The need for SEA of Metal Mining in Argentina

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Abstract

Investments in the large-scale metal mining industry have been booming in Argentina. Projects have multiplied promoted by high minerals market prices and based on large mineral reserves, an attractive mining potential due to undiscovered resources along the Andes Mountain Range, a series of fiscal incentives and a permissive legislation. Project leases are granted through the performance of Environmental Impact Assessment studies, which is the common legal requirement in Argentine provinces for the environmental permitting. Nevertheless, these studies are not enough and have not become efficient tools to protect natural ecosystems or prevent social conflicts. Furthermore, to date, no legislation, regulations or guides of procedures exist demanding the application of Strategic Environmental Assessments (SEA). This tool requires urgent implementation in the Argentine territory as it enables better evaluating the sustainability of the activity, analyzing operation and technology alternatives, cumulative impacts, technological transfers, citizen participation, regional development, conflict prevention, among other benefits. In this study we briefly examine the weakness of the current legal environmental requirements, pressure on natural resources, transference to the communities, conflicts associated and outline the benefits such assessment tool would provide in improving the sustainable management of minerals.

Key words: Metal Mining - EIA - SEA – Sustainability management

1. INTRODUCTION

1.1. Metal Mining in Argentina

The very favorable geological and mineral rich characteristics of the Argentine territory, a high percentage of the mining potential still unexplored, a series of tax incentives, a highly permissive legislation and a suitable international market, have driven high the number of projects submitted for exploration or construction approval in recent years, placing the country at the top of the investment rankings in the sector (Secretaría de Minería, 2008).

Many of the mineral deposits are located along the 4,500 km of the Andes Mountains, at head of watersheds, located in jurisdictions displaying a wide range of administrative requirements to ensure an effective environmental protection. The Argentine territory is marked by a great ecological diversity, being divided into 18 eco-regions (Burkart et al 1999), and also has a noticeable diversity in the economic, socio-cultural and political fields, as well as in the degree of industrial and agricultural development per region.

Given the high and growing socio-environmental conflictivity that exists in relation to these projects, it becomes essential the performance of a Strategic Environmental Assessment (SEA) (IAIA, 2002; Partidário, 2004; Croal, et al. 2010) of the sector in order to analyze, for example, the absorption capacity of the affected ecosystems, regulatory activity, transfer and distribution of economic benefits to the population, tax burden of the activity, contribution to improving the living standards of communities, cumulative and synergistic impacts.

1.2. Some numbers of the sector - evolution

At the national level, in the 20 years from 1987 to 2007, the value of mineral production in Argentina more than tripled, going from 130 to 410 million U$S (Secretaría de Minería, 2008). This growth was followed by a change in the composition of the minerals extracted, becoming the metal minerals categories the leading one while other categories were reduced by a half (Table 1).

<table>
<thead>
<tr>
<th>TABLE 1: contribution to the production value by type of mining</th>
<th>1987</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal minerals</td>
<td>%</td>
<td>14.16</td>
</tr>
<tr>
<td>Non-metal minerals</td>
<td>%</td>
<td>23.4</td>
</tr>
<tr>
<td>Rocks</td>
<td>%</td>
<td>62.31</td>
</tr>
<tr>
<td>Semi-precious rocks</td>
<td>%</td>
<td>0.1</td>
</tr>
</tbody>
</table>

The declared production of metal minerals, consists of Gold, Copper, Lithium, Silver, Zinc, Lead, Iron and Cadmium. Within this set of minerals, however, entries for 2007 in the total production are very different: only the gold and copper represent (aggregate) 90% of the value of the metal minerals production.

The following Table 2, shows the evolution of the projects proposed in recent years for exploration and data of investments, jobs and exports.
Investments in exploration, development and construction of mining projects in the country have generated a new record during 2011, with investments up to more than 11,000 million Argentinean pesos (2,500 million US$), representing a cumulative growth of 5,700% in the last 10 years (Diario Los Andes, 2011).

1.3. Regulatory framework

In order to attract venture capital and to modernize the sector to current international practices (compared to previous decades and the Mining Code, enacted in 1886), during the 1990s and driven by neoliberal policies enacted after the Washington Consesus, it became imperative to have a special regulatory framework that would allow the country to achieve a leading position in the international context. Consequently, in 1994 the National Constitution was amended and other laws followed setting up a legal framework attractive for global mining corporations. Nevertheless, during the 2000s decade and the pressure exerted by environmental movements due to socio-environmental conflicts resulted in sanctions of environmental laws, e.g. the disputed Act 26.639 which establishes a protection framework for glaciers and periglacial environments, affecting projects located in the Altos Andes ecoregion, like the Pascau-Lama one (Table 3).


<table>
<thead>
<tr>
<th>PROJECTS</th>
<th>NATIONAL MINING PRODUCTION</th>
<th>INVESTMENTS</th>
<th>DIRECT EMPLOYMENT</th>
<th>INDIRECT EMPLOYMENT</th>
<th>EXPORTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUMBER</td>
<td>Millions of US$</td>
<td>Millions of US$</td>
<td>Thousands</td>
<td>Thousands</td>
<td>Millions of US$</td>
</tr>
<tr>
<td>2001</td>
<td>40</td>
<td>1116</td>
<td>21.4</td>
<td>no data</td>
<td>861</td>
</tr>
<tr>
<td>2002</td>
<td>110</td>
<td>1089</td>
<td>19</td>
<td>no data</td>
<td>990</td>
</tr>
<tr>
<td>2003</td>
<td>200</td>
<td>1360</td>
<td>24</td>
<td>24</td>
<td>1062</td>
</tr>
<tr>
<td>2004</td>
<td>275</td>
<td>1523</td>
<td>27.8</td>
<td>97</td>
<td>1410</td>
</tr>
<tr>
<td>2005</td>
<td>336</td>
<td>1887</td>
<td>27.8</td>
<td>106.7</td>
<td>1550</td>
</tr>
<tr>
<td>2006</td>
<td>403</td>
<td>3150</td>
<td>30.7</td>
<td>116.8</td>
<td>2781</td>
</tr>
<tr>
<td>2007</td>
<td>364</td>
<td>3435</td>
<td>37</td>
<td>160</td>
<td>3750</td>
</tr>
<tr>
<td>2008</td>
<td>403</td>
<td>3750</td>
<td>42</td>
<td>168</td>
<td>4057</td>
</tr>
</tbody>
</table>

**Source:** CAEM - Mining Press Nº25 Dic07/Gen08 - Editorial RN - Secretaría Minería de la Nación

### TABLE 3. Main standards concerning mining in Argentina.

<table>
<thead>
<tr>
<th>STANDARDS</th>
<th>SOME CHARACTERISTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiscal stability</td>
<td>30/06/2011</td>
</tr>
<tr>
<td>Financial Taxation</td>
<td>20/06/2011</td>
</tr>
<tr>
<td>Capital expenditures</td>
<td>20/06/2011</td>
</tr>
<tr>
<td>Immobilization, maceration, vehicle</td>
<td>20/06/2011</td>
</tr>
<tr>
<td>Import duties</td>
<td>20/06/2011</td>
</tr>
</tbody>
</table>

### TABLE 4: Main characteristics of the Mining Investment Regime (24,196 National Law).

<table>
<thead>
<tr>
<th>STANDARDS</th>
<th>CHARACTERISTICS</th>
<th>APF.</th>
<th>CHARACTERISTICS</th>
<th>OBSERVATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiscal stability</td>
<td>National, provincial y municipal</td>
<td>5/10</td>
<td>Stability</td>
<td>Tax of profits and shares</td>
</tr>
<tr>
<td>Financial Taxation</td>
<td>5/10</td>
<td>Deduction</td>
<td>Tax of profits and shares</td>
<td></td>
</tr>
<tr>
<td>Capital expenditures</td>
<td>10/10</td>
<td>Deduction</td>
<td>Tax of profits and shares</td>
<td></td>
</tr>
<tr>
<td>Immobilization, maceration, vehicle</td>
<td>10/10</td>
<td>Deduction</td>
<td>Tax of profits and shares</td>
<td></td>
</tr>
<tr>
<td>Import duties</td>
<td>10/10</td>
<td>Deduction</td>
<td>Tax of profits and shares</td>
<td></td>
</tr>
</tbody>
</table>

**Source:** CAEM - Mining Press Nº25 Dic07/Gen08 - Editorial RN - Secretaría Minería de la Nación
2. MATERIAL AND METHODS

The study is based on 19 mining projects in different phases, all of them as defined by the run of mine extraction volume. The study area involves the main mining provinces of Argentina and also extends to the Republic of Chile, because most of the studied projects falls under the area covered by Treaty of Mining Integration between the two countries.

For the selection of projects following aspects were considered, in order to be representative of the current status and cover most of the territory:
- Project stage: the projects should be at least in the exploration phase.
- Administrative Jurisdictions Location: it was designed to cover as much as possible.
- Location of Eco-regions: with a preponderance of those located in areas near heads of watersheds.
- Extraction method: preponderance was given to the open pit extraction method.
- Start date of operations: special care was taken to include projects operating for some years since only in this way they can become reference points for some indicators.
- Principal mineral: must include a carrier metal, especially gold, silver and/or copper.

Based on these criteria we selected the 19 projects that are presented in Table 5. While the number of projects is still limited (there would be more than 400 throughout the country in various stages of development) are representative of the current situation and future trends. The map aside the table shows the location of the selected projects. In blue dotted line, the limits of the Treaty of Mining Integration between Argentina and Chile can be observed. (Anglogold Ashanti. 2008, Knight Piésold. 2006, Rescan. 2007 Minera Alumbrera. 2011, Secretaría de Minería. 2008).

<table>
<thead>
<tr>
<th>Nº</th>
<th>PROVINCE (mining location)</th>
<th>DEPARTMENT</th>
<th>MINING LOCATION</th>
<th>MINE NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>JUJUY</td>
<td>Picoesante</td>
<td>346 Km NO S.S. de Jujuy - 4200 masl</td>
<td>Picoesante</td>
</tr>
<tr>
<td>2</td>
<td>CATAMARCA</td>
<td>Andacollo</td>
<td>60 km NO Andacollo y 88 km S.Jujuy</td>
<td>Aquinas</td>
</tr>
<tr>
<td>3</td>
<td>JUJUY</td>
<td>Iglesia</td>
<td>310 Km NO Ing. Jacobacci y de proyecto Campo del Arenal</td>
<td>Iglesia</td>
</tr>
<tr>
<td>4</td>
<td>SAN JUAN</td>
<td>Iglesia</td>
<td>60 km NO of the north of the city of Mendoza in the Uspallata Valley</td>
<td>Iglesia</td>
</tr>
<tr>
<td>5</td>
<td>JUJUY</td>
<td>Iglesia</td>
<td>60 km NO of the capital city of Mendoza in the Uspallata Valley</td>
<td>Iglesia</td>
</tr>
<tr>
<td>6</td>
<td>CATAMARCA</td>
<td>Iglesia</td>
<td>60 km NO of the north of the city of Mendoza in the Uspallata Valley</td>
<td>Iglesia</td>
</tr>
<tr>
<td>7</td>
<td>SANTA CRUZ</td>
<td>Iglesia</td>
<td>60 km NO of the north of the city of Mendoza in the Uspallata Valley</td>
<td>Iglesia</td>
</tr>
<tr>
<td>8</td>
<td>NEUQUÉN</td>
<td>Iglesia</td>
<td>60 km NO of the north of the city of Mendoza in the Uspallata Valley</td>
<td>Iglesia</td>
</tr>
<tr>
<td>9</td>
<td>RIO NEGRO</td>
<td>Iglesia</td>
<td>60 km NO of the north of the city of Mendoza in the Uspallata Valley</td>
<td>Iglesia</td>
</tr>
<tr>
<td>10</td>
<td>CHUBUT</td>
<td>Iglesia</td>
<td>60 km NO of the north of the city of Mendoza in the Uspallata Valley</td>
<td>Iglesia</td>
</tr>
<tr>
<td>11</td>
<td>SANTA CRUZ</td>
<td>Iglesia</td>
<td>60 km NO of the north of the city of Mendoza in the Uspallata Valley</td>
<td>Iglesia</td>
</tr>
</tbody>
</table>

3. RESULTS AND DISCUSSION

3.1. Impacts on water resources

The rational management of water resources appears as a key issue because these are key inputs in the production process (like capital, energy, know-how, machinery) for processing of mineral ores. Also, in many arid and semi-arid regions, the value of scarce water resources is maximized and the competition for the use with other traditional economic activities such as agriculture appears as a growing issue.

Table 6 shows the values of extraction of fresh water and permit issue by the Provincial Secretariat of Water and Environment, from the Campo del Arenal aquifer, according to the Sustainability Reports of Alumbrera Mining and others. The numerical differences presented and the lack of technical precision in the critical arguments, are notables. It is also notable, moreover, the lack of reliable technical studies, which allow for verification and audit of baseline and impact assessment carried out by the mining company.
The most emblematic case is currently the Agua Rica project, which would place its water extraction wells in the same aquifer (Campo del Arenal) and in the same area where Minera Alumbrera operate at 25 km upstream. (Rescan, 2007).

According to the Environmental Impact Statement (EIS), the project (Agua Rica) will require a constant volume of extraction of 250 l/sec.(Rescan, 2007) and the model performed the extraction of groundwater for the process will result in a decrease in water level of about 6.73 m in the center of Campo del Arenal, near the well field of Mining Alumbrera, and 0.1 m at the boundary along the Rio Santa Maria.

In the Campo del Arenal, always according to the EIS, there are few rural settlements, and in general, wells extracting groundwater that are known and used for domestic and agricultural uses are located in areas with easy access to water including wetlands along National Route 40. Thus, the predicted decline in the groundwater layer in this area due to groundwater extraction for use in the project will vary from 0.1 to 1.0 meters, which was evaluated as moderate impact of well according to the type and depth of drilling (Rescan 2007, Vol II).

However, it is remarkable to note that in the report referred not assess synergistic impacts that this new water withdrawals would cause the aquifer. As the baseline value was used to coat a surface of groundwater historical (1997) and therefore the impacts occurred due to groundwater extraction by Alumbrera were not considered (Rescan 2007, Vol II, 23 - 76).

This is consistent with the current legal framework that requires only the approval of an Environmental Impact Report without a Strategic Environmental planning.

Meanwhile, regarding the Mining Integration Treaty with Chile (Act 25.243) should be revised in order to tend to real sustainability of the protected area. In this sense some of their articles do not seem to agree with that purpose, for example, article n° 3; ‘...also allow for this purpose (“mining business”) the use of all natural resources...” and article n. 6 of the Supplementary Protocol: “… understanding in this concept existing water resources in their territories…”

### 3.2. Energy consumption

The energy consumption of mega mining projects, restricted exclusively to the project area, are always of great magnitude and inputs for their production can be summarized in two types: diesel fuel for heavy and light vehicles and electricity for essentially the activity of plant machinery.

The Agua Rica project (see Table 5) is planning to consume 70 million liters of diesel per year and requires an installed capacity of 126 MW. The annual consumption of 1,004 GWh would be, equivalent to 15% of that generated by Salto Grande (hydropower central) (6.900 GWh annual energy). This consumption, in operation phase, would correspond to 1% electricity generation from all over the country. Considering the direct jobs (976) and indirect (2640) that the company will create at that stage, they correspond to a 0.023% of the Economically Active Population (EAP). (Giraud, M. 2009)

With regards to the Pascua-Lama project (see Table 5) it would consume 102 million liters of diesel oil per year in the construction phase and 35.4 million liters / year in the operation phase. As for electricity, the average annual consumption during the 21 years of the project, would be about 928.56 GWh. (Knight Piésold, 2006).

The Veladero project (see Table 5) has 22 diesel generators of 2,250 HP each with a capacity of 23 MW, and recently launched the first wind generator in the province at 4,100 meters above sea level installed with a power of 2 MW. Currently, is under construction a wind farm with 18 wind turbines (36 MW) to supply both projects, Pascua-Lama and Veladero.

From the data in Section 1.2, it can be demonstrated that the energy demand of the present and future projects of great magnitude has implications for the national social-productive sector, in addition, to the strictly environmental for the use for generating energy almost exclusively on non-renewable fossil fuels.

### TABLE 6. Alumbrera and Agua Rica Mines. Water consumption and extraction permits.

<table>
<thead>
<tr>
<th>Permit issue by the province</th>
<th>Extraction of fresh water</th>
<th>sec.</th>
<th>day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minera Alumbrera (2010; 2011)</td>
<td>0.73</td>
<td>61.758</td>
<td></td>
</tr>
<tr>
<td>Montenegro R.</td>
<td>1.10</td>
<td>93.060</td>
<td></td>
</tr>
<tr>
<td>Minera Alumbrera (2010; 2011)</td>
<td>0.81</td>
<td>68.526</td>
<td></td>
</tr>
<tr>
<td>Machado Aráoz (2009)</td>
<td>1.20</td>
<td>101.520</td>
<td></td>
</tr>
<tr>
<td>Extraction of fresh water</td>
<td>Agua Rica (2007)</td>
<td>0.25</td>
<td>21.150</td>
</tr>
<tr>
<td>Alumbrera and Agua Rica Mines. Water consumption and extraction permits</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.3. Communities transfer – Social indicators

The following Table 7 shows the tendency of some social indicators and it shows the trend in terms of the investment plan of state resources in the province of Jujuy, Catamarca and Santa Cruz, those with older projects, in recent years. It will be very important to follow-up future trends in investment in this sector.

**TABLE 7: Social indicators (Self elaboration based on data of National Institute of Statistics and Census. National Census 2001)**

<table>
<thead>
<tr>
<th>PROVINCE</th>
<th>CITY / DEPARTMENT</th>
<th>EDUCATION</th>
<th>EMPLOYMENT</th>
<th>HEALTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>with UBN (NBI)</td>
<td>No toilet or total without running</td>
</tr>
<tr>
<td></td>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>NAION</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JIJUY</td>
<td></td>
<td>10.076.014</td>
<td>14.3</td>
<td>16.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CATAMARCA</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
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</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SANTA CRUZ</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.4. Royalties

Table 8 shows some numbers, possible only with the benefits provided by the current tax system (see 1.4).

(*) **TABLE 8**: Investments, exports and royalties paid by La Alumbrera

<table>
<thead>
<tr>
<th>LA ALUMBRERA</th>
<th>CONCEPT</th>
<th>YEAR</th>
<th>MILLIONS US$</th>
</tr>
</thead>
<tbody>
<tr>
<td>INVESTMENTS</td>
<td></td>
<td>2002</td>
<td>647</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2003</td>
<td>647</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2004</td>
<td>647</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2005</td>
<td>897</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2006</td>
<td>n/d</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2007</td>
<td>1558</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2008</td>
<td>1249</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2009</td>
<td>1203</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2010</td>
<td>1506</td>
</tr>
<tr>
<td>EXPORTS</td>
<td></td>
<td>2002</td>
<td>n/d</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2003</td>
<td>n/d</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2004</td>
<td>n/d</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2005</td>
<td>n/d</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2006</td>
<td>n/d</td>
</tr>
<tr>
<td>ROYALTIES (average)</td>
<td>Since 2006</td>
<td>32.6 per year</td>
<td></td>
</tr>
</tbody>
</table>

3.5. Administrative procedure

The administrative procedure usually required by the provinces is the performance of a process of Environmental Impact Assessment, which requires the presentation of an Environmental Impact Report, which after being reviewed and improved by designated technical authorities, possibly with some instance of non-binding citizen participation, culminates in the formulation of an Environmental Impact Statement (EIS) by the authority, leading to the actions requested by the mining consortium in question.

Interestingly, often conflict of interests appear through these instances as the Provincial Environmental Management Units (UGA) depend administratively from the Provincial Mining Secretariat, a fact that does not help to promote transparency and build trust on government regulations and control of approvals.

The National State has issued minimum requirements mandated by the Constitution, through Law No. 24.585, as Title Complementary Mining Code of the Nation. Nevertheless, provincial authorities make the final decisions.

3.6. Conflicts

As an example, it can be mentioned the removal of the Governor (ex – Secretary National Mining when Act 24,196 was passed) relative to the Famatina gold mining project, when the provincial legislature passed the law banning open pit mining and the use of cyanide (03/08/07). Barrick Gold dropped out exploration work on the Cerro Famatina. Some days ago, the company Osisko, new manager of the prospecting, also retired until they obtained the social license. (Mining Watch Canadá. 2012).

There are now around the country, a movement of Citizen Assemblies that are in constant mobilization and alert, with special emphasis in the La Rioja and Catamarca provinces. (Montenegro, R. 2009). Unfortunately, in Argentina referendums for the pursuit of social license are not institutionalized as public consultation tools. One of the few institutionalized stages of citizen participation is non-binding public audience happening before the release of the Environmental Impact Statement. The stages of previous consultations during the SEA process would be very useful to achieve the consensus.
4. CONCLUSIONS

Argentina is a country with huge historical imbalances in regional terms, lack of technology transfer and real regional development plans, what makes it paramount to promote real development programs of these regional economies through specific policies in order to reassemble production in each region.

It is necessary to revise the country’s mining policy through a comprehensive strategic environmental assessment (SEA), in order to assess the sustainability of the activity, analyzing operational alternatives, cumulative impacts, public participation, technology transfer, regional development, etc.

The SEA process should provide clear messages for decision makers, based in issues related to achieve the sustainability. The environmental impact that society demands toward an equitable progress, present and future, must be determined by the use of systematic, clear and judicious tools. In this sense, SEA is presented as a need, as it is absolutely imperative to generate studies that analyze the sustainability aspects from a global dimension in space and time.

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