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REGULATING INDUSTRY EMISSIONS:
ASSESSING THE MOROCCAN
CEMENT EXPERIENCES

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Abstract

This paper analyzes the way heavy polluting industries may be regulated in the Middle East and North Africa (MENA) region by examining the case of the cement industry in Morocco. It suggests some answers to the following research questions. First, it questions the consequences of cement production on the environment and quantifies the related welfare loss through methodologies of economic valuation. More particularly, it demonstrates that the cost of regulating the emissions of the cement industry is lower than the benefit it creates. Secondly, the case of environmental inefficiencies in material and energy inputs is examined in the cement production in order to identify in which circumstances spontaneous action by cement producers could be fostered. Thirdly, the paper examines the whole set of instruments that could be used by the regulator to reduce the environmental consequences of cement production and presents for each one some of its applications in the MENA region and the cement sector. It proposes an in-depth analysis of the voluntary agreements used in Morocco. It presents a set of criteria that constitutes the basis for choosing the best instrument in each situation (economic efficiency, environmental effectiveness, the way the instrument deals with uncertainties, equity, the economic cost or the impact of the instruments on competitiveness, the way the instruments deal with imperfect competition, the influence of political behavior, applicability and acceptability). Finally, a multicriteria framework is built in order to identify a possible strategy for regulating the emissions of the cement sector. Its main conclusion is to formulate a global strategy which proposes criteria that set rules for trading-off environmental and economic objectives.

ملخص

تحلل هذه الورقة الطريقة التي يمكن بها تنظيم الصناعات الثقيلة الملوثة في منطقة الشرق الأوسط وشمال أفريقيا من خلال دراسة حالة لصناعة الاسمنت في المغرب وتقترح بعض الاجوبة على الأسئلة البحثية التالية. الأول ، فإنه يشكك في النتائج المترتبة على إنتاج الأسمنت على البيئة وتحدد فقدان الفائدة العامة ذات الصلة من خلال منهجيات التقييم الاقتصادي. على الأخص ، فإنها توضح أن تكلفة تنظيم الانبعاثات من صناعة الأسمنت أقل من المنافع التي تخلقها. ثانيا ، يتم فحص حالة عدم الكفاءة البيئية في مدخلات المواد والطاقة في إنتاج الاسمنت من أجل تحديد الظروف التي يمكن من خلالها تعزيز طرق العمل السريع من قبل منتجي الاسمنت. وثالثا ، فإن الورقة تبحث مجموعة كاملة من الأدوات التي يمكن استخدامها من قبل الجهة المنظمة للحد من الآثار البيئية لإنتاج الأسمنت ، ويقدم لكل واحد من بعض تطبيقاتها في منطقة الشرق الأوسط وقطاع الاسمنت. وتقترح الورقة إجراء تحليل متعمق للاتفاقيات الطوعية المستخدمة في المغرب. فهي تقدم مجموعة من المعايير التي تشكل أساسا لاختيار أفضل أداة في كل حالة (الكفاءة الاقتصادية ، والفعالية البيئية ، والطريقة التي تتعامل مع حالات عدم اليقين ، والإنصاف ، فإن التكلفة الاقتصادية أو تأثير على القدرة التنافسية للصكوك ، والطريقة التي أدوات التعامل مع المنافسة غير الكاملة ، وتأثير السلوك السياسي والتطبيق ، والقبول). أخيرا ، تبني الورقة إطارا متعدد الزوايا من أجل تحديد استراتيجية ممكنة لتنظيم انبعاثات قطاع الاسمنت. الاستنتاج الرئيسي هو صياغة استراتيجية عالمية المعايير والتي تقترح وضع قواعد للمفاضلة بين الأهداف البيئية والاقتصادية.

Introduction

This paper aims at analyzing the ways heavy polluting industries may be regulated in the Middle East and North Africa (MENA) region. It will more specifically focus on the cement industry and will rely on an existing theoretical base and empirical evidence.

Section 1 proposes evidence indicating why environmental regulation of cement production is necessary in the MENA region. It more particularly demonstrates—through methodologies of economic valuation—that consequences of pollution and using natural resources by the sector generate significant welfare loss and inefficiencies. It also shows that losses can be avoided and welfare gains can be generated. In other words, the cost of environmental remediation is lower than the benefit it creates. Section 1 also shows that cement producers have an incentive to act spontaneously in order to reduce inefficiencies in material and energy inputs.

Section 2 lists the available means or instruments that could be used by the regulator to reduce the environmental consequences of cement production. It presents a whole set of instruments (persuasive measures, voluntary agreements, standards, taxes, subsidies, tradable permits) and presents for each one some of its applications in the MENA region and, when available, in the cement sector. It proposes an in-depth analysis of the voluntary agreements used in Morocco. Section 1 and 2 implicitly conclude that a combination of environmental protection instruments constitutes an interesting practice.

Section 3 presents a set of criteria (economic efficiency, environmental effectiveness, the way the instrument deals with uncertainties, equity, the economic cost or the impact of the instruments on competitiveness, the way the instruments deal with imperfect competition, the influence of political behavior, applicability and acceptability) that should constitute the basis for choosing the best instrument in each situation.

1. Why regulate the emissions of the cement sector?

Cement is the main binding agent in concrete, the most common building and construction material in the world, with an average per capita consumption of three tons per annum. World cement production is expected to grow by 3-4% annually in the next 15 years, driven mainly by increasing consumption in emerging market economies. The availability of cement remains essential for construction and economic growth. In Algeria, the cyclic shortage of cement during the last decade has constituted an obstacle for development.

The first section intends to establish the necessity of regulating emissions in the cement sector by proposing evidence on the environmental damages associated with the production of cement. It also identifies the available remediation measures and proves that such actions are welfare enhancing, i.e. lead to larger social gains in comparison to their costs.

1.1 Environmental damages of the cement sector: An economic appraisal

In the MENA region, the cement industry grew rapidly during the last decades in parallel to the boom in the construction sector. MENA's cement production capacity in 2008 is estimated at about 376 million tons, and is expected to grow by around 40% in 2012. As reported by AUCBM¹ (2008), the largest Arab cement producers are Egypt (around 40'000'000 t/y), Saudi Arabia (37'000'000 t/y) Morocco, Algeria and UAE (all three around 15'000'000 t/y). Together, Egypt and Saudi Arabia represent around 50% of total Arab cement production in 2008.

While producing the main building material in the world, the cement industry is also one of the most significant industrial polluters, requiring large amounts of raw minerals and water.

¹ Arab Union for Cement and Building Materials.

The cement production process is also extremely energy intensive, even when producers make great efforts to reduce their energy costs. Indeed, more than 40% of the manufacturing costs are related to energy consumption. Furthermore, the production process releases significant quantities of atmospheric emissions which cause respiratory diseases and skin allergies. In Tunisia and Syria, the number of people affected by dust from cement pollution doubled during the last decade. Additionally, the cement sector accounts for 5% of global man-made CO₂ (Turmes 2005). Finally, the extraction of raw material (limestone, clay, sand and iron ore) from quarries has an important impact on land and biodiversity.

The previous description of the economic dimension and environmental damages of the cement sector establishes the incentive for regulating it. However, one should not forget that cement and concrete are necessary for development. In order to judge the trade-off between positive and negative aspects of cement production, one needs to examine both the economic value and the environmental consequences of the cement industry. The theory of externalities allows us to consider the non-marketable consequences of production and consumptions activities. Externalities allow the analysis of the cement industry's environmental impact as pollution emitted by the cement plants affects the welfare of people (health problems or the quality of life) or has a negative effect on the production of other activities (e.g. agriculture) without taking into consideration and compensating the preferences of the latter victims. Externalities constitute a market failure, where the cement industry does not have to pay for the implicit cost it imposes through environmental and health damage. These costs are thus not fully taken into account in production decisions.

Environmental economics proposes methods to extend the picture beyond the frontier of the market. Table 1 proposes some empirical evidence on the damages and inefficiencies of cement production in the MENA region².

From an economic point of view, damage costs (CD), i.e. costs of environmental degradation, are defined as a loss of well-being for a community or a country. The cost of inefficiencies (CI) in the use of resources entails economic losses in the sense of a waste of resources.

In the case of an industrial sector, like the cement sector, the costs of damage and inefficiencies (CDIs) are calculated in percentage of the value added (VA) of the sector as such. Several works (Maradan et al. 2009; Pillet 2001; Pillet et al. 2005) discuss how environmental damages have been estimated in the case of cement production³. Annex 1 proposes a summary of the valuation protocol⁴.

Table 1 shows that the CDIs of cement production are high and may represent a significant part of the VA. The differences between countries are explained by technical (the age of process, the use of clean air device such as electro-filters, etc.) and economic factors (price of material, energy, labor and capital) coupled with existing regulations. The relative level (in % of VA) of damages and inefficiencies may give an indication of the environmental measures taken by the cement producers and the regulating authorities. The estimates presented in Table 1 should be considered with caution since a large margin of error (30% to 40%) remains (due to lack of data). Furthermore, considering the rapidly increasing size of the cement sector, the relative decline in CDIs should not hide their increase in absolute amount.

1.2 Remediation opportunities

To overcome externalities in the cement sector, Table 2 presents some technical measures.

² Refer to the MESO program of Ecosys and *sba*, 2001–2009. For further details see www.meso-platform.org

³ An interested reader can refer to www.meso-platform.org for further details on the valuation methodologies.

⁴ An interested reader can refer to www.meso-platform.org for further details on the valuation methodologies.

To illustrate one of the above mentioned technical measures (electro-filter⁵), data related to the absence of an electro-filter may be proposed in the specific case of a plant in Western Algeria which had a deficient electro-filter and management was delaying its repair. This situation lasted six months and thus provided interesting environmental economic evidence for the profitability of an electro-filter in mitigating air pollution. The electro-filter has proven its efficiency in recovering raw materials and preventing respiratory diseases. The 'pay-back' of the electro-filter was five years for an investment of USD 1.5 million. Similarly, its maintenance and repair proved to be a profitable environmental remediation.

Another interesting measure is co-processing. It refers to the use of waste materials in industrial processes, such as cement, lime or steel production, and power stations or any other large combustion plants. Co-processing means the substitution of primary fuel and raw material by waste. It is a recovery of energy and material from waste.

1.3 Cost-benefit (CB) analysis

For a given budget, environmental protection should be oriented where benefits from remediation are highest. Thus, avoiding damage from an economic viewpoint is efficient or optimal only if the benefit of the action (the avoided damage) is greater or equal to the cost generated by this action (i.e. the remediation cost). Ratios between avoided cost of damages and inefficiencies and remediation costs highlight the cost-effectiveness of the remediation.

Figure 1 presents the average cost-benefit ratios for the cement industry by environmental domains and thus indicates where the remediation is the most efficient in terms of avoided damages. In order to propose some contrasting benchmark, results concerning tractor engine production⁶, power generation, the tourism sectors⁷ and the urban community of Agadir⁸ are also presented.

Results show that the environmental domains that are a priority for action differ across sectors. Remediation in the domain of energy & materials might be the most beneficial for the cement sector while air is indeed the priority in power generation sector and soils, and landscape and coastal zones are the priority for the tourism sector. Such results are crucial and rather unique as they indicate the priorities of action for environmental policies on the basis of cost-benefit ratios. As the priorities vary across activities, they confirm the need for adapting environmental legislation to the specificities of sectors.

Figure 2 compares sector specific cost-benefit ratios of environmental remediation and national ones in Algeria. Again, environmental priorities (the most efficient remediation actions) at the national level may not correspond those of the cement industry. Industrial priorities for action thus differ from those determined at the country level.

⁵ From a technical viewpoint, the stability of electro-filters (working with magnetic fields) was rather difficult to reach, thus leading to many days per year where the electro-filters needed repair and maintenance. Production stress on the cement sector in the MENA region has thus pressured the plants to produce despite heavy air pollution and loss of raw material. In recent years, the emergence of bag filters as alternative to electro-filters became a trend. Bag filters need to be replaced frequently, however their advantages are many: low maintenance, low price, and little time where the plant is stopped for maintenance.

⁶ Evidences based upon the results of the MATE & CPI (2001) concerning the tractor engine production in Constantine (Algeria). They may not be as comparable as the other evidence, since they are based on another valuation protocol.

⁷ Evidence is based upon the MESO program and on a similar valuation protocol; they may thus be directly compared. The error margin determined by a sensitivity analysis on the most uncertain and influential parameters (as the numbers of victims, WTP) is around 20%-80%. Countries examined for the cement sector are: Algeria, Libya, Morocco, Syria and Tunisia | for Power production: Libya, Algeria and Morocco | for Tourism: Morocco.

⁸ Evidence based on the MESO program studies, see Pillet et al. (2004)

An important finding concerns the degree of inefficiency, which seems systematically high in the cement sector (see figure 1). This could be interpreted as an indication of the large potential for voluntary environmental protection measures in the cement sector in the MENA region. Such proposition rests on differentiating between internal and external advantages of remediation for firms.

Internal advantages imply positive overall financial incidences for the sector; the cost of remediation is compensated by gains in efficiency through reducing energy and material consumption. Their identification confirms the Porter hypothesis, indicating that firms may have an incentive to protect the environment so far as it decreases their operational cost. Incentives to reduce inefficiencies can thus be linked with voluntary measures and flexible constraints.

External advantages of environmental remediation addresses the welfare gains that benefit the surrounding population and other economic activities. Although remediation actions are socially desirable, they induce costs for the polluters. For the cement sector, they mainly concern air, soil and water pollution where damages have no direct consequences on the activity of industries. State intervention and restrictive measures are necessary to enforce such actions and will logically be met by resistance from the polluters.

1.4 Conclusions from the economic estimation of damages and inefficiencies in the cement sector

The previous findings lead to the following conclusions:

- Environmental consequences of the cement industry are important and remediation opportunities do exist.
- By comparing damages and inefficiencies with their respective remediation cost, the most beneficial remediation opportunities lay in reducing inefficiencies in energy and material domains.
- Priorities for actions are sector specific, thus environmental policies should also be sector specific.
- Environment impacts of the cement sector and their remediation differ little from one country to another thus it becomes interesting to analyze and share experiences at a regional level
- As inefficiencies constitute a profitable area for action, voluntary measures could be implemented since they may lead to internal advantage for the firms.

The previous finding stresses the need for an integrated environmental strategy that could combine the use of voluntary programs (focusing on inefficiencies reduction) with the use of environmental policy instruments (for avoiding air pollution, waste, and soil and water degradation). It might be worth noting that despite some large cost-benefit ratios, remediation is likely to be undertaken by companies even if it does not lead to financial advantages (inefficiency reduction). In such cases, policy instruments are needed.

2. How to regulate the emissions of the cement sector

Economists subdivide environmental protection measures into two broad categories: regulatory and economic instruments. The first category includes emission standards; the second encompasses taxes, subsidies as well as tradable permits. It is also common to consider two additional categories: persuasive instruments and voluntary agreements (see J-P Barde 2000 or Pillet 2006). Table 3 presents a short overview of environmental protection

instruments, and a detailed description follows. For each instrument, examples of applications in the MENA region are presented and, when possible, in the cement industry.

These categories are not mutually exclusive; they are rather complementary. Indeed, successful environmental policies combine various instruments, integrating, for example, regulations to meet certain environmental objectives through emission standards or taxation while allowing polluters at the same time to evade the standards or the taxation via negotiated agreements with the State. Economic instruments are often used as a complement to standards by providing additional incentive for pollution abatement or additional revenue for financing environmental measures (Barde 2000). The Swiss climate policy in this regard is emblematic; the tax on CO₂ emissions has come into force in 2008 when voluntary agreements seemed insufficient to fulfill the objectives of Greenhouse Gas (GHG) reduction. Firms may however still escape taxation by means of formal agreements with the government. The objectives set by those agreements can be reached through private reduction measures and through active participation in tradable permits frameworks (CO₂ market).

2.1 Voluntary agreements

Voluntary agreements refer to situations where economic agents reduce their negative impact on environment without being legally constrained to do so (Baranzini and Thalmann 2004, 4). They are remediation efforts done in the absence of legislation or that exceed what is required by legislation. Voluntary agreements may range from self-regulation by the firm to negotiated contracts between firms and regulators:

- Self-regulation is a unilateral commitment and is not motivated by the counterpart proposed by the regulator. Firms are not bound to the mentioned target. This is the case, for example, of the adoption of environmental management systems or ISO 14001 certification. The role of the legislator is limited to offering opportunities to the private firms by proposing a label, for example (see section 2.2 below).
- Negotiated contracts are usually between the regulator and firms. Such contracts state the obligation of each party. The firm commits to pollution reduction, respecting a calendar and fixed targets, in exchange for financial or technological help from the State or a reward (like a grace period) or an exemption from taxes or regulations. The control of the regulator is rather high, imposing constraints, rules and deadlines. Contracts could also be generalized, taking the form of packages of commitment and rewards proposed by the State that each agent might accept or refuse.

Applications of voluntary agreements are rare in the MENA region. However, the cement industry in Morocco and Algeria constitute interesting case studies providing lessons learnt on the efficiency and the applicability of such instruments in the MENA region. Our analysis will focus on the case of Morocco since voluntary agreements in Algeria concern only public firms. It is noteworthy that in Algeria, voluntary agreements have been set under the “Environmental performance contracts” and have been signed between individual public cement plants and the Ministry of Environment. These contracts include a set of voluntary measures that the national cement producers commit to implement under the supervision and assistance of the Ministry of Environment. Such contracts have also been signed in Algeria with the steel and the chemical industries.

Example in the MENA region: voluntary agreements in the Moroccan cement sector

The cement sector in Morocco was privatized in the 1990s. Four international groups (namely Holcim, Lafarge, Italcementi and Asment) bought the existing cement plants and committed to environmentally upgrade their operations while also respecting certain social and economic plans. The four groups created a national cement association, the *Association*

Professionnelle des Cimentiers (APC), that acts as a lobby group for the cement industry and promotes the sector's interests vis-à-vis third parties (government, unions, etc.).

In June 1997, the APC, on behalf of the whole cement sector, signed a six-year voluntary agreement⁹ with the Moroccan Ministry of Environment marking its willingness to enhance its efforts for environment protection. Thus, the cement sector committed to limit, as much as possible, its negative environmental impacts by integrating the environmental dimension in the choice of the location, equipment and industrial processes. In 1997, the Ministry of Environment started developing environmental laws as no standards were yet available for most types of emissions. Through this voluntary agreement, the Ministry of Environment granted the cement sector a grace period during which the sector has committed to reach European standards by 2003. The oligopolistic structure of the industry was also a key element for a successful implementation of the voluntary agreement. Additionally, as explained in section 1, the cement sector had a real economic incentive to reduce its inefficiencies.

In order to assess the impact and outreach of the voluntary agreement in Morocco, we will rely on the findings of three different analyses performed between 2003 and 2009 (Maradan et al. 2009) as well as on a survey undertaken in spring 2010. On the one hand, environmental economic analyses show the decreasing impact on environment of cement production. On the other hand, the survey¹⁰ presents the motivation, the advantages and drawbacks of the cement sector concerning the voluntary agreement as such, knowing that part of the answers may also be strategically motivated so that interpretation remains difficult.

Environmental economic analysis

The environmental economic analysis of the cement sector in Morocco shows the success of the voluntary agreement. During the last 12 years, the cement sector invested MAD 2.5 billion (around 230 million Euro) in environmental protection. Since 2003, 15% of the total investments are dedicated to improving environmental performance. Between 1997 and 2008, the contribution of the cement industry to the Moroccan GDP increased from 0.61% to 0.74%; meanwhile, the environmental impacts decreased from 1.41% to 0.19% of the total environmental degradation in Morocco (figure 3). According to the previous evidence, the cement industry, since 2004, contributes more to the creation of economic value-added and less to national environmental degradation.

The previous statement is clear when examining the cost of damages and inefficiencies (CDI) per environmental domains¹¹ (see figure 4 below). Damages are reduced in all environmental domains. It is noteworthy to say that for the waste domain, negative damages (i.e. benefits for the environment) were computed due to the fact that toxic wastes were burned (and thus destroyed) in their kilns (co-incineration). The cement sector also incorporated waste (namely fly ashes) as an input for the cement production (co-generation). Such substitution is justified for the cement sector on purely economic ground (lower production cost). However, it leads

⁹ Besides this main voluntary agreement, the APC also signed specific agreements: old oil elimination (2004), plastic elimination (2008) as well as a broader agreement (2006) with various ministries committing to environmental and social performances.

¹⁰ To conduct the survey a questionnaire was developed and sent to all four cement groups as well as representatives from the APC in order to document their opinion of voluntary agreements. A slightly modified version of the questionnaire was also sent to the Ministry of Environment to get the opinion of the legislator. Subsequent telephone interviews were conducted with each respondent in order to clarify and double-check the answers. All cement groups provided their opinion, leading to a total of eight interviews. The interviews did not aim for a statistical analysis. We expected to have rather uniform answers from the cement companies since the sector is organized through the APC.

¹¹ The latest analysis addressed the year 2012, with a prospective approach.

also to environmental benefit, as it is a proposed alternative for the deficient public waste management. The cement sector is now able to benchmark its performance with the best practices in Europe (Germany, Spain or Switzerland).

The reduction of the cement industry's CDI during the last 12 years has been linked to several environmental outcomes as the certification ISO 14001 of major cement plants, the adoption of effective filtration systems (64% decrease of dust emissions, from 50-100 mg/Nm³ in 1997 to 10-20 mg/Nm³ in 2009; SO₂ emissions has also decreased by 62% and NO_x by 41%), the decrease of CO₂ emissions from 729 to 643 kg per ton of cement (reduction of 12%) due to process optimization and to the use of renewable energy (wind energy), the reduction of water consumption by 60% (from 300 to 120 liters/ton of cement), the decrease of energy consumption by 49% (from 1,500 to 770 Kcal/ton of clinker) and of electricity by 35% (from 120 to 78 kWh/ton of cement), the rehabilitation of 230 ha of quarries (plantation of 440,000 trees). Finally, the co-generation and co-incineration introduced in 2009 allowed the replacement of 11.5% of fuel by the combustion of 80,000 tons of waste (old tires, oil and greases, hazardous waste, etc.).

Even if the Moroccan example seems interesting, one should bear in mind that such an isolated example might not set a rule. However, with regard to the Moroccan case study there are several unanswered questions:

- What would have happened in the absence of voluntary agreements? The cement sector has indeed saved costs by adopting environmental actions. They may have implemented them in any case without State intervention. Additionally, the regulator should set targets independently of the polluters in order to avoid 'regulatory capture' where cost-minimizing polluters have an incentive to negotiate agreement goals down to the business as a usual scenario (Blackman et al. 2007).
- Are the implementation costs really lower? For the OECD (2003), negotiation and administrative costs are rather diverse in order to draw conclusions; additionally, no evidence in this respect is available in a developing country.
- Do voluntary agreements effectively lead to better regulation in the long-run? It could also provide an opportunity for industry to influence the regulator's decision-making process and delay needed and more stringent state interventions.

Factors of success and participation

Looking at the performance of the Moroccan cement sector, one may conclude to the success of voluntary agreement. One crucial element in this situation would be to determine which factors might favor or hinder such outcome.

First, the success of voluntary agreement remains dependent on the effective participation of firms. Various theoretical motives may explain the interest of firms in voluntary agreements. Abatement actions may reduce inefficiencies and, hence, energy and material consumption. Such actions are voluntary since they lead to benefits larger than the abatement cost incurred (win-win). The firm may have an incentive to prevent more stringent regulations (future costs) by taking a proactive attitude. They can also use such feature as a proof of their 'green attitude' and enhance their environmental image. The financial advantage (tax reduction or exemption) granted by the State may also be the main motivation. By adopting a tailor-made contract, firms can propose measures that better fit their situation and reduce compliance costs.

However, empirical evidence on the impact of regulatory pressure on participation and success of voluntary instruments are mixed (see for example, Vidovic and Khanna 2007;

Gamper-Rabindran 2006). Implicit pressure by the consumers seems to be a rather effective incentive for firms to participate.

In the Moroccan case, all cement producers confirmed the incidence of upcoming regulation and economic gains; the State offers a counterpart by delaying environmental legislation. The survey undertaken in spring 2010 shows that the collaborative framework set with the legislator also allows anticipating new environmental regulations and providing channels for information exchange. The option of voluntary agreement has been favored by cement producers since they are not binding agreements but instead provide a framework for the cement sector to address environmental protection in its operations. For example, the cement sector was always consulted during the elaboration of new laws. In this respect, emission standards have been set taking into account the sector's capability to meet them. The legislator was also convinced that such collaboration would be beneficial for environmental protection and was not an artifact used by the industry.

From the economic point of view, the pursuit of improved productivity and lower operational costs is mentioned by the majority of cement groups as well as the quest to have a technological advantage over competitors and to develop 'green' products for the market. Consumer pressure is not mentioned as a motivation. This is not surprising in the situation of relative scarcity of cement and the local natural monopoly position of cement producers. However, cement companies do not confirm that only economic incentives explain their attitude. All of them (but one) declare feeling responsible for their environmental impact and search for a proactive attitude to contain or reduce it. The notion of 'corporate social responsibility' is raised in this respect.

Looking at empirical research in industrialized countries, past environmental performances appear to be a strong determinant for participating in voluntary programs (Blackman et al. 2007). Thus the environmental benefits of these programs are limited because they mainly attract firms that are either relatively clean or becoming cleaner for reasons unrelated to the program (see also Vidovic and Khanna 2007; Morgenstern and Pizer 2007). Such firms join the voluntary programs since the costs are relatively low (no additional pollution control investments are required to meet the voluntary programs' environmental performance goals) while the benefits, which may include positive publicity, pollution control subsidies, and preferential treatment by regulators, can be significant. Firms that join for these reasons are said to be 'free riding' on unrelated investments in pollution. In the case of the cement industry, the decision to participate is taken in coordination with cement groups through the APC. Indeed, the Moroccan cement sector forms a cartel, due to the small number of competitors and excessive cost of transport. Each cement plant will develop a local natural monopoly in a 200 km range. Thus, it was easy for them to adopt a common stance toward voluntary agreement, as it is independent from any gain or loss of market share.

The survey however reveals that differences of past environmental performance lead to difficulty in defining the aim and setting of voluntary agreements. The main difficulty is that companies with different environmental performance levels do not address environmental problems in the same way. A joint sector approach has to deal with confidentiality of information among the different groups as they face each other in the national and international market. In the case of Morocco, such approach has been declared a viable practice since it provides a strong position vis-à-vis other stakeholders and a good experience exchange among the different companies.

Empirical analysis on the performance of voluntary measures in the MENA region or even in developing countries remains thin. A recent article by Blackman et al. (2007) tests the effectiveness and efficiency of Mexico's Clean Industry Program. The Mexican authorities examined plant-level data on more than 60,000 firms to identify the drivers of participation in

the Clean Industry Program. The results show that the threat of regulatory sanctions drives participation in the program and thus attracts relatively dirty firms. They also found that firms that sold their goods in overseas market and to government suppliers using imported inputs were more likely to participate in the program. The type (sector) and size of the plant and its location may also influence participation.

Jimenez (2006) confirms that voluntary agreements encourage the implementation of environmental initiative in the Chilean industries. However, the improvements were rather marginal and not as strong as the one monitored in Morocco where voluntary agreements succeeded in reducing operational and transaction costs. The existence of industrial association is a strong determinant of participation; regulatory pressure and governmental funding are however of secondary importance. In the case of Morocco, the APC indeed leads the way in setting the approach with the legislator.

The Moroccan Ministry of Environment has noticed no evidence of regulatory capture. This will happen if the cement producers use their exclusive information and market power in order to lower the ambitiousness of the targets, addressing easier and cheaper environmental issues or already implemented measures (Jimenez 2006). However, this is difficult to judge since voluntary agreements were rather general. In Chile, Jimenez noticed, to the contrary, that the targeted environmental problem did not improve significantly even if environmental improvement were significant in other areas.

2.2 Persuasive instruments

Persuasive instruments aim at influencing the agents' set of values. Such instruments rest mainly on the production and dissemination of information, which aims to foster environmental concerns. Examples range from advertising campaigns in favor of environmental issues to the setting and dissemination of eco or energetic labels. Note that persuasive instruments may either directly inform agents (posters and commercials) or support them to certify their ecological behavior (labels).

Usually only economists take persuasive instruments into consideration. However, environmental policy-makers should consider them carefully as they seem to be essential for the following reasons:

1. Persuasive instruments do not impose any obligation and imply no direct costs for polluters. Their acceptability is thus not less at stake. They are adequate instruments explaining the need for environmental actions and how such actions could be undertaken. In this regard, they may pave the way for the acceptability of upcoming stringent measures.
2. Persuasive instruments constitute warning signals for polluters; they may thus anticipate actions and minimize future adaptation costs. Persuasive measures create an announcement effect for the economy. Such signal may also show the necessity for the polluters to defend their pollution rights and initiate lobbying activities against environmental policies.

Overall, persuasive measures address the 'soft power' of the State (Nye 1990/2004), i.e. the power of the State to convince without any attempt to control the behavior of agents or adopt sanctions.

A short review of the factors for success and failures of persuasive instruments remains difficult since it lies on scarce evidence. However, combining marketing and advertising principles, it seems that:

- A campaign has to identify the targeted public, test the available information and consider how the targeted agents may modify their environmental behavior.

- Labels have to be clearly indicated and confirmed by an authority. The Federal Trade Commission's (FTC) Guidelines for Environmental Marketing Claims or 'Green Guides' were issued in 1992 and are designed to have an effect on labeling. They are intended to prevent false or misleading use of advertising claims such as 'environmentally friendly', 'degradable', and 'recyclable' (EPA 2001).
- The additional cost for being 'certified' (as in the building sector) should be transparent for the agents and accompanied by other financial advantage such as fiscal exemptions.
- Persuasive instruments for environmental protection have to be frequently tested and evaluated by the State since their opportunity cost is not negligible.
- Persuasive instruments may sometimes be used as a lure, masking the lack of a stringent environmental policy. Environmental policies should set a strategy, indicating what would be done if persuasive measures remain insufficient to protect the environment.

Examples in the MENA region

In the MENA region, persuasive instruments have been used such as training programs and tools for primary education in Algeria (Train Vert). Most countries in the Maghreb and Mashreq have also embarked on promoting the DELTA¹² eco-management tools to the industry, providing agents with training and tools to better manage their environment and thus become more competitive. However, no persuasive program has focused on the cement industry as such. The case of the cement sector in Morocco shows that the persuasive measures used by the State were decided by direct discussions with the cement producers. It also seems that the threat of more stringent environmental legislation fostered the use of voluntary agreement (see section 2.1).

2.3 Regulation: standard and ban

Standards modify the set of the agents' choices by assigning property rights on the environment to both polluters and victims via institutional negotiations. Standards set free and non-tradable rights to pollute until a limit. Ban constitutes a particular type of regulation where the limit is set to zero and addresses issues of ecological irreversibility (e.g. impact on species and ecosystems) and moral choices (e.g. is there an acceptable rate of cancer linked to air pollution?). The ban of polychlorobiphenyl (PCB), constitutes one traditional example.

In practice, two categories of regulation have to be distinguished. While the outline regulation sets environmental objectives, standards are means to achieve them. For example, a regulation determines the concentration level of acceptable airborne particle matter and simultaneously sets a technological standard for motor vehicles to respect the defined limit (catalyst). However, in most cases, the regulation sets the limit and requests the legislator to take the appropriate measures. These could be a standard, an advertising campaign, a tax or a tradable permit framework, etc. In this regard, the analysis of environmental regulation should distinguish the outline regulation (which sets the objectives of environmental protection) from the strategy and the policy tool (which provide the means for their achievement). The former is usually an essential condition for setting any type of environmental protection measures (Pillet 2006). Outline regulation should indicate criteria for judging the appropriateness of the measures. However, the criteria selection remains a

¹² DELTA stands for *Developing Environmental Leadership Towards Action*. The program has been implemented during 1996 and 2006 in 11 countries in the Mashreq (Egypt, Jordan, Lebanon, Palestine, Syria, and Turkey) and the Maghreb (Algeria, Libya, Mauritania, Morocco, and Tunisia). See <http://sba-int.ch/index2.php?id=1044>

controversial issue. For some, appropriate means the least polluting option. For others, a measure is appropriate as long as its related benefits exceed its costs. Actually, many environmental outline regulations are not applied due to the incapacity to find compromises on the way to reach the objectives.

Standards and bans constitute alternatives to other environmental protection instruments such as taxes or tradable permits. Standards might address the quality of an amenity, emission standards, product standards, or standards regarding the use of a particular production process¹³ (Opschoor and Vos 1989). Standards are based on environmental (maximum acceptable pollution load), technological (best available technology), economic (optimal) and political criteria (equitable, acceptable, simple).

Examples in the MENA region

During the 1990s most MENA countries based their environmental policy on standards due to the long-standing experience of public administration with such instruments. Morocco and Algeria, for example, developed an outline regulation in order to organize the dispersed body of environmental clauses into specific regulations. According to analysts (see Pillet 2001), the Algerian environmental standards are not implemented and include conflicting clauses.

Focusing on the industrial sector, standards rest frequently on administrative authorizations to operate. Such authorizations are needed for each new industrial installation (or major transformation of existing ones) and require that the industries list their environmental impacts and prove that they take all the necessary measures to respect environmental standards. In Algeria (law n° 83-03) and in Morocco (Decree n° 1-3-60), the environmental law sets the obligation of performing environmental impact studies for industrial activities. Environmental legislation also set the principle of maximum authorized pollution loads (emission standards) for dangerous substances (nuclear radiation, Decree n° 86-132 in Algeria) or sensitive area for public health (bathing water bodies, Decree n° 93-164 in Algeria). For industries in Morocco, standards set the principle of maximum concentration load (Decree n° 1-03-61) or the obligation to use particular environmental protection devices or technology (process standard) for industrial activities.

2.4 Economic instruments: taxes, subsidies and tradable pollution permits

Economic instruments aim at setting a price-signal (i.e. adjusting relative prices) in order to modify the agents' costs and benefits associated with their environmental choices. The main economic instruments are environmental taxes, subsidies and tradable permits:

- **Tax:** the tax base covers the amount of pollution emitted, the amount of resources used or the quantity of polluting goods consumed. Common examples range from the taxation on tons of CO₂ emitted or the taxation on the quantity of non-renewable energy consumed.

¹³ **Standards regarding the quality of an environmental amenity** tend to specify quality objectives. For air, water and soil these tend to be expressed as maximum acceptable values of pollution concentration (limits). For noise, the standards relate to a threshold noise pollution level (these can differ depending on whether the area is inhabited or not, etc.). **Emission standards** relate to limit values for emission rates, which are fixed according to production processes. An example of this type of standard is the quantity of dust per cubic meter emitted by a cement factory. The most recent available production technologies can be ten times as efficient as older ones which emit from seven to fifteen times higher than the norm. **Product standards** define the characteristics of potentially polluting products (e.g. paint) or products that can be dangerous for individuals' health (e.g. pesticides in food). Standards regarding noise pollution levels for vehicles and planes are also part of this category. **Production process standards** determine the production process or treatment processes for emissions (e.g. water treatment). Using current available technology allows the immediate use of technology and processes whilst best available technology or the experimental standard approach refers to processes that have been put in place or conceived by the highest performing units.

- **Subsidy:** the subsidy acts as a negative tax. The polluter is rewarded when he reduces his impact on the environment. As opposed to tax, the financial burden of subsidies is reversed. Subsidies can take the form of grants, loans, tax benefits or procurement mandates.
- **Tradable permits:** the rights to pollute are distributed or sold by the legislators to the concerned agents. Pollution rights could be exchanged between agents according to their needs. A market of pollution rights is thus created limiting the role of legislator. There are two approaches to trading emissions: (i) cap-and-trade, in which an aggregate cap on emissions is distributed in the form of allowance permits, (ii) baseline-and-credit, in which firms earn emission reduction credits for emissions below their baselines.

Economic instruments are usually qualified as incentive instruments since they offer an alternative: one may or not pay taxes, get subsidies, sell or buy tradable permits. The decision will depend, at the margin, on comparing the costs of remediation and the tax rate, the price of the permit and the rate of subsidy.

The analysis proposed in this section will discuss in detail the main advantages and disadvantages of economics instruments. However, few clarifications seem necessary at this stage:

1. Setting the appropriate tax, the subsidy rate or the number of permits in order to reach a given environmental target requires information on damages and remediation costs. Such information is usually lacking and polluters have no incentive to reveal it. However, in a practical situation, the political process, that has to mediate between the advantage of environmental protection and its costs, sets the rates. In such a situation, it is essential to offer the opportunity to the legislator to regularly adapt the tax rate according to environmental and economic criteria.
2. The determination of the tax bill (or subsidies earned, needed allowance permits or created reduction permits) may require specific measurement devices (energy meter or water meter, for example). This may delay the applicability of economic instruments in developing and transition economies.
3. The exact design of tax, subsidies and tradable permit schemes may be complex due to the exemptions and exonerations that usually come with it. However, such exemptions and exonerations could be necessary for economic and acceptability reasons.
4. Economic instruments also generate money transfer between the regulator and agents (and also between agents in framework of tradable permits). For example, the polluters will pay a tax on the remaining units of pollution to the State. In the case of permits, agents might have to buy them from other agents or the regulator. Those transfers distribute the burden of environmental protection in various manners and influence consequently their acceptability.
5. Taxes will also generate fiscal income for the State. How to use these revenues on the other hand remains a politically sensitive issue especially if one takes into account their allocating and distributive consequences. The same is true for tradable permits if the permits are initially sold to the agents by the State. Contrarily, subsidies call for public expenditures.

Environmental taxation includes the case of “full cost pricing” which designates price adjustments for raw material and waste disposal services. They are considered by the OCDE

as environmental charges or fees, as designate payments for specific environmental services or resources offered to whoever pays.

Examples in the MENA region

We find few examples of the use of economic environmental protection instruments in the MENA region. In Algeria, the finance law of 2002 (Law n° 01-21) allows for differentiating the rates of the tax on economic activity according to the nature of the activity, the quantities involved as well as the type of waste it generates. The law n° 01-21 also introduces a tax on hospital waste and on leaded fuel. As far as we focus more specifically on industrial activities, Algeria introduced a tax on the storage of industrial waste (once the waste disposal facilities are projected, a three-year grace period is before the tax comes into force). Finally, it also sets a tax on air pollution. Such tax is again based on the differentiation of the tax on economic activities according to the type of activity and the type of emissions generated. Note that in Algeria the law also indicates the allocation of the revenues of environmental taxes.

To our knowledge, Algeria constitutes the only application of environmental taxation in the MENA region. However, the State Secretary in charge of environmental affairs in Morocco considers the introduction of ecological taxation in Morocco.

Also note that when examining figures resulting from the C-B analysis presented in section 1.2, CDI/CR ratios (cost-benefit ratios) for cement production do not vary much across companies or countries. Such findings may be due to the use of a common valuation protocol. However, it might indicate that in general market-based instruments such as taxes or fees may not perform better than regulatory instruments such as technology standards (since remediation costs are relatively similar across units). Indeed, cement factories use similar technology so that remediation opportunities are close across firms.

Subsidies for environmental protection are also used in the MENA region. Algeria as well as Morocco use abatement subsidies through their abatement fund. Table 4 presents the mechanism of the Moroccan FODEP (Fonds pour la dépollution).

However, when looking at economic instruments, one should also consider environmentally harmful subsidies and taxes (OCDE 2005). Such subsidies and taxes distort prices, thus resource allocation decisions have negative effects on the environment, unforeseen or ignored in the policy process. For example, fuel tax rebates and artificially low energy prices stimulate the use of fossil fuels and greenhouse gas emissions; subsidies for road transport increase congestion and pollution; agricultural support can lead to the overuse of pesticides and fertilizers; and support for commercial fishing can result in overexploitation of fish stocks. In Morocco, for example, the distribution of gas and fuel are partially exonerated of the value added tax. In Algeria, fuel, natural gas and electricity prices are artificially low for social and economic reasons. Evidence from Morocco also shows that electricity is sold below its cost. Finally note that we find no tradable permits system in the MENA region.

3. Environmental policies for the cement sector in the MENA region: Decision-making criteria

In order to provide recommendations for environmental policy setting in the case of cement industries, we will examine key requirements or decision-making criteria to be taken into consideration. We can then decide which alternative seems the most viable.

Setting environmental policies requires a compromise between conflicting needs, benefits, economic activities, regions and generations. For example, economic leaders are concerned with the potential negative effect of environmental policies on economic growth and the burden of environmental compliance costs on the firms. In Algeria, environmentalists are

fighting for preserving the environment at any price while others fear the distributive consequences of environmental policies. This led to three main criteria for judging policy options: environmental effectiveness, economic efficiencies and equity. Note that in order to enhance the readability, we will first focus on the general arguments and then examine how conclusions remain valid when uncertainty is considered in a non-competitive market structure. This element is particularly important for the situation of the cement industry in the MENA region. Furthermore, additional criteria will be examined, such as the applicability and the acceptability of potential alternatives.

3.1 Economic efficiency

An efficient or optimal policy is defined as the one that maximizes the net benefit. Such statement implies that one has to be able to measure both costs and benefits of environmental policies in a comparable unit, money (or, sometimes, energy). The efficiency argument does not account for equity as it ignores who bears the cost and enjoys the benefits. Stated more formally, the efficiency argument supports an incremental (or marginal) increase in environmental quality (or a marginal decrease in pollution) only as long as the cost of achieving such increase (the marginal remediation cost) is lower than the benefit resulting from it (the marginal benefit of environmental quality). The important corollary is that an efficient environmental policy equates the marginal remediation costs with the marginal benefits of environmental protection.

a) Static and dynamic efficiencies

Efficiency should constitute an important decision-making criteria for environmental policy when one considers the scarcity of resources devoted to environmental protection in the MENA region and the common fear that environmental policies constitute a burden for economic development and welfare enhancement.

In a partial equilibrium analysis and under perfect competition, economic instruments are considered as more efficient because they help achieve environmental targets while minimizing overall remediation costs. Barde (2001), Pearce and Turner (1990), Baumol and Oates (1988) explain that such advantage comes from the flexibility of the economic instruments, as polluters can choose either to decrease the environmental burden or pay a tax (abandon the subsidy, buy permits). In such situations, each agent will have the possibility to choose to decrease his emissions comparing the marginal cost of remediation to the tax rate (the subsidy or the price of the permit). As long as the cost of avoiding pollution is lower than the tax rate, agents will reduce pollution so that marginal costs of remediation are the same among agents. Abatement efforts are thus realized where they are the easiest and the overall remediation costs are minimized. Contrary to economic instruments, standards force each polluter to reach a given common target without considering the cost it generates for each agent. Each agent should consider the environmental target fixed by the regulator and not the cost of remediation. Agents with high remediation costs have to abate pollution as much as those with low remediation costs.

The efficiency of environmental policy is neither a trivial nor a purely theoretical issue. Tietenberg (1985) Anderson et al. (1990) and the OCDE (1997) propose evidence that gives indications on the cost saving potential linked to the use of economic instruments. The gains associated with any specific economic instruments range from a factor of 1.2 to 22. However these gains are highly influenced by the type of the tool applied and the political context in which it is used.

A related advantage to economic instruments is the creation of a continuous incentive to reduce pollution levels as each supplementary effort is rewarded by a lower tax burden, a higher subsidy earning or supplementary permits to be sold. They are thus 'dynamically

efficient'. The problem with standards, contrary to economic instruments, is that once an agent respects the level imposed by a standard, he has no more incentive to do better. For example, when standards oblige agents to adopt a specific technology (e.g. as double-glazing of windows in the building sector or the use of electro-filters in cement plants) no attention is given anymore to the amount of energy consumed or Particulate Matters (PM) emitted even if better options become available. In this respect, economic instruments favor the adoption of new remediation options when such options offer remediation opportunities at a lower cost. They set an incentive to adopt innovations.

Looking at the argument on efficiency in detail, the efficiency advantage of economic instruments rests on an information problem. The setting of efficient standards would require that the regulators know the marginal remediation costs of each polluter. Polluters, however, have no incentive to reveal them spontaneously since agents with the lowest remediation costs will be given the most stringent standards in order to minimize the overall cost of environmental protection. For obvious reasons, no agent would provide such information to the regulator. Economic instruments induce polluters to reveal such information spontaneously, as they will decide to abate pollution or pay the tax according to their remediation cost. However, information problems and uncertainties remain crucial elements when the environmental effectiveness of economic instrument is considered (see section 3.1 b).

b) Ecological taxation and the double dividend hypothesis

Focusing on environmental taxes, Barde (2000) and Pillet et al. (2001) consider that one advantage of environmental taxes is to generate revenue that may either be earmarked to environmental expenditures or added to the general government budget. Many MENA countries (Algeria since 2001, Morocco since 2007, Jordan since 2004) consider that environmental taxation has a way of orienting behaviors in an ecological direction while generating the necessary revenue for covering environmental public programs. However, revenue and ecological targets are inherently conflicting. If the tax reduces pollution levels (ecological target), it also reduces the tax base and revenues¹⁴.

The ecological fiscal reform case, i.e. using the revenues of ecological taxes to reduce traditional charges, constitutes an interesting option when the instrument has no fiscal objective (does not have to cover new environmental public expenditures). This may however not correspond to the needs of a newly developed environmental administration that lacks financial resources as it is the case in the MENA region.

Such ecological fiscal reform could generate the so-called second dividend¹⁵ that results from the associated benefits linked to the reduction of existing taxes, i.e. the reduction of the deadweight loss they generated which lead to a positive effect on employment and economic activities. The double dividend hypothesis has become a widely discussed topic both in real-world economic policy and in economic theory. It seems that now the conclusions of Bovenberg & de Mooij (1994) and Goulder (1995) are generally accepted, considering that:

- Even if the revenues are used to cut pre-existing distortionary taxes on labor or capital, environmental taxes increase the overall distortion of the tax system. This is due to the fact that environmental taxes are usually more narrow-based than taxes on labor income and capital. There is thus no strong double dividend (Goulder 1995).

¹⁴ However, the after-tax pollution level will rarely be null and behaviors may change on a long-term basis while revenues are immediate.

¹⁵ The double dividend was first mentioned by Tullock (1967).

- However, such revenue allocation through the reduction of existing taxes is considered as more efficient than the case where environmental taxes are returned as a lump sum. This leads to a weak double dividend hypothesis.

Looking at the results of empirical investigation (based on general equilibrium model), the meta-analysis performed by Patuelli et al. (2005) shows that important determinants of the double dividend hypothesis are the way income from environmental taxation is recycled in addition to the existing distortions (and associated deadweight loss) due to the existing fiscal system. The model used in the simulations significantly influences the chance that a “double dividend” effect can be obtained.

The efficiency criterion clearly sets an advantage for economic instruments relative to standards. Economic instruments allow reaching environmental objectives at a lower global cost. Note however that environmental standards may be efficient if they are adapted to each polluter, this may be possible when the number of pollution sources is small and easily differentiable. Ecological taxation may even go further by allowing a reform of the existing tax system. It could also generate the necessary revenue for financing the public environmental expenditure.

3.2 Environmental effectiveness

Environmental policy instruments differ according to their ability to reach environmental targets, i.e. their environmental effectiveness. In this regard, a distinction between quantity-based and price-based instruments has to be made.

Quantity-based instruments, such as environmental standards or tradable permits, explicitly set the maximum amount of pollution to be allowed. Such instruments would guarantee that a threshold of pollution won't be exceeded (if the penalties are credible). Price-based instruments such as taxes and subsidies set a price signal for polluting, but do not set maximum amount of allowed pollution. In other words, quantity-based instruments like direct regulation or tradable permits guarantee a particular impact on pollution, but at an uncertain abatement cost, while environmental taxes guarantee an upper bound on marginal abatement costs, but have an uncertain pollution outcome. Which matters more will depend on the environmental problem under consideration, and on whether society would prefer to take risks on environmental quality or on the costs of environmental policy.

In case of environmental taxes or subsidies, the fact that policy maker does not have the relevant information to predict the agents' reaction to the price-signal¹⁶ will lead to uncertainties for fixing the tax or subsidy rate. One solution would be to propose regular revisions of the rate. However, the administrative and political difficulties related to such revisions are enough reasons to refrain from adhering to this option. Environmental legislation should thus set automatic tax or subsidy increases if environmental objectives are not reached.

However, in a dynamic environment the use of standards is not the answer. When standards set individual limits, new polluters may still appear, increasing the global pollution load. This rebound effect has been an important factor in the stagnation of air quality improvement in many European cities that forbid non-catalyst cars. This rebound effect addresses the limits of any end-of-pipe solutions. In the case of cement production, production is indeed growing rapidly even if new cement producers are not likely to appear due to the non-competitive nature of the market.

¹⁶ This will depend on the marginal remediation cost of the agents, information that remains unknown to the policymakers and that agents have no interest to spontaneously reveal.

Tradable permits are often considered an interesting instrument since they ensure environmental effectiveness in addition to economic efficiency. By issuing a limited number of permits, the regulator limits the quantity of possible pollution while allowing the exchange of permits between agents, inducing economic efficiency. Nevertheless, tradable permits may avoid the rebound effect if the overall number of permits is limited in the cap-and-trade system or if the emissions baseline is fixed in the baseline-and-credit framework. This may also prevent new firms from entering the market since no pollution permits are available. The legislator will thus have to closely consider how the permits are initially sold or given. As we will see, tradable permits may be distributed for free to polluters according to their past pollution level (grandfathering). In such setting, firms voluntarily increase their emissions in previous periods in order to increase the number of permits they have in hand.

The credibility of the enforcement mechanism is also crucial. For example, tradable permits frameworks may allow agents that violate the caps on emissions, to “borrow” emissions from the next commitment period with a given penalty¹⁷. It does not constitute an effective enforcement mechanism since agents might build the penalty into their future allocation when negotiating the future baseline. Such risk is present in the cement market in the MENA region, the non-competitive nature of the market will indeed put at stake any permit system as producers might easily arrange a "group" violation of the regulation or exit the system (which becomes de facto pointless).

Another important element for enhancing the environmental effectiveness of instruments is to strengthen their link with the pollution they fight or the behavior they aim to modify. The legislator should take care to regulate pollution by using instruments that are most closely related to pollution. Price-based instruments and quantity-based instruments cannot be clearly classified according to the difficulty of linking them with behavior or pollution. In both cases, the choice of the tax-based or quantity-based may be more or less closely related to the behavior to be modified. The nature of the link depends more on the type of pollution and the way regulators measure and control the amounts and emissions than on the type of instrument. For example, if the aim is to reduce the PM emission of the cement industry, the environmental effectiveness of a tax-based on the concentration of emitted PM will be higher than that of a tax related to the amount of energy consumed by the kiln. However, it may be quite costly to measure and control the former compared to the latter.

Environmental effectiveness also depends on the acceptability of the instruments used. In this regard, even if voluntary measures may not set constraints on environmental behavior, they have proven—as shown in section 2.1—to be quite successful in the case of the Moroccan cement industries.

The environmental effectiveness criterion seems to give the lead to quantity based instruments as far as those latter may lead to ease the difficulty of reaching the environmental target.

3.3 Managing uncertainties

The previous discussions on the relative efficiencies and effectiveness of environmental protection instruments do not account for uncertainties. Uncertainties are however twofold. First, neither benefits nor costs of environmental protection are accurately known, so that setting the instrument (the optimal pollution level or the optimal tax rates) may be difficult. Second, uncertainties are also related to natural sciences especially when the long-term impact of pollution and resource use are concerned.

¹⁷ Such a rule makes some sense when sudden fluctuations happen beyond the control of the agents that are genuinely committed to meeting their long-term targets.

As stated earlier, one advantage of economic instruments is to set a price-signal on pollution and let agents react in an optimal way. However, as far as the remediation cost curve of each agent remains uncertain, it is difficult for the legislator to guarantee the fulfillment of the environmental target. If the tax rate is too low, such a mistake could be dramatic if the damages of pollution are high. Contrarily, standards may guarantee the environmental target by imposing a defined limit on pollution loads. However, this may be particularly costly for the economy, as all agents have to remediate to pollution whatever the level of their remediation cost. Hence, with taxes, the financial outcome of environmental policy is fairly straightforward, whereas with standards and marketable permits the scale of environment protection is somehow guaranteed.

The regulator may overestimate or underestimate the benefits and costs of implementing too stringent/weak standards; too high/low taxes or subsidy rates; distributing too many or not enough pollution rights, setting a too high/low emissions baseline. This will lead to a non-optimal situation where abatement efforts are too high/low. In his seminal paper, Weitzman (1974) analyses the efficiency of tax and tradable permits under uncertainties. His conclusions show that if a marginal change in the level of pollution does not lead to much higher damages, an erroneous evaluation of the remediation costs leads to a lower social loss with tax and subsidies (price-based instruments) than with quantity-based instruments. To the contrary, in the case where damages vary considerably with pollution level, quantity-based instruments are more efficient when remediation costs are uncertain. One should thus use taxes in order to reduce the risk of too high remediation costs when a small variation in pollution does not have a large impact on welfare. To the contrary, if welfare may be jeopardized when pollution levels increase by a small amount (for example, in the case of nuclear radiation), one should reduce the risk of too high pollution level by using tradable permits.

3.4 Consequences on equity

An equitable policy is a policy that balances costs and benefits across all stakeholders. Environmental protection instruments aim at transferring part of the property rights on the environment to the polluters and the victims. Such transfer has distributive consequences and affects the acceptability of environmental policies. For example, an energy tax may increase energy prices and lead to regressive distributional effects.

Taxes, subsidies and tradable permits may have radically different implications for polluters. Taxes may imply potentially large costs, composed of remediation costs and the burden of the tax on the remaining pollution units. Thus economic instruments generate money transfers. Even if the tax revenue is not an additional cost for the society, but a simple transfer from polluting firms to citizens, firms will prefer to be exonerated from payments on the remaining units of pollution. Examining the practices, it is no surprise that tax regimes sometimes exonerate directly or indirectly some pollution sources or a fixed amount of pollution to strengthen their acceptability¹⁸.

Subsidies constitute a nice option for polluters since they transfer the costs of environmental remediation partially or completely to the State and the tax payers. Finally, tradable permits will imply a transfer of payments among polluters, those with higher remediation cost will buy certificates from those with lower remediation cost. Tradable permits may lead to complex interaction among agents and some fear that they might change the distribution of the market power leading to a negative social outcome. For example, an important emitter

¹⁸ Examples of direct exoneration of a fixed amount pollution: water pollution non-compliance fee in Bulgaria, the manure tax in Belgium (0.9900€ per kg nitrogen and phosphorous production above the allowed amount). See also the OECD database on environmentally related taxes.

could choose to monopolize the permits in order to induce larger remediation costs on his opponents.

Tradable permits generate money transfer between polluters. In the Cap and trade system, the way the permits are distributed initially has equity consequences. One option would be that the State sells them to polluters and thus generates revenues. However, in order to minimize costs for polluters, permits may be initially offered to agents either on an equal basis or according to past pollution level (grandfathering). Grandfathering provides those in business at the time trading was initiated who qualified for an allocation with an advantage over new entrants who would have to buy. While this would probably enhance the ability of the former to stay in business and indeed expand, it would damage an economy's overall competitiveness, as it could inhibit some potentially more efficient companies from entering the market (Convery et al. 2003).

Overall, polluters should be more in favor of subsidies, tradable permits (especially if permits are distributed for free) or standards than taxes. Empirical analyses show that the distributive impacts of environmental protection instruments should not be inferred only from the type of instruments used. Exonerations, time delay (e.g. grace period) and special regimes should be attentively considered since they aim to reduce the burden of environmental protection for the most affected groups.

However, three caveats apply:

- Instruments leading to money transfers (taxes, subsidies, tradable permits) between agents—or between the regulator and the agents—generate more distributive concerns.
- When environmental legislation increases the price (or decreases the quantity) of necessary goods, the consumption of which is difficult to substitute or decrease (electricity, fuel, water), the distributive impacts should be monitored closely and corrective measures may be implemented.
- Distributive impacts may also concern countries, regions, generations, and economic sectors.

Note also that the distributive impact may also address the way benefits of environmental policies are shared among groups of the population or among economic activities. However, even if it may accrue to high-income households who have the most “willingness to pay” for public protection (Fullerton et al. 2008), this may be not the case when environmental protection benefits agricultural activities and rural communities.

3.5 Consequences on competitiveness

When adopted on a unilateral basis, environmental policies generally face political opposition since creeping environmental controls may strangle the economy and undermine economic competitiveness. The argument that environmental regulations increase costs and thus reduce economic performance is particularly exacerbated in industries facing actual deregulation and increased competitive pressures. This may not be the case of cement, where producers are local monopolists. The risk is thus rather low that regulated industries will move to countries with lower environmental standards, through either trade or direct investment, leading to value added (VA) and job losses in the country of origin.

Evidence in favor of the ‘pollution haven hypothesis’ (or displacement hypothesis) is indeed sparse. Nordström and Vaughan (1999) show that in the United States costs linked to environmental regulations remain low and vary from 1% to 5% of overall firms costs. The empirical analyses of Xu (1999) and Tobey (1990) confirm that environmental standards have no significant impact on the structure of international trade and investments flows (Jaffe

et al. 1995). The traditional structure of the comparative advantages (based on labor and capital) is not modified by the divergence in environmental costs.

Empirical analyses of the relationship between industry location and the stringency of environmental regulations have yielded mixed results. Some studies, such as McConnell and Schwab (1990), find that regulations have no impact on the location decisions of firms because other factors are more important. Henderson (1996) and List and Co. (2000) find that industry location decisions are negatively affected by environmental regulatory stringency. The political economy theory tends to explain the setting of environmental policy as a compromise between governmental objectives. The weight the government places on different objectives determines the stringency of regulations. For example, in Damania et al. (2003), Fredriksson et al. (2003), and Fredriksson and Svensson (2003), a corrupt government places greater emphasis on getting campaign contributions from an industry in comparison to the importance it gives to social welfare, leading to insufficient environmental regulation.

Jaffe et al. (1995) assess evidence on the relationship between environmental regulation and competitiveness and find little support for the conventional wisdom that environmental regulations have large adverse effects on competitiveness. When estimating the effects of environmental regulations on net exports, overall trade flows, and plant-location decisions, the estimated coefficients remain statistically insignificant or not robust.

Similarly, the Network of Heads of Environment Protection Agencies (2005) declares that good environmental policies do not impede overall competitiveness and economic development but may reduce costs for industry and business, create markets for environmental goods and services, drive innovation, reduce the business risk, increase the confidence of the investment markets and insurers, assist competitive advantage and create competitive markets, create and sustain jobs and improve the health of the workforce and the wider public. They present evidence based on specific case studies where environmental regulation seems to have favored economic development, innovation or cost reduction. It is however noteworthy that Jaffe et al. (1995)—in a similar study to the one mentioned above— finds no systematic evidence that environmental regulations stimulate innovation and improved competitiveness.

Overall, the relationship between environmental protection and competitiveness is not obvious. However, the distribution of costs, the benefits and opportunities created by environmental regulations may clearly disfavor extractive and polluting industries and benefit the eco-industries and services economy. We thus easily understand the incentive for the former to curb the implementation of environmental regulation by lobbying activities.

3.6 The impact of market structure

The relevance of the market structure for the application of environmental regulations deserves attention especially when one examines the cement industry. The cement industry is indeed a typical example of an oligopolistic sector composed of local monopolies, since cement is a homogeneous good characterized by a low price elasticity of demand. The local monopoly comes from the heavy investments needed and the high transportation costs, so that there are few local competitors. Conditions for agreement among members on prices and market shares are mentioned and the sector has a rich history of anti-trust cases in the U.S.A, Japan and Europe.

In the MENA region, the cement sector remains largely public-owned. In Algeria the State accounts for 67% of the production and Lafarge-Orascom accounts for the rest. In Egypt,

cement production is privatized and 13 companies are active (Hasan et al. 2009)¹⁹. In Morocco, the cement sector was privatized in the 1990s, four international groups (Holcim, Lafarge, Italcementi and Asment) bought the existing cement plants and committed themselves to environmentally upgrade their operations while also respecting certain social and economic plans. The four groups created a national cement association, the *Association Professionnelle des Cimentiers* (APC), that acts as a lobby group and promotes the sector's interests vis-à-vis third parties (government, unions, etc.).

In a non-competitive structure, the theoretical settings of environmental policies are second best. There are distortions associated with market power, and corresponding welfare losses, but there are also distortions and welfare losses associated with environmental externalities. Conclusions with respect to general welfare are notoriously difficult to draw and a lot of case-specific results should be anticipated (OECD 2006). For example, Buchanan (1969) refuses to apply emission taxes to a monopoly since monopolists distort the market by holding down output. An emission tax would exacerbate the distortion. However, taxation remains a welfare-enhancing alternative but the tax rate should be lower than the rate applied in perfect competition. Subventions also question equity since subvention will increase the benefit of the monopoly. Under pure monopoly, issuing permit does not make sense since there is only one firm on the supply side. However, if several local monopolies are concerned, the option remains plausible even if the small number of participants will impair the market of pollution permits.

Standards offer practical solutions in case of imperfect competition, especially when they set obligations relative to the way goods are produced and not their quantity or quality. However, reference according to best available technology may lack benchmarking in a non-competitive environment.

Currently available research does not offer a complete spectrum of results for all types of policy instruments and market structures (see Requate 2005, for a review). We may however conclude that when an environmental regulation creates or reinforces barriers to entry or enhance the market power of some agents, potential benefits of environmental policy are decreased. Such cases should be closely examined. Note also that agents may use their market power in order to influence environmental policies.

3.7 Political behavior

As previously mentioned, economic agents will try to influence environmental policies and reduce their burden of costs by influencing the government. In such a setting, there is no surprise that large industrial groups, benefiting from historical relations with the State and representing a non-negligible part of employment and economic activities, may pressure the administration for less stringent environmental regulations and control or for advantageous setting when an environmental policy is adopted²⁰.

Such rent-seeking behavior is not specific to environmental regulation but may explain why environmental taxation and tradable permits have not been frequently used with top industries in the MENA region. For some, the influence of industries on the decision-making process is

¹⁹ In Egypt, the cement industry belongs to a more competitive environment. Egypt is the fifth largest exporter of cement in the world.

²⁰ Boemare and Quirion (2001) argue that “The choice of grandfathering in most systems of permits is a direct consequence of the political influence of regulated firms in the policy process... indeed a lesson from positive political economy is that firms which risk an important loss are more likely to incur the costs of lobbying than households or firms which could benefit from a reduction in pre-existing taxes...”. Therefore, there appears to be a conflict between the ideal economic efficiency on the one hand, and the political reality on the other that encourages policy systems to provide free allocation.

so important that no generality could be drawn and the political and economic context constitutes a major component of environmental protection programs.

In the case of the cement industry, there is no doubt that industrial leaders and the environmental administration strike a bargain when setting environmental legislation. In such regards, the way Morocco considers the problem and the proposed solution (voluntary agreements) seems to be a viable practice between the interest of the environment and the economic importance of the industry. However, it is too soon to judge such strategies since more stringent regulations are still underway. This also shows that cement producers have learnt from the European experiences in addressing environmental regulation by adopting a collaborative attitude.

The strategic behavior of firms towards environmental regulation may alter the competitiveness of agents. Firms may, for example, strategically invest in new abatement technology to reduce their abatement costs so as to create incentives for the regulator to increase future regulation that can, in turn, place other firms at a competitive disadvantage. Agents may buy many permits and freeze them so that other agents have to invest in abatement activities if they want to respect the emission baseline. In the cement industry, we still have no evidence of such behavior. However, environmental objectives seem to lead to new competitive frameworks between cement producers, namely in relation with some inputs as waste (for co-incineration) or human capital (environmental specialists).

3.8 Applicability

Complex regulations leads to poor compliance, fraud and excessive administrative and control costs (Barde 2000) . They thus lack applicability.

One limit for the applicability of environmental taxation in the MENA region was to determine how the tax bill of each polluter (or subsidies earned or needed or created permits) could be monitored and calculated by the regulator. This may require specific measurement devices (energy meters and water meters, for example), which are not available. In this regard, the environmental regulation faces local conditions that may lead to the setting of second-best instruments. In Algeria, the first environmental taxation instruments set in 2002-03 (Loi de finance, 2002) are only indirectly linked to the amount of pollution (waste, air pollution) generated by industries and households as it was not possible to measure the effective amount of emissions or waste (the regulator uses the classification of industrial activities and sets different tax rates according to the type of activities and their postulated environmental incidence). Similarly, the tax on municipal waste has not been linked to the quantity of waste generated by each household but was set as a defined amount per household. We directly see here how practical constraints decrease the environmental effectiveness and the economic efficiency of environmental taxation.

The issue of applicability concerns also implementation costs. For example, setting different tax rates for environmental or distributive reasons will lead to higher administrative cost. Similarly, exemptions and special regimes raise the implementation cost of environmental policies. Compliance costs should also be an issue. In this regard, environmental policies influence the existing technological opportunities or behavioral changes and their costs. Finally, the cost of control is directly linked to the number of concerned agents as well as to the complexity of environmental policies.

For the cement industry, the state of available technology and the fact that most inputs (energy and material) and output can be measured and monitored without excessive cost does not lead to application problems. However, the emissions and waste of many cement plants are still neither measured nor controlled by the legislator. In many cases however, the

regulator is capable of controlling the adequate and effective running of large abatement installation such as clean-air device.

3.9 Acceptability

It is commonly argued in Algeria that the enforcement of the tax on municipal waste is weak, since most households refuse to pay for inefficient and lacking services. Such example shows that acceptability issues constitute an important prerequisite for the effectiveness of environmental policies. The acceptability of environmental policies depends on the distribution of generated costs and benefits and on transparency and public participation.

Several economic, political and sociological studies have addressed the issues raised by the acceptability of environmental protection measures. They tend to show that measures that promise low cost to the polluters have more chances of being accepted even if their environmental effectiveness is low. This may be due to the fact that polluters may get more easily organized to influence the political process than the large group of victims. When damages are uncertain, when victims are future generations, the previous argument is even stronger. However, the picture is far more complex. Empirical investigation done in Switzerland on the public acceptance of green tax and environmental standard (Maradan 2005; Thalmann 2004, Buergermeier et al. 2007, Jegen 2001) shows that people working in polluting activities and right wing parties were less prone to accept environmental measures. The economic context seems to be as important: Periods of economic uncertainty were less favorable to more stringent measures such as taxation. Buergermeier et al. (2007) more particularly show, on the basis of an opinion survey, that environmental protection associations are more prone to support standards that allow for direct control. Even if firms declared favoring environmental taxation, they preferred voluntary agreements. An analysis performed by Santarius and Ott (2002) shows that German firms have limited knowledge of tradable permits and no preference for a specific system of regulation. They also declare that they do not believe that tradable permits constitute significant economic costs for them.

To our knowledge, no acceptability study has covered the MENA region to date. We thus decided to shed some light on this issue by conducting a survey on the Moroccan environmental protection strategy as perceived by the cement companies currently active in Morocco. A questionnaire was developed and sent to all four cement companies as well as representatives from the APC. A slightly modified version of the questionnaire was also sent to the Ministry of Environment in order to document their opinion on voluntary agreements. Subsequent telephone interviews were conducted with each respondent in order to clarify and double-check their answers. A total of 15 interviews were conducted and thus offer only a partial picture. Note that the cement sector is not subject to economic instruments (taxes, subsidies, negotiable licenses, etc.) for the protection of the environment.

Unsurprisingly, one cement company declared feeling responsible for its environmental impacts and evoked a proactive attitude to contain or reduce them. Besides classic environmental domains that constitute a priority for action (air, energy & materials, waste, water, soil), the cement sector mentions also eco-consumption and environmental communication. They also declare being aware of the emission limits they have to respect and try to be ahead of them.

Concerning the environmental strategy and environmental protection instruments, the main findings of the survey can be summarized as follows:

- A joint sector approach to deal with environmental issues is seen as a realistic and viable practice. It provides a strong position vis-à-vis other stakeholders and allows a gain-in-time as well as a good experience exchange among the different companies. Credibility of the sector is reinforced and its image is thus improved. One of the

difficulties of a sector approach identified by respondents is the fact that companies do not address environmental problems in the same way, as their levels of environmental performance differ. Additionally, a joint sector approach would have to deal with confidentiality of information among the different groups.

- Voluntary agreements with the Ministry of Environment are non-binding agreements; they provide instead a framework for the cement sector to address environmental protection in its operations. A good collaboration has been established with the Ministry of Environment, providing channels for information exchange. The cement sector was always consulted during the elaboration of laws. In this respect, emission standards have been set taking into account the cement sector's capability to meet them.
- The subsequent Moroccan laws on emissions standards are considered by the cement sector as slightly constraining. Standards are similar to the ones in France but less strict than those applied in Germany. In fact, the active cement companies belong to international groups that have set their global strategies and targets vis-à-vis environmental protection. It is mainly those global strategies and targets that constitute the driving force for the Moroccan cement sector.
- Voluntary agreements are not considered as having an impact on competition as the cement sector in Morocco is operating like a cartel. Due to the high cost of transport, each cement plant will, *de facto*, develop its market within a 200 km range.
- Voluntary agreements create a good working environment and allow for resources preservation. They are not binding but create a good framework for proactive attitudes. Nevertheless, they can require substantial investments in remediation equipments.
- Cement producers also seem to favor the polluter-pay-principle. They however do not think that the administration is able to tax pollution efficiently (since they already seem to have trouble in managing the existing tax system). They consider voluntary agreements to be an interesting solution for the administration, which lacks resources for environmental protection.
- Cement producers consider that voluntary programs constitute a way to anticipate new environmental regulations (but not to avoid or delay the coming into force of new ones), to comply with the corporate social responsibility of the cement groups, to improve productivity and operational costs and to have a technological advantage over competitors and eventually to develop 'green' products for the market.

In light of the cement sector's environmental performance, and based on the interviews undertaken during this survey, voluntary agreements seem to have reached their objectives, namely environmental protection through a proactive attitude of the cement industry. Having been co-developed with the cement sector, the emission standards have proven to be understood and wanted by the cement industry that has taken necessary steps to reduce its pollution intensity.

4. Multi-Criteria Analysis and Recommendations

Even if no clear ranking of the instruments may be made for some criteria (market structure, impact on competitiveness), and even if conflicting interpretations are possible for others, we propose as a conclusion a multi-criteria analysis based on the evidence presented in this paper and on our working experience with industries in the MENA region. The multi-criteria analysis should be conducted for each specific situation thus the results presented here are purely indicative. The multi-criteria analysis should also consider a combination of

instruments in order to maximize their relative strengths and minimize their relative weaknesses. Finally, the weights have been chosen on a subjective basis, relating the existing theoretical and empirical works relative to each criterion.

Table 5 presents the results of the multi-criteria analysis in the case of cement production in Morocco. The instruments are each rated from 1 (low performance) to 4 (high performance) for each criterion. The first column present the weight assigned to each criterion. These illustrative results show that the optimal way for action lays in a combination of voluntary agreements, standards and taxes. We would thus recommend to pursue the actual strategy based upon voluntary agreements but to set stricter standards and taxes relative to air and soil degradation. However, differences across instruments are minimal as far as the general grade is concerned. This means that one also needs to consider individual criteria.

Such recommendation stresses the adequacy of an integrated environmental strategy in cement production that would rest first on voluntary programs, and then on the use of environmental policy instruments. The latter is the stick while the former is the carrot. The idea is to promote participation by announcing future environmental constraints that could be avoided by the participation in voluntary programs. In such a setting, voluntary environmental agreements may allow authorities to tackle environmental problems more rapidly and to avoid the legislative and administrative processes necessary to introduce new standards and taxes. This could be extremely valuable in the MENA region which faces urgent environmental problems²¹ while the regulatory framework required for the enforcement of environmental policy remains underdeveloped. Voluntary agreements thus set a flexible mechanism for implementing environmental policy and create a framework for facilitating communication and information dissemination between the polluters and the regulators.

However, the announced regulatory framework has to be credible. Applicability, acceptability and resistance to political pressure are important in this regard. Standards seem clearly better than economic instruments. Furthermore, since remediation costs look similar across units, the traditional efficiency argument in favor of economic instruments may not be as strong as usual.

On this basis, the following recommendations may be formulated:

- Environmental protection needs to adopt a global strategy. Such strategy has to combine the various types of instruments from persuasive to more stringent ones, according to the environmental goals, the economic challenges as well as the power and reaction of stakeholders. Such strategy should also set the timeframe and be communicated as the agenda to all parties. Environmental law should set the objectives and allow decision-makers to adapt the instruments to reach them in a specific situation and for specific partners. In this regard, the case of voluntary agreements in the cement industry in Morocco shows the potential for applying non-binding voluntary agreements. Such opportunity is strengthened when large environmental inefficiencies are likely to last due the lack of incentives and misinformation.
- The environmental strategy should propose criteria that set rules for trading-off environmental and economic objectives. The criteria have to clearly indicate how conflicting objectives will be prioritized. In the multi-criteria analysis, they will

²¹ Such problems concern the over consumption of water but also the increasing pollution of water, air and soil since the beginning of the 1990s due to the development of industries and increased traffic. For more information see « Plan National d'Actions pour l'Environnement le Développement Durable » in Morocco and Algeria.

constitute the weight to be applied. In Morocco, such procedure indicates that a global strategy should promote first voluntary programs and then the use of environmental policy instruments. The latter is the stick while the former is the carrot.

- Voluntary programs should focus on inefficiencies, since inefficiencies reduction implies a financial benefit (cost reduction) for the firms. In the presence of incomplete information and firms behaving strategically, such inefficiencies may last if no additional benefits are proposed by the regulator.
- The time dimension of environmental policies is particularly important (gradual introduction, announcement effect), and more especially when acceptability and applicability issues are at stake.
- The environmental strategy has to be sector specific in order to take advantage of the environmental economic situation of each sector. In such setting, standards may be appropriate if they concern one specific sector where technological options and remediation costs do not vary much. However, if the environmental policy concerns several sector, the previous conclusion may not hold since economic instruments would induce efficiency gains whereas remediation costs differ across actors.

5. Conclusion

This paper analyzes the way heavy polluting industries may be regulated in the Middle East and North Africa (MENA) region. It focuses on the cement industries and rests on existing theoretical base as well as original empirical evidence. The paper reports unique economic evidence on the environmental damages and inefficiencies costs of cement production. Figures show the necessity of implementing an environmental regulation for the cement production in the MENA region.

On this basis, available means or instruments are examined (persuasive measures, voluntary agreements, standards, taxes, subsidies, tradable permits) and examples of their application in the MENA region are given. Finally, to allow the selection of the best instrument several criteria are proposed among which are: economic efficiency, environmental effectiveness, the way the instrument deals with uncertainties, equity, the economic cost or the impact of the instruments on competitiveness, the way the instrument deals with imperfect competition, the influence of political behavior, applicability and acceptability.

However, some elements have not been analyzed in this paper, as how controls and penalties should be implemented. Also, we did not analyze the numerous links between land settlement and environmental policies.

References

- Anderson R. C., Rusin M. and Hoffman L.I. (1990), The Use of Economic Incentive Mechanisms in Environmental Management, *American Petroleum Institute Research Paper*, No. 051
- Baranzini A. and Thalmann P. Ed. (2004), *Voluntary Approaches in Climate Policy*, Edward Elgar, Cheltenham, UK
- Barde J-P (2000), Environmental policy and Policy instrument, In Folmer and Gabel, *Principles of Environmental and Resources Economics*, Oates and Folmer Ed., Edward Elgar
- Baumol W.J. and Oates W.E. (1988), *The Theory of Environmental Policy*, Cambridge University Press, second edition, 299 pp.
- Blackman A., Lahiri B., Pizer W., Rivera Planter M. and Muñoz Piña C. (2007), Voluntary Environmental Regulation in Developing Countries: Mexico's Clean Industry Programme, *Resources for the Future Discussion Paper*, 07-36
- Blackman A., and N. Sisto (2006), Voluntary Environmental Regulation in Developing Countries: A Mexican Case Study, *Natural Resources Journal* 46(4), 1005–42.
- Boemare C. and Quirion P. (2001), *Implementing Greenhouse Gas Trading in Europe: Lessons from Economic Theory and International Experiences*, paper presented at the Concerted Action on Tradable Permits (CATEP) Workshop hosted by Fondazione ENI Enrico Mattei, Venice, December 3-4 2001.
- Bovenberg, A. L. and de Mooij R. A. (1994), Environmental Levies and Distortionary Taxation, *American Economic Review*, 94(4), 1085-89.
- Bovenberg, A. L. and Goulder L. H. (1996), Optimal Environmental Taxation in the Presence of Other Taxes: General Equilibrium Analysis, *American Economic Review*, 86(4), 985-1000.
- Buchanan J.M. (1969), External diseconomies, correctives taxes and market structure, *American Economic Review* 59, 174-177
- Buergenmeir, B. Greppin H. et Perret S. (2007), *Economie aux frontières de la nature*, Edition l'Harmattan, Paris
- Copeland B.R. and Taylor M.S. (2004), Trade, Growth, and the Environment, *Journal of Economic Literature* XLII, 7-71
- Convery F.J., Dunne L., Redmond L. and Ryan L. B. (2003), *Political Economy of Tradable Permits – Competitiveness, Co-operation and Market Power*, OECD Global Forum On Sustainable Development: Emissions Trading Concerted Action On Tradable Emissions Permits Country Forum, OECD Headquarters, Paris
- Copeland B.R. and Taylor M.S. (1994), North-South Trade and the Environment, *Quarterly Journal of Economics* 109/3, 755-87

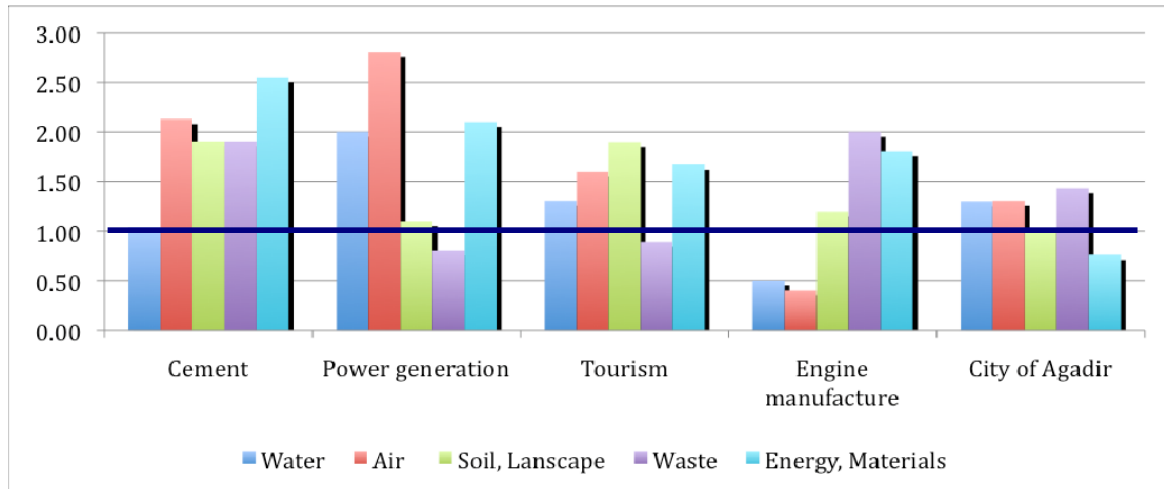
- Damania R. (2001), When the weak win: The role of investment in environmental lobbying, *Journal of Environmental Economics and Management* 42, 1-22.
- Damania R. and Fredriksson P. (2000), On the formation of industry lobby groups. *Journal of Economic Behaviour and Organization* 4, 315-335
- Damania R., Fredriksson P. and List J. (2003), Trade liberalization, corruption, and environmental policy formation: theory and evidence, *Journal of Environmental Economics and Management* 46(3), 490-512.
- Ecosys and sba (2001-2009), The meso-economic program, economic-environmental analysis at the sector level and for urban communities, see www.meso-platform.org
- Ederington J. and Minier J. (2003), Is environmental policy a secondary trade barrier? An empirical analysis, *Canadian Journal of Economics* vol. 36(1), 137-154
- EPA (2001), *The United States Experience With Economic Incentives for Protecting the Environment*, Report No. EPA-240-R-01-001, available on line from EPA or on Blackboard site.
- Fredriksson P. (1997), The political economy of pollution taxes in a small open economy, *Journal of Environmental Economics and Management* 33, 44-58.
- Fredriksson P., List J., and Millimet D. (2003), Bureaucratic corruption, environmental policy and inbound US FDI: theory and evidence, *Journal of Public Economics* 87, 1407-1430.
- Fredriksson P. and Svensson J. (2003), Political instability, corruption and policy formation: the case of environmental policy, *Journal of Public Economics* 87, 1383-1405.
- Fredriksson, P., Vollebergh H. and Dijkgraaf E. (2004), Corruption and energy efficiency in OECD countries: theory and evidence, *Journal of Environmental Economics and Management* 47, 207-231
- Fullerton D., Leicester A. and Smith S. (2008), Environmental Taxes, National Bureau Of Economic Research, Working Paper 14197, <http://www.nber.org/papers/w14197>
- Gamper-Rabindran S. (2006), Did the EPA's Voluntary Industrial Toxics Programme Reduce Emissions? A GIS Analysis of Distributional Impacts and by Media Analysis of Substitution, *Journal of Environmental Economics and Management* 52(1), 391-410.
- Goulder L. H. (1995), Environmental Taxation and the "Double Dividend": A Reader's Guide.", *International Tax and Public Finance*, August 2 (2), 157-83.
- Hasan F., Soheim M., Hussein A. A., Weshahy R. (2009), Egypt Cement Sector, Against All Odds..., Global Research, Global Investment House KSCC, Kuwait, http://www.menafn.com/updates/research_center/Egypt/Economic/gih090709.pdf
- Henderson V. (1996), Effects of air quality regulation, *American Economic Review* 86(4), 789-813
- Jaffe A.B., Peterson S.R., Portney P.R. and Stavins R.N. (1995), Environmental Regulation And The Competitiveness Of U.S. Manufacturing: What Does The Evidence Tell us?, *Journal Economic Literature* 33/1, 132-63

- Jegen M (2001), *The Acceptance of Instruments Among Energy Policy Key Players*, in Ruth Kaufmann and Heinz Gutscher (eds.), *Changing Things - Moving People, Strategies for Promoting Sustainable Development at the Local Level*, Basel Birkhäuser, 191-211.
- Jimenez O. (2006), Voluntary agreements in environmental policy: an empirical evaluation for the Chilean case, *Journal of Cleaner Production* 15, 620-637
- Keohane R. O. & Raustiala K. (2009), *Toward A Post-Kyoto Climate Change Architecture: A Political Analysis* In *Post-Kyoto International Climate Policy: Implementing Architectures for Agreement*, New York, Cambridge University Press
- La Vie Eco* (2009), La dégradation de l'environnement coûte au Maroc 13 milliards de DH par an, published 18/05/2009
- List J. A. and Co C. Y. (2000), The effects of environmental regulations on foreign direct investment, *Journal of Environmental Economics and Management* 40, 1-20.
- Maradan D., Zein K., Meylan G. et Amor R. (2009), Economic-environmental analysis of the Moroccan cement sector : Benefits from co-processing and production of renewable energy, *Cahier de recherche de la Haute Ecole de Gestion de Genève*, to be published in «ALITinform: Cement. Concrete. Dry building mixtures».
- Maradan D. (2005), *Prosperity and environmental quality*, Thesis no584, University of Geneva
- McConnell, V. and R. Schwab. (1990), The impact of environmental regulation on industry location decisions: The motor vehicle industry. *Land Economics* 66(1): 67-81
- Meade J. E. (1973), *The Theory of Economic Externalities*, Ed. by A. W. Sijthoff Leiden, Graduate Institute of international studies, Geneva, International Economics Series – 2, 92 pp.
- Morgenstern D. and Pizer W. (2007), *Reality Check: The Nature and Performance of Voluntary Environmental Programmes in the United States, Europe, and Japan*, Washington DC, Resources for the Future Press
- Committee on National Statistics, Commission on Behavioral and Social Sciences and Education, National Research Council, National Academy Press, Washington D.C., 250 pp.
- Nordström H. and Vaughan S. (1999), Trade and Environment, *Special Studies* 4, The World Trade Organization, Geneva
- Nye J. (1990), *Bound to Lead: The Changing Nature of American Power*, New York: Basic Books
- Nye J. (2004), *Soft Power: The Means to Success in World Politics*, New York: Public Affairs Press
- Meyer S. M. (1995), The Economic Impact of Environmental Regulation, *Journal of Environmental Law & Practice* 3 -2
- OCDE (2008), *OECD Studies on Environmental Innovation, Environmental Policy, Technological Innovation and Patents, Environment & Sustainable Development*, 1-183

- OCDE (2005), *Environmentally Harmful Subsidies: Challenges for Reform*, OCDE, Paris
- Opschoor J.B and Vos H. B. (1989), *Economic instruments for environmental protection*, Paris: OECD
- Patuelli R., Nijkamp P. and Pels E. (2005), Environmental tax reform and the double dividend: a meta-analytical performance assessment, *Ecological Economics* 55-4, 564-583
- Pearce D. and Turner R. K. (1990), *Economics of Natural Resources and the Environment*, Harvester Wheatsheaf, London, 378 pp.
- Pillet G. (2006), *Economie de l'environnement, Ecologie de l'économie*, Ed. Helbing&Lichtenhan, Basel
- Pillet G., Maradan D., Mayor K., Stephani E., Zein K. (2005), *Meso Environment-Economic Analyses, Methodology and Main Results – Industry and Urban Communities in Arab Countries*, SMIA – Sustainable management in Practice, Proceedings Genève - 2005
- Pillet G. (2001), *Dimension économique des diagnostics environnementaux d'entreprises industrielles en Algérie : Société des Ciments de Hamma Bouziane et Complexe Moteurs Tracteurs de Constantine*, Technical report for the Deutsche Gesellschaft für Zusammenarbeit, www.ecosys.com
- Pillet G., Oberson X., Maradan D., Niederhäuser N., Calderari M. (2001), *Réforme fiscale écologique. Fondements, applications*, Helbing & Lichtenhahn (Economie écologique), Bâle
- Requate T. (2005), Environmental Policy under Imperfect Competition, *Economic working paper no 2005-12*, Christian Albrechts Universität Kiel
- Santarius T. et Ott H. (2002), *Attitudes of German companies regarding the implementation of an emission trading scheme, A qualitative and quantitative analysis*, Wuppertal paper no 122, Wuppertal Institute for Climate
- Thalmann P. (2004), The Public Acceptance of Green Taxes: 2 Million Voters Express Their Opinion, *Public Choice* 119/1-2, 179-217
- Tobey J.A. (1990), The Effects of Domestic Environmental Policies on Patterns of World Trade: An Empirical Test, *Kyklos* 43, 191-209
- Tullock G. (1967), Excess Benefit, *Water Resources Research* 3(2), 643-645
- Turmes E. (16 January 2005), Reconciling Sustainability with Economic Growth in the Cement Industry, *Frost & Sullivan Market Insight*
- Vidovic M. and Khanna N. (2007), Can Voluntary Pollution Control Programmes Fulfil Their Promises? Further Evidence from EPA's 33/50 Programme, *Journal of Environmental Economics and Management* 53, 180–95
- Weitzman M.L. (1974), Prices vs. Quantities, *Review of Economic Studies* 41, 477- 491.

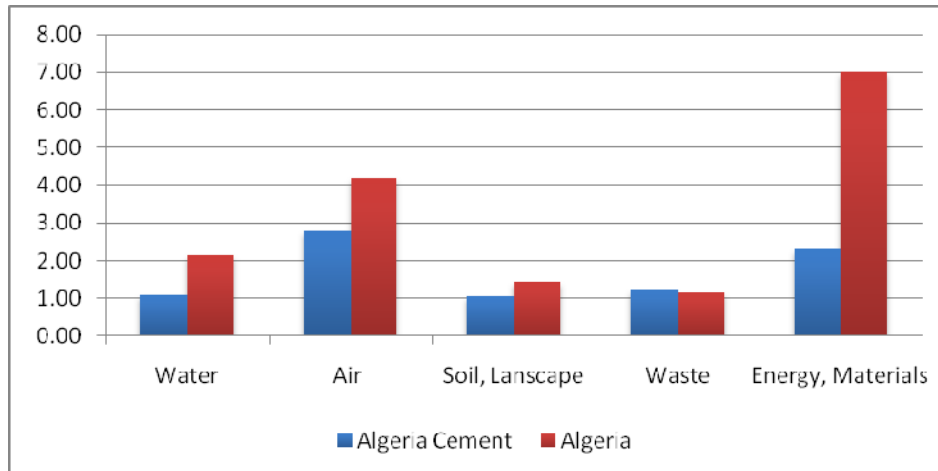
Xu X. (1999), Do Stringent Environmental Regulations Reduce the International Competitiveness of Environmentally Sensitive Goods? A Global Perspective, *World Development* 27/7, 1215-26

Figure 1: Cost/Benefit ratios of environmental remediation in various industries according to environmental domains



Source: Ecosys and sba (2001–2009), MESO program

Figure 2: Cost/Benefit ratios of environmental remediation by environmental domain, comparing national level and cement industry in Algeria



Source: Ecosys and sba (2001–2009), MESO program

Figure 3: Contribution of cement sector to GDP vs. contribution to environmental degradation

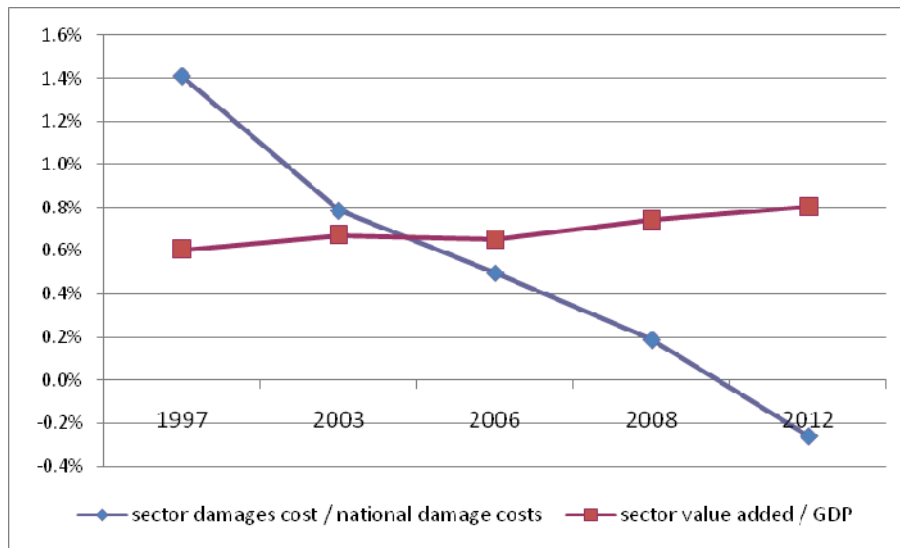


Figure 4: CDI of Moroccan cement sector per environmental domain

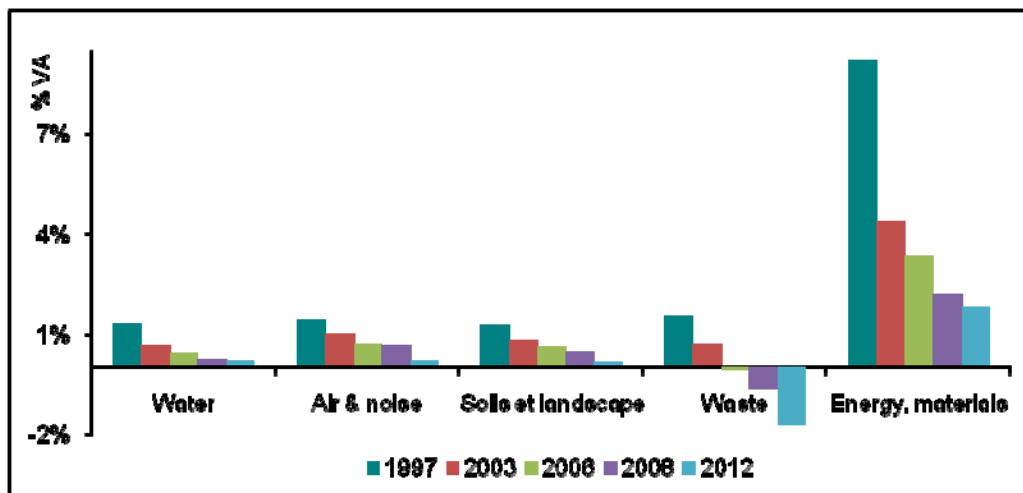


Table 1: Costs of damages and cost of inefficiencies – cement sector – MENA region

	<i>CD (%)</i>	<i>CI (%)</i>	<i>CDI (%)</i>
Algeria (2001)	6	12	18
Tunisia (2001)	7	10	17
Syria (2002)	10	13	23
Libya (2003)	14	13	27
Syria (2006)	13	10	23
Morocco (1997)	5	10	15
Morocco (2003)	3	5	8
Morocco (2006)	2	4	6
Morocco (2008)	1	2	3

Source: Ecosys and sba (2001–2009), MESO program.

Table 2: Technical measures for reducing environmental damages in cement production

<i>Environmental damage</i>	<i>Proposed technical measure</i>
Air pollution & noise	<ul style="list-style-type: none"> ▪ Electro-filter or Bag filter ▪ Individual protection devices (i.e. gloves, boots, masks, etc.)
Loss of raw material	<ul style="list-style-type: none"> ▪ Electro-filter or Bag filter ▪ Air suction during grinding phases ▪ Use of alternative raw material (e.g. fly ashes)
Energy	<ul style="list-style-type: none"> ▪ Use of alternative fuels ▪ Co-generation (i.e. burning waste)
Loss of biodiversity and land degradation	<ul style="list-style-type: none"> ▪ Quarries rehabilitation ▪ Reforestation

Table 3: Typology of environmental protection instruments

Instruments	Mechanism / setting	Role of the regulator
Voluntary agreements	Economic agents act without being legally constrained to do so (Baranzini and Thalmann 2004).	Legitimate / propose contracts to the polluters / set advantages in exchange of participation into voluntary programs.
Persuasive instruments	Influencing the agent's set of values.	Disseminate information (advertising campaigns, eco - or energetic-labels).
Regulation	Modifying the agent's set of choices.	Assign free and non-tradable rights to pollute until a certain limit.
Tax /subsidies	Modifying the benefits and costs associated with agent choices.	Tax the amount of pollution emitted, the amount of resources used or the quantity of polluting goods consumed. Subsidize the decrease of pollution, the reduction of the quantity of resources used or the consumption of greener products.
Tradable permits	Modifying the benefits and costs associated with agent choices.	Create, distribute or sell pollution permits that may be traded among agents according to their needs.

Table 4: The Moroccan FODEP

Eligibility	<ul style="list-style-type: none"> ▪ Heavy polluting industrial and small scale activities whose turnover is below MAD 400 million (40 million Euro). ▪ Projects have to refer to water treatment, emission reduction and treatment, solid waste management and disposal, resource uses, process change, implementation of clean technology.
Mechanism	<ul style="list-style-type: none"> ▪ Subsidies given by the fund are combined with the bank loan. ▪ Subsidies of 20% for projects that aim at reducing industrial pollution and using resources more efficiently. ▪ Subsidies of 40% for projects that aim at reducing industrial pollution by adopting water, gaseous and solid waste treatment disposal facilities. ▪ Self-financing has to cover 20% of the total cost. ▪ A technical study of the project has to be presented. ▪ Agreement of principle with a bank has to be presented.

Table 5: Multi-criteria analysis

	Weights	Voluntary agreement	Standard	Taxes	Subsidies	Tradable permits
Eco. efficiency	2	3	1	4	3	3
Env. effectiveness	2	2	3	3	2	2
Uncertainties	2	1	3	2	2	2
Equity	2	3	2	3	2	2
Competitiveness	1	4	3	1	2	2
Market structure	1	3	3	2	2	2
Political behavior	1	1	3	3	1	2
Applicability	1	2	3	2	1	1
Acceptability	1	4	3	1	4	2
		32	33	33	28	27

Annex 1

Annex 1 aims at presenting the methodology necessary to understand the steps of the analysis. The objective is to guide the follow-up and review of the calculations undertaken in cement plants.

The quantitative environmental diagnosis of a production unit is undertaken in two phases. Firstly, a diagnosis is realized at the scale of all the inputs and outputs by examining the process and diagnosing both internal environmental impacts (for example, air quality, and noise level in a cement plant, as well as illnesses and accidents due to environmental problems, or storage of scrap and waste) and external environmental impacts (surrounding air quality, water supply, soil degradation, outdoor storage of waste, transport of raw materials and finished products, etc.). Following environmental diagnosis, economic valuation of the costs of environmental degradation is also carried out. The work consists of quantifying the direct consequences of degradations reported in the environmental diagnosis (number of illnesses and accidents due to environmental causes, the population affected by air pollution, alterations in environmental qualities and amenities and impacts on production) and necessitates the collaboration of experts in the related disciplines. Then, the economic valuation consists of expressing in monetary terms the environmental consequences thus established; that is, estimate the value of lost workdays, lost agricultural production, and lost amenities (less agreeable setting), and the economic consequences of uncontrolled waste dumping, etc.

Estimation of the costs of environmental damages and inefficiencies in the use of natural resources **Water**. With respect to the natural capital, a relatively large quantity of water is used at the expense of other possible uses, particularly in the case of cement production via wet-process. If, in addition, water is scarce in the region or the local water table is overexploited, then the cement plant represents a competitive user of high consumption. Accordingly, an average value was assigned to competitiveness associated with water consumption on the basis of the following rationale: if the cement plant needed to mobilize the required amount of water from alternative sources or the distribution network, it would have to pay a mobilization cost much higher than the price currently paid. The marginal cost at the medium-run of obtaining water from another well was considered as an alternative. Distribution losses (beyond the rate of unavoidable losses) as well as a part of water saving (5 to 20%) were considered as inefficiencies.

Air. The main consequences of air pollution are due to indoor pollution (dust, poor visibility, increased risks of occupational accidents, etc.) and outdoor pollution. Regarding indoor pollution, the number of work days lost as a result of occupational illnesses and accidents and unjustified absences was used. The value of one day was calculated with respect to the basic salary (excluding allowances and other additions). Alternatively, a part of the environmental “allocation for nuisance” in the enterprise was also calculated for the annoyance, which does not lead to absenteeism. For outdoor pollution (region), the calculated DALYs for the country were estimated as a proportion of the concerned population and as a function of the “surplus” contributed by the cement plant to air pollution at the local level.

Noise. The noise issue is relatively serious, particularly in the quarries and at the level of some production equipment (compression hall, for example). Regular measurements are recent and not always available for each enterprise. Cases of professional deafness exist. In the absence of any data, damage from noise cannot be taken into consideration in the economic-environmental analysis.

Soil and landscape. The degraded area of the site (not the footprint) was considered with respect to unachieved agricultural production (according to the region in question). The parts

of contaminated soil (storage of oils and transformers for example) were reported. With respect to the landscape, the loss of aesthetics was accounted for based on the following estimation (based on the Tunisian study): A portion of the neighboring households (25%) was willing to relocate away from dust and other aesthetic nuisance and to pay a difference in the price of rent.

Waste. Waste of raw materials, semi-final product and cement were expressed in terms of a forgone opportunity for benefit (they can be somehow sold for recycling or road building) as well as refractory bricks and balls. Lubricants were considered along with the costs of treatment, whereas, oils constitute a forgone opportunity for benefit in terms of recycling; the same applies to ferrous and non-ferrous metals, tyres and rubber from hydraulic belts. Potential PCB waste is accounted for according to the cost of treatment in Europe. Where recycling is applied, values become negative (they reduce the costs of inefficiencies). Burning dangerous and municipal waste in cement kilns is also considered as a negative damage (an environmental benefit) when no other public facility is available. This fact explains the low damage found in the case of Morocco in 2008.

Energy and materials. The use of energy and materials is subject to inefficiencies. Energy sources are unsaved or lost (through their use in lost semi-finished or finished products). Some materials are lost in excess of normal rejects. They are taken into account under inefficiencies in the use of natural resources, as a fraction of the saving potential of lost energy and materials in addition to reported waste. Unplanned stoppages due to environmental constraints, such as the repair of an electro-filter may to be included in the calculation.

Global environment. Costs associated with the global environment were considered in terms of CO₂ emissions and alternatively as loss in biodiversity. CO₂ emissions originate from the transformation of limestone (CaCO₃) and the combustion of natural gas and fuel in proportion to consumed quantities. The monetary valuation is undertaken at the value of carbon in the market of London (USD 10 per ton, 2002).

Estimation of the costs of remediation

Water. For water, costs of remediation refer to the sustainability of supply, water treatment at the local cost and consumption savings.

Air. With respect to air, calculations include the cost of environmental investments (electro-filters, bag filters, etc.), upgrade of existing installations (repairing bag filters, repairing or replacing broken-down equipment) and, on the short run, increasing spending on protection measures within the production unit. Costs associated with electro-filters in particular are accounted for in terms of real payback period of investments or actual costs of repair.

Noise. Expenditure on protection measures against noise was addressed under “air” (individual protection expenditures).

Soil and landscape. Clean up, remediation and restoration costs concern soil and landscape. The predetermining factor is the number of households willing to pay for the restoration of the site.

Waste. Waste is addressed, on one hand with the cost of recycling or landfill disposal (mainly waste from raw material, semi-final products, including bricks, and cement), and on the other hand with the cost of treatment (lubricants, PCBs, etc.). The costs used are all local with the exception of the cost of treating PCBs, evaluated at the European cost.

Energy and materials. Energy was considered at half the opportunities for saving. Materials were recovered at half their price (this is not recycling but avoiding their losses). Indeed, this does not concern only costs associated with fine-tuning management (in terms of economic costs of transaction), but also changes to be undertaken at the level of the production process.

Global environment. Costs of environmental remediation resulting from greenhouse gas emissions were not calculated.