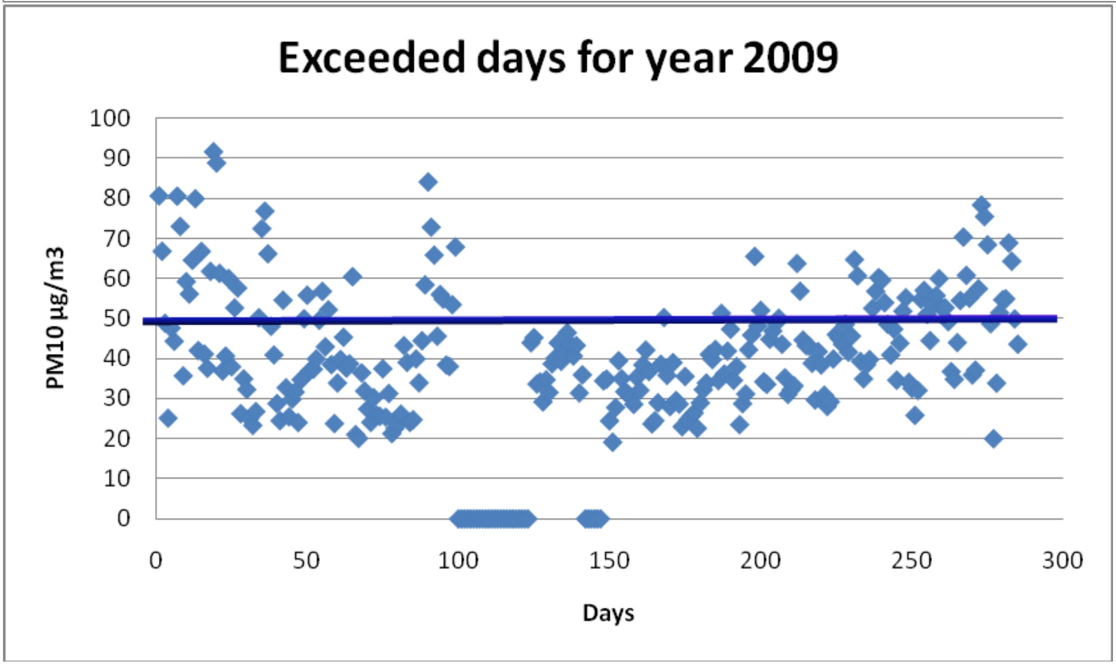
months


Daily averages for year 2009
PM10 µg/m3
100
80
60
40
20
0
1
12
23
34
45
56
67
78
89
100
111
122
133
144
155
166
177
188
199
210
221
232
243
254
265
276
daily


Average per day for year 2009
PM10 µg/m3
50
45
40
35
30
25
20
15
10
5
0
M
T
W
T
F
S
S
days


Exceeded days for year 2009
PM10 µg/m3
100
90
80
70
60
50
40
30
20
10
0
0
50
100
150
200
250
300
Days

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Project co-finnaced by the European Regional Development Fund

7. FRAMEWORK ANALYSIS

7.1 INTRODUCTION

By itself, technology is as likely to harm the environment as to help it. That's why laws and regulations have been such an important part of tackling the problem of pollution. Many once-polluted cities now have relatively clean air and water, largely thanks to anti-pollution laws introduced during the mid-20th century. In England, following the 1952 smog tragedy that killed thousands of people in the capital city of London, the government introduced its Clean Air Act of 1956, which restricted how and where coal could be burned and where furnaces could be sited and forced people to build smokestacks higher to disperse pollution. In the United States, a series of Clean Air Acts were passed between the 1960s and 1990s. The 1990 Pollution Prevention Act went even further, shifting the emphasis from cleaning up pollution to preventing it ever happening in the first place.

National laws are of little help in tackling trans-boundary pollution (when air pollution from one country affects neighboring countries or continents), but that doesn't mean the law is useless in such cases. The creation of the European Union (now comprising around 30 different countries) has led to many Europe-wide environmental acts, called directives. These force the member countries to introduce their own, broadly similar, national environmental laws that ultimately cover the entire European region. For example, the 1976 European Bathing Water Directive tried to enforce minimum standards of water quality for beaches and coastal areas across Europe to reduce pollution from sewage disposal, while the 1996 European Directive on Integrated Pollution Prevention and Control (IPPC) attempted to limit air and water pollution from industry. Other successful international laws include the Convention on Long-Range Trans-boundary Air Pollution (1979), which has helped to reduce sulfur dioxide emissions from power plants and, of course, the Montreal Protocol, which successfully brought 196 countries together to target ozone depletion. Unfortunately, attempts to control global warming through international laws and agreements have so far proved less successful.

Any effective program regulating maritime emissions will need to take account of the legal circumstances that govern maritime activity. Indeed, the international nature of shipping means that international regulations need to be accounted for in considering the legal context. To that end, the following section provides a very brief discussion of the existing international legal framework and its relevance for shipping.

7.2 INTERNATIONAL FRAMEWORK

INTRODUCTION

Exhaust emissions from ships are considered to be a significant source of air pollution, with 18-30% of all nitrogen oxide and 9% of sulphur oxide pollution. The 15 biggest ships emit about as much sulphur oxide pollution as all cars combined. Sulfur in the air creates acid rain which damages crops and buildings. When inhaled the sulfur is known to cause respiratory problems and even increase the risk of a heart attack. According to Irene Blooming, a spokeswoman for the European environmental coalition Seas at Risk, the fuel used in oil tankers and container ships is high in sulfur and cheaper to buy compared to the fuel used for domestic land use. "A ship lets out around 50 times more sulfur than a lorry per metric ton of cargo carried." Cities in the U.S. like Long Beach, Los Angeles, Houston, Galveston, and Pittsburgh see some of the heaviest shipping traffic in the nation and have left local officials desperately trying to clean up the air. The increasing trade between the U.S. and China is helping to increase the number of vessels navigating the Pacific and exacerbating many of the environmental problems. To maintain the level of growth China is currently experiencing, large amounts of grain are being shipped to China by the boat load. The number of voyages is expected to continue increasing. 3.5% to 4% of all climate change emissions are caused by shipping.

Although international regulation in other environmental areas is long standing, international efforts to reduce air emissions from ships are relatively new. The need for measures to reduce air pollutant emissions from international shipping has been on the agenda since the late 1980s. After years of negotiation, a first agreement – the Annex VI1 to the IMO's MARPOL Convention – was adopted in 1997. But even at the time of adoption it was widely recognized as being insufficient.

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Project co-financed by the European Regional Development Fund

LEGISLATION AUTHORITIES

There are some common elements that an emissions policy for ships must include; one of them is an appropriate legal basis, which is also related to an effective monitoring and enforcement regime. Any new policy to control emissions would have to be in conformity with international and EU law. The United Nations Convention on the Law of the Sea ("UNCLOS") sets out the basic legal framework that governs international shipping. The Convention gives some support for the control of air emissions (Article 212), but this is balanced against the right of ships to innocent passage without being subject to any charges, except for services received. Relevant are also the current international environmental regulations, notably the International Maritime Organization's ("IMO's"), International Convention on the Prevention of Pollution from Ships ("MARPOL"), which sets a global limit on fuel sulphur content, and also designates Sulphur Oxide Emission Control Areas ("SECAs") in the North Sea and the Baltic Sea. MARPOL also sets NOx emissions standards via the IMO "NOx curve". (The 2005 EU Sulphur Directive imposes additional requirements to limit fuel sulphur content in SECAs, imposes restrictions on passenger vessels throughout the EU, and requires ships at berth to use 0.1 percent sulphur fuel or better from 2010 onward. The considered policies must be consistent with the existing legal framework for addressing emissions from shipping, although it is likely that certain details need to be worked out for each one.

The mentioned authorities are based on studies of emissions from ships. This is complicated by the fact that fuel consumption and emission factors are highly variable, depending on engine size, age, and load, on existing emission control technologies, on fuel composition, and on ambient conditions. In general, monitoring can be divided into periodic and continuous monitoring (periodic monitoring is cheaper but less accurate than continuous monitoring) and into monitoring of the fuel used or direct measurement of exhaust emissions (fuel-based is cheaper but less accurate than the monitoring of exhaust emissions). The appropriate trade-off between cost and accuracy is likely to depend on the instrument used, as requirements differ between different approaches. Additional considerations include the ability to keep track of emissions within a specific geographical area, which poses significant challenges without continuous monitoring.

UNITED NATIONS CONVENTION ON THE LAW OF SEA (UNCLOS)

The United Nations Convention on the Law of the Sea ("UNCLOS"), formally codified in 1982, is the basic legal framework that governs international shipping. As noted in Davies et al. (BMT 2000), states operate in three capacities: as flag, port, and coastal states. UNCLOS gives flag states the primary authority to impose environmental regulations (including those related to air emissions) on marine sources through their responsibility to enforce international laws. The roles of other jurisdictions—i.e., port and coastal states— "have traditionally been more limited" (BMT 2000). However, the language in UNCLOS suggests that non-flag states do have some authority to regulate marine emissions.

UNCLOS guarantees port states the right to "establish particular requirements for the prevention, reduction and control of pollution of the marine environment as a condition for the entry of foreign vessels into their ports or internal waters" (Article 211, paragraph 2). In addition, UNCLOS gives each coastal state the authority to control in-port emissions through its right to "exclude vessels from its ports or place conditions upon their entry" (BMT 2000). Although coastal states have limited authority to regulate general pollution under UNCLOS, they appear to have greater power in the regulation of air emissions. Articles 212 and 222 of UNCLOS, which govern air emissions from marine vessels, are somewhat vague with respect to the jurisdictional limits of coastal states. Indeed, when it comes to air emissions, a state's jurisdiction is defined with respect to infringement upon its airspace. Article 212 allows states to "adopt laws and regulations to prevent, reduce and control pollution of the marine environment from or through the atmosphere, applicable to the air space under their sovereignty." While UNCLOS gives some jurisdiction to port and coastal states in the control of marine air emissions, the Convention professes a clear preference for international regulations wherever possible. IMO would manage any such international regulations. Though IMO is explicitly mentioned only once in UNCLOS (Article 2 of Annex VIII), UNCLOS frequently refers to the "competent international organization" in connection with the adoption of international shipping safety and pollution standards; in most cases, this phrasing (i.e., "the competent international organization") has been interpreted to refer exclusively to IMO. IMO is generally responsible for the oversight of international shipping activity. In particular, IMO's charter explicitly charges it with the oversight of safety and antipollution efforts in international shipping. Since its creation in 1948, IMO has established a variety of measures to enforce increased safety and reduced pollution from international shipping. A major limitation affecting any jurisdictional authority relates to the right of innocent passage, which is also codified in UNCLOS. UNCLOS Part 2, Section 3 guarantees innocent right of passage for foreign-flag vessels in the territorial sea without being subject to any charges, except for services received. This restriction is clearly relevant to the control of emissions from shipping, since under a strict reading of this requirement, payments or charges related to reducing emissions from foreign-flag vessels would have to be embodied in a framework of providing services to those vessels. In addition, one aspect of the right of innocent passage, articulated in Article 21 of UNCLOS, precludes coastal states from enforcing any regulations that apply to the design, construction, manning or equipment of foreign vessels. This could be interpreted as restricting the ability of coastal states to require pollution abatement equipment or engine modifications on foreign vessels. A reason for considering market-based approaches to emissions regulations is that they offer a flexible means of complying with environmental regulations, and therefore may make it easier to promote the use of low-emissions technologies in certain sea areas, without impinging upon ships' right of innocent passage.

INTERNATIONAL MARITIME ORGANIZATION (IMO)

International Maritime Organization (IMO) is an agency of the United Nations which has been formed to promote maritime safety. It was formally established by an international conference in Geneva in 1948, and became active in 1958 when the IMO Convention entered into force (the original name was the Inter-Governmental Maritime Consultative Organization, or IMCO, but the name was changed in 1982 to IMO). IMO currently groups 167 Member States and 3 Associate Members.

IMO ship pollution rules are contained in the "International Convention on the Prevention of Pollution from Ships", known as MARPOL 73/78. On 27 September 1997, the MARPOL Convention has been amended by the "1997 Protocol", which includes Annex VI titled "Regulations for the Prevention of Air Pollution from Ships". MARPOL Annex VI sets limits on NOx and SOx emissions from ship exhausts, and prohibits deliberate emissions of ozone depleting substances.

The IMO emission standards are commonly referred to as Tier I...III standards. The Tier I standards were defined in the 1997 version of Annex VI, while the Tier II/III standards were introduced by Annex VI amendments adopted in 2008, as follows:

1997 Protocol (Tier I)—The "1997 Protocol" to MARPOL, which includes Annex VI, becomes effective 12 months after being accepted by 15 States with not less than 50% of world merchant shipping tonnage. On 18 May 2004, Samoa deposited its ratification as the 15th State (joining Bahamas, Bangladesh, Barbados, Denmark, Germany, Greece, Liberia, Marshal Islands, Norway, Panama, Singapore, Spain, Sweden, and Vanuatu). At that date, Annex VI was ratified by States with 54.57% of world merchant shipping tonnage.

Accordingly, Annex VI entered into force on 19 May 2005. It applies retroactively to new engines greater than 130 kW installed on vessels constructed on or after January 1, 2000, or which undergo a major conversion after that date. The regulation also applies to fixed and floating rigs and to drilling platforms (except for emissions associated directly with exploration and/or handling of sea-bed minerals). In anticipation of the Annex VI ratification, most marine engine manufacturers have been building engines compliant with the above standards since 2000.

2008 Amendments (Tier II/III)—Annex VI amendments adopted in October 2008 introduced (1) new fuel quality requirements beginning from July 2010, (2) Tier II and III NOx emission standards for new engines, and (3) Tier I NOx requirements for existing pre-2000 engines.

The revised Annex VI enters into force on 1 July 2010. By October 2008, Annex VI was ratified by 53 countries (including the Unites States), representing 81.88% of tonnage.

EMISSION CONTROL AREAS

Two sets of emission and fuel quality requirements are defined by Annex VI: (1) global requirements, and (2) more stringent requirements applicable to ships in Emission Control Areas (ECA). An Emission Control Area can be designated for SOx and PM, or NOx, or all three types of emissions from ships, subject to a proposal from a Party to Annex VI.

Existing Emission Control Areas include:

- Baltic Sea (SOx, adopted: 1997 / entered into force: 2005)
- North Sea (SOx, 2005/2006)
- North American ECA, including most of US and Canadian coast (NOx & SOx, 2010/2012).

EMISSION STANDARTS

NOx

NOx emission limits are set for diesel engines depending on the engine maximum operating speed (n, rpm), as shown in Table 18 and presented graphically in Figure 34. Tier I and Tier II limits are global, while the Tier III standards apply only in NOx Emission Control Areas.

Table 18. MARPOL Annex VI NOx Emission Limits

Tier	Date	NOx Limit, g/kWh		
		n < 130	130 ≤ n < 2000	n ≥ 2000
Tier I	2000	17.0	$45 \cdot n^{-0.2}$	9.8
Tier II	2011	14.4	$44 \cdot n^{-0.23}$	7.7
Tier III	2016†	3.4	$9 \cdot n^{-0.2}$	1.96

† In NOx Emission Control Areas (Tier II standards apply outside ECAs).

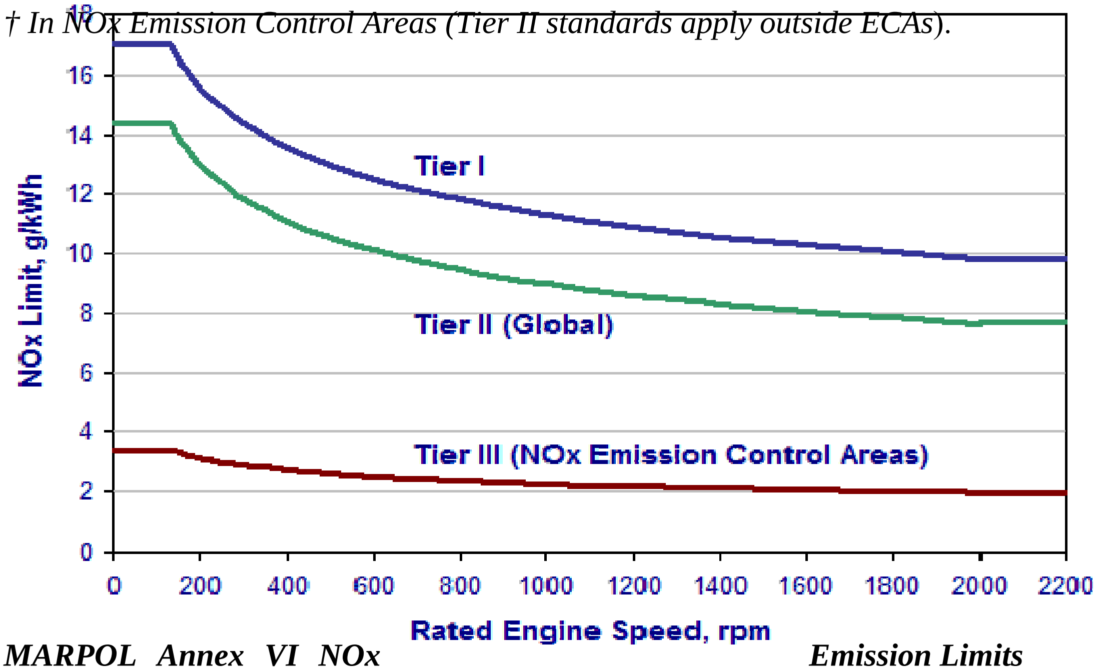

Figure 34: MARPOL Annex VI NOx Emission Limits

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Tier II standards are expected to be met by combustion process optimization. The parameters examined by engine manufacturers include fuel injection timing, pressure, and rate (rate shaping), fuel nozzle flow area; exhaust valve timing, and cylinder compression volume.
Tier III standards are expected to require dedicated NOx emission control technologies such as various forms of water induction into the combustion process (with fuel, scavenging air, or in-cylinder), exhaust gas recirculation, or selective catalytic reduction.
Pre-2000 Engines. Under the 2008 Annex VI amendments, Tier I standards become applicable to existing engines installed on ships built between 1st January 1990 to 31st December 1999, with a displacement ≥ 90 liters per cylinder and rated output ≥ 5000 kW, subject to availability of approved engine upgrade kit.
Testing. Engine emissions are tested on various ISO 8178 cycles (E2, E3 cycles for various types of propulsion engines, D2 for constant speed auxiliary engines, C1 for variable speed and load auxiliary engines). Addition of not-to-exceed (NTE) testing requirements to the Tier III standards is being debated. NTE limits with a multiplier of 1.5 would be applicable to NOx emissions at any individual load point in the E2/E3 cycle. Engines are tested using distillate diesel fuels, even though residual fuels are usually used in real life operation.
Further technical details pertaining to NOx emissions, such as emission control methods, are included in the mandatory “NOx Technical Code”, which has been adopted under the cover of “Resolution 2”.

SULFUR

Annex VI regulations include caps on sulfur content of fuel oil as a measure to control SOx emissions and, indirectly, PM emissions (there are no explicit PM emission limits). Special fuel quality provisions exist for SOx Emission Control Areas (SOx ECA or SECA). The sulfur limits and implementation dates are listed in Table 19 and illustrated in Figure 35.

Table 19. MARPOL Annex VI Fuel Sulfur Limits

Date	Sulfur Limit in Fuel (% m/m)	
	SOx ECA	**Global**
2000	1.5%	4.5%
2010.07	1.0%	
2012		3.5%
2015	0.1%	
2020[a]		0.5%

a - alternative date is 2025, to be decided by a review in 2018

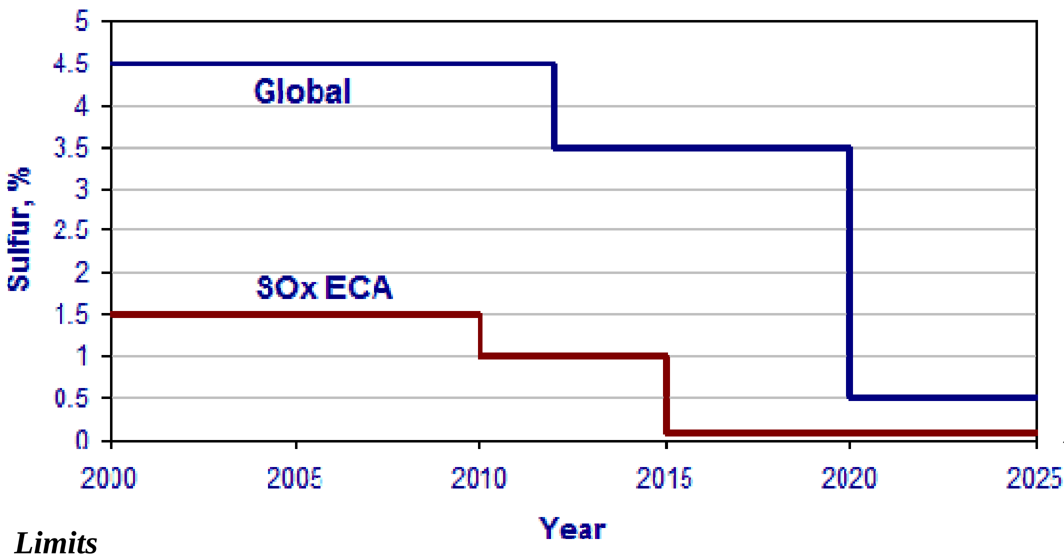

Figure 35: MARPOL Annex VI Fuel Sulfur Limits

Heavy fuel oil (HFO) is allowed provided that it meets the applicable sulfur limit (i.e., there is no mandate to use distillate fuels).

Alternative measures are also allowed (in the SOx ECAs and globally) to reduce sulfur emissions, such as through the use of scrubbers. For example, in lieu of using the 1.5% S fuel in SOx ECAs, ships can fit an exhaust gas cleaning system or use any other technological method to limit SOx emissions to ≤ 6 g/kWh (as SO_2).

OTHER PROVISIONS

Ozone Depleting Substances. Annex VI prohibits deliberate emissions of ozone depleting substances, which include halons and chlorofluorocarbons (CFCs). New installations containing ozone-depleting substances are prohibited on all ships. But new installations containing hydro-chlorofluorocarbons (HCFCs) are permitted until 1 January 2020.

Annex VI also prohibits the incineration on board ships of certain products, such as contaminated packaging materials and polychlorinated biphenyls (PCBs).

Compliance. Compliance with the provisions of Annex VI is determined by periodic inspections and surveys. Upon passing the surveys, the ship is issued an “International Air Pollution Prevention Certificate”, which is valid for up to 5 years. Under the “NOx Technical Code”, the ship operator (not the engine manufacturer) is responsible for in-use compliance.

Greenhouse Gas Emissions. Annex VI does not cover the emission of greenhouse gases from ships. In November 2003, the IMO adopted resolution A.963(23) on IMO Policies and Practices related to the Reduction of Greenhouse Gas Emissions from Ships.

7.3 EUROPEAN

INTRODUCTION

Most European ports are free to determine their own dues and therefore also free to introduce dues differentiation. Indeed, dues are already commonly differentiated according to vessel class or particular vessel characteristics. The addition of environmental criteria is not likely to require new institutions, provided that ports can easily verify the status of ships with respect to the differentiation criteria it has in place. In the absence of existing institutions to carry out certification of ships according to the desired criteria, this may require that procedures be put in place.

AIR QUALITY STANDARTS

Humans can be adversely affected by exposure to air pollutants in ambient air. In response, the European Union has developed an extensive body of legislation which establishes health based standards and objectives for a number of pollutants in air. These standards and objectives are summarized in the table below. These apply over differing periods of time because the observed health impacts associated with the various pollutants occur over different exposure times.

Table 20: Air quality standards per pollutant

Pollutant	Concentration	Averaging period	Legal nature	Permitted exceedences each year
Fine articles (PM2.5)	25 µg/m3***	1 year	Target value enters into force 1.1.2010 Limit value enters into force 1.1.2015	n/a
PM10	50 µg/m3	24 hours	Limit value enters into force 1.1.2005**	35
	40 µg/m3	1 year	Limit value enters into force 1.1.2005**	n/a
Sulphur dioxide (SO2)	350 µg/m3	1 hour	Limit value enters into force 1.1.2005	24
	125 µg/m3	24 hours	Limit value enters into force 1.1.2005	3
Nitrogen dioxide (NO2)	200 µg/m3	1 hour	Limit value enters into force 1.1.2010	18
	40 µg/m3	1 year	Limit value enters into force 1.1.2010*	n/a
Lead (Pb)	0.5 µg/m3	1 year	Limit value enters into force 1.1.2005 (or 1.1.2010 in the immediate vicinity of specific, notified industrial sources; and a 1.0 µg/m3 limit value applies from 1.1.2005 to 31.12.2009)	n/a
Carbon monoxide (CO)	10 mg/m3	Maximum daily 8 hour mean	Limit value enters into force 1.1.2005	n/a
Benzene	5 µg/m3	1 year	Limit value enters into force 1.1.2010**	n/a
Ozone	120 µg/m3	Maximum daily 8 hour	Target value enters into force 1.1.2010	25 days averaged over 3 years

		mean		
Arsenic (As)	6 ng/m3	1 year	Target value enters into force 1.1.2012	n/a
Cadmium (Cd)	5 ng/m3	1 year	Target value enters into force 1.1.2012	n/a
Nickel (Ni)	20 ng/m3	1 year	Target value enters into force 1.1.2012	n/a
Polycyclic Aromatic Hydrocarbons	1 ng/m3 (expressed as concentration of Benzo(a)pyrene)	1 year	Target value enters into force 1.1.2012	n/a

**Under the new Directive the Member State can apply for an extension of up to five years (i.e. maximum up to 2015) in a specific zone. Request is subject to assessment by the Commission. In such cases within the time extension period the limit value applies at the level of the limit value + maximum margin of tolerance (48µg/m3 for annual NO2 limit value).*
***Under the new Directive the Member State can apply for an extension until three years after the date of entry into force of the new Directive (i.e. May 20011) in a specific zone. Request is subject to assessment by the Commission. In such cases within the time extension period the limit value applies at the level of the limit value + maximum margin of tolerance (35 days at 75µg/m3 for daily PM10 limit value, 48µg/m3 for annual PM10 limit value).*
****Standard introduced by the new Directive 2008/50/EC*

Under EU law a limit value is legally binding from the date it enters into force subject to any exceedences permitted by the legislation. A target value is to be attained as far as possible by the attainment date and so is less strict than a limit value.
The new Directive is introducing additional PM2.5 objectives targeting the **exposure** of the population to fine particles. These objectives are set at the national level and are based on the average exposure indicator (AEI).
AEI is determined as a 3-year running annual mean PM2.5 concentration averaged over the selected monitoring stations in agglomerations and larger urban areas, set in urban background locations to best assess the PM2.5 exposure to the general population.

Table 21: Air quality standards for PM2.5 in lines of AEI

Title	**Metric**	**Averaging period**	**Legal nature**	**Permitted exceedences each year**
PM2.5 Exposure concentration obligation	20 µg/m3 (AEI)	Based on 3 year average	Legally binding in 2015 (years 2013,2014,2015)	n/a
PM2.5 Exposure reduction target	Percentage reduction* + all measures to reach 18 µg/m3 (AEI)	Based on 3 year average	Reduction to be attained where possible in 2020, determined on the basis of the value of exposure indicator in 2010	n/a

** Depending on the value of AEI in 2010, a percentage reduction requirement (0, 10, 15, or 20%) is set in the Directive. If AEI in 2010 is assessed to be over 22 µg/m3, all appropriate measures need to be taken to achieve 18µg/m^3 by 2020.*

PRINCIPLES
European legislation on air quality is built on certain principles. The first of these is that the Member States divide their territory into a number of zones and agglomerations. In these zones and agglomerations, the Member States should undertake assessments of air pollution levels using measurements and modeling and other empirical techniques. When levels are elevated, the Member States should prepare an air quality plan or program to ensure compliance with the limit value before the date when the limit value formally enters into force. In addition, information on air quality should be disseminated to the public.

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CLEAN AIR FOR EUROPE (CAFE)

In May 2001, the European Commission formally adopted the Clean Air For Europe (CAFE) program. The program is aimed at integrating the various strands of air pollution policy under the 6th Environmental Action Program and includes the preparation of a thematic strategy on air pollution – one of seven covering various areas of EU environmental policy. The CAFE process has therefore effectively become the focal point for the EU's air quality work, providing a framework within which air pollution measures, such as the Auto Oil program, national emissions ceilings Directive and the air quality Daughter Directives can be coordinated.

In September 2005, the Commission published its Thematic Strategy on Air Pollution; its aim being to cut the annual number of premature deaths caused by air pollution by 40% by 2020 from the 2000 level and to reduce the continuing damage to Europe's ecosystems. To do this the Strategy says that emissions of sulphur dioxide will need to be reduced by 82%, nitrogen oxides by 60%, volatile organic compounds by 51%, ammonia by 27% and fine particulate matter by 59% (compared to their 2000 levels).

The Strategy proposes streamlining European air quality legislation and to this end includes a proposal for a Directive on Ambient Air Quality and Cleaner Air for Europe (COM (2005) 447) which will replace the Air Quality Framework Directive and three of its Daughter Directives (on sulphur dioxide, oxides of nitrogen, particulate matter and lead; on carbon monoxide & benzene; and that on monitoring & information on ozone).

The Strategy also outlines proposals for reviewing the National Emission Ceilings Directive, and for consideration to be given to the feasibility of tighter (Euro 5) emission limits for cars and Euro VI for heavy goods vehicles. Consideration is also to be given to extending the Integrated Pollution Prevention Control Directive to cover small combustion plant, a new Directive reducing VOC emissions from fuel stations, setting NOx emission limit values for ships, and reducing nitrogen use for animal feedstuffs and fertilizers.

EUROPEAN QUALITY LIMIT VALUES

European Limit Values are legally binding, and exceedences can result in the European Commission taking legal action against the country at fault. In 1996, the European Union adopted the Air Quality Framework Directive (96/62/EC), which in turn gave rise to a series of "Daughter" Directives containing Limit Values for seven pollutants. In June 2008, a new Air Quality Directive (2008/50/EC) came into force and must have been implemented by member states by 11 June 2010. This merges the former framework Directive and the first three Daughter Directives into a single Directive with no change to existing air quality objectives. It also introduces new air quality objectives for $PM_{2.5}$ (fine particles) including a limit value and exposure related objectives – exposure concentration obligation and exposure reduction target. The new Directive also introduced several new features that weaken the previous legislation, including the possibility to discount natural sources of particles (e.g. sea salt) when assessing compliance against limit values, and the possibility (with EU approval) of time extensions of three years (PM_{10}) or up to five years (NO_2, benzene) for complying with limit values.

EU MARINE SULPHUR DIRECTIVE

In 2002, the European Commission presented a proposal to amend Directive 1999/32 as regards the sulphur content of marine fuels (henceforth, the "marine fuel sulphur directive") The European Parliament and Council finalized the marine fuel sulphur directive in April 2005 with a second reading agreement. At the time of writing, the directive had not yet been published in the EU Official Journal, but it had been formally signed and given the directive reference number 2005/33. The directive includes the following provisions: Ships in IMO Sulphur Emission Control Areas must use 1.5 percent sulphur fuel or better – starting with the Baltic Sea in May 2006, then extending to the North Sea and Channel in autumn 2007. All passenger vessels on regular services to or from Community ports must use 1.5 percent sulphur fuel or better from May 2006 onward. Ships at berth in ports must use 0.1 percent sulphur fuel or better from 2010 onward.

These provisions should apply to all marine fuels and replace the current regulations on marine gas oil, thereby establishing a similar regime for marine fuels as for heavy fuels and gas oils used by land-based sources, which are limited to 1.0 percent and 0.1 percent sulphur content, respectively. The Directive also allows ships to use other technical abatement technologies that achieve the same or greater levels of emission reductions, provided it can be demonstrated that these technologies do not adversely affect the marine environment. (The most often mentioned acceptable abatement technology is the desulphurization of exhaust gases via "seawater scrubbing.")

EU CONTEXT- SUBSIDIES AND STATE AID RULES

The Commission has adopted the following three sets of state aid guidelines that define the context with regard to possible state subsidies for ship emissions reductions.

1. Community guidelines on state aid for environmental protection (2001/C37/03) allow aid where it serves as an incentive to firms to achieve levels of protection that are higher than those required by Community standards, or where no Community standards exist—as is the case for NOX emissions from seagoing ships. Investment aid can be given for plant and equipment intended to reduce or eliminate pollution, but may not exceed 30 percent gross of the eligible investment costs.

2. Community guidelines on state aid to maritime transport (1997/C205/05) allow investment aid in certain circumstances to promote the use of clean ships, such as providing incentives to upgrade Community registered ships to standards which exceed mandatory environmental standards laid down in international conventions.

3. Finally, the most recent Commission framework on state aid to shipbuilding (2003/C317/O6) allows aid for research and development and allows aid up to 20 percent of gross expenditure for innovation, i.e. technologically new or substantially improved products and processes compared to the state of the art referring to industry. Thus, it appears to be legally possible for Member States to provide subsidies for emissions reductions generated

through the development and use of emissions abatement technologies for ships, either for new vessels or for retrofits.

MARKET BASED APPROACHES TO AIR EMISSIONS POLICY

Once a primarily theoretical approach to environmental policy, economic instruments have gained wide acceptance over the last three decades. Indeed, virtually all environmental policy initiatives that have been developed recently in the US include a market-based component. Market-based approaches have recently gained wider acceptance in Europe as well. The EU Emissions Trading Scheme (the "EU ETS") represents perhaps the most prominent example of Europe's use of market-based approaches. Under the EU ETS, Member States are permitted to trade CO2 emissions reduction credits among one another, as part of an EU-wide initiative to meet anticipated obligations under the Kyoto Protocol. The Commission has recognized that market-based instruments might be used to deal with various environmental issues. Experience suggests that well-designed market based approaches can reduce the costs and increase the likelihood of achieving environmental targets (see, e.g., Ellerman, Joskow and Harrison 2003). This experience also indicates, however, that the market-based approaches need to be carefully thought out in order to achieve these and other objectives. Moreover, it is important to include all interested parties in this process, particularly since the approach is relatively new for shipping.

7.4 NATIONAL FRAMEWORK

Spanish legislative and normative framework regarding air quality and port management

Spanish legislative and normative framework regarding air quality

In Spain, the Law 34/2007 adopts provisions concerning air quality and environmental protection. This law aims at establishing the basis concerning prevention, control and reduction of emission of atmospheric pollution in order to avoid, and when this is not possible, diminish the damage to people, the environment and other goods originated by this pollution. The text of the law contains: object of the Law; extent of application; definitions; guiding principles; authority of public administrations; inter-administrative cooperation; obligations of persons responsible for facilities involved in activities potentially pollutant of the atmosphere; information to the public; evaluation and management of the air quality; prevention and control of emissions; planning; instruments of promotion of protection of the atmosphere; control, inspection, vigilance and follow-up; system of sanctions. It repeals the regulation of unhealthy, harmful and dangerous activities, approved by Decree 2414/1961 of 30 November 1961; Law 38/1972 of 22 December 1972, and annexes II and III of Decree 833/1975 of 6 February 1975.

The institution in charge of air quality is the General Direction of Environmental Quality and Evaluation within the Ministry of Environment. In particular, it is the National Authority for the National Inventory System of Pollutant Emissions to the Atmosphere.

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Air quality legislated values

After the adoption of the Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe, Spain is working on a new royal decree to integrate the new regulations on new pollutants, such as the particulate matter with diameter ≤2,5 µm (PM2,5), and new requirements related to assessment and management of air environment quality. Although the directive should be incorporated into the Spanish legislation by 11th June 2010, the royal decree is still not passed.

Thus, the main legal instrument to establish the pollutants values is the Royal Decree 1073/2002 on the evaluation and management of the air environment quality concerning sulphur dioxide, nitrogen dioxide, oxides of nitrogen, particulate matter, lead, benzene and carbon monoxide, which incorporates into national legislation the Directive 96/62/EC, 1999/30/EC and 2000/69/EC. Further details on normative is provided at the following tables which summarize the air quality objectives by pollutant:

- Sulphur dioxide (SO_2)

Reference values according to Royal Decree 1073/2002		
	Period	Limit value
Hourly limit value for human health protection	1 hour	350 µg/m^3 Not possible to exceed more than 24 times per civil year
Daily limit value for human health protection	24 hours	125 µg/m^3 Not possible to exceed more than 3 times per civil year
Limit value for ecosystems protection	1 civil year and winter period	20 µg/m^3
Threshold warning	1 hour	500 µg/m^3

- Nitrogen dioxide and oxides of nitrogen (NO_2 and NOx)

Reference values according to Royal Decree 1073/2002		
	Period	Limit value
Hourly limit value for human health protection	1 hour	200 µg/m^3 of NO_2 Not possible to exceed more than 18 times per civil year
Annual limit value for human health protection	1 civil year	40 µg/m^3 of NO_2
Limit value for vegetation	1 civil year	30 µg/m^3 of NOx

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protection		
Threshold warning	1 hour	400 µg/m^3

- Particulate matter with diameter ≤10 µm (PM_{10})

Reference values according to Royal Decree 1073/2002		
	Period	Limit value
Daily limit value for human health protection	24 hour	50 µg/m^3 Not possible to exceed more than 35 times per civil year
Annual limit value for human health protection	1 civil year	40 µg/m^3

- Benzene

Reference values according to Royal Decree 1073/2002		
	Period	Limit value
Annual limit value for human health protection	1 civil year	5 µg/m^3

- Lead

Reference values according to Royal Decree 1073/2002		
	Period	Limit value
Annual limit value for human health protection	1 civil year	0,5 µg/m^3

- Carbon monoxide (CO)

Reference values according to Royal Decree 1073/2002		
	Period	Limit value
Limit value for human health protection	Maximum daily 8 hours	10 mg/m^3

- Ozone (O_3)

Reference values according to Royal Decree 1796/2003		
	Period	Limit value
Objective value for human health protection	Maximum daily 8 hours mean	120 µg/m^3 which can't be exceeded more than 25 days average every civil year within a 3

		years period
Objective value for vegetation protection	AOT40	18000 µg/h·m^3 Average within a 5 years period
Long-term objective for human health protection	Maximum daily 8 hours mean within a year	120 µg/m^3
Long-term objective for vegetation protection	AOT40	6000 µg/h·m^3
Threshold warning	Hourly average	240 µg/m^3
Threshold to inform population	Hourly average	180 µg/m^3

- Hydrogen sulphide (H_2S)

Reference values according to Decree 833/75		
	Period	Limit value
Semi-hourly limit value	Semi-hourly average	100 µg/m^3
Daily limit value	Daily average	40 µg/m^3

- Chlorine (Cl2) and hydrogen chloride (HCl)

Reference values according to Decree 833/75		
	Period	Limit value
Semi-hourly limit value	Semi-hourly average	300 µg/m^3
Daily limit value	Daily average	50 µg/m^3

- Arsenic (As), cadmium (Cd), nickel (Ni) and benzo(a)pyrene

Reference values according to Directive 2004/107/EC from 31st December 2012	
Pollutant	Objective value
Arsenic	6 ng/m^3
Cadmium	5 ng/m^3
Nickel	20 ng/m^3
Benzo(a)pyrene	1 ng/m^3

National emission ceilings

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The Directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants aims at limiting emissions of acidifying and eutrophying pollutants and ozone precursors in order to improve the protection in the Community of the environment and human health against risks of adverse effects from acidification, soil eutrophication and ground-level ozone and to move towards the long-term objectives of not exceeding critical levels and loads and of effective protection of all people against recognised health risks from air pollution by establishing national emission ceilings, taking the years 2010 and 2020 as benchmarks, and by means of successive reviews as set out in Articles 4 and 10 of this directive. To this aim, it sets national emissions ceilings (the maximum amount of a substance expressed in kilotonnes, which may be emitted from a Member State in a calendar year) by 2010 for certain pollutants; in particular, for Spain, these are the ceilings:

- NOx: 847 Kilotonnes
- COV: 662 Kilotonnes
- SOx: 746 Kilotonnes
- NH_3: 353 Kilotonnes

In order to fulfil these ceilings, Member States must elaborate, revise and update national programmes for progressive emissions reduction. Spain elaborated in 2003 its first National Programme and later on the second National Programme for Emissions Reduction (Resolution of 14th January 2008, of the General Secretariat for the Prevention of Pollution and Climate Change. BOE nº 25, 29.01.08). This plan includes a number of policies and measures related to port activity, such as the Strategic Plan of Infrastructures and Transport 2005-2020.

Spanish legislation on port and navigation management and air emissions

In Spain there are two institutions in charge of navigation and ports which are regulated by the Law 27/1992 and could play a role on air emissions management: the General Direction of the Merchant Navy of the Ministry of Public Works and State Ports of Spain.

The General Direction of the Merchant Navy

It is the competent body for general planning of maritime navigation and the Spanish civil fleet. In the light of the APICE project, two of its functions must be highlighted:

a) The prevention and fight against marine pollution from ships, boats and fixed platforms, as well as marine waters cleansing
b) The elaboration and proposal of sectorial normative, especially that coming from communitary regulations or from international organizations, internal legal advice and processing sanction proceedings. The coordination of the international activity of the General Direction of the Merchant Navy, especially related to the European Union and the International Maritime Organization.

For these functions, there are two General Subdirections concerned:

- General Subdirection for Safety, Pollution and Maritime Inspection
- General Subdirection for Maritime Normative and International Cooperation

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Therefore, in terms of the APICE project, these subdirections have an important role to play.

State Ports of Spain

It is a Public Body dependent of the Ministry of Public Works with global responsibilities on the state ports system, in charge of the execution of the governmental port policy and the coordination and efficiency control of the port system made up of 28 Port Authorities (Port Authority of Barcelona, among them). The principal aim of State Ports of Spain is to ensure that the ports contribute efficiently to the economic development of the country. Supporting initiatives, ensuring the smooth functioning of procedures, drawing up plans and designing strategies of combined action and optimizing management efficiency are just a few of the functions carried out by the State Ports of Spain. This implies revising the port policy of the government and serving as intermediary between the ports and the central administration.

Regarding environment, takes responsibility in the environment protection through:

- Controlling the compliance with environment legislation.
- Promoting the development and review of the current Environment Policy of the port authorities through the implementation of Environment Management Systems and clean technologies in order to achieve the environment purposes established. Involvement in a continuous enhancement.
- Increasing State Ports and port authority staff's awareness of environment problems through environmental programs.
- Developing prevention strategies to face the pollution originated by operations and activities of State Ports. Analyse and promote the actions required to reduce the impact of these agents on the environment.

The Barcelona Port Authority, though working at a local level, has a character of national body since it is part of State Ports of Spain. Its mission consists in leading the development of the Port of Barcelona, to generate and manage infrastructures and to guarantee reliable services in order to contribute to clients' competitiveness and create value for society at large.

The Environment Service (Servei de Medi Ambient–SMA), as a part of the Barcelona Port Authority structure, is made up of a team of professionals prepared to offer a series of services related with the environmental vigilance. The objective of this vigilance is to contribute to the protection of the environment, with regard to the atmospheric environment (air), the aquatic environment (water) and the edaphic environment (land).

Other important objective is to offer to the concessionaire companies of the Port an advice service about the environmental subjects (licenses, ISO 14000, emissions control, etc.) in order to collaborate in the compliance of the requirements specified by the competent administration.

For the development of its objectives, the Environment Service (SMA) has its own resources (weather stations, automatic and manual pollutant analysers, marine multiparametrical sound (CTD), water cleaner boats, antipollutant barriers, etc.) and, in some cases, supervises the task of the contracted external companies.

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The Environment Service of the Port of Barcelona has two different performances. On one hand, it offers to the port companies and to the different public entities the information related to the environmental data which are processed in the measuring stations of the Port of Barcelona, and on the other hand, it offers to the port companies an advice service on environmental subjects.
The vigilance of the air quality in the port environment is carried out through the measurement of the pollutants concentrations in the air and the study of its diffusion on the atmosphere.
In order to achieve this objective, the Environment Service (SMA) of the Port of Barcelona has been equipped with its own infrastructure which turns the Port of Barcelona into a territory with one of the densest atmospheric networks existing nowadays. This infrastructure is made up of a weather stations network, two measuring stations networks of environmental concentration, one manual and the other automatic, and a mobile unit.
The atmospheric problems in the Port have an additional importance because of its closeness to the city; there is a synergy between the two systems which causes that the vigilance of the air quality arouses too the interest of the local entities of public health and environment.

Specific national legislation regarding air emissions in ports and navigation

Spain deposited the Adhesion Instrument to 1997 Protocol to Marpol 73/78 Convention in 2004 (BOE núm. 251, 18th October 2004[1]). This protocol contains the regulations for prevention of air pollution from ships, and it is included as Annex VI of the Convention. The revised Annex VI entered into force on 1st July 2010.

BARCELONA

Air Quality Plan in the Metropolitan Area of Barcelona

At the regional level, the competence on air quality is hold by the General Subdirection for Prevention and Control of the Atmospheric Pollution, within the General Direction of Environment Quality, Generalitat of Catalonia. In particular, it aims at:

1) Assessing air quality parameters through the Network of Vigilance and Prevision of Atmospheric Pollution
2) Reducing and preventing pollutants emissions
3) Elaborating plans when the air quality is not appropriated

In the light of the APICE project, it is of utmost importance to take into account the current air quality plan in the metropolitan area of Barcelona.

The Decree 322/1987, which develops the Law 22/1983, regarding protection of atmospheric environment, establishes that the zones where the admissible limit values are exceeded must be declared special protected zones, and medium and long term measures are needed in order to restore the air quality. Once the special protection zone has been declared, the Executive Board must pass an Action Plan that comprises the specific needed actions to restore the air quality.

In this context, the Decree 226/2006, of 23rd May, established Special Protected Zones of the Atmospheric Environment for the pollutants NO_2 and PM_{10} (see Figure 18 and 19). The Action plan for the air quality improvement, passed by Decree 152/2007, has been extended by Decree 203/2009 since many measures have not implemented, and the preliminary assessment of the air quality shows that EU objectives by 2009 will not be met.

The plan comprises 73 measures structured in the following areas: prevention (10), industrial (27), energy (4), road transport (6), maritime transport (8), air transport (3), domestic sector (4) and public awareness (11). The selection of the measures of the action plan has been done by the Interdepartmental Commission (promoted by the Department of Environment and Housing and composed by the departments of Territorial Policy and Public Works; Health; Innovation, Universities and Enterprise; and Interior and Institutional Relations and Participation, besides the Catalan Energy Institute and the Metropolitan Transport Authority) keeping in mind, in addition to the environmental efficiency criteria, the social impact, economic costs and whichever other factor that could has an impact on the measure, giving priority to the measures involving public administrations.

Concerning the port, the objective was to reduce 20% NO_2 and 10% PM_{10} through these measures:

- Actions over the containers lorries fleet (environmental requirements)
- Promotion of rail transport of goods
- Electric supply for ships
- Inner float ships renewal
- Modification of Port taxes
- Renewal of auxiliary loading and unloading machinery

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- Handling of dusty material improvement
- Strategic plan for the reduction of the emissions in the port

The Environment Service of the Barcelona Port Authority is the main responsible for the implementation of these measures and has reported yearly to the Generalitat on the progress. The degree of implementation varies from one measure to other, but remarkable achievements have been met.

The action plan includes the establishment of the Technical Office for the Plan Monitoring, attached to the General Subdirection for Prevention and Control of the Atmospheric Pollution. Its function is to follow-up the schedule and implementation degree of the measures regarding the emissions reduction and the impact on the air quality levels, through indicators, as well as to report about the Plan evolution and to prepare measures or actions proposal to fine-tune the initial measures.

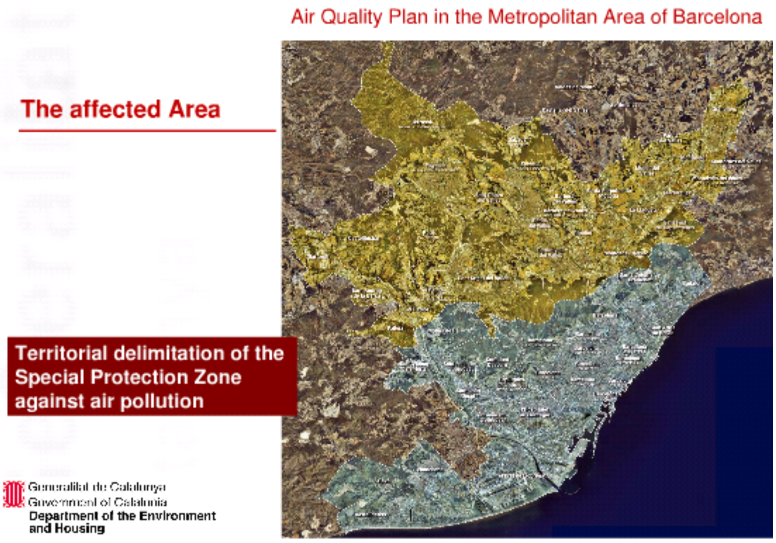

Figure 18. Special protection zone of the Atmospheric Environment for the pollutants NO_2 and PM_{10}.

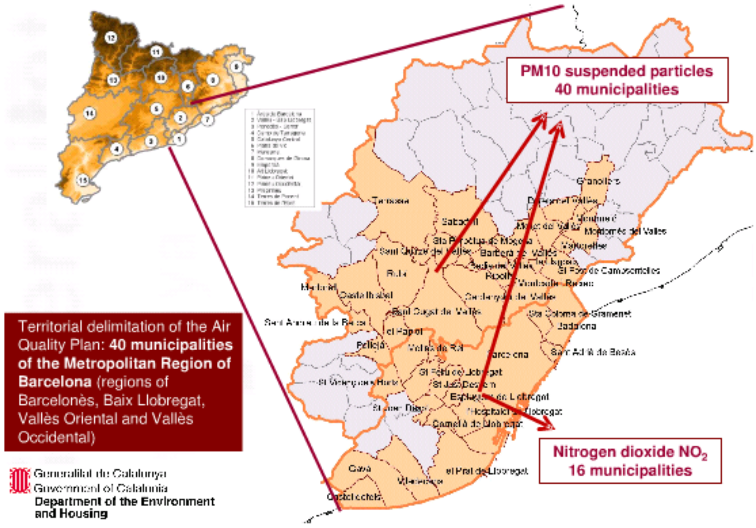

Figure 19. Territorial delimitation of the Air Quality Plan for NO_2 and PM_{10}.

8. EVALUATION OF AIR QUALITY IN REGION OF THESSALONIKI

The current report has been redacted in lines of APICE program (Common Mediterranean strategy and local practical Actions for the mitigation of Port, Industries and Cities Emissions). The report includes a brief analysis of the air quality of the area during the last years. The interest is focused on the Port of Thessaloniki, which is one of the largest Greek seaports and one of the largest ports in the East Mediterranean basin. The air quality network of Thessaloniki region includes eight stations, five of them in the city center. The monitored pollutants are NOX, SO2, CO, PM2.5, PM10, benzene (not in all stations).
The atmosphere of Thessaloniki is characterized by aggravated air quality due to several factors: intense source emissions, topography and meteorological/climatic conditions. In particular, the city is densely populated (over 1,000,000 inhabitants) and anthropogenic activities as emissions from vehicles (over 400,000 in a daily basis) and the industrial units at the north-northwestern part of the area contribute to air pollutants' levels under the prevailing meteorological conditions which in some cases, lead to pollution episodes. Furthermore, as the climatic pattern of the area is characterized by low precipitation levels (rain during 33% of the year) and low wind velocity values, the accumulation of air pollutants is quite frequent. Photochemically formed pollutants are also produced by the combination of sunlight and sources (vehicles, central heating, plants emissions). In general, higher pollutants levels are observed during cold season due to prevailing meteorological conditions and intense source emissions (central heating, emissions from engine start up). Regarding the hourly variation, pollutants peaks are observed during morning and afternoon hours, coinciding with rush hours with extensive vehicle circulation and usually absence of wind. The problem is aggravated as streets layout enforce pollutants accumulation.

Concerning the period 1989-2008, the NO_2 annual E.E. limit ($40\mu g/m^3$) was exceeded at the stations which are situated at the center of the city. Vehicles' emissions and traffic due to metro construction activities are the main reasons for NO_2 levels increase at these stations.
Regarding SO_2, the E.E. daily limit ($125\mu g/m^3$) was not exceeded in anyone of the city stations. The highest values are observed at Hall station (center of the city) for the period 1989-1999. However, a reduction during the next years (2000-2006) is noticed -in all stations-possibly because of the fuels' quality improvement, the vehicles' new technology and the construction of a peripheral highway. A further decrease in SO_2 levels was noticed during 2007 and 2008 due to the reduced industrial activity and the natural gas use.
As far as ozone O_3 is concerned, a different picture is observed. The 8-hour limit of $120\mu g/m^3$ was not exceeded for more than 25 times/year at three urban stations. Nevertheless, at the two suburban stations (Eptapirgiou and Toumpas stations), 80 and 112 exceedances were recorded respectively during 2008, implying an increasing trend. Taking under consideration that ozone is a pollutant which is photochemically produced (under the prevailing meteorological conditions), suburban areas are expected to be characterized by higher levels. This issue should be under consideration, for Thessaloniki's air quality in the near future.
A decreasing trend in CO levels during the lasta year is noticed mainly due to the old-technology vehicles withdrawal and their replacement with those of catalytic engine (in the beginning of

90's). An exception is observed for Lagada station where an increase in CO levels was reported for the year 2008, because of the construction activities of Egnatia highway in its background.
The annual level of benzene was exceeded at Hall station (ground level) and at Martiou station (first floor level) in the periods 2005-2006 and 2007-2008 respectively.
PM2.5 measurements were available at two monitoring stations for the years 2005-2008. As shown, the annual limit value of 120μg/m^3 was exceeded during all years at the (urban) Hall station. The intense vehicles circulation and the metro construction activities are expected to be the main sources for the increased particles levels.
Regarding PM10, at the Hall station (urban station, in the city center), both daily and annual limit values were exceeded during all years. The other two urban stations (Martiou and Lagada stations) reported lower levels, but still exceeding the annual limit of 40μg/m^3 and in same cases the daily limit (40μg/m3) too. In opposition, PM10 levels at the two suburban stations did not exceed the annual limit for the years 2007-2008. It is obvious that particles levels are lower in suburban areas because of the reduced vehicles emissions.

In conclusion, as mentioned previously, the aim of the present report was to briefly describe the air quality conditions in the region of Thessaloniki, based on the data collected from the air quality and meteorological networks. A source apportionment study which will follow in the frame of APICE project will lead to focused conclusions on the main sources contributing to PM levels. The role of the ports emissions, in combination with the meteorological pattern of each area will be extensively examined.

L'Europe en Méditerranée
Europe in the Mediterranean
Project confinancé par le Fonds Européen de Développement Régional
Project co-financed by the European Regional Development Fund

ANNEX I
PUBLICATIONS
SCI JOURNALS BY TOPIC
URBAN AIR QUALITY

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ANNEX II
PROJECTS
EUROPEAN PROJECTS

- Integrated assessment of health risks of environmental stressors in Europe (INTARESE). 161.701E. 2004-2007.
- European Super-sites for Atmospheric Aerosol Research (EUSAAR) RII3-CT-2006-026140. 99.449E. 2006-2010
- Climate Change and Impact Research: the Mediterranean Environment (CIRCE). 55754 E. 2007-2011.

NATIONAL PROJECTS

- Estudio y evaluación de la contaminación atmosférica por material particulado y metales en España. 795.000 E. 2006-2009.
- Interpretación de series temporales de niveles de partículas en las estaciones de la red EMEP-CAMP-VAG de España y para la ejecución de analítica química en muestras de aerosoles de la estación VAG de Izaña. 452.900 E. 2007-2010
- CALIOPE: sistema de calidad del aire operativo para España. 44.600 E. 2006.
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- Evaluación integral del impacto de las emisiones de partículas de los automóviles en la calidad del aire urbano. 194.575 E. 2004-2007.
- Multidisciplinary Research Consortium on GRadual and Abrupt Climate Changes, and their Impacts on the Environment (GRACCIE). 460.000 E. 2007-2012.
- Sistema de Evaluación de Riesgos por Contaminación Atmosférica (SERCA). 230.757 E. 2008-2011.
- CAMPAÑAS DE MEDIDAS PARA LA DETERMINACION DE ORIGENES DEL AEROSOL ATMOSFERICO EN AMBIENTE URBANO Y RURAL DE ESPAÑA (DAURE). 43.000 E. 2008-2010.
- Caracterización integral de aerosoles troposféricos de fondo continental en el NE de Iberia (CARIATI). 173.000 E. 2009-2012.
- Acuerdo de encomienda de gestión entre el Ministerio de Medio Ambiente, y Medio Rural y Marino- y la Agencia Estatal Consejo Superior de Investigaciones Científicas para la realización de trabajos relacionados con el estudio y evaluación de la contaminación atmosférica por material particulado y metales en España. 1.203.585 E. 2010-2013.

Project confinancé parle Fonds Européen de Développement Régional
Project co-finnaced by the European Regional Development Fund