Economic Impact Study of a New Park for Heavy Industry in Paraguay

Prepared for Rio Tinto Alcan

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Their participation was important to base the study on realistic set of assumptions, in order to estimate the impact of what would be a new park for heavy industry in Paraguay. E&B DATA thanks them for their precious collaboration.

Note

The investment scenario presented in this report is only for indicative purposes. There can be no guarantee that such a scenario will materialize and a new park for heavy industry in Paraguay could develop very differently. The study also assumes that the Government of Paraguay and its agencies concentrate significant efforts to enhance local content and in international business promotion and attraction, and is ready to work with potential investors, to remain competitive when potential investors consider alternative sites in other countries. The monetary estimates in this document are presented in constant Guaranies and US dollars (2010) with an exchange rate of 4,740 Gs/US$. Totals and currency conversions may be approximate because of number rounding.

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Executive Summary

Rio Tinto Alcan (RTA) is considering an investment in a primary aluminium smelter in Paraguay. The RTA project can be an opportunity for Paraguay to develop a heavy industry park with the RTA smelter as an anchor tenant :

- Other capital-intensive international investors will want to benefit from the infrastructure that is necessary to be set in place (e.g. power lines, port facilities, utilities) by locating new industrial facilities within the new heavy industry park;

- Local and foreign suppliers will want to locate either within the park or in the proximity to benefit from these new business opportunities. In fact, some have already expressed an interest in locating nearby the projected smelter.

This development could be a first step into the diversification and growth of Paraguay's industrial sector. Indeed, while there are other industrial parks in Paraguay, they are focused on light industry. The current state of infrastructure in Paraguay prevents the attraction of heavy industrial investors for whom the physical availabilty of such infrastructure is a key location factor. The country's attractiveness for heavier industry seems therefore to have been largely unnoticed. Its landlocked geographical situation combined with weaknesses in physical infrastructure (transportation and power distribution) have likely been compelling deterrents for major capital-intensive investments.

The present document estimates the economic and tax impacts related to the construction and operations of a heavy industry park as well as anticipated impacts on industrial and regional development. The impact estimates cover three scenarios : 1) a stand-alone aluminium smelter with an annual production of 485K metric ton, 2) a stand-alone 674K metric ton aluminium smelter, and 3) a heavy industry park including a 674K metric ton aluminium smelter and other major industrial tenants.

- **Projects**. Twenty-five large-scale industrial projects have been identified as presenting valid investment opportunities, assuming 1) an on-site sub-station with up to 250 MW of power (beyond the needs of the RTA smelter) at competitive prices, 2) direct access to barge transportation facilities as well as proximity to highways linking Paraguay to Brazil and Argentina. While some projects are linked in terms of physical flows of products, overall they present a diversified mix, ranging from traditional consumer goods (e.g. agri-food, automotive parts) to energy products (e.g. turbines, solar panels, electricity transport components) and intermediate industrial products (e.g. steel, concrete products). These products show positive growth outlook. Further, they present diversified business cycles, suggesting that temporary downturns will not affect all operators in the new heavy industry park, at the same moment.

- **Jobs and regional development**. In the ultimate scenario (a 674K metric ton aluminium smelter associated with an industrial park), a range of up to 50-75,000 permanent jobs would be established in Paraguay. While the southeastern part of Paraguay appears to be a viable place for the investment, the specific region where the industrial park could be developed has not yet been selected. It is therefore too early to estimate the regional socio-economic impact with any precision. However, based on the extent of the national (country-level) impact on jobs and given the demographic distribution of labour markets within southeastern Paraguay, it is conceivable that between 12,000 and 15,000 permanent jobs would be created and supported within 50 km of the industrial park and close to 7,000 in the industrial park itself. This employment impact does not include the construction jobs related to the development of the park. Based on E&B DATA's observations in industrially mature regions, a base of more than 300 supplier businesses could be developed over the medium to long term, in the vicinity of the industrial park.

- **Capital investments.** The ultimate scenario modelled herein involves an investment of more than US$6 billion in the smelter and other heavy industries. The impact of subsequent capital investments has not been calculated (they typically reach an annual 5% of initial capital costs). The development of a telecommunication system, roads, water ducts and treatment systems are likely to occur in parallel or even accelerate with the development of the RTA project. While some of these projects are possibly already on the design phase, the decision by RTA to invest would likely have an influence on the deployment of these projects, on their schedule and on their scope. The impact of such public infrastructure projects has not been taken into account in the current study.

- **GDP**. The annual contribution to GDP for the ultimate scenario (674K metric ton smelter combined with a heavy industry park) could reach approximately US$1.5 billion to US$1.8 billion, that is three to four times the amount of the contribution for the original scenario. This increase corresponds to a nine GDP percentage point increase (from ~3.0% to ~12.0%) over the current GDP level[1]. For the ultimate scenario, net contribution to Paraguay's GDP would range between US$100/MWh and US$150/MWh, excluding the direct impact of the purchase of electricity.

- **Local spend.** In the ultimate scenario, local expenditures in Paraguay required for carrying out operations could reach between US$700 and US$800 million yearly, excluding the purchase of electricity by RTA and other heavy industry park operators.

[1] US$ 15 billion (2009) – Source: World Bank

- **Government revenues**. For a typical year (steady state operation) and excluding income from the sale of electricity, government revenues in the ultimate scenario modelled herein could reach between US$250 and US$300 million each year, representing approximatively 15% of current annual government revenues[2]. Some initial cost outlays would be required but could be minimized by modular design of the key infrastructure (e.g. water supply) and by adjusting capacities as new investors come.

- **Time horizon.** These capital-intensive industries typically have a long life-span (30 to 50 years) and little to no mobility over the short to medium term. Indeed, the scale of the capital investment involved requires a longer depreciation period than with light industries. Relocating production capacities is an option that investors in such industries try to avoid. In fact, if the investment conditions remain stable, such investments are followed by later reinvestments and modernizations which lead to extended stay (often more than 50 years) and ensuing economic contribution. This is observed in several heavy industry parks worldwide.

The feasibility of the new heavy industry park in Paraguay is to a large degree attributable to the scale of the investment for a world class aluminium smelter, which exceeds considerably that of most other industrial facilities. Indeed, the physical infrastructure required by an aluminium smelter – in particular for energy - can, within some conditions, be shared or extended to other nearby industrial operators which could not by themselves front the cost that such an environment involves.

Further, the several-year period required for the preparation and construction of an aluminium smelter would involve in-depth coordination with public administration, whether for manpower training program design and deployment, environmental evaluations and guidelines, energy distribution infrastructure, or physical site lay-out studies. Such programs, once deployed, require marginal additional efforts by public administrations to accommodate the needs of new industrial investors. The enhanced accessibility of a fully-serviced heavy industrial site is a significant location factor. It is in this manner that the aluminium smelter investment acts as a major catalyst for the successful development of an industrial park.

As can be seen in Figure 1, the new investment scenario considered in this document and which involves a 674K metric ton aluminium smelter and a heavy industry park, generates impacts which are three to six times larger for employment, government finances and exports than for the original investment considered (a stand-alone 485K metric ton aluminium smelter).

[2] Tax revenues estimated at 12% of GDP (2008). Source: World Bank.

Figure 1 Key Impacts

	Electricity consumption (TWh)	Annual Permanent Jobs *(Man-years)*	Annual Contribution of Operations to GDP [1]			Exports of Goods [2]		Annual Tax Revenues [3] - Operation [4] US$ million
			US$ billion	% GDP	GDP/MWh (US$)	US$ billion	% Total Exports of Goods	
RTA I (485K m.t.)	7.0	10 000 - 15 000	0.4 - 0.5	2.5% - 3.0%	50 - 60	0.9 - 1.0	~30%	40 - 50
RTA II (674K m.t.)	9.6	12 500 - 17 500	0.6 - 0.7	3.5% - 4.0%	50 - 60	1.3 - 1.5	~40%	50 - 60
RTA II + Heavy Industry Park	11.4	50 000 - 75 000	1.5 - 1.8	10.5% - 12.0%	100 - 150	2.5 - 3.0	80% - 90%	250 - 300

Notes :
(1) Paraguay GDP: US$15 billion (2009) – Source: World Bank.
(2) Paraguay's exports of goods: US$3.2 billion (2009). Source: Banco Central del Paraguay.
(3) Excluding revenues from the sale of electricity.
(4) Steady state.

In addition to these macro-economic impacts, the new industrial park could have additional economic effects, in particular for new cluster development. Indeed, the possibility of industrial linkages within the park, facilitated by adequate facilities, energy and transportation infrastructure, tax advantages and the availability of serviced areas can speed up the development and integration of industrial clusters. Such clusters which could form due to the industrial park are energy products, building materials, agri-business, transportation material as well as an aluminium cluster. Indeed, it is possible that the aluminium smelter presence could attract the presence of specific suppliers and customers.

RTA's initial investment in a given site may be a catalyst for other heavy industrial operators to follow suit, assuming an adequate design of the site with public agencies. In fact, the infrastructure to be put in place for the industrial park and shared between tenants is substantially less than what would be required for the same number of individual companies scattered over a comparatively larger area. An industrial park having a smelter as the main tenant can therefore be the first step in a structured development of heavy industries in Paraguay and the further diversification of its economic base.

1. Introduction

1.1 Context and Study Objectives

RTA has previously studied the economic impact of an investment of US$2.5 billion for an aluminium smelter in Paraguay, with a 485K metric ton annual production capacity. This study was announced in December 2009. In 2010, as a result of technological research and development, RTA made available a new technology for aluminium smelting. In discussion between RTA and the Government of Paraguay, the possibility of a larger smelter using this new technology was considered (US$3.5 billion smelter in Paraguay, with a 674K metric ton annual production capacity). The aluminium smelter envisaged would use the AP60 technology, with a life span which would be expected to be competitive for 50 years and beyond. Current thinking anticipates a 30-month construction period which would start in 2014 with first metal production in 2016. The preferred location for a smelter within Paraguay has yet to be selected and would be determined along with the Government of Paraguay.

Beyond the new economic activity that would be generated in Paraguay among local suppliers by a new aluminium smelter, its presence could trigger other large investment projects in productive industries. As the Government of Paraguay has expressed interest in knowing the impact that such new investments could bring, RTA has commissioned E&B DATA 1) to develop a theoretical investment scenario related to the larger smelter and a new park for heavy industry, and 2) to estimate their overall economic impact in Paraguay.

This document presents the results of this study :

- This first section describes the study context and overall approach.
- The second section presents the concept of a heavy industry park and how it could take shape within the Paraguayan environment. It presents the mix of industries which could establish within a medium term time horizon (15 years).
- The third section presents the assumptions related to key quantitative factors such as capital investments, energy, employment and taxes.
- The fourth section presents the national macro-economic impacts of a heavy industry park.
- The fifth section presents the structuring impacts of the new heavy industry park in terms of industrial (cluster) development and regional development.

A concluding section highlights the main conditions for such an opportunity to develop successfully in Paraguay.

1.2 Approach and Scope of Study

In addition to the classical input-output approach focusing on upstream flows resulting from the incremental impact of the new project, a preliminary analysis of downstream (structuring) impacts on the Paraguayan economy and on the local economy has also been made.

1.2.1 Investment Scenario Development

A preliminary list of potential investments was developed by E&B DATA, based on a series of factors including industrial linkages with primary aluminum, international investment patterns and preliminary assessment of investment opportunities based on local resources availability, and/or access to markets. To ensure such investments were compatible with Paraguay's investment climate, basic location factors were discussed with the relevant agencies, whether it concerned energy (ANDE), workforce (e.g. Sinafocal, Servicio Nacional de Promoción Profesional - SNPP), transportation (e.g. Ministerio de Obras Públicas y Comunicaciones) and raw materials (e.g. Rediex). This initial mix of potential investments was thus discussed with Government agencies, following which some investment possibilities were discarded as being unrealistic and others were added so as to, ultimately, determine the industry mix (see Appendix A) used in this study.

1.2.2 Input-Output Analysis

The economic impact estimates are based on input-output modeling techniques[3]. The input-output model calculates how expenditures for both construction and operations related to the smelter and the industrial park trickle down among the network of local suppliers (suppliers as well as "suppliers of suppliers"). Through a mapping (matrix) of current intersectoral relations in the country, it calculates how much value is added to the GDP. It also calculates the employment and tax impacts.

The modelling process is based on existing statistical tables available at the Banco Central del Paraguay, which are used for national accounts calculations. A key element in the process is the preparation of an input-output table, which represents the breakdown of all interactions within the different sectors of the economy. Sets of relative values ("technical coefficients" or multipliers) are then derived for the variables to be studied: employment, government revenues and contribution to GDP. The model thus allows

[3] E&B DATA uses the methodological framework and statistical standards set by the System of National Accounts (joint effort of the UN, EU, IMF, OECD and World Bank).

simulations of the changes which are provoked in a national economy by an external cause, such as a major investment project or by a new industry.

See Appendix B for additional methodological notes.

1.2.3 Regional and Industrial Analysis

While input-output analysis is useful for country-wide economic impact analysis, it is useful to complement it with additional analyses pertaining to the structuring effects of a major investment, on the regional economy and on industrial structure.

1.2.4 Sources

Information was gathered from various sources during work sessions and exchanges in the 2009-2010 period:

- Government of Paraguay, in particular for input-output tables (Central Bank), wage estimates (Rediex), and tax assumptions (Ministry of Finance);
- Rio Tinto Alcan, in particular for the preliminary cost structures and origin of goods for the RTA project;
- E&B DATA's internal databases on heavy industries[4] and knowledge of international business investment patterns.

1.2.5 Work Steps

Key work steps were as follow:

- Obtaining information on Paraguay's national accounts, (in particular the Supply and Use tables) and assessing their structure for a possible use of input-output analysis.
- Building an input-output table, the intermediate tool used to model a shock on the Paraguayan economy which can be attributed to a capital investment (e.g. smelter construction and industrial park) or to an on-going industrial activity.

[4] E&B DATA's Heavy Industries Database includes cost structure (e.g. energy use), and investment patterns (e.g. capital investment value, direct employment, locational preferences) for over 50 heavy industries. For the aluminium industry in particular, E&B DATA possesses databases on over 4,000 suppliers to the aluminium industry.

- Making tax assumptions in order to estimate of government taxes which could be generated during both construction and operations. Either existing tax rates were used, or when the case presented too many undetermined issues (e.g. dividend transfers), aggregate levels were determined and agreed upon with government representatives.

Additional steps were conducted in the current study to capture the impact of the new scenarios:

- Outlining the new heavy industry park concept and tenant mix;

- Developing investment and operating assumptions for the new heavy industry park;

- Conducting a set of simulations covering economic and tax impacts for the construction and operations for three scenarios: 1) a stand-alone 485K metric ton new aluminium smelter, 2) a stand-alone 674K metric ton aluminium smelter, and 3) a heavy industry park including a 674K metric ton aluminium smelter and other major industrial tenants.

2. Heavy Industry Park Concept

The planning and development of an industrial park requires a vision and a substantial coordinated effort to be supported through the various branches of government (e.g. infrastructure, transportation, power, environment, human resources, education, health). In fact, a heavy industry park requires a considerable initial investment before any revenues can be derived. The development of these parks can be catalyzed by large private investors whose physical requirements have structuring effects in the sense that their presence can act as an incentive or anchor[5] to other investors.

This section presents the various aspects of a heavy industry park, selected examples worldwide and what would be a possible scenario for such a park in Paraguay.

2.1 Definition

Heavy industries can be defined as manufacturing industries characterized by large capital investments, in plants, machinery and related infrastructure (e.g. transport, energy). Examples are the oil industry, chemicals, pulp & paper, primary metals, industrial machinery and mass transit transportation equipment (e.g. rail equipment, trains, shipbuilding).

Because of the heavy infrastructure requirements which can to some degree be shared with other large investors (e.g. access to port facilities) and because of their preference to try to locate away from residential areas in order to minimize potential inconveniences, heavy industrial users tend to concentrate in specific areas.

2.1.1 Physical Requirements

Physical requirements for an industrial park destined for heavy industries are different from other industrial concentrations because such an industrial park requires a set of infrastructure and services without which large capital-intensive industrial companies cannot operate. These physical requirements include:

- Large serviced surface areas. Such areas can easily encompass 2,000 hectares and sometimes much larger (more than triple this surface). Well-designed

[5] The “anchor tenant” metaphor originates from the retail trade. It is usually the largest tenant in a shopping center, with its presence attracting both customer traffic and smaller tenants. Its presence helps securing financing for the shopping center.

industrial parks include space for future expansion as well as buffer areas ("green belt") between the industrial park and other areas (e.g. residential).

- Soil conditions. To accommodate heavy industries and loads, a large load carrying capacity is required (e.g. in excess of 200 tons per square meter).

- Electric power (i.e. lines, sub-stations and transformers). These include high-tension and low tension lines, transformers and other equipment (e.g. anti-flicker equipment).

- Ground and/or water transportation. These include port facilities (i.e. berths, loading/unloading equipment) as well as rail sidings.

- Liquid and dry bulk storage. These are meant for a variety of products ranging from outputs of the operators (e.g. metal ingots, containers) to inputs (e.g. agricultural goods, industrial gases, oil products).

- Water supply. Industrial water supply is generally required for a variety of reasons (e.g. cooling) and requires large pumping facilities. Additional filtering may if required be done at each investors' premises, depending on their requirements.

- Waste treatment. In modern industrial sites, waste treatment is done at the operators' premises, to be released once it conforms to the regulated quality standards.

In addition, industrial synergies may be a requisite for some operators, such as so-called "over-the-fence" type of feedstocks (e.g. hot metal) and utilities (e.g. steam, industrial gases). Also, for several common requirements (e.g. waste treatment), neighboring industrial companies can effectively work together to reduce costs.

Of course, these investors require access to a trainable labour pool, access to urban area(s) and international connections (physical and telecommunications). Access to the services of local suppliers is a requirement and proximity to these services will be an important factor for locating the industrial park.

2.1.2 Synergies and Clusters

A natural cluster to be developed in and around the heavy industry park is related to aluminium. This would include several value-added downstream products as well as selected raw materials, even though the main raw materials would have to be imported.

In addition, other clusters for heavy industry products can be found in the construction and energy markets (e.g. pipe-line fittings, solar cells), automotive, pulp and paper industries and industrial applications (e.g. alloying agents, industrial refractories). This

variety of end-markets contribute to make such an industrial park more resistant to economic shocks. Further, the close presence of suppliers (e.g. equipment rental, port operator, liquid bulk storage, industrial gases, steam) serving several of these industries contribute to the effectiveness of the overall operation. In several ways, the park can become, if conditions are right, an "industrial ecosystem" maximising economic and environmental benefits resulting from proximity and well-designed common infrastructure and shared services.

2.1.3 Formalization

Some heavy industry parks are formalized within set institutional boundaries while others present similar physical concentrations but without a common and explicit organization. In the former case, public (or publically-regulated) administrations promote and service the park while in the latter case, ownership and organization may be scattered between several parties. In this study, the former case is retained because it allows:

- for a rigorous planning process (e.g. green belt to insure a transition zone between industrial activities and residents);
- for better branding and promotion of the investment opportunities at the international level.

In fact, some countries even design special laws to provide an investment framework which is beneficial to both investors and to the host country.[6]

2.2 Examples of Heavy Industry Parks

Examples of heavy industry parks can be found in many countries. From each country's perspective, these parks provide an opportunity to concentrate infrastructure development and upgrading in few locations - and obtain significant economic results - without waiting for the country as a whole to be serviced. From the investors' perspective, they offer the right mix of locational advantages.

Generally speaking, two fairly distinct sets of heavy industry parks can be observed: 1) those centered around oil refining and petrochemical industries, and 2) those centered on other capital-intensive investments, in particular those based on the metal and inorganic chemical clusters. The latter is of interest in this study (given the current lack of hydrocarbon production in Paraguay). The following provides a few examples of industrial parks in the Metal/Chemical clusters currently in operation (Canada, Australia, Finland, Bahrain, Oman) or in the design phase (Malaysia).

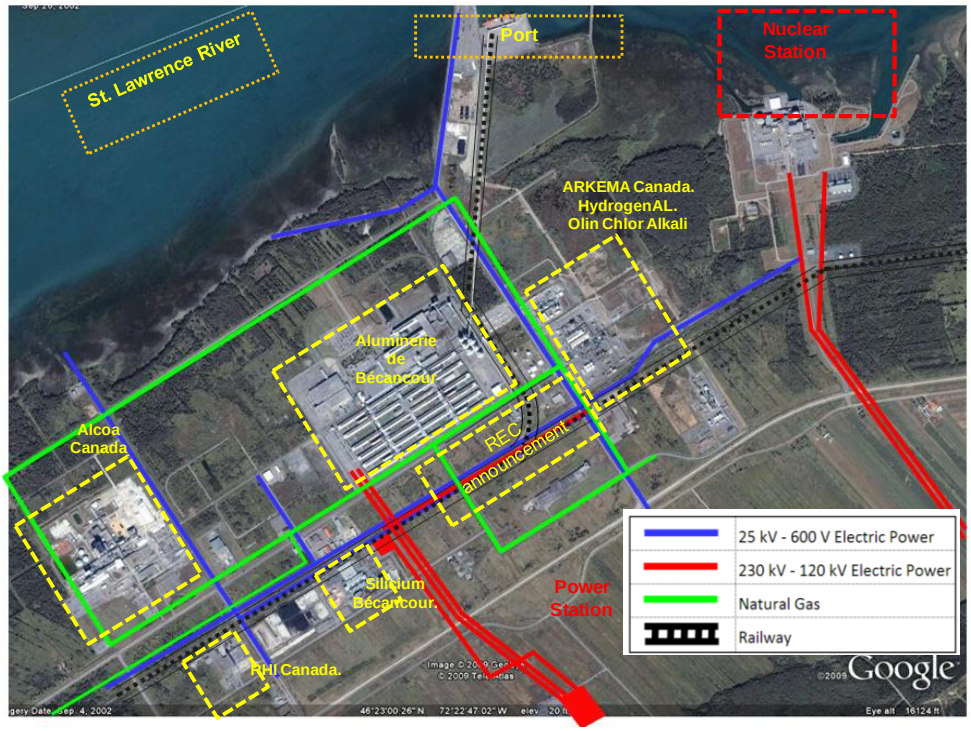
[6] Such laws can include information on the governance of the park, its capacity to buy and sell land, develop infrastructure and conduct international promotion.

2.2.1 Canada

The Becancour industrial park is located inland, along the St-Lawrence River in Canada, approximately 1,000 km from the Atlantic Ocean. It is also within a 30-minute drive from a city with a population of 150,000 (Trois-Rivières), offering higher education and business services. The park underwent massive developments after the initial investment in 1984 of a primary aluminium smelter[7]. These developments covered other electro-intensive industries, in diversified industries. The actual electro-intensive facilities now in place include :

- Metallurgy : primary aluminium, processed aluminium, steel, silicon metal ;
- Chemicals : chlorine, caustic soda, hydrogen peroxide, sulphuric acid ;
- Other : refractory products, high quality polysilicon (announced), vegetable oil (in construction).

Figure 2 Becancour Industrial Park



Other investments were also made in support of industries such as port operation, concrete manufacturing and cogeneration unit.

[7] Pechiney S.A., since then acquired by Alcan before its acquisition by Rio Tinto. RTA owns share in the Aluminerie de Becancour (ABI) smelter.

2.2.2 Australia

The Kemerton industrial park is located in Australia's South-West region, approximately 140 km from Perth. The town of Bunbury (17 km away) includes a port (12 million tons per year) and an overall population of 80,000. At present, the park comprises over 5,400 hectares of land (including 1,800 hectares of buffer) and is currently being expanded. Its mix of tenants includes plants operating in the silicon, titanium and chlor-alkali industry clusters. A 330kV line connects Kemerton with nearby power stations (1,040MW and 330MW).

Figure 3 Kemerton Industrial Park

2.2.3 Finland

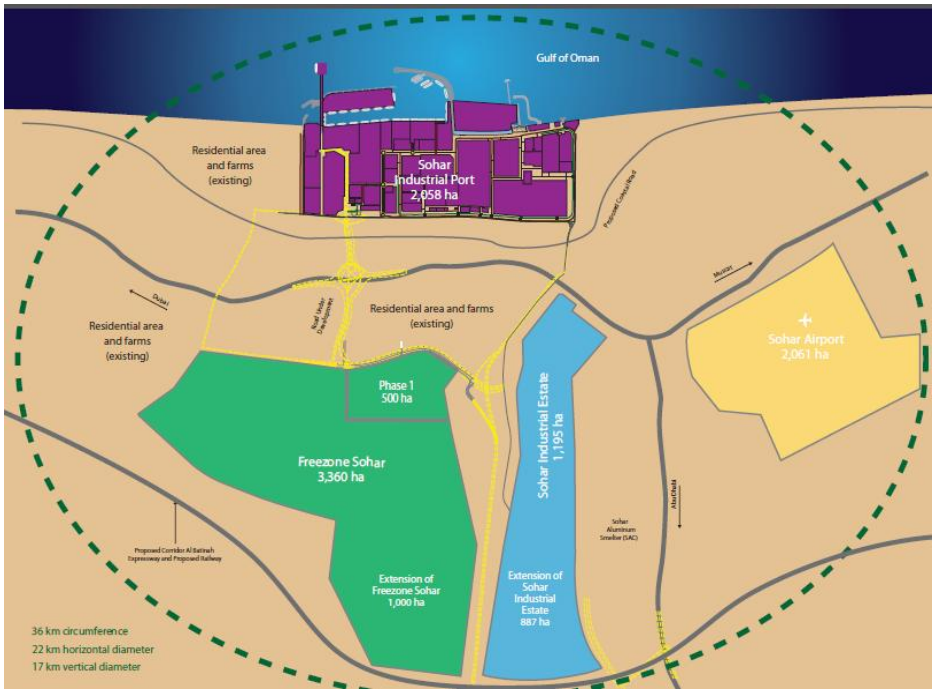
The Kokkola Industrial Park is located on the gulf of Bothnia and is focused on large chemicals and minerals production. The 300-hectare area houses around twenty large manufacturing companies. The infrastructure which was constructed during the second world war, includes a power plant, water supply plant and transport structures and has now been modernized to serve the Park's companies. Industries present include cobalt, zinc, sulfuric acid, calcium chloride, as well as fine chemicals.

Figure 4 Kokkola Industrial Park

2.2.4 Oman

Located in Oman and less than 200 km from Dubai, Sohar has become an important industrial area since initial investments were made in 1992. The Greater Sohar Industrial Zone includes the Industrial Estate, the Industrial Port Area, the Sohar Free Zone as well as other transportation infrastructure.

Figure 5 Greater Sohar Industrial Zone



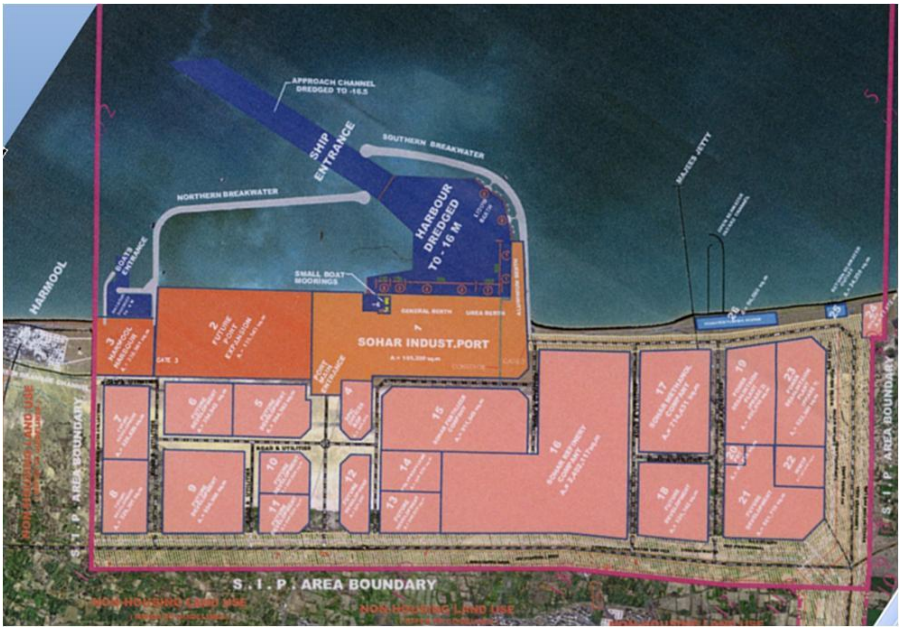
2.2.4.1 Sohar Industrial Estate

The Sohar Industrial Estate in Oman is located a few kilometres from the Sohar Industrial Port. This 2,000-hectare park was part of a plan to diversify the economy. It now comprises a primary aluminium smelter, an aluminium wire and cable plant, an aluminium direct casting plant, an aluminium rolling mill (under development) as well as other industries operating in steel, ceramic, glass, food products, fabrication shops and services and goods providers. The total number of jobs in Sohar Industrial Estate exceeds 6,000.

2.2.4.2 Sohar Industrial Port

In addition to deep sea-port facilities, utilities center for water and waste treatment, power lines distribution and custom facilities, the Sohar Industrial Port houses approximately thirty heavy industries including oil refining, steel mill, power plants and chemical and petrochemical industries.

Figure 6 Sohar Industrial Port Estate



2.2.5 Bahrain – Industrial Park

In the Bahrain industrial park, Aluminium Bahrain (ALBA) has constructed a smelter which currently produces 870,000 metric tons of aluminium per year. Fifty one percent of ALBA's production is transformed in the neighbouring industrial park, which manufactures rod, wires, overhead conductors, tubes, alloys wheels, sheets, foils, standard profiles, foundry alloys, aluminium powder, pellets for the paint industry, architectural systems and kitchen cabinets. Overall, 440,000 metric tons of value-added

aluminium products are thus manufactured locally every year. In addition, the 250-hectare park comprises other industries not related to aluminium such as glass fibers, plastics, food products, medical devices and electronics.

Figure 7 Bahrain International Investment Park alongside the ALBA Aluminium Smelter

2.2.6 Malaysia

As one of the largest states in Malaysia, Sarawak (located on the island of Borneo) is planning heavy energy-based industry development. Based on the regional, untapped energy resources (28,000 MW), particularly hydropower (20,000 MW), the Samalajau park is being designed for heavy industrial development (aluminium, steel, glass, oil and other) with 2020 as the target date for implementation.

Figure 8 Samalajau Industrial Park (design phase)

2.3 Potential Scenario for Paraguay

The following section presents a possible industry mix that appears to be viable for Paraguay, given its current investment climate.

2.3.1 Current Investment Climate

Paraguay offers the following location advantages for international industrial investors: 1) Competitive electric power rates, 2) Competitive and trainable workforce, 3) Access to MERCOSUR consumers and industrial markets[8], 4) Access to ocean routes though barge traffic on the Paraná, 5) Favourable tax regimes in place.

Some weaknesses have prevented significant investment to date but the RTA investment can trigger the development of key infrastructure, in particular power lines, roads, ports and utilities. Other weaknesses can be addressed over time such as the link to the South American railway grid and eventually access to natural gas. For the purpose of this study, the latter was assumed not to be expected within the timeframe of this study (15 years) which caused some investments to be excluded from the industry mix. As well, some other industrial developments were discarded because key raw materials are absent for the moment, either due to underdevelopment (e.g. forest products) or lack of information about the level of natural reserves within Paraguay (in particular for minerals).

2.3.2 Key Assumptions and Limits

Key physical assumptions for the presence and extent of heavy industrial operations in Paraguay are :

- Availability of up to 250 MW of power (in excess of RTA's requirements) at competitive rates;
- Direct access to river transportation;
- Land availability (500 hectares minimum).

It is to be borne in mind that the following industry mix is made for study purposes only and that a heavy industry park in Paraguay could develop very differently. It also assumes that the Government of Paraguay and its agencies concentrate significant efforts in international business promotion and attraction, and are ready to offer incentives, as the case may be, to remain competitive when potential investors consider alternative sites in other countries.

[8] The well-know growth prospects of the Brazilian market, combined with the increasing pressures on the Brazilian industrial sector (e.g. appreciation of the real, high cost of borrowing, high energy costs, heavy tax burden) are to the advantage of industries in bordering countries with more favorable cost factors.

2.3.3 Physical Outline

While it is not in the realm of this study to provide a physical description of the park, the following are very broad indications of the infrastructure which could be involved within the Park:

- Paved roads: 30 km;
- Fuel storage: 1 million liters plus;
- Water pumping station: 100,000 cubic meters/day;
- Water treatment: responsibility of each industrial operator, within their premises;
- Electric sub-station: 250 MW (additional to RTA needs);
- High and medium tension lines: 220 kV, 66 kV, 23 kV;
- Port facilities: sufficient to handle cargo, liquid fuels and bulk materials;
- Railroad sidings and connection: to be linked to the South-American network (Argentina, Brazil).

Concerning the latter item, linkages should be planned with the Brazilian grid through current extension work being planned from the railhead at Cascavel towards the Paraguayan border.

2.3.4 Industry Mix

The following industrial mix was deemed feasible for investment and operations in an industrial park in Paraguay. In total, 25 investment projects are considered for the industrial zone, to be implemented over a 15-year time frame. The following presents the specific projects which were included in the Industrial Park concept and for whom the aggregated impact of capital investment and operations was estimated. Overall power needed for the modelized industries is 244 MW (maximum possible of 250 MW), in addition to RTA's needs.

Large capital-intensive investments

- **Primary Metals and Chemicals**

  The following are products which require infrastructure and services specific to heavy industries. Indeed, they are all capital-intensive, large scale operations.

- Aluminium cluster: primary aluminum (RTA), aluminium processing such as for extrusion billets (separate corporate operations) wire and cable, aluminium wheels and other related downstream developments (e.g. automotive castings, architectural profiles, aluminium powders);
- Steel: mini-mill;
- Other basic metals: includes alloying metals such as silicon metal (alloying element or key input for high technology applications);
- High purity metals: one instance is polysilicon (high purity silicon metal, for use in photovoltaic cells (and subsequently solar panels);
- Basic inorganic chemicals: includes acids (e.g. sulphuric acid) and industrial gases (e.g. hydrogen, nitrogen);
- Agricultural chemicals: includes insecticides and fungicides.

- **Energy-related**

  - Power plant within the Industrial Park. A biomass-based cogeneration plant is added to the mix of investments. Frequently found directly within a heavy industry park to accommodate for surges in demand and provide a degree of redundancy;
  - A multi-mode fuel distribution terminal. The terminal accomodates several transportation modes (e.g. water, trucking and in the future, rail transit operation).

Each of these investments often represent more than US$100 million in capital investments. Power requirements typically range from 30 MW upwards. Employment varies considerably, from aluminium and steel (500 employees upwards) on the high-end, to industrial gases and cogeneration plant (less than 50 employees) on the low-end.

Export-Oriented Large Scale Fabrication

- Transportation materials: include plastic/rubber products (e.g. tires), metal parts (e.g. wheels, body parts and suspension parts) and finished products (e.g. barges);
- Energy products: include aluminium wires and cables and structural components (e.g. steel) for energy transportation. Also includes turbines (e.g. wind, hydraulic turbine) and solar panels;
- Agri-businesses: include grain processing, biofuels, dairy products, agriculture machinery and equipment;
- Construction materials: include ready-mix plant, concrete products (e.g. pipes, panels).

Each of these investment represent typically US$20 to 30 million in capital investments. Power requirements are typically below 10 MW.

Other likely investments which were not factored in the estimations

- Cement,
- Server farms,
- Industrial chemicals (in particular selected feedstocks for an aluminium smelter, such as petroleum coke calcinating or pitch processing),
- Meat processing.

2.3.5 Market Justification

While it is not in the scope of this study to prepare feasibility analysis for each of these investments, the following elements provide enough ground to believe basic market conditions are in place to justify new investments in the study time horizon (15-years):

- Strong forecast growth in MERCOSUR for consumer goods, such as the automotive markets. In fact, even the Paraguayan market could provide markets for some products originating from the park (e.g. injection-molded aluminium motorcycle parts).

- Large-scale infrastructure projects: waterways, roads, railroads, natural gas and electricity grid.

- Value-added potential for Paraguay's agri-food staples (e.g. soy).

Since the business cycles of the various industries in the new heavy industry park are not identical, this mix of industries provides a degree of economic diversification and resilience to the heavy industry park and surrounding area in case of economic difficulties. For instance, the upstream part of these industries tends to be a part of the supply chain of other products. As a result, their stocks will often rally at the beginning of an economic upturn and are often the first to benefit from an increase in demand. Conversely, manufactured end-products (e.g. solar panels, steel barges) are in full activity when the economic cycle is nearing its high.

3. Assumptions

3.1 Capital Investment

According to E&B Data's investment scenario for the new heavy industry park, the associated capital expenditures would reach US$6.2 billion, including US$3.5 billion for the RTA smelter (674K metric tons) and US$2.7 billion for other potential investing companies. Capital investments are based on actual values of comparable investments made internationally in recent years.

3.2 Local Spend

In total for the ultimate scenario, local spend estimates for construction range between US$1.2 billion and US$1.3 billion and for operations: between an annual US$700 million to US$800 million, excluding the purchase of electricity.

Whereas the local spend of heavy industries is naturally higher for those industries (such as agro-businesses) that benefit from local raw material sourcing, this is not the case for aluminium, since Paraguay does not currently produce bauxite nor alumina. However, the primary aluminium industry can be a heavy user of local goods and services, whether for construction (e.g. subcontracting portions of engineering, building construction, assembly and installation) or operations. As will be seen in Section 5.2, the variety of such services is considerable.

3.3 Energy

A maximum of 250 MW is assumed to be available at the sub-station, in addition to the power needed for RTA. Electric consumption will reach 11.4 TWh in the ultimate scenario, assuming:

- an overall load factor of 98% for RTA and 80% for other park tenants as a whole;
- a break-out of the available power (250 MW[9]) among the heavy industrial site operators, based on their typical usage patterns, as indicated in the figure below.

[9] For study purposes, the total power required by other industrial operators within the heavy industry park is estimated at 244 MW.

Figure 9 Industrial Park Tenants Power Needs

Type of Projects	Industry	Industry Sector	Power (MW)
Large capital-intensive investment projects	Primary Metals and Chemicals	Primary aluminium	1 100
		Processed Aluminium (extrusion	20
		Steel mini-mill	100
		Other basic metal (silicium)	30
		High purity metals (polysilicium)	50
		Acids	5
		Industrial gases	10
		Agricultural chemicals	2
	Energy-related	Power plant	-
		Fuel distribution terminal	1
Export-Oriented Large Scale Fabrication Projects	Transportation material	Plastic/rubber products	1
		Metal parts (e.g. wheels)	5
		Metal finished products (e.g. barges)	3
	Energy products	Aluminium wires and cables	2
		Turbines - wind	1
		Turbines - hydraulic	1
		Solar panels	1
	Agri-business	Grain processing	3
		Biofuels	5
		Dairy products	1
		Agriculture machinery and equipment	1
	Construction materials	Ready-mix plant	1
		Concrete products (e.g. pipes, panels)	1
			1 344

3.4 Direct Employment

Direct employment basically refers to workers employed on the site, whether the temporary workers employed during the construction period, or the permanent workers employed during operations. Since this study focuses on the impact of the project on the Paraguayan economy, care must be taken to identify imports - which do not add value in the economy – and which may concern goods and services as well as labour. Assessing direct employment therefore has to take into account the capacity of the local labour market to supply the required workforce.

3.4.1 Construction

The construction of the industrial park is a major undertaking which will spread over a long time period (15 years). Most of these capital projects require more than one or even two years of construction. While the Itaipu power dam construction experience suggests

that the Paraguayan construction labour market can adapt to a steep rise in demand, it is nevertheless assumed in this study that a significant proportion (30%) of the construction labour will be composed of expatriates, especially as the several construction projects running in parallel in initial years will put strains on the local labour market.

As these projects develop, however a specialized construction labour pool could develop locally, provided a thorough and large-scale training program is put in place. Any reduction of this ratio of expatriates versus Paraguayans nationals would then impact positively on overall economic impacts and government revenues.

3.4.2 Operations

Once the park is developed and in full operations, total direct employment is estimated to range between 6,500 and 7,000 permanent workers (ultimate scenario) in the park. The largest employers would be the RTA smelter (1,250 workers) followed by the primary steel plant (800 workers). The lowest employment levels would be found in the chemical and cogeneration plants. This estimate does not include the manpower required for the site administration (water supply, road maintenance, customs) and on-going re-investment activities within existing plants. For estimation purposes, the new heavy industry park, itself includes only heavy industries since the study aimed at distinguishing direct effects (heavy industrial investors) created from the park from its indirect effects (suppliers). In reality, of course, many small suppliers could be located within a section of the new heavy industry park.

It is assumed that expatriates only form a marginal part of the permanent labour force. For instance, according to RTA's experience, 95% of a smelter's workforce are nationals of the host country, after 5 years of operations from start-up.

The following average labour overall costs data[10] are as follow:

- Construction: US$7,000/year;
- Operations : US$10,000/year.

3.5 Taxes

The tax revenues estimates represent gross government revenues as they do not take into account investments and expenditures which the governement of Paraguay's departments and agencies might need to make to support the project (e.g. infrastructure, training facilities and programs). Also, they do not include government revenues stemming from the sale of electricity to RTA nor to other industrial operators within the heavy industry park. Existing tax provisions including Law 60/90 and the Maquila Regime have been used in this model.

[10] Sources : Wages : Rediex. Skills requirements : RTA.

The model developed to estimate impacts on government revenues is an economic model rather than a tax model *per se*. The core input-output model estimates production taxes (corporate income tax, employee benefits) as well as consumption taxes (i.e. VAT, import duties). It estimates taxes based on historical average ratios rather than on a detailed application of the tax laws. These can be disaggregated at the direct level using RTA-specific data, while the model produces aggregated estimates at the indirect and induced level.

3.5.1 Production Taxes

These include :

- An overall corporate income tax assumed to be 1% of gross sales for all major industrial operators in the new heavy industry park (and assumed to use the Maquila regime). For domestic sales in excess of 10% ot total sales, a corporate income tax of 30%[11] applicable on taxable income, applicable to large industrial operators' sales within Paraguay.

- 16.5% of total wages are paid by all employers as a contribution to health and retirement. This amount is included in the wages paid. This applies to employees' wages only and not to independent workers' income, as should be according to current laws and regulations.

- 10% corporate income tax applied at the indirect/induced level.

- No taxes on loan interest. For the purpose of the study, it is assumed investors have a financing structure with no debt.

- No duties on capital equipment goods.

3.5.2 Consumption Taxes

These include:

- 10% VAT paid on local procurement of goods and services.

- 5% rate for consumption taxes was used, for the aggregate of VAT, import duties and excise taxes (tobacco, alcohol, fuels) at the indirect/induced levels.

[11] General rate (10%), additional rate for dividend distribution (5%), withholding tax (15%) applicable to taxable income.

- No import tax payable on raw materials and services not available in Paraguay as they can all be found in MERCOSUR.

- No import tax on capital goods, supplies and part components.

3.5.3 Personal Taxes

Personal tax is planned to be introduced in 2013 in Paraguay and is to be deployed over several years, with key data not yet fully known. For the purpose of the analysis, a flat rate of 10% was applied for incomes in excess of the following thresholds.

Figure 10 Personal Income Tax Thresholds Estimates – 2013-2020

		2013	2014	2015	2016	2017	2018	2019	2020 onwards
Minimum threshold for personal income taxes	Guaranies (millions)	174	157	139	122	104	87	70	52
	US$ (thousands)	36.7	33.1	29.3	25.7	21.9	18.3	14.7	10.9

Source: Based on Rediex's note on Wages and Personal Taxes- Nov 26, 2009 and adapted to reflect delays in application.

Note: Rounding may explain small variances in US$ and Gs after conversion.

The table was used to calculate income taxes for direct employees. The indirect/induced workers' income tax could not be calculated due to the absence of information on the wage structures of the various industries involved. Any income taxes from indirect/induced workers would therefore come in as an addition to the personal income tax estimates made in this study.

3.5.4 Health and Retirement Benefits

The model calculated employees' (direct, indirect and induced) contributions to health and retirement benefits and other social benefits (9%). The model allows the distinction between employees and independent workers. Therefore, it is possible to apply health and retirement deductions to the case of employees and not to independent workers, as should be according to current laws and regulations.

3.5.5 Other Taxes

It was not possible in the course of this study to obtain an estimate of the property tax which would have to be paid by investors in a new heavy industry park to be built in Paraguay and there was no attempt at property evaluation for the industrial park private facilities and employee housing. For this study's purposes and based on E&B DATA's observations abroad, a property tax rate was estimated to range between 0.15% and 0.20 % of the value of the capital investments.

3.6 Export level

For the purpose of the study, it is estimated that:

- 85% of the value of primary aluminium is exported;
- 15% of aluminium is destined to be consumed in the Paraguayan market, most of it for export of higher value added products;
- 80% of the production value of other park tenants is exported.

The impact will therefore be felt on the overall Paraguay export volume as well as on government revenues. Indeed, within the Maquila regime, sales beyond 10% within Paraguay are subject to general taxation regime.

4. National Economic Impacts

The impacts presented in this section include those on employment, GDP, national investment and external trade. Estimates of direct, indirect and induced effects were calculated[12] for the construction expenditures and for operating expenditures.

- *Direct effects* are those occurring at the construction site or at the heavy industrial operators' facilities, once they are built. *Example : Number of permanent employees within the new park for heavy industry.*

- *Indirect effects* are those occurring within the network of suppliers to the heavy industry park operators in Paraguay, whether for the construction phase or the operating phase. Includes further levels of suppliers beyond direct suppliers, ("suppliers of suppliers") as long as these are operating in Paraguay. *Example : Procurement for civil engineering professional services in Paraguay.*

- *Induced effects* are those generated by the expenditures of workers' wages, for Paraguayan goods and services. Workers are those employed by heavy industrial operators and by their suppliers' networks in Paraguay. *Example : Workers' household expenditures for food and shelter.*

4.1 Employment

Employment estimates distinguish the employment created by the on-going operations of the industrial park from the construction employment generated by the capital investments required.

4.1.1 During Construction

Over 130,000 person-years for Paraguayan workers would be generated in terms of work load during the 15-year initial period of the park, which would mean an approximate annual average of 8,000 to 10,000 workers, excluding the construction workers associated with other public infrastructure projects which would develop in parallel (e.g. power lines, transportation links).

4.1.2 During Operations

At the ultimate scenario, total employment generated annually by the industrial park, once in full operation, would reach between 50,000 and 75,000 in Paraguay:

[12] The method was presented by E&B DATA and discussed with representatives of the Government of Paraguay (Banco Central del Paraguay in particular) in December 2009.

- Direct effects. Between 6,500 and 7,000 would be employed directly by the heavy industrial operators, including RTA.

- Indirect and induced effects. 43,000 to 68,000 additional jobs would be generated in the rest of the Paraguayan economy.

Figure 11 Annual Employment Impact – Operations

		Employment
RTA I (485K m.t.)	Direct	1 000
	Indirect and induced	9 000 - 12 000
	Total	**10 000 - 13 000**
RTA II (674K m.t.)	Direct	1 250
	Indirect and induced	13000 - 16 000
	Total	**14 000 - 17 000**
RTA II + Heavy Industry Park	Direct	6 500 - 7 000
	Indirect and induced	43 000 - 68 000
	Total	**50 000 - 75 000**

In terms of jobs per MW, the triggering effect of aluminium on job creation can be seen in the table below.

Figure 12 Operating Employment Annual Impact per MW

	Capital Investment ($US B)	Total Job Impact per Year	Jobs/MW
RTA I (485K m.t.)	**2.7**	**10 000 - 13 000**	**13 - 16**
RTA II (674K m.t.)	**3.5**	**14 000 - 17 000**	**13 - 16**
RTA II + Heavy Industry Park	**6.2**	**50 000 - 75 000**	**37 - 55**

The resulting 37 to 55 jobs/MW generated overall is incremental to the job impact currently generated by electricity exports.

4.2 Impact on GDP

Impact is measured in terms of US$ million (2010).

4.2.1 During Construction

For the ultimate scenario, average annual contribution to GDP during the 15-year period exceeds US$300 million. As a matter of comparison, this contribution of the local spend (US$ million) is in the order of 2.0% of Paraguay's GDP in 2009 (US$15 billion[13]). It should be mentioned that this contribution is uneven, as most of the capital investment occurs within the first three years (RTA's investment for a 674K m.t. smelter representing more than half of the total capital investment for the new heavy industry park).

4.2.2 During Operations

For the ultimate scenario, total annual contribution to GDP by the heavy industry park operations in Paraguay ranges between US$1.5 billion and US$1.8 billion. As a matter of comparison, this annual contribution corresponds to 10.5% and 12.0% of Paraguay's GDP in 2009.

4.3 Impact on National Investment

The overall investment (US$6.2 billion) is more than twice the level of total public and private investment (gross fixed capital formation) made in Paraguay in 2009 (US$2.7 billion[14]).

4.4 Impact on External Trade for Goods

For the ultimate scenario, the value of exports of goods would range between US$2.5 billion and US$3.0 billion per year. This represents between 80% and 90% of the current (2009) value of goods exports for Paraguay[15].

This positive impact on the balance of trade would be preceded however with a major one-time import of capital goods during construction. However, the productive capacities thus acquired would contribute to the country's economy for the following fifty years.

[13] World Development Indicators database, April 2009.
[14] See note above.
[15] US$3.2 billion (2009). Source : Banco Central del Paraguay.

4.5 Impact on Government Revenues

As discussed in Section 3.5, the model developed to estimate impacts on government revenues is an economic model rather than a tax model *per se*. The core input-output model estimates production taxes (corporate income tax, employee benefits) as well as consumption taxes (VAT, import duties). It estimates taxes based on historical average ratios rather than on a detailed application of the tax laws.

- For direct impacts, it is possible to apply a higher degree of precision, based on the availability of data on operating surplus or wage structure.

- For indirect and induced impacts, aggregates are produced at the corporate level. At the employee level, personal income taxation is not measured because industry wage information available concerns wage *averages* and not wage *structures* therefore preventing the application of minimum taxable income.

4.5.1 During Construction

In the ultimate scenario, total government income would reach between US$210 million and US$260 million during the 15-year construction period.

- Direct effects. Between US$20 million and US$30 million would be collected, mostly from VAT from local procurement and contribution to health and retirement.

- Indirect and induced effects. US$190 and $US230 million would be collected mostly from contribution to health and retirement and corporate income tax.

4.5.2 During Operations

In the ultimate scenario, total government revenues generated annually by the industrial park's operations in Paraguay are estimated to reach US$250 million to US$300 million for a typical year (steady state operation for the smelter and the industrial park):

- Direct effects. Government would gain US$125 million to US$150 million from the estimated taxes on corporation of RTA and other park tenants.

- Indirect and induced effects. US$125 million to US$150 million would be collected, from contribution to health and retirement, corporate income taxes, as well as VAT and import taxes.

5. Industrial and Regional Impacts

The contribution of heavy industry park would go beyond its macro-economic impact to include structuring effects in terms of industrial and regional development.

5.1 Industrial Impacts

The heavy industry park could be beneficial to the development, and indeed the formation of various industry clusters. This section presents a few of them, starting with the aluminium cluster which could form around the RTA smelter.

5.1.1 The Aluminium Cluster

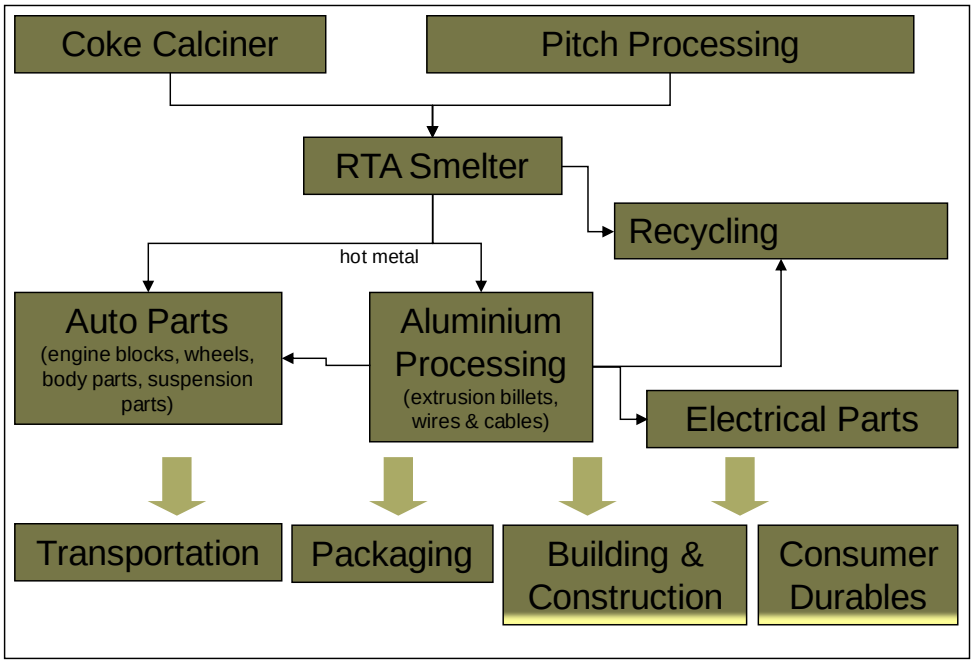
RTA is a primary aluminium producer with a degree of upstream integration. Indeed, it is a major producer of bauxite and alumina, with little involvement in downstream applications. The announcement possibility of a Paraguayan aluminium smelter has in fact already attracted the interest of downstream clients, which are interested in transforming the smelter's primary aluminium output into value added products for the Latin American market. Indeed, the presence of a large primary metal operation is always attractive to downstream industries for strategic and economic reasons. Potential interested parties include:

- Raw materials producers, especially if the aluminium plant is of large scale. This would be the case for the option RTA is currently considering (674K m.t.) as the capacity envisaged would make the plant rank among the largest aluminium smelters in the world. Instances of such a smelter's feedstock include industrial chemicals (e.g. pitch, calcined coke).

- Aluminium processors. One reason for their locating in the immediate vicinity of the primary aluminium smelter is that the use of hot metal can reduce the operating cost of the processor (no need to remelt aluminium ingots). Further, the possibility of downstream processing is a possibility worth considering once the smelter is built. Such possibilities include aluminium castings (e.g. for transportation materials such as motorcycle parts, wheels, suspension parts), rods, wires and cables (e.g. cables for the energy equipment), all sectors which should meet high demand growth in Latin America in the next years, and in Brazil in particular, thus consolidating industrial linkages between the two countries.

The graph below outlines the aluminium cluster which could develop within the new heavy industry park.

Figure 13 A Possible Aluminium Cluster in Paraguay



5.1.2 Other Clusters

Several other clusters can be developed in the park:

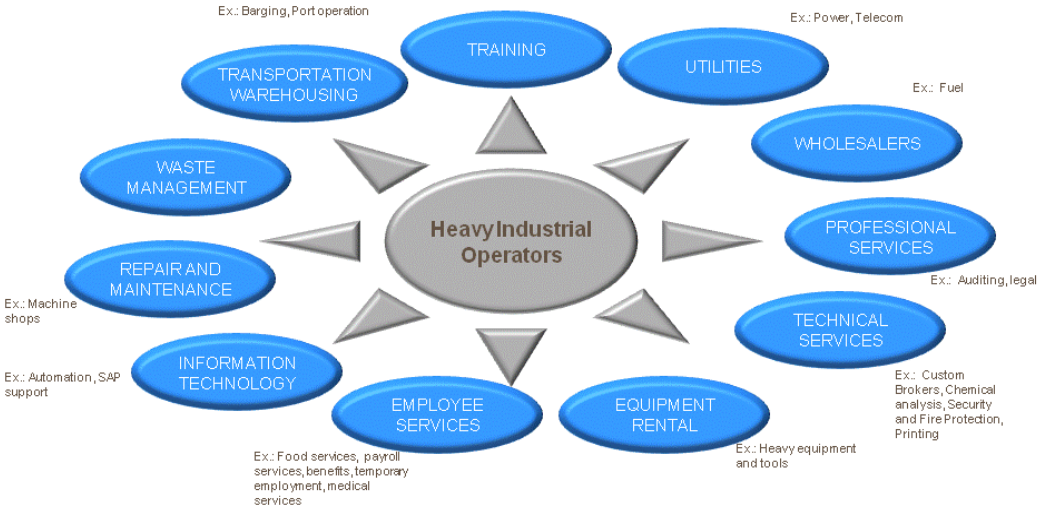
- an agri-food cluster, providing added value to Paraguayan agricultural production (e.g. soybean) and substituting imports of key inputs such as agricultural chemicals (e.g. insecticides, fertilizers) and agricultural machinery;
- an energy cluster focusing on both large infrastructure projects in MERCOSUR (aluminium cables, steel structural components for electricity transmission towers) as well as on new renewable energies (e.g. wind turbines, photovoltaic cells and solar panels, biofuels);
- a transportation equipment cluster, including both intermediate parts (e.g. wheels, suspension parts) and finished products (e.g. steel barges);
- a building material cluster: including ready-mix plant, concrete products as well as steel and aluminium components.

As can be seen, several of these clusters are linked at various levels with synergies with benefits for various operators. The heavy industry park can thus be a platform for industrial development.

5.2 Support to Regional SMEs

The operation of a smelter makes extensive use of various services on an on-going basis. Based on E&B DATA's observations in industrially mature regions, a base of more than 300 supplier businesses could be developed over the medium to long term, in the vicinity of the smelter (see Appendix C for examples of such developments). This base would be larger for the operation of a diversified heavy industry park.

Figure 14 The Potential for Local Network of Suppliers



For the construction period, other types of suppliers are involved more intensively. While the construction period is limited in time, it is long and intensive enough to justify efforts in developing local suppliers, such as through preparatory training, obtaining certifications and/or negotiating joint ventures with foreign suppliers (e.g. distribution, assembly, installation, technology transfer).

The following are examples of local suppliers which would benefit from the presence of a park for heavy industry (including RTA's smelter as well as the other large industrial operators presented in Section 2.3.4 "Industry Mix").

Transportation and warehousing

- General truck service
- Specialized truck service (e.g. for hot metal)
- Barging service
- Railway transportation
- Trucking transportation
- Rental equipment
- Auto Rental
- General storage
- Cold storage
- Logistics/brokers
- Port operations
- Law offices
- Engineering firms

Construction and maintenance

- Building construction
- Heating, Ventilating and Air Conditioning (HVAC)
- Hydraulic systems
- Electrical systems
- Refrigeration systems

Employee services

- Training
- Cafeteria (catering)
- Personal equipment and uniforms
- Payroll
- Medical services

Professional services (not necessary local)

- Legal
- Accounting
- Public relations/advertising
- Custom brokers
- Financial institutions
- Insurance
- Management consulting
- Marketing
- Industrial design

Information technology

- Automation
- SAP support
- Cell phones services
- Radio communication
- Network maintenance
- Computer maintenance

Technical services

- Safety and Environmental Services
- Security
- Fire protection
- Printing

The sole presence of a large scale investment project is not a guarantee however, that it contributes to the development of local small-and-medium-sized enterprises (SMEs). For such a process to happen, the will and know-how of the investor is needed as well as a public policy of SME support followed-through with adequate resources for at least a decade.

In order to increase the possibilities of local procurement, RTA has a track record[16] of involvement in SME development plans, involving the identification of existing capabilities, analyzing gaps (technological, managerial, labour-force-related), targeting key opportunities and eventually helping SMEs develop an Upgrade Plan (i.e. skills, equipment, methods), find financing and answer bids. The businesses that win RTA bids have greater chances of winning contracts with other large industrial operators, and even supplying other RTA smelters worldwide, thus entering global supply networks.

Examples of areas where opportunities are opened to SMEs can be found in civil engineering trades (e.g. soil analysis, earth work, road, drainage, building), metal working (e.g. welding, structural steel, sheet metal), installation (e.g. electricity, instrumentation, mechanical work) and other specialized work (e.g. gas collectors).

5.3 Attractiveness of Paraguay for Foreign Direct Investment

RTA is part of one of the world's largest industrial groups in mining and metallurgy. Its investment decisions are observed and sometimes followed by other investors, who may not have the same research resources when scouting for new locations. Since RTA's investment decisions mean an implicit acknowledgement of a country's positive

[16] Examples can be found in North America (e.g. Saguenay,Canada), Europe (Isère, France), Africa (Cameroon).

investment climate, these other investors may then decide to invest in the same country, following RTA's decision.

While industrial FDI (Foreign Direct Investment) is on the increase in Paraguay, most if not all of these investments to date have been directed towards light industry. The country's attractiveness for heavier industry seems therefore to have been largely unnoticed. The widespread perception of a landlocked country with no access to maritime routes combined with weaknesses in physical infrastructure (transportation and power) have probably been compelling deterrents for major capital-intensive investments.

It is likely that RTA's investment program would help increase Paraguay's international visibility and recognition for its investment climate, therefore increasing investors' interest for new investments in the country. RTA's decision to invest would reflect positively on the country's infrastructure, namely its capacity to develop heavy industries using its power generating capacity, as well as its river transportation capacity, thus dispelling the perception that the country is necessarily excluded of global trade flows for seaborne commodities.

6. Conclusion

Locating an aluminium smelter within a heavy industry park is a way for Paraguay to generate the full potential of economic benefits derived from its access to abundant hydro-electric energy. The presence of the smelter itself within the park is also important given its capacity to attract other industries which would in turn lead to the economic growth and diversification within the heavy industry park and beyond.

This was illustrated by studying the new investment scenario considered in this document which involves a 674K m.t. aluminium smelter located within a heavy industry park. This proposed scenario generates impacts which are three to six times larger for employment, GDP, government finances and exports than for the original investment considered (i.e. a stand-alone 485K m.t. aluminium smelter). These increased benefits are in addition to significant impacts on regional and industrial development, in particular for SMEs, industry diversification and cluster development.

It is important to caution though that the scenario presented in this study is only indicative and that a new park for heavy industry in Paraguay could develop very differently.

For the impacts stated above to materialize, a series of conditions must be met:

- Government willingness to design, plan for and coordinate the implementation of an industrial development platform and a willingness to follow-through for at least a decade;
- Timely availability of key energy infrastructure. In addition to the sub-station within the park, this involves the interconnection of different electrical systems (i.e. Itaipu and Yacyreta) in a common Paraguayan grid;
- Coordination of a large-scale training program at middle and superior levels (secondary, technical and tertiary education);
- Well-planned design of the park with adequate infrastructure and proper consideration for future needs and buffer zone;
- Effective international promotion (branding) and targeted initiatives and incentives to attract businesses.

If these conditions are met, the new heavy industry park would be noticed and perceived positively by the international investment community, leading to further projects. In this way, RTA's investment could thus trigger a new phase in the development of Paraguay's industrial potential.

Appendix A Industry Mix

The following mix of industries was retained for economic and tax purposes.

Primary Metals and Chemicals

- Aluminium
- Steel
- Other basic metals (e.g. silicon)
- High purity metals
- Basic inorganic chemicals
- Agricultural chemicals

Export-Oriented Large Scale Fabrication

- Transportation parts (e.g. wheels, auto body parts and suspension parts)
- Plastic/Rubber products
- Wires and cables
- Turbines (hydraulic, wind)
- Solar panels
- Metal fabrication (e.g. steel barges, structural components)
- Ready-mix plant
- Concrete products (e.g. pipes, panels
- Grain crushing
- Biofuels
- Agriculture machinery and equipment
- Dairy products

Energy infrastructure

- Cogeneration plant (biomass)
- Fuel distribution terminal

Appendix B Methodological Notes

B.1 Definitions

Heavy Industry

Typically includes mining as well as the part of the manufacturing sector characterized by large capital investments, in plants, machinery and related infrastructure (transport, energy). Examples are the oil industry, chemicals, primary metals, industrial machinery and mass transit transportation equipment (e.g. rail equipment, shipbuilding).

Another trait of heavy industry is that it most often sells its goods to other industrial customers, rather than to the end consumer. Heavy industries tend to be a part of the supply chain of other products. As a result, their stocks will often rally at the beginning of an economic upturn and are often the first to benefit from an increase in demand.

Economic Effects (direct, indirect, induced)

Direct effects are those occurring at the construction site or at the heavy industrial operators' facilities, once they are built. Example: Wages of permanent employees within industrial park.

Indirect effects are those occurring within the network of suppliers to the heavy industry park operators in Paraguay, whether for the construction phase or the operating phase. Example : Procurement for civil engineering professional services in Paraguay.

Induced effects are those generated by the expenditures of workers' wages, including employees of both heavy industrial operators and their suppliers' networks in Paraguay. Example : Workers' household expenditures for Paraguayan goods and services.

Gross Domestic Product

For reference purposes, the definition is provided below, originating from the System of National Accounts (SNA) 1993, i.e. the conceptual base for the international statistical standard for the measurement of the market economy. It is published jointly by the United Nations, the Commission of the European Communities, the International Monetary Fund, the Organisation for Economic Co-operation and Development, and the World Bank.

Gross value added at basic prices is the output valued at basic prices less intermediate consumption valued at purchasers' prices.

- "Gross value added" is a measure of the contribution to GDP made by an individual producer, industry or sector.

- The "basic price" is the amount receivable by the producer from the purchaser for a unit of a good or service produced as output minus any tax payable, and plus any subsidy receivable, on that unit as a consequence of its production or sale; it excludes any transport charges invoiced separately by the producer.

- The "purchaser's price" is the amount paid by the purchaser, excluding any deductible VAT or similar deductible tax, in order to take delivery of a unit of a good or service at the time and place required by the purchaser; the purchaser's price of a good includes any transport charges paid separately by the purchaser to take delivery at the required time and place.

B.2 Intersectoral (input-output) Analysis

Most of the data needed to estimate the economic impact of the smelter and heavy industry park project is derived from existing statistical tables which are at the basis of Paraguay's national accounts, i.e. product-related transactions (domestic production, imports, consumption, investment and exports), distribution-related transactions (income, transfers) and financial transactions of the main economic agents (corporations, public administration and households).

Based on these datasets, GDP calculations seek to calculate overall output of the economy, whereas the input-output analysis done in this study focuses on tracking interindustrial linkages within the economy. While GDP calculations are used to measure economic growth, input-output analysis is used to estimate the impact of a change in some part of the economy on the rest of the economy. Both models are based on the same statistical framework[17].

The incremental activity which would result from a new heavy industry park in Paraguay would generate new volumes of activities in several supplier industries. These aggregated volumes will result in changes in a series of variables (e.g. jobs, government revenues and GDP) which the model seeks to estimate.

Schematically, the process involves three steps:

- Assemble a transactions table or matrix of monetary flows of an economy in a given year. This double-entry matrix (income and expenditures) covers industry production, supply and demand of goods and services, primary inputs, intermediate consumption, and foreign trade.

[17] E&B DATA uses the methodological framework and statistical standards set by the System of National Accounts referred to in Appendix B-1.

- Derive multiplier tables for value added, taxes and employment. These input-output coefficients (multipliers) reflect direct and indirect transactions.

- Simulate change (« shock ») in one sector: This change is simulated by applying the multipliers derived in the preceding step on new expenditures (in the current case, the expenditures associated with the new heavy industry park), in order to obtain new set of macro-economic data.

B.3 A Few Comments on Job Estimates

- **Job calculations.** The overall number of jobs calculated is based on national workload (e.g. person-years) generated 1) at the direct level by the heavy industrial operators, and 2) at the indirect/induced level by the expenditures of these operators in Paraguay and by the personal expenditures of employees of the heavy industrial operators and of their suppliers in Paraguay. The workload reflect the basic cost structures breakdown (labour versus procurement of goods and services) which are implicit in the transactions table of the economy. The labour component is divided by average industry wages to obtain employment estimates.

  The number of jobs provided captures the workload generated upstream from the smelter and heavy industry park tenants' procurement within Paraguay. It does not capture downstream impacts resulting from additional processing of the heavy industry park's output, outside of the park.

- **Regional job estimation**. The interindustrial (input-output) model provides workload estimates at the national level only. The regional impact can be broadly assessed by adding the direct jobs within the park (6,500 – 7,000) to a pro-rata attribution of the national indirect/induced job impact (43,000 – 68,000 jobs nationally) to the population share (in the order of 20%) of the southeastern-most regions (e.g. Alto Parana, Itapúa) where the smelter would most likely be situated. Indeed, it is reasonable to suppose that many of the indirect/induced jobs created would be located close to the heavy industry park.

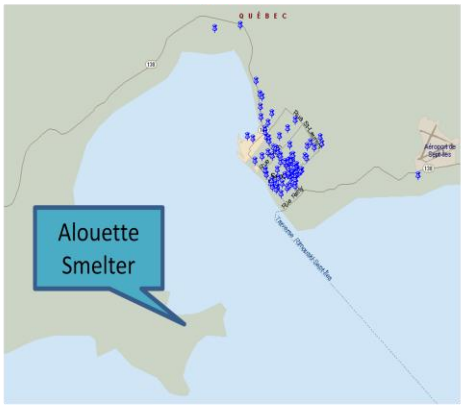
- **Possibility of double-counting.** The 10,000 - 15,000 job impact attributed to the stand-alone 800 MW smelter (the original investment scenario) cannot be added to the overall 50,000 – 75,000 job impact of the heavy industry park since the latter includes the RTA smelter. A worker already providing work for the smelter or for a direct and indirect industry may also provide some work hours to an industry within the heavy industry park but his workload would increase correspondingly. Since the 50,000 – 75,000 "job" estimation reflects workload rather than "physical persons", the national workload necessarily increases as a direct result of the new heavy industry park, with no possibility of double counting.

Appendix C RTA Proximity Suppliers Network in Canada

The supplier network of two of RTA's smelters in Canada is depicted below.

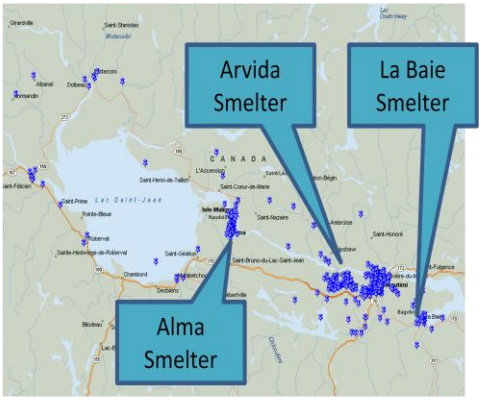
The graphical depiction is based on a georeferenced analysis of each of these smelters (using the Accounts Payables files).

Sept Îles



More than 200 suppliers within 10 km

Saguenay–Lac-Saint-Jean



More than 800 suppliers within a radius of 35 km

The first case "Sept-Iles" presents the situation for the Alouette smelter, in which RTA is the largest shareholder. With operations starting in 1990, the smelter has 1,000 suppliers in the province of Quebec, including 200 in close proximity (across the bay).

The other case presents the suppliers networks of three RTA smelters in Saguenay-Lac St-Jean region in Quebec. With operations starting in 1925 (Arvida), 2000 (Alma) and 1975 (La Baie) and with total capacity of over 1 million tons (excluding current expansion projects), more than 800 suppliers are located within a 35 km radius of the smelters. These suppliers also supply other customers.

These developments reflect a mature industrial fabric, which took years to develop. While several suppliers are limited to services which are local by nature (e.g. security), others have developed expertise, certification and reputation which allow them to serve other RTA smelters, and indeed other large industrial operators worldwide.

Appendix D About E&B DATA

E&B (Economic & Business) DATA is specialized in economic and tax impact studies. Its clients include international corporations, industrial associations, public administrations, utilities and labour unions. It has carried out such studies for investments in several countries, in both developed and developing countries and focuses on heavy industries. Industries thus covered include oil & gas, chemicals, fertilizers, forest products as well as ferrous and non-ferrous metals and non-metallic minerals. The aggregate value of capital investment projects for which it has estimated economic impact over the last five years exceeds US$100 billion. E&B DATA's expertise goes beyond economic impact analysis to include supplier development, regional development and foreign direct investment analysis.

- E&B DATA's Heavy Industries Database includes cost structure and investment patterns (e.g. capital investment value, direct employment, locational preferences) for over 50 heavy industries. For the aluminium industry in particular, E&B DATA possesses databases on over 4,000 suppliers to the aluminium industry.

- E&B DATA regularly conducts international benchmarking studies of government business attraction and assistance programs.

- E&B DATA conducts sensitivity analysis on the economic and tax impact of different level of financial assistance for internationally mobile projects.

- E&B DATA's prepares prospective studies related to industrial investment.

Finally, E&B DATA has a realistic understanding of the potential for national and regional procurement. This understanding not only is based on an assessment of the industrial capabilities of the local firms but it also goes further in terms of the time and conditions needed for a cluster to develop. The project manager has been a close observer of the development of the Quebec aluminum cluster for the past twenty years. From this experience gathered with both industry participants and public administrations, he was well placed to observe over time the growth of a specialized supplier base in Quebec.