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Environmental Fiscal Instruments for Quarry Management: Global Experience and Options for Lebanon



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**Support to Reforms – Environmental Governance,
Beirut, Lebanon**

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**Environmental Fiscal Instruments
for Quarry Management:
Global Experience and Options for Lebanon**

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in no way be taken to reflect the views of the European Union.

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PREFACE

This report is one of several addressing the international experience with environmental fiscal instruments (EFIs) for environmental management and protection. It has been produced in the context of the EU-funded Support to Reforms: Environmental Governance (StREG) project being carried out through the Ministry of Environment in Lebanon.

What are EFIs?

The term “environmental fiscal instruments” is used to refer to tools that encourage sound environmental management by working through economic instruments and market mechanisms, as contrasted with “command and control” tools that protect the environment through mandatory compliance with fixed laws or regulations. These economic instruments classically include such tools as emissions taxes or cap-and-trade systems to manage pollution rather than reliance on fixed, technology-based emissions standards applicable to all industries and to all firms within them. In the solid waste arena, they include taxes on primary products to encourage recycling, and taxes on landfills or incinerators to encourage people to “reduce, reuse, recycle,” and “pay-as-you-throw” pricing for trash collection to encourage households to reduce their waste streams.

In an ideal world, all countries would implement the polluter pays principle, and subsidies would not be needed to encourage environmental protection. In the real world, however, almost all countries offer some subsidies for environmental protection. In some cases they are necessary to deal with market imperfections, for example when private financial markets consider new practices like recycling too risk to offer loans for industrial development, or when lack of information makes it difficult for firms to know how to reduce emissions in cost-effective ways. In many countries subsidies have been used to ensure that smaller or low-margin firms are not put out of business by mandatory emissions controls, with consequent loss of jobs. In countries for which environmental protection is new, subsidies may be used to encourage firms to begin emissions reductions before they become mandatory, or to ease the financial burden that will be incurred throughout the economy at that time. While such subsidies are not conventional market-based economic instruments, they nevertheless create important incentives in the process of introducing environmental controls, and are therefore considered in these reports.

Some other market-related tools go beyond what can be considered “economic instruments” and are not discussed in these reports. For example, information programs to help industry find suitable “green” technologies, public information campaigns to encourage source separation of waste, and green labeling may all be understood as mechanisms for enabling markets to work more smoothly by ensuring access to information. While they certainly do help markets work better, they are not considered in these reports, as they are considered too far removed from actual economic instruments or incentive-based tools. Similarly, tools such as minimum energy efficiency standards for appliances, while designed in part to reduce prices for efficient equipment by increasing demand, are not considered in these reports, as they are primarily regulatory rather than market-based.



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About these reports

One of the tasks called for from the EFI component of the StREG project was an overview of the use of EFIs elsewhere in the world. This series of reports is the response to that activity. The scope of “EFIs elsewhere in the world” has been narrowed to focus on application of EFIs to issues on which the project is focusing, and that fall under the jurisdiction of the Ministry of Environment. Each of these reports focuses primarily on the tools that can be used to encourage environmental protection and how they have been applied elsewhere in the world. The reports then more briefly consider which of the tools may be of interest to Lebanon and what additional analysis would be needed to determine how they might actually be used in that country.

These reports are being circulated within the Ministry of Environment and to key individuals outside the Ministry, to obtain their feedback on which tools they feel warrant additional analysis for possible application in Lebanon. Their recommendations will be submitted to a technical working group, which will determine what additional analytical work should be undertaken. That work will provide the more detailed information necessary to understand how the proposed instruments may interact with the market context, institutional framework, and legal context for environmental protection in Lebanon. If appropriate based on the additional analysis, more detailed recommendations and draft legislation will be prepared for the eventual introduction of the proposed EFIs.



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EXECUTIVE SUMMARY

This report is one of several being produced through the Support to Reform: Environmental Governance (StREG) project in the Lebanese Ministry of Environment. These reports consider how environmental fiscal instruments (EFIs) have been used elsewhere in the world as a tool for environmental management. EFIs are tools that encourage sound environmental management by working through economic instruments and market mechanisms, as contrasted with “command and control” tools that protect the environment through mandatory compliance with fixed laws or regulations. The term is typically used to refer to such mechanisms as emissions taxes, cap and trade systems, bottle deposits, or taxes intended to encourage “prevention, reuse, and recycling” of solid waste rather than landfilling or incineration. In addition, because direct subsidies for environmental protection are a widely used in countries beginning to tackle environmental problems, they are discussed here even though they do not apply the polluter pays principle that is at the core of all environmental policy.

This report considers economic instruments tools commonly used elsewhere in the world to support quarry management. It focuses on three general problems:

- Reducing quarry impacts through policy tools to shift demand from primary to recycled building materials.
- Effective use of financial guarantees to ensure that quarry operators take responsibility for rehabilitating the sites after excavation has ceased.
- Amassing the funds to rehabilitate abandoned quarries for which no known company or property owner can be held liable. This is primarily a fund-raising problem, rather than one that is based in use of economic instruments to create incentives for environmentally preferable behavior.

EFIs are likely to be useful in Lebanon only in addressing the first challenge. Recent research suggests that at least in the Beirut area recycled construction and demolition waste has the potential to be a financially viable industry, especially if provided with some public support through such tools as aggregates taxes or direct subsidies. This issue warrants additional analysis, in conjunction with the analysis of support for recycling proposed in the paper in this series on solid waste management.

Since 2011, the Ministry of Environment has implemented financial guarantee requirements that are sufficiently strict to create a financial incentive for quarry owners to rehabilitate their properties; thus the second problem seems to have been addressed. The Ministry is now confronting the many abandoned quarries in the country. Unlike elsewhere in the world, in Lebanon the responsible agents are almost always known, so the challenge is to hold them liable more than it is to raise funds to pay for rehabilitation. The Ministry is initiating the use of legal measures to implement Decree 8803 / 2002, which requires that quarry owners pay for rehabilitation, and hopes that the example of a few lawsuits will demonstrate to other owners that they must take this requirement seriously.



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ABBREVIATIONS

ALSF	Aggregates Levy Sustainability Fund
AUB	American University of Beirut
CAC	command-and-control
CDM	clean development mechanism
CDW	construction and demolition waste
CNRS	Centre National pour la Recherche Scientifique
EEA	European Environment Agency
EFI	environmental fiscal instrument
EI	economic instrument
ELV	emissions limit values
EPR	extended producer responsibility
FNCCC	Framework Convention on Climate Change
FODEP	Fonds de Dépollution (Pollution Reduction Fund)
GPP	green public procurement
IFC	International Finance Corporation
JI	joint implementation
LEPAP	Lebanon Pollution Abatement Project
NGO	non-governmental organization
PAYT	pay as you throw
QPA	Quarry Products Association (UK)
RGGI	Regional Greenhouse Gas Initiative
SWM	solid waste management
SWMP	solid waste management plan
WCA	waste collection authority
WDA	waste disposal authority
WRAP	Waste and Resources Action Programme
WtE	waste to energy



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1 INTRODUCTION

Both active and abandoned quarries pose a major problem in Lebanon. As has been documented in a variety of other studies, quarries have been built all over the country, with little or no permitting, regulation, or environmental controls (ELARD 2007; MOE/UNDP/Ecodit 2011). They are unsightly, can be dangerous due to the risk of collapse, and create externalities from dust, contamination of water supply, structural damage elsewhere from blasting at the quarry, reduced property values when scenic views are lost, and other harms (Sarraf et al, 2004, p. 54). The proliferation of quarries in Lebanon reflects the very high level of construction activity in the country due in part to the frequent wars both within the country and in its neighbors, which makes the demand for building materials much higher than it might be in a calmer region. However the fact that demand is high does not justify the lack of environmental controls, nor does it eliminate the need to deal with the many orphaned and abandoned quarries across the country.¹

The quarry sector faces three distinct problems, which can be considered separately:

- Demand for building materials; how much can this be shifted from primary to recycled material in order to reduce the need for quarry outputs? How can taxes or subsidies be used to encourage the recycling of construction and demolition waste, and how much impact might they have?
- How can we ensure that currently operating quarries or new ones will be rehabilitated at the end of their life? This depends on obtaining adequate financial guarantees that fully cover the costs of rehabilitation, so that quarry operators will suffer a significant loss if they abandon their quarries after closure.
- What can be done to rehabilitate orphaned and abandoned quarries? The concern in most countries is how to finance the rehabilitation of quarries for which there is no enterprise or property owner who can be held liable for the costs involved.

The second part of this report considers the economic instruments that have been used elsewhere in the world to address these three concerns. The third part considers the particular problems facing Lebanon, and which of those tools may offer some potential to address them.

¹ The term "abandoned" in this context refers to quarry sites that are not active, but whose owners can be identified. "Orphaned" quarries, in contrast, are those that are inactive and have no known owners who can be pursued to take responsibility for their rehabilitation.



2 USE OF ECONOMIC INSTRUMENTS FOR QUARRY MANAGEMENT OUTSIDE OF LEBANON

2.1 Reducing use of primary material

Two kinds of fiscal instruments are typically used to reduce the rate of extraction from quarries; taxes on quarried material to increase its cost, and incentives to increase the use of recycled construction and demolition waste (CDW) in place of primary material. In some countries, such as the UK, they are used jointly; this appears to be an effective strategy for shifting from primary to recycled construction inputs. The European Environment Agency (2008) has analysed the use of these measures through case studies in four countries - Sweden, Italy, the Czech Republic, and the UK – and found the experience mixed.

Sweden: Sweden (Legg 2007a) introduced a tax on gravel in order to encourage its replacement with crushed bedrock. They faced high levels of gravel extraction in southern and central parts of the country, where the supply is quite limited and the quarries were hurting the water supply. They hoped to replace gravel with crushed bedrock, which is readily available and would have less harmful environmental impacts. Shifting to recycled CDW was not an option, as old buildings are rarely demolished in Sweden. Gravel shortages are not a problem in the northern part of the country; however they felt having different taxes in different regions would be complicated and lead to other market distortions. They therefore introduced a uniform gravel tax throughout the country.

The tax was initially low, but was then raised to more than the difference in price between crushed rock and gravel, so the financial incentive was for crushed rock. Revenues from the tax went into the treasury, and were not used for any specific environmental purpose (such as mitigating the water quality problems created by existing gravel quarries). The tax did lead to increased use of crushed rock instead of gravel. It also led to increased energy use in materials processing, in order to run the crushing machinery. However this was more than offset by a decreased use of energy in transportation, as the crushed rock could be sourced closer to its final destination, and therefore did not have to be transported long distances. In addition, crushing rock creates more jobs than quarrying; while this was not an objective of the tax, it was a beneficial outcome.

The primary purpose of the tax was to prevent harm to water quality, but according to the Legg study there has been no research into whether that actually occurred. There was also no analysis of whether the tax achieved that objective more efficiently than strategies to mitigate the water quality harm, e.g. by treating the water supply before use. It does, however, highlight the importance of factoring transportation into any analysis of quarrying taxes, since it is a key component of decisions about which building materials to use.

United Kingdom: In the UK, extraction of aggregates was already declining before the aggregate tax was introduced in 2002, in part because of the introduction of landfill taxes and shifts to use of glass and metal in building construction (Legg 2007b, p. 4). The tax is set at £1.60 per ton (about €2.00 at 2014 exchange rates), and is imposed on gravel and aggregates but not on lower-quality slate, shale, and china clay. There is disagreement over how it is actually affecting extraction, as Legg found in interviewing industry stakeholders. Some believed that the tax had led to a shift from gravel and aggregates to slate, shale, and



china clay. Others, however, argued that the untaxed lower quality products were merely the byproducts of extracting the taxed higher quality products, so the production of low-quality materials is not related to the tax itself, although they acknowledged that some additional extraction of low-quality material is in fact attributable to the tax.

As in Sweden, transport costs combine with taxes to influence materials choice; the low quality slate, shale, and china clay are apparently only competitive with taxed gravel in a small area where the transport costs influence price less than the tax. Further away, the decrease in use of taxed aggregates is due to replacement with recycled materials rather than untaxed primary products. The tax has been associated with increased use of secondary aggregates, notably untaxed power station ash and slag. Additionally, it has been associated with increased use of mobile crushers that can break up material for recycling on-site, so a building can be demolished and the material crushed and then directly used in the new construction. Legg also found, based on his interviews, that enterprises dealing in secondary and recycled aggregates have grown, both in number and in turnover (Legg 2007b, p. 14). The number of new firms initially increased with the landfill tax and further increased when the aggregates levy was introduced. All of these relationships are correlations rather than clearly causal; however they suggest that the tax may indeed be leading to replacement of primary material with recycled waste.

For about ten years, a portion of the UK aggregates tax was directed to the Aggregates Levy Sustainability Fund (ALSF), which operated until 2011 (Natural England 2011, Legg 2007b). The purpose of this fund was to support recycling of building materials, complementing the landfill and aggregate taxes and ensuring that recycled materials would be available to those wishing to reduce use of primary products. The fund supported aggregates-related activities of the Waste and Resources Action Programme (WRAP, <http://www.wrap.org.uk>), a broad-based national effort to promote “the circular economy” and use of recycled materials. Some WRAP support takes the form of direct subsidies to the recycling industry, but much of it goes to research and development, improved information flow, and other strategies to help the market operate more smoothly. Some of the specific activities supported with these funds are:

- Establishing quality standards for waste-derived aggregates.
- Providing information to industry about opportunities to use recycled materials, through the website <http://aggregain.wrap.org.uk/>.
- Capital support for equipment to recycle CDW, reprocess aggregate, and build other recycling infrastructure.
- Increasing awareness in the industry and among local authorities of opportunities to use recycled materials in construction projects.
- Research into a wide range of issues related to quarrying, building materials, recycling CDW, and quarry rehabilitation.

Although ALSF itself is no longer operating, WRAP is still actively working with the aggregates industries, and public sector support continues to be important in facilitating materials reuse.

In the UK the tax is imposed on imported aggregates as well as on those produced within the country (Legg 2007b p. 8). In Sweden, in contrast, the tax is not imposed on imports, but is imposed on exported primary product (Legg 2007a p. 8). Thus in Sweden the producer is expected to bear the burden of the tax, whereas in UK it is the consumer. In neither country



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did any aggregates firms go out of business, suggesting that in all cases they were able to adapt and to shift the tax to the consumers.

The UK study looks at the administrative costs of the levy as well as at its impacts. Interestingly, it finds that one of the major costs to government is the detailed consultant studies that were carried out before its introduction; however such studies would probably have to be conducted for any well-planned new policy. The study also compared the combination of taxes introduced in the UK (aggregates and landfill) with the package of voluntary measures that industry had proposed as an alternative, in an attempt to avoid imposition of the taxes. They conclude - as did the government when it rejected the industry proposal - that the taxes were more effective than the voluntary measures would have been. Moreover, since the industry measures were voluntary, the study finds that the impact of the taxes is more equitable across firms than the industry package would have been.

Italy: Italy has a very decentralized system of quarry taxation (Mazzanti et al, 2007). The purpose of their levies is to generate funds for mitigating environmental impacts of the industry, not to create an incentive to shift from primary to recycled materials, and according to Mazzanti et al there is in fact very little recycling of aggregates in Italy. The rates are set at regional or municipal levels and revenues go to the municipalities, which use them to finance land conservation activities. The levies are quite low compared to other countries, typically €0.41 - €0.57/cubic meter, which would be equivalent to about €0.23 - €0.35 /ton², as compared with the UK's £1.60 or about €2/ton. Thus they do not have much impact on demand for or supply of primary material for construction.

In other ways, the Italian tax has had positive impacts. There is better monitoring of extraction, in order both to assess the taxes and to ensure compliance with quarry permits that specify the quantity to be extracted. The public sector has an incentive to generate good data, to ensure that they can collect their revenue. Moreover, "good" firms are reporting on illegal quarries, which don't pay tax and constitute unfair competition; this contributes to enforcement of the law. There is, however, no assessment of whether the municipalities are actually using the revenue to fund land conservation, which was the primary purpose of the tax.

Czech Republic: The Czech Republic imposes two charges on quarry activity (Herczeg and Musil, 2007). The first is essentially a royalty, set at €356 per year per km² for the right to extract. The second is a sales tax at 2-3% of the sale price, depending on the material; at the time of the study this came to about €0.10 per ton. So charges are very low, and are not thought to have any impact on output.³ They only apply to "reserved deposits" that were

² Based on the following conversion rates, from <http://onlineconversion.vbulletin.net/forum/main-forums/convert-and-calculate/2151-cubic-meters-to-metric-ton-using-gravel>:

Gravel, loose, dry - 1.52 tonne/cubic meter
Gravel, w/sand, natural - 1.92 tonne/cubic meter
Gravel, dry 1/4 to 2 inch - 1.68 tonne/cubic meter
Gravel, wet 1/4 to 2 inch - 2.00 tonne/cubic meter
Concrete, Gravel - 2.40 tonne/cubic meter

³ At the time of the Herczeg and Musil study a new charging system was being developed, through which the area-based charge would vary according to the ecological value of the area, with lower charges for areas of low ecological importance and considerably higher charges for those of greatest value. This could create some incentive not to excavate land of ecological value.



claimed by the government in the past as being of strategic importance (irrespective of whose land they were on). Other reserves, termed "unreserved," are not subject to the charges and in other respects as well are regulated differently. The reserved deposits account for about two third of total extraction. The tax revenues are shared between municipal and national government, 75% going to the former and 25% to the latter. Total annual revenues were estimated at €1.4 million / year. (Herczeg and Musil p. 3)

Because the amounts are so low, this charge has no impact on the incentive to use recycled rather than primary aggregates. However transport costs, unlike the tax, are a key factor in the decision not to use recycled material. The cost to transport a ton of aggregate one kilometer is about 25% of the price of the material. Therefore the existing tax costs about as much as moving the material only 100 meters; it will pale by comparison with transport in the decision about what to purchase. Moreover, primary aggregate is available throughout much of the country, whereas facilities that process and sell recycled material are not. This means that, except in some larger cities where recycled material may be available locally, transport costs are likely to make recycled inputs considerably more expensive than primary inputs. The aggregates taxes are far too low to have any impact on that calculus. (Herczeg and Musil p. 21)

Overall, these four studies suggest that a levy on aggregates alone may not suffice to shift from primary to recycled building materials, especially if the tax is low and the spatial distribution of supply and demand are taken into account. However a combination of measures, such as the landfill and aggregates taxes and the ALSF in the UK, can create a significant shift from primary to recycled materials in construction.

Another study of aggregates taxes, which took a more academic perspective, draws the same conclusion. (Söderholm 2011) This study begins with a consideration of the reasons why countries might tax aggregates, distinguishing first between taxes designed to raise revenue (as in Italy) and those that aim to change behavior in order to protect the environment (as in the UK). Among environmental taxes, the author further distinguishes among those designed to prevent resource depletion, to deal with externalities in extraction, to reduce externalities from disposal of the final products made out of the primary materials, or to shift consumption from primary to recycled materials. His paper also looks at the experiences of Sweden, the UK, and Denmark. He also concludes that a combination of policies is likely to be more effective than an aggregate tax alone. He also emphasizes, however, that taxes designed to meet only one objective are likely to be more effective than ones designed to meet multiple objectives, because each objective will require a different tax structure; compromise among objectives may lead to a tax that accomplishes none of them. In practice, of course, this is not always possible, because governments are juggling many different problems and goals as they design policies. However it still highlights the importance of being explicit about the different goals, and how policies are expected to relate to each of them.

2.2 Operational quarries

As the old adage says, an ounce of prevention is worth a pound of cure. Ensuring rehabilitation of currently operating quarries when they are closed is more cost-effective than

However because charges per ton were unchanged, it would not affect incentives to shift to recycled material. Overall revenues should increase somewhat, but even the highest charges were not high enough to have much impact on output.



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finding the funds to rehabilitate them if they are abandoned. In most countries, this is done through regulatory mechanisms reinforced with economic incentives. ELARD (2007) has looked at the legal framework for quarry management in a number of countries including the UK, France, Malta, Algeria, Cyprus, and Canada. In all places, a permit is required to open a quarry. One of the permit requirements is to have a financially and technically viable plan through which the site will be rehabilitated at the operator's expense when it is no longer being used. Another is that some form of financial guarantee be provided to ensure that will actually occur.

The financial guarantees to ensure rehabilitation come in several forms, typically including third party bonding, actual deposit of the full amount needed for rehabilitation, insurance policies, bank lines of credit, or similar instruments. Some jurisdictions allow companies to use self-bonding or corporate guarantees, where the resources of a parent or related company provide the guarantee that rehabilitation will be carried out. (See, for example, State of Victoria (Australia) 2014, US BLM undated, Conrad 2014, IMCC 2013.)

The amount of guarantee required is estimated by the operator, based on the characteristics of the mine and the technology to be used for operation and rehabilitation. The regulatory authority must approve the amount, which is typically reviewed on a regular basis over the active life of the mine, and adjusted in response to deviations from the permitted activities, inflation, and so on. Some jurisdictions require operators to rehabilitate their site on an ongoing basis over the life of the mine, rather than leaving this to the end. This ensures that they will not abandon the property without any rehabilitation; it can also be less expensive than doing all of the work at the end. It may also permit reuse of the land for other purposes during the life of the quarry, which could bring additional revenue to the business.

A slightly different approach has been developed in the UK (ELARD p. 27-29). The Quarry Products Association (QPA) and the British Aggregates Association (BAA), the two trade associations for the industry (the former covering 90% of activity, the latter covering small firms responsible for the remaining 10%), have developed mutual funding schemes through which the associations guarantee that rehabilitation will be carried out and paid for should one of their members not comply with the requirements in its operating permit. This was initially proposed as part of the voluntary measures that the QPA offered in an attempt to head off the aggregates levy. Their proposal was rejected and the levy was introduced (as discussed above), but the schemes are in place nevertheless. The government recognizes coverage under the schemes as an acceptable alternative to financial guarantees for individual quarry sites.

The bonding systems commonly used face a number of risks. It can be difficult to estimate actual reclamation costs in advance, leading to underfunding should the quarry company default. The companies issuing the bonds can go out of business, leaving the financial guarantees worthless. Where corporations are allowed to self-bond, there is the obvious risk of the corporation going out of business. The quarry activity may cause unanticipated environmental problems, such as downstream water quality; bond requirements based on area and depth of land disturbance will not cover this kind of cost. Conventional bonds are released when the regulator guarantees that the site has been fully rehabilitated and no future environmental harm will occur. This is feasible where the need is for land rehabilitation and revegetation. However water pollution from a mine or quarry can require ongoing treatment of the water supply because of pollution from the mine or quarry, which cannot be covered by a lump-sum bond. Instead, some jurisdictions are requiring operators



to establish trust funds, the interest on which can be used in perpetuity to pay for such costs (Conrad, 2014).

2.3 Orphaned / Abandoned quarries

Orphaned and abandoned quarries are a commonplace occurrence for several reasons:

- Companies deliberately go out of business to avoid liability for rehabilitation for quarries or mines. In some cases the site operators are deliberately structured as single-purpose "closed" firms, created only to work in that one place, even if that firm is the creation of a larger one that could be purchasing its outputs or engaged in similar activities elsewhere. The operating firm works until the site is no longer economically viable. At that point they don't have the money to rehabilitate it, and they don't have assets they can sell to fund rehabilitation. Because they are legally independent from any other firm, including the one that might have created them, there are no "parent" resources to bail them out. Their best option is to declare bankruptcy, leaving no assets that can be used to rehabilitate the site. (Nazari 2000)
- In some cases the firm that operated the quarry legitimately does not exist any more, and it has been too long to find anyone who might be responsible for the site. Of course this is not the case of currently operating quarries.

Abandoned quarries obviously create a different set of problems from operational ones, since the companies responsible for the extraction generally cannot be required to rehabilitate the properties. This is a problem faced by every country, as mining has existed since antiquity and mine reclamation requirements perhaps only a century.

In Canada, a significant national effort has recently been made to analyze and resolve the dilemma of managing and funding the rehabilitation of abandoned mines and quarries, through the National Orphaned / Abandoned Mine Initiative (www.abandoned-mines.org). This initiative commissioned a study of strategies for funding mine rehabilitation (Castrilli et al 2003), which provides a comprehensive overview of the issues and options. The authors identify a set of principles that may be applied to decide who should pay for rehabilitation; these, in turn come from an earlier Canadian study in this area (CCME 2006/1993, p. 4):⁴

- Polluter pays - the company responsible for damaging the landscape should pay. Unfortunately, since the premise of work on orphaned and abandoned mines or quarries is that it is impossible to hold the polluter liable (usually because they have gone out of business or are no longer operating within a jurisdiction where they could be prosecuted), this is not usually viable.
- Beneficiary pays - this concept is interpreted variously. Castrilli et al suggest it means that the beneficiaries of the environmental and safety improvements from rehabilitation should pay for it; this would typically be the local community. CCME (2006/1993), on the other hand, explains it in two different ways. If the abandoned mine is on private land that was purchased at a discount because of the mine's presence, then the property owner is the beneficiary, and she or he should pay for its rehabilitation. Alternately,

⁴ ELARD (2007) also relied on the Castrilli and through it the CCME paradigms in their analysis of how to fund rehabilitation of abandoned quarries.



CCME suggests this could mean that those who benefited from the activity that led to the abandoned mine should pay; this would be the equivalent of the polluter pays principle.

- "Fairness" - which, according to CCME incorporates issues such as certainty in process, effectiveness and efficiency, and timeliness in achieving economic objectives. The remediation process should also be open, accessible, and permit public participation.
- Application of principles of sustainable development, which is not clearly defined by the CCME document, but does include attention to environmental, health, and economic issues.

Building on these principles, the CCME report considers who could be held financially liable for funding the rehabilitation of abandoned mines, and who explicitly should not be held liable. Among the issues raised by their report are the personal liability of the owners of companies that insured the mine operations (explicitly excluded from liability, though their firms are still liable for making good on the insurance policies) and the allocation of liability between the seller and buyer of land with an abandoned mine (depends on how much each knew about the condition of the land and how that factored into the price).

Castrilli et al present a more practical breakdown of who could pay for mine rehabilitation, and the logic behind each approach:

- The government (central or local) could pay, in which case costs are borne by the taxpayers. The logic here would be that the government has collected extensive taxes from the industry already, which it can use for this purpose. Moreover, if the damage was done at time when it was not illegal, proponents of this view would argue that it is not fair to hold the mining industry liable.
- Charges can be levied on current mining or quarrying operations to fund rehabilitation of abandoned or orphaned mines. The logic for this approach is that the industry as a whole - and its customers - should be held liable for harm done in the past, even if the individual companies (and customers) that caused specific harm cannot be prosecuted.
- Government could provide financial incentives for individual mining companies to rehabilitate damage that they did not cause, through tax breaks, issuance of mining licenses on adjacent land, or other mechanisms. Depending on the magnitude of the financial support offered by government, this may share the financial burden between taxpayers and the company's customers.
- Government could allocate a portion of the taxes already levied on the industry to rehabilitation, or reduce support to the industry for this purpose. While these approaches may be administratively different from the previous ones, they amount to the same thing; the former would mean government pays (since those funds would otherwise be available for other government activities) while the latter would mean industry pays (as they lose support they used to get from government).

All of these approaches have been used throughout the world, as have combinations of tools. In the US, Public Law 95-87, the Surface Mining Control and Reclamation Act of 1977, assesses a fee of \$0.35 per ton of surface-mined coal and \$0.15/ton of underground



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coal, to fund the rehabilitation of abandoned mines; these funds are allocated to the states which take responsibility for carrying out the rehabilitation. The US Comprehensive Environmental Response, Compensation, and Liability Act combines revenues from a special income tax on industry, excise taxes on petroleum and chemicals, and federal appropriations in the Hazardous Substance Superfund, used to clean up abandoned hazardous waste sites. In Canada, Indian and Northern Affairs Canada manages the Northern Contaminated Sites Program, through which the federal government has direct responsibility for mine rehabilitation; unfortunately, the funding available is totally inadequate for the amount of work that remains to be done (Castrilli et al p. 36). Many Canadian provinces have also undertaken to rehabilitate abandoned mines using general funds, and the country also has a wide array of joint federal/provincial cleanup programs. Canada has also authorized the creation of provincial rehabilitation funds whose revenues come from assessments on quarry or mine operators. Castrilli et al review many of these programs, considering the criteria which make one or another more suitable approaches in different contexts.



3 APPLICATIONS TO LEBANON

From a management perspective, the quarries in Lebanon fall into a number of different categories, as shown in Table 1. At present, the number of quarries in each category is not known. There are many partial sources of information on the number of quarries in total (both operational and closed), the number with permits, and so on, but no one comprehensive database that provides a full overview of all of the categories below.

In terms of the three broad quarry issues discussed above, only two seem to be important in Lebanon; the possibility of reducing demand through recycling CDW, and strategies to ensure that abandoned quarries are rehabilitated by the responsible agent. According to Ministry of Environment staff there are no orphaned quarries, i.e. sites for whom no individual or business can be identified to take responsibility.

Table 1. Overview of the status of Lebanese quarries

Type of quarry	Comments	Ministry Response	Role for EFIs
Operating legally with permit and adequate financial guarantee	These are the most recently opened quarries, which began operation after the financial guarantee requirements were raised enough to exceed the actual rehabilitation costs.	The Ministry expects that owners of these quarries will take direct responsibility for rehabilitation, because it costs less than the guarantee they have put up.	EFIs to reduce demand for primary material for construction could reduce the number of operating quarries and thus their overall environmental impact. The rationale for introducing these tools would be that preventing the environmental harm by reducing demand is better than making up for it through rehabilitation.
Operated with permit and financial guarantee, but now abandoned	The required financial guarantees were initially set below the actual cost of quarry rehabilitation. Consequently, some owners have abandoned their quarries after closure, preferring to lose the guarantee rather than pay for rehabilitation.	The Ministry plans to rehabilitate a selection of these quarries, and take the owners to court to force them to reimburse the government for the costs.	No need for EFIs.
Operating legally with permits but inadequate financial guarantee	These quarries began operating when the financial guarantee requirements were lower than the cost of rehabilitation. Their owners may be expected to abandon them after closure.	If the lawsuits mentioned above are effective, this may lead quarry owners to rehabilitate without further Ministry action because it would cost less than a lawsuit.	If legally feasible, increasing the financial guarantee now would create an incentive to rehabilitate; however it appears that this is not feasible.



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Type of quarry	Comments	Ministry Response	Role for EFIs
Operating illegally, with no permit or financial guarantee		What Ministry action?	EFIs to reduce demand could reduce this type of activity; however legal action to stop it is more appropriate.
No longer operating, with financial guarantee, rehabilitated (or rehabilitation in process)	There are no quarries in this (hypothetical) category.	No action required other than oversight.	No need for EFIs.
No longer operating, no financial guarantee, but owner or operator is known	If these quarries operated before permits and financial guarantees were required, it is not clear whether owner is liable for rehabilitation.	No action at present.	Tax on current operators to cover costs of rehabilitating abandoned mines could raise necessary funds; however it appears that such a tax is not the preferred Ministry strategy.
No longer operating, predates decree 8803/2002, owner not known.	Apparently there are no quarries in this category; owners are known for all quarries.		

3.1 Reducing Use of Quarry Products

Several different tools may offer potential to encourage recycling of construction and demolition waste, which would reduce demand for primary products. These include the introduction of aggregate taxes, taxes imposed on CDW disposed in landfills, and direct support for the recycling of construction and demolition waste. In addition, changes in architectural fashion in favour of glass and steel buildings could lead to less use of primary materials; however this would not be the object of public policy. The broader use of incentives to support the recycling industry in general has been discussed in the report in this series on solid waste management; here we will focus specifically on CDW.

Recycling CDW as a way to reduce both waste and demand for primary aggregates may be financially viable in Lebanon. A team of researchers at the American University of Beirut (AUB) has carried out a number of studies on the potential for CDW recycling (Srouf, Chehab et al 2012, Srouf, Tamraz et al 2012, Srouf et al, 2013; Tamraz et al 2012). Their work has developed empirical estimates of the actual composition of construction waste, the volume of such waste generated per year in the Beirut area, and how it is now disposed of. They construct an algorithm for analysing whether recycling could be financially viable, based on assumptions about gate fees for a recycling plant and sale prices for recycled building materials (both of which would be revenue sources for the plant in their model). Using data on annual waste flow in Beirut, they estimate the cost of building and operating a recycling plant on three different sites in the urban area, with capacity about 50% greater than current annual flows of recyclables. Assuming a 7% discount rate, they find that the total start-up costs of the plant could be recovered in from 2 to 13 years, depending on the assumptions about gate fees and market prices of recycled building materials. Using their figures, with their lowest revenue assumptions (no gate fee and the price of recycled



aggregates only 18% of the price of primary material, i.e. \$2), their plant would have a rate of return on investment of 3.94%. With total plant revenue at \$4.15/ton, the return on investment would match the 7% discount rate assumed by the analysis.

Both Law 444 on Protection of the Environment and the draft solid waste management law authorize the use of tax credits and other fiscal instruments for environmental purposes, including to encourage growth of the recycling industry. Article 20 of Law 444 authorizes a 50% reduction in customs duties on equipment used for waste treatment or recycling, as well as a 50% reduction in any other tax related to these activities, such as income taxes, VAT, and so on. The implementing decrees for these provisions have not yet been drafted. This may provide a relatively straightforward opportunity for introducing tax incentives to support the development of the recycling industry, if it proves to be financially viable. Law 444 also authorizes the use of any other economic or financial measures approved by the Council of Ministers to support environmental protection; this could include direct support to new industries in the form, for example, of subsidized interest rates or loan guarantees. Article 27 of the draft Solid Waste Management Law reiterates this, with references both to Article 20 of Law 444 and to Section 2 of Article 5 (repeated), pertaining to income tax exemptions to companies initiating the manufacturer of new products in Lebanon. Thus the laws already in place offer fairly broad scope for introducing subsidies to encourage the start of an active recycling industry in Lebanon.

The AUB work suggests that using such instruments to encourage recycling of CDW in particular may justify further analysis. Among the additional issues that could be included in further work are:

- More detailed consideration of recycling technology, to determine how much of the available waste could in fact be recycled. The AUB work assumes that 80% of the CDW could be reused; in fact, it is possible that some will have to end up as landfill because there is no market for it. This is both a technical and an economic question.
- Whether recycling plants can charge gate fees. This is part of a broader question about recycling; whether recyclers have to buy the material, or whether they can charge people for taking it off their hands. This can go either way, depending on the material and the structure of the recycling market. At present steel in Lebanese CDW is all extracted for sale to recycling companies (in other countries); more information is needed about the economics of recycling other less valuable products.
- Projected growth of construction and therefore of demand for building materials. This will take into account factors such as population growth, household structure, government road-building plans, the expected demand for second homes by non-Lebanese, and so on. It will also consider the market for exported Lebanese cement, which may be expected to grow once the hostilities in Syria and Iraq have abated.
- Trends in building technology. The projections for construction material could also factor in anticipated increases in green building, which could affect both demand and willingness to pay for recycled material. Green building could be the subject of policy decisions, as well, for example requiring new buildings to be LEED certified.



- Transportation costs. The AUB team's analyses do not factor in the cost of transporting waste to alternate disposal sites, the costs of bringing building materials (whether new or recycled) to building sites, or the feasibility of using mobile crushers that could allow materials to be reused without transporting them at all. This additional detail should be included in further analysis of CDW recycling.
- Consideration of how this might play out outside of Beirut; the AUB analysis is of the potential for CDW recycling only in the capital area.

In addition, the AUB work does not look analytically at the possible roles of quarry or landfill taxes to create stronger financial incentives for recycling. As discussed above in considering the UK example, the combination of a significant tax on quarry products, a possible landfill tax for CDW, and the use of the tax revenues to strengthen the recycling industry may be an effective strategy for reducing extraction from quarries and increasing recycling. Given the difficulty of regulating the quarry industry, it could be more effective to introduce a sales or excise tax on primary (but not recycled) quarry products, or exempt recycled building materials from the VAT, rather than to impose a tax on the quarry owners. This would ensure that the final consumers of building materials are bearing the costs; hopefully it would also create a pull from the demand side for industry to offer recycled products. Of course there would be demand-side opposition to such a tax from builders who buy quarry products, just as the producers would object to an aggregates tax.

A number of direct funding mechanisms, identified in the paper in this series on solid waste, may be relevant here as well:

- Income tax reductions to encourage environmentally beneficial activities such as recycling. These are authorized by the draft Solid Waste Management Law, with the mechanisms for their implementation to be set by decree.
- Exemption (or perhaps temporary exemption) of new firms in the recycling industry from other taxes including the VAT, customs duties on imported machinery, and so on.
- Exemption of recycled building materials from the VAT.
- Subsidized loans or loan guarantees to support the purchase of recycling equipment.

Any further analysis of recycling CDW waste should be combined with analysis of mechanisms to support other recycling activities, as they are both addressing the same general industry, and require consideration of the same economic, legal, and institutional issues.

3.2 Ensuring Rehabilitation of Operational Quarries

Since promulgation of Decree 8803 of 2002, the legal framework for mining in Lebanon requires quarry operators to take physical and financial responsibility for rehabilitation of their quarries when they are closed. The decree requires quarry owners to provide the Ministry of Environment with a financial guarantee ensuring that it will be rehabilitated after closure. For the first eight years of its implementation, the financial guarantees required were less than the cost of rehabilitating the quarries. As a result, quarry owners did not rehabilitate the area when they ceased operation, since it was less expensive to lose the



guarantee than to undertake the work themselves. Since then, however, the amount has been raised to a level above the cost of rehabilitation, and quarry owners are unwilling to risk losing this by not managing their property correctly. For quarries now coming into operation, therefore, ensuring eventual rehabilitation seems to have been addressed by the economic incentive of the significant financial guarantees.

A significant number of quarries operate in the country with neither permits nor financial guarantees. Since the law is clear that all quarry operations must be permitted, this issue must be addressed through enforcement rather than economic instruments. The Ministry recognizes this, and staff are planning work with the Ministries of Interior and Finance to identify the owners of those quarries and take steps to stop their operations if they do not comply with the laws requiring permits, financial guarantees, and rehabilitation.

3.3 Abandoned Quarries

Abandoned quarries are a significant problem in Lebanon, although their numbers are not known. These include relatively recent quarries for which inadequate financial guarantees were posted, recent quarries operating without permits or financial guarantees despite the law, and older ones for which financial guarantees were not required. The Ministry's initial strategy is to target a group of recent quarries with inadequate financial guarantees, which have been abandoned rather than rehabilitated. The Ministry plans to redeem the financial guarantees on these quarries, and carry out the rehabilitation at government expense. They will then ask the owners for the difference between the guarantee funds and the actual cost, as authorized by Decree 8803 / 2002. If the owners do not pay, the Ministry plans to launch judicial proceedings against them to obtain the rest of the funding. The expectation is that these lawsuits will show other quarry operators that the government is serious about requiring rehabilitation, and they will then carry out the work themselves in order to avoid both the risk of losing their guarantees and the cost of a lawsuit.

Whether this strategy will suffice to ensure rehabilitation of all or most of the quarries that need it is not yet clear. For the present, it appears that the Ministry has at its disposal the funds needed to front the cost of rehabilitating the fifteen initial quarries. This may not always be the case, however, if the initial judicial proceedings do not induce other owners to take responsibility for rehabilitating their own quarries without legal pursuit. In this case, it would appear that the Ministry hopes to obtain the necessary funding to front the cost of rehabilitation from donors or other sources, rather than imposing a tax on existing operators to pay for rehabilitation of abandoned sites. The proposal of such a tax was thoroughly studied by ELARD (2007), including attempts to estimate the level at which the tax might be set in order to cover the full costs of rehabilitating the then-identified abandoned quarries (p. 45).⁵ The Ministry has not followed up on the ELARD recommendations, however, and

⁵ There appear to be some errors in their calculations, quite aside from the unavoidable need to make many rough estimates. They calculate a fee per ton of production by dividing the estimated total rehabilitation cost by the estimated annual production of *the quarries that need rehabilitation*, had they all been in operation at the same time. In fact, the cost should be per ton of *current production*. Current production will be much lower than the total annual production of the quarries needing rehabilitation had they all been in operation at once, so the fee per ton would be higher than the ELARD estimate.



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appears to hope that the deterrent provided by the upcoming redemption of financial guarantees will create the needed incentives without them having to find the funds to rehabilitate additional quarries.

The ELARD work (p. 45) suggests that some funding for rehabilitation may be available from the quarries themselves. In some cases, extracting additional material from abandoned quarries may be necessary in order to begin their rehabilitation. This material could be sold, and the revenues used to fund the rehabilitation. Perhaps more interestingly, some abandoned quarries may be in urban areas where property values are very high. Their rehabilitation could create valuable urban land, which could be sold to fund rehabilitation. (If the latter opportunity were available, however, presumably the owners would recognize it, and would already have rehabilitated the quarry in order to sell the land for use in more lucrative activities.)

The total magnitude (number and area) of quarries needing rehabilitation is not actually known. The choice of those actually to be rehabilitated would be based in part on the actual environmental harm that they cause. It would also be based on an assessment of the feasibility of rehabilitating them. Darwish et al (2008) have examined the technical feasibility of rehabilitating the existing quarries for either revegetation or water storage, and find that in fact many cannot be rehabilitated at all. Of the 1278 quarries they identify using on 2005 Landsat imagery⁶, they find that 251 have low potential to be rehabilitated for either use, as shown in Table 2. Another 683 are only of medium potential for at least one type of reuse. Only 344 quarries are of high or very high suitability for some type of rehabilitation; not a small number, but still far less than the 1278 in their database. While the total numbers may be too high, the share that can be rehabilitated may be accurate, suggesting that the problem is of less magnitude than might have been imagined. Moreover, the authors do not determine which of these quarries are operational; for those that are, holding the owners responsible for their rehabilitation makes much more sense than seeking other funds for that purpose. So the number of abandoned quarries that might warrant rehabilitation with government laying out the initial funds may be relatively modest. If so, this may make the task of finding donor or other support to cover the cost of rehabilitation pending proceedings to obtain reimbursement from the responsible parties a less significant challenge than initially anticipated.

Table 2. Quarry sites: suitability for rehabilitation

Revegetation success \ Suitability for water harvesting	Very High (A)		High (B)		Medium (C)		Low (D)	
	Class	Quarries #	Class	Quarries #	Class	Quarries #	Class	Quarries #
High (1)	1-A	3	1-B	37	1-C	82	1-D	98
Medium (2)	2-A	15	2-B	77	2-C	188	2-D	162
Low (3)	3-A	2	3-B	30	3-C	333	3-D	251

Source: Darwish et al, 2008, p. 281

⁶ This total figure may be incorrect; Ministry of Environment staff indicated that there was no ground truthing of the interpretations from the Landsat imagery, and many places were classified as quarries that in fact are not.



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3.4 Conclusion

Additional work on EFIs in the Lebanese quarry sector should most appropriate focus on reducing the use of primary materials by encouraging recycling. While this will not solve some of the pressing issues in the sector, and may have only a moderate impact over time, the issues of quarry rehabilitation will be better addressed through enforcement of the existing law, as the Ministry of Environment is in the process of doing, than through economic instruments. The further economic and legal analysis of the potential for recycling, discussed above in section 3.1 of this chapter, should be carried out in conjunction with similar work on incentives for recycling that are discussed in the report on solid waste in this series.



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⁷ NB: This reference list applies to the full series of EFI reports, not only to this one.



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