Chapter 2
Environment and Health in Italian Cities: The Case of Taranto

Tiziana Banini and Cosimo Palagiano

Abstract Like "heterotrophic organisms," cities live on the basis of a strong imbalance between the relevant inflows of matter and energy and outflows of waste and emissions, which can extend over large areas. The data of the *ecological footprint* of cities have quantified emblematically this imbalance. The rapid growth of urbanization, especially in developing countries, is a matter of serious concern.

Unsustainable by definition, cities generate environmental impacts of all kinds, with intensities that vary according to the characteristics of the areas in which they develop. Italian cities are a significant case study, for the high density of population and economic activity, the shortage of green areas, the internal mobility largely centered on the private car, as well as for the frequent breaches of the rules and laws oriented to protect the environment.

Air pollution is one of the major environmental problems, especially in some cities of the country where industrial activities with high environmental impact are located. After a critical review of the literature focused on the relationship between environmental depletion, air pollution, and health conditions in Italian cities, this chapter explores the case of Taranto, a city of Southern Italy with serious problems of pollution and public health due to the presence of a large industrial area.

Keywords Cities · Italy · Industrial pollution · Environmental degradation · Human health · Taranto

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2.1 Introduction

Cities are the main topic of political and scientific debate on environmental degradation and sustainability (Allegrini and De Santis 2011). Compared to parasitic organisms (Odum 1971), which can live only by taking nourishment from other organisms, cities have an extremely unbalanced metabolism, including inflows of matter and energy from many different parts of the world and outflows of waste and emissions, which can extend over large areas and generate damage to the environment and to human health (Decker et al. 2000; Kennedy et al. 2007; Kennedy et al. 2011). Studies on the ecological footprint of cities have emblematically shown just how great this imbalance is (Rees and Wackernagel 1996; Wackernagel et al. 2006), beginning with the examples of Santiago de Chile (Wackernagel 1998), London (Best Foot Forward 2002), and Liverpool (Barrett and Scott 2001). The rapid growth of urbanization, particularly in developing countries, is a matter of serious concern. Unsustainable by definition, cities generate environmental impacts of all kind, whose intensity varies according to the environmental and social features of the territories they occupy. As a major cause of the increase of greenhouse gas emissions and the consequent effect on the thermal balance of the Earth, cities are also favored sites for finding solutions to air pollution and climate change (Dodman 2009).

Urban environmental problems are often made worse by the presence of industrial areas, which for historical, economic, and urban dynamic reasons are often very close to densely populated areas or areas used for commercial activities or tourism (e.g., the case of locating industries on the waterfront).These industrial activities create artificial ecosystems that become subsystems within the urban ecosystems, which constrain the city both at the local scale (especially as regards employment) and to the global logic of production, strongly influencing decisions, including the permanence of the industrial plant in the city (Bai 2007).

The recent scientific literature has focused on the issues of environmental justice and of the socially unequal impact of pollution. These studies try to detect whether and to what extent air pollution is produced and suffered by social groups, according to variables related to age, ethnicity, income, or deprivation. In addition, they try to answer the question of how social groups are aware of the pollution generated by their behavior (King 2010). Studies like these have been carried out in some New Zealand cities, showing how pollution affects social groups, so that those who produce the most pollution suffer the least exposure to particulate air pollution, while the most disadvantaged social classes suffer increased exposure to pollution and higher incidences of related diseases (Pearce et al. 2006; Pearce et al. 2011). Some studies in Britain reached the same conclusion, highlighting how the economically disadvantaged social groups produce less pollution but experience the highest pollution levels (Mitchell and Dorling 2003). Another study, also in Britain, showed strong correlations between degraded living environments, especially those where there were high levels of spatial aggregation, and high levels of air pollution (Briggs et al. 2008). The location of housing near the freeways in two West Coast American metropolitan areas (Seattle and Portland) has also been considered as one of the variables that can affect health: The most vulnerable populations living in these risk areas (in particular, those living 330 meters from the highway) suffer higher levels of pollution and are, therefore, exposed to greater health risks (Bae et al. 2007). The same conclusions were reached in Italian studies on younger age groups, who have higher incidences of respiratory problems when they reside in areas subject to intense air pollution and traffic (Galassi et al. 2005). Because of the close relationship between the residential context and the exposure to pollutants and related diseases, these issues were listed among the main topics to which geography can give a significant contribution (Curtis and Oven 2012; Reed and Colleen 2011).

Italy is a relevant case study not only because of its high population density, economic activities, and urbanization but also because of a lifestyle and mobility largely centered on the private car, as well as for its frequent breaches of the European Union's (EU) rules and laws, which have progressively emphasized the integration of environmental issues with economic and social ones (Dansero and Bagliani 2011).

Air pollution is among the most important environmental problems of Italy, especially in some cities which suffer pollution caused by industrial activities. After a critical review of the scientific literature on the relationship between environmental characteristics, air pollution, and health conditions in Italian cities, also in reference to the presence of industries which are at risk of a major accident, this chapter explores the case of the city of Taranto, which in recent years has become a protagonist in the national and international debate because of the historical presence of an industrial area with high environmental impact.

2.2 Urban Air Quality and the Impact on Human Health

In Italy, as elsewhere, the depletion of the environment derives not only from the high population density, economic activities, and urbanized areas but also from the lifestyle of the people, marked by a significant consumption of materials and energy from fossil fuels[1].

Air quality is compromised particularly in the cities, in reference to PM_{10}, $PM_{2.5}$, and other major pollutants (carbon dioxide, nitrogen oxides, sulfur oxides, ozone), which systematically exceed the level required by European legislation. In 2012, out of 95 cities monitored, as many as 51 exceeded the limit (35 days) for PM_{10}, while the $PM_{2.5}$ values were over the legal thresholds in 50 % of cities (Zampetti

[1] Italy is at the top of the European ranking for population density (201 inhabitants/km^2), after the Netherlands (492), Belgium (359), UK (254), Germany (229), and Liechtenstein (231) (http://epp.eurostat.ec.europa.eu). In the 12 metropolitan cities (Rome, Milan, Turin, Naples, Palermo, Florence, Bologna, Padua, Bari, Catania, Pescara, Genoa), the average of density of population is about 3,100 inhabitants/km^2, with a peak of 8,182 in Naples, 7,272 in Milan, and 6,972 in Turin. Taken together, these cities represent 0.9 % of the national area and include 8.8 million people, accounting for 14.5 % of the national population (ISPRA 2012).

and Minutolo 2013). The worst case was in the Po Valley (Northern Italy), due to the particular climatic conditions that facilitate the accumulation of pollutants in the air (Pinna 1991), so that among the top 20 Italian cities with the highest air pollution levels there are 18 northern cities, including Milan, Turin, and Padua, which are subject to the most critical conditions. As for the whole of Europe, ozone and particulate matter (PM) are the main pollutants posing a problem to human health and ecosystem balance (EEA 2011). While the concentrations of PM_{10} and $PM_{2.5}$ frequently exceed the limits during winter, forcing the periodic restriction of movement of private vehicles, the concentration of ground-level ozone tends to reach its highest values in summer (Parodi et al. 2005): In 2012, ground-level ozone exceeded the threshold levels in 44 out of 78 monitored cities. In this sense, Italy is one of the European regions with the highest annual average concentration of PM_{10} and $PM_{2.5}$ (EEA 2011) and has been found in breach of the European Court of Justice for having exceeded the limits (Directive 1999/30/EC) for long periods and in many areas, both in 2006 and in 2007 (Zampetti and Minutolo 2013)[2].

Major contributors to high levels of urban air pollution are traffic and the heating/air-conditioning of private, public, and commercial buildings. Overall, the emissions of sulfur oxides are produced mostly by industrial activities (78 %), while road traffic is responsible for 53 % of emissions of benzene, 52 % of carbon monoxide (CO), and 44 % of sulfur oxides (SO_X), and 27 % of PM_{10} (*Ibid.*). The general trend for using private cars for even short-range journeys contributes significantly to air pollution in urban areas. Italy has the highest motorization rate in EU-27 after Luxembourg, with 614 automobiles per 1,000 inhabitants (ISTAT 2012) and the car fleet mainly consists of the most polluting cars (Euro 0, I, II, III), compared to those of the new generation (Euro IV and V). This social habit of the wide use of the private car, however, is caused not only by the inefficiencies of the public transport system, subject to continual cuts due to the economic crisis, and the lack of bicycle lanes, especially in the cities of Central and South Italy (ISPRA 2012, p. 322–323), but also by the perception that riding a bike, going on foot, or using public transport exposes people to more sources of air pollution, as some studies confirm (Gulliver and Briggs 2004). The heavy private car traffic is augmented by commercial traffic using the road system, which is due not only to Italy's geomorphological diversity but also to the historical lack of investment in the rail network and the lack of navigable rivers and waterways.

The pedestrianization of the historic centers of cities, with the creation of limited traffic zones (ZTL, zona traffico limitato), has greatly helped in reducing emissions,

[2] For oxides of nitrogen (NO2), European legislation (Directive 2008/50/EC, implemented in Italy by Legislative Decree 155/2010) taken from the World Health Organization (WHO) guidelines (WHO 2006) establishes an annual average concentration of 40 μg/m3 and an hourly average concentration of 200 $\mu g/m^3$ not to be exceeded for more than 18 days a year. For $PM_{2.5}$, this threshold is 25 $\mu g/m^3$. For PM_{10}, it comes to a daily average of 50 micrograms/m^3, not to be exceeded on more than 35 daysyear^{-1}. For tropospheric ozone (O_3), the limit is set at a maximum of 25 days exceeding the daily threshold of 120 mg/m^3, calculated on the average of eight consecutive hours. For sulfur oxides (SO_2), the limit is equal to 20 g/m^3 average of 24 h and 500 mg/m^3 average of 10 min.

Table 2.1 Changes in emissions of major air pollutants between 2000 and 2010 in Italy. (Source: Zampetti and Minutolo 2013)

Pollutant	2000	2010	Change (%)
IPA (Kg)	115,020.72	152,627.68	32.7%
Benzene (Mg)	I8,933.50	7,078.99	−62.6%
PM10 (Mg)	208,970.78	202,063.62	−3.3%
PM2.5 (Mg)	178,059.03	173,207.57	−2.7%
CO_2 (Mg)	462,485,087.54	426,086,644.32	−7.9%
CH_4 (Mg)	2,180,924.77	1,788,288.63	−18.0%
N_2O (Mg)	127,706.97	87,798.39	−31.3%
CO (Mg)	4,856,674.95	2,710,995.19	−44.2%
NOx (Mg)	1,431,155.58	965,975.31	−32.5%
NMVOC (Mg)	1,620,132.39	1,102,514.96	−31.9%
SOx (Mg)	749,479.24	210,147.38	−72.0%
NH_3 (Mg)	448,580.65	379,026.00	−15.5%

as reported in a recent study carried out in Milan (Invernizzi et al. 2011). In addition, due to the increased energy efficiency of motor vehicles and the improvement of the refining processes of fossil fuels, which have reduced the presence of sulfur compounds, in the last 10 years there have been significant reductions in various pollutants, such as carbon monoxide (CO), benzene, and sulfur oxides (SO_X). For other pollutants, however, emissions have remained at the same level, as in the case of PM_{10}, $PM_{2.5}$, and carbon dioxide (CO_2), or there has been an increase, as in the case of polycyclic aromatic hydrocarbons (PAHs, Table 2.1).

The minimal reduction of the oxides and nitrogen dioxide is related to both the increase in the number of high-power vehicles in circulation and the fact that the emission of these pollutants is also attributable to the processes of high-temperature combustion that occur in industrial plants. For PAHs, the increase is instead due to domestic heating (more than 50% of national emissions) and industry (about 30%), and only for a small part to vehicular traffic (2%) (Zampetti and Minutolo 2013).

While the air quality in the northern regions is generally worse due to the increased traffic and the higher level of industrialization and urbanization, in the southern regions air quality is strongly influenced by the illegal disposal of hazardous industrial waste, as well as by the problem of municipal solid waste, which engenders substantial illicit trafficking run by the local eco-mafias. The traffic of hazardous waste arising from industrial activities is estimated at 7 billion Euro; in Campania, from 2006 to 2009, more than 13 million t of waste are estimated to have been illegally disposed of. The problem, however, covers the entire country and is linked to a vast global organization, involving several European, African, and Asian countries, especially Malaysia, China, and India (Legambiente 2012).

The recent increase in atmospheric temperature, which is perceived significantly in large urban centers, which are already affected by the heat island phenomenon (Colacino and Lavagnini 1982), further exacerbates the presence and accumulation of pollutants in the atmosphere, with relative impairment of the standards of air quality. The remarkable expansion of air-conditioning systems has contributed to this phenomenon; their presence in private homes, more than doubled over the last 10 years, especially in cities (ISPRA 2012, p. 389), is now added to that of other buildings (public offices, shopping malls, mega stores, etc.) and generates a significant increase in air humidity and, therefore, in the perceived temperature.

The environmental and climatic factors at a local and supra-local level also contribute to the concentration of pollutants. For Palermo, for example, a study has shown an increase of PM_{10} due to the presence of particles of iron (Fe) and aluminum (Al) deposited in the soil (Dongarrà et al. 2007). A study covering the period 2003–2005, the years when, especially in 2003, there was a considerable increase in summer temperatures, shows a correlation with the dust from the Sahara Desert and the resultant increase in mortality in Italy, especially in older age groups (Pederzoli et al. 2010). Another study comes to a similar conclusion examining the contribution of Saharan dust to concentrations of PM_{10} in Rome in 2001, showing an increase in the incidence of PM_{10} in some areas of the city (Gobbi et al. 2007). More generally, all the countries of southern Europe are subject to Saharan dust, causing an excess of the daily limits allowed by European regulations for PM_{10}; in the case of a study conducted in Tuscany, the contribution of Saharan dust has been estimated at 1–2 % (Nava et al. 2012).

The high levels of air pollution, as we know, are considered a major cause of acute and chronic diseases: irritation of the upper respiratory organs, chronic bronchitis, lung cancer, cardiocirculatory diseases, ischemic stroke, as well as allergies and asthma, especially in children (EEA 2011; Kampa and Castañas 2008; Villeneuve et al. 2012; Gasana et al. 2012). A study of 13 Italian cities, covering the period 2002–2004, showed that urban air pollution, in particular at a PM_{10} concentration of more than 20 μg/m^3, can be responsible for 8,220 deaths per year, equivalent to 9 % mortality for all causes of death (excluding accidents) in the population over 30 years and 1.5 % of the total mortality of the entire population (1,372 deaths) (Martuzzi et al. 2006). Another study, covering the period 1996–2002, on the short-term exposure to air pollutants, particularly NO_2, CO, and PM_{10}, ICR, found a direct correlation with the increase in daily mortality for all causes of death, cardiorespiratory mortality, and hospital admissions for heart and respiratory diseases. The same study found a strong correlation between pollutants, mortality, and hospital admissions in the summer, without finding differences or significant changes in children (0–24 months) and the elderly (> 85 years). Overall, the impact on mortality is between 1 and 4 % and 4.1 % for the gaseous pollutants (NO_2 and CO), while for PM_{10} values vary between 0.1 and 3.3 %. The peak of mortality varies depending on the type of pollutant: 2 days for PM_{10} and 4 days for CO and NO_2. The study also highlighted that the implementation of European legislation could prevent about 900 deaths (1.4 %) for PM_{10} and 400 deaths (1.7 %) for NO_2 (Biggeri et al. 2004). Another study conducted in the period 1988–1999 on eight Italian cities (> 400,000 inhabitants) had shown that 4.7 % of deaths (3,472 deaths) were attributable to PM_{10} concentrations above 30 mg/m^3, rising to 7 % (5,148 deaths) considering a concentration equal to 20 g/m^3. It also showed that around 4,500 hospital admissions each year for cardiovascular disease and respiratory tract diseases were due to air pollution, which rose to 7,000 with the threshold located at 20 μg/m^3 (Martuzzi et al. 2002).

The overall consideration is that in Italy, as elsewhere, the environmental risk from human activities is closely related to the production, stockpiling, and use of nonrenewable energy, which on a national scale is still 60 % of the total energy consumed (ENEA 2012), or rather below the standards set down by the 20–20–20 European Strategy, which requires the achievement, by 2020, of the threshold of 20 % of energy consumed from renewable sources, reducing consumption by 20 %, capable of being increased to 30 % (European Commission 2010). Compared to other European countries less endowed in terms of solar radiation, Italy is in a low position, which raises even more concern considering the huge potential it has. Here, the perception that people have of pollution (Gatto and Saitta 2009) plays a relevant role, which concerns not only information campaigns and the activity of associations and local committees but also the decision-making power held by certain social groups in managing environmental information and the ability/possibility of individuals to access this information (Bickerstaff and Walker 2003). Several studies, for example, have highlighted the different perceptions of risk between men and women and between whites and people of color (Flynn et al. 1994; Finucane et al. 2000).

The recent adoption of the EU Smart Cities and Communities initiative, aimed at reducing carbon emissions and improving the energy efficiency performance of the city, is touting a number of initiatives, in view of the objectives that the EU has set in relation to the Strategy 20–20–20 to be achieved by 2020 (−20 % in greenhouse gas emissions compared to 1990, at least 20 % of energy consumption from renewable sources, and −20 % of energy consumption)[3]. The Smart Cities strategy seeks to create virtuous circles for Europe to be regarded as an outpost of the world in terms of clean, efficient, and low-carbon technologies, generating new lifestyles, integrated projects, and positive effects in terms of employment and sustainable economic growth. While in immediate terms the Smart Cities strategy can prove useful in promoting the transition to a society with low environmental impact, in the long run different ways of thinking about mobility, production, and consumption have to be made, starting from energy sources and the methods of production and consumption of materials. The initiatives under way in many cities, both from the municipalities and citizens' associations, with or without the collaboration of environmental and cultural associations (ISPRA 2012), are an important point of departure.

[3] According to the Global Greenhouse Gas Standard, launched by United Nations Environment Programme (UNEP), UN-HABITAT, and the World Bank at the World Urban Forum in Rio de Janeiro in March 2010 as the first global system for calculating the greenhouse gas emissions in the cities, the Italian cities appear with CO_2 emissions per capita ranging from 4 tons of the province of Naples, at 9.7 of Turin, to 11.1 in the province of Bologna. At the international level, Rotterdam, with 29.8 million t of CO_2 per capita, is the city's biggest polluter (http://corriere.com).

2.3 Industrial Cities and Environmental Risk

In addition to the pressures produced by traffic, heating/air-conditioning systems, and the other standard urban factors, many Italian cities are subjected to high levels of pollution from the presence of industrial plants with a high environmental impact, including the plants at Rischio di Incidente Rilevante (RIR; major accident risk), or in other words, plants which, because of the presence of specific substances or categories of substances over certain predetermined thresholds can generate, in the case of an accident (emission of substances, fire, explosion, etc.) "a serious hazard, for immediate human health or the environment, either inside or outside the industrial plant" (Legislative Decree no. 334/1999).

RIR industries are regulated by the Seveso Directive, which takes its name from the town that suffered most from the results of the accident that occurred in 1976 in the industrial plant of ICMESA located in Meda (Milan hinterland), which caused the emission of a cloud of dioxin that still today shows significant effects on the health of the local population (Consonni et al. 2008). The "Seveso" Directive was issued a few years later (Directive 82/501/EEC) and was amended by the "Seveso II" (Dir. 96/82/EC) and "Seveso III" (2003/105/EC)[4] (Ceci et al. 2012), which govern the activities of the RIR plants.

The Seveso Directive does not establish a minimum distance between the RIR industrial plant and residential areas, leaving the decision to the member states "to maintain appropriate distances" between plants and "residential areas, buildings and areas of public use, the major transport routes as far as possible, recreational areas and areas of particular natural interest or sensitivity from the environmental point of view and to establish for existing establishments technical measures…to reduce the risks to people" (Article 12 Dir 2003/105/EC). The European Commission, through the *Major Accident Hazards Bureau* (MAHB), has developed some guidelines for the allocation and use of land in areas where RIR plants are situated (http://mahbsrv.jrc.it), in support of the implementation of Article 12 of the Directive (see http://ipsc.jrc.ec.europa.eu/?id=694), which have been adopted in Italy by a Decree of the Ministry of Public Works, May 9, 2001.

In Italy, however, the distance between the RIR plants and residential, commercial, and/or hospital areas is often insufficient to avert the consequences of a major accident (ISPRA 2012). In most cases, industrial plants are located close to densely populated residential areas, as in the case of Taranto, which in addition to the presence of three plants subjected to the Seveso Directive, including Ilva SpA (MATTM 2012), is one of the 57 Sites of National Interest (SIN) for environmental reclamation that exist in Italy (Fig. 2.1)[5]. Several epidemiological studies have been

[4] The Seveso II Directive requires the manager of the establishment to notify the quantity and type of work related to hazardous substances included in the Appendix and the reports on the activities of risk prevention and management of major accident emergency. Directive 2003/105/EC extended the legislation to other industries and has included additional requirements on the safety of facilities and participation of workers and citizens.

[5] "The concept of 'polluted site' was firstly introduced in Italy with the definition of 'environmental high risk areas' (Rule 349/86). Later, the decree 471/99 stated that a site is considered polluted

Fig. 2.1 Sites of National Interest (SIN) for land reclamation in Italy. (Source: Pirastu et al. 2011)

produced on these areas to detect the incidence of mortality from diseases related to pollutants (Fano et al. 2005; Pirastu et al. 2011).

Another problem relates to the activities carried out by RIR plants; they must, in fact, meet a series of requirements: In addition to the obligation to notify the competent authorities about the activities performed by the establishment (hazardous substances and their quantities, analysis of the environment of the establishment, possible causes of accidents, etc.) and the preparation of a Safety Report, they must prepare an Internal Emergency Plan (by the manager of the factory) and an External Emergency Plan (by the competent governmental authority) to respond quickly to the need to safeguard public health and the environment (Legislative Decree no. 334/1999, Legislative Decree no. 238/2005; Dir 2003/105/EC)[6].

A survey conducted in 2010, however, showed a lack of enforcement (Legambiente 2013): Besides the fact that only 29 % of the municipalities surveyed (with at least one RIR industry in their territory) responded, 86 % said they had identified the areas of damage, but only 49 % specified the vulnerable and/or sensitive struc-

if the concentration of even just one index pollutant in anyone of the matrices (soil or subsoil, surface or ground waters) exceeds the allowable threshold limit concentration. The boundaries of Italian polluted sites (IPS) were defined (Decree 152/06) on the basis of health, environmental and social criteria" (Pirastu et al. 2011, p. 20).

[6] The External Emergency Plan requires the delimitation of three areas of risk: (1) *areas of maximum exposure* (threshold of high mortality in the immediate vicinity of the plant), (2) *area of damage* (threshold of irreversible damage), and (3) *area of attention* (subject to effects that are generally not serious). These areas are identified according to the type of damage (explosion, fire, toxic cloud, etc.), the hazard to human health, and the environmental features of the area where the industrial plant is located (seismic, hydro-geological risk, etc.) (DPCM 2005).

tures, only 50 % provided information to the citizens about the plans, and only 36 % proposed the organization of emergency exercises and among these only 16 % with the involvement of the population. The regional variability, however, is considerable, so that some regions are very much behind with the Legal Compliance (Abruzzo, Basilicata, Campania, Sicily, Marche, Lazio) and some regions appear more efficient (Emilia Romagna, Friuli Venezia Giulia, Tuscany, Umbria).

In December 2012, 1,143 RIR plants were operating in Italy, mostly concentrated in certain northern regions (Lombardy 288, Veneto 112, Piedmont 103, Emilia Romagna 99), while in the central and southern regions there were Lazio (69), Sicily (71), and Campania (70) (MATTM 2012). The local scale shows a scattered distribution of these enterprises, which affects the whole country, especially in petrochemical plants, oil refineries, or storage facilities of oil or liquefied petroleum gas (LPG): In addition to Ravenna and Porto Marghera (Venice), hosting the greatest number of RIR industries, we focus our attention on the industrial centers and ports of Genoa, Naples, Taranto, and Brindisi (Fig. 2.2).

Overall, the majority of RIR plants are engaged in the storage of mineral oil (26.5 %), chemical and petrochemical industries (25.6 %), and storage of liquefied gas (22 %) (www.isprambiente.gov.it), confirming the vulnerability of the Italian territory, especially of the coast, to activities related to the production, processing, and use of fossil fuels, although many studies have highlighted the major impact that comes from petrochemicals (Gatto and Saitta 2009), the emission of metals (arsenic, chromium, cadmium, etc.; Stigter et al. 2000), and volatile organic compounds (Cetin at al. 2003), benzene, vanadium, and benzo[a]pyrene (Iturbe et al. 2004).

The major accident database (International Beacon Registration Database, IBRD), established by the Ministry of the Environment to collect, process, and disseminate data and information of environmental interest, including information about accidents, had collected, a few years ago, about 5,000 national and international incidents, although they do not refer to RIR industries alone (Ricchiuti et al. 2007). At the European level, the computer system Major Accident Reporting System (MARS), established by the European Commission to collect data on accidents and to allow an exchange of information between the member states, as determined by the Seveso II Directive, has surveyed more than 450 major accidents. The European Environment Agency, in the list of the 622 most polluting industrial plants on the continent, included more than 60 Italian companies, with Ilva of Taranto placed second (EEA 2011), for environmental damage estimated at 0.75 billion Euro (Table 2.2).

These costs, however, are underestimated, since they refer only to air pollutants, without considering the pollution of the subsoil, soil, and aquifers; for this reason, the impact of coal and minerals that affect the environment of Taranto and Brindisi, two of the main Italian RIR locations, is not considered (Attardi et al. 2012)[7].

[7] The Ilva of Taranto, in particular, according to *European Pollutant Release and Transfer Register* (E-PRTR) for 2004, generates atmospheric emissions of 9.6 million t of carbon dioxide (CO_2), 446,000 tons of carbon monoxide (CO), 350 kg of cadmium (Cd), 468 tonnes of methane (CH_4), 27,800 tons of oxides of nitrogen (NO_x/NO_2), 40,600 tons of sulfur oxides (SO_x/SO_2), 1,500 tons

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