

# **PRODUCTIVITY IN THE CHILEAN COPPER MINING INDUSTRY**

## **EXECUTIVE SUMMARY**

NATIONAL PRODUCTIVITY  
COMMISSION  
**MAY 2017**

## EXECUTIVE SUMMARY

### Importance of Mining in Chile

Mining, specifically copper mining is the most significant economic activity in Chile. Copper mining represents over 10% of GDP, more than 50% of exports, and is the leading recipient of foreign direct investment: accounting for one in every three dollars entering the country. The sector has grown steadily in the past 60 years: it tripled between 1960 and 1990; and trebled again during 1990-2016, reaching 5.5 million tons in 2016 causing Chile to be the world's leading producer, accounting for 30% of total production. The country also boasts a third of the known world reserves, the largest at a global level. Copper opens a window of opportunity to expand our development, and thus achieve economic and social progress.

Given the sharp price increase during 2004-2014, Chile raised not only its copper production but also its value. Exports grew from an average of US\$1.4 billion<sup>1</sup> between 1960 and 1990 to US\$5.5 billion between 1990 and 2003 and then US\$34 billion during the so-called "super-cycle" (2004-2014). The value exported in 2016 was of US\$28 billion.

Between 1994 and 2003, mining accounted for approximately 6% of fiscal revenues, a contribution that tripled between 2004 and 2014, reaching an annual average of 20%. Including state enterprises (Codelco and Enami), copper contributed US\$96 billion to the treasury in 2004-2014, ten times more than the previous decade (US\$9 billion). This allowed the accumulation of more than US\$20 billion in Sovereign

Wealth Funds<sup>2</sup>. From 2015, the contribution returned to the levels previous the super-cycle.

Given its size and development, the ecosystem around mining involves many organizations and functions and is highly complex in its interactions. Nationally, there is no other sector like it: it includes (i) large, medium and small enterprises; (ii) state owned; transnational and local capital; (iii) a significant supplier sector (both domestic and foreign); workers' organizations, (v) companies and suppliers associations, and (vi) specialized State agencies.

Chile has a clear comparative advantage in the mining sector, particularly in copper mining, and must take advantage of the potential that nature has provided: a third of the world's copper reserves are in Chile. In fact, no country rich in natural resources has achieved development by overlooking its comparative advantage, and Chile is no exception. It is not a matter of focusing our development exclusively on mining, but instead, taking advantage of opportunities to develop and diversify our economy.

The benefit to Chile and the attractiveness of mining investment depends on the difference between the price of copper and its production costs. Chile does not control the price of copper or the mineral's grade, but it can manage its productivity and thus its costs. Reversing the deterioration in the copper mining industry's productivity is fundamental for it to continue making its valuable contribution to the national development. Hence, the Government has mandated the

---

<sup>1</sup> One billion equals one thousand millions.

---

<sup>2</sup> Pension Reserve Fund and Economic and Social Stabilisation Fund (FRP and FEES in spanish, respectively).

**National Productivity Commission** this report, with the aim of proposing a strategy that will allow the country to regain its international leadership, not only regarding reserves and production but also in productivity. As it will be seen, the implementation of this strategy will require the joint effort of both public and private sectors: that is, the State, mining companies and their workers, contractors, suppliers and civil society.

This Commission considers that the set of recommendations proposed for both the public and private sectors are the basis of a mining strategy that ensures the industry's continuity, its expansion and its adaptation to new technological challenges and social demands. Applied separately, the 53 recommendations of this study would have limited impact. As in any complex system, the most restrictive component will determine the set's potential. However, applied as a whole, and centered on twelve proposed strategic areas, the impact is maximized. Due to its complexity and magnitude, the sector is in a privileged position to reach agreements and implement long-term policies around this strategy, which will be decisive in the country's future development.

## Main Findings

In recent years, commodity-producing countries have seen their productivity growth rate decline. Chile is no exception. The 2016 Annual Report of the **National Productivity Commission** found that the total factor productivity (TFP) of the Chilean economy as a whole decelerated from 2.3% annually in the 1990s to 0.1% per year in 2000. The primary, though not the only reason, was the reduction in mining productivity. This fall was mainly due to the companies' reaction to the super cycle of copper prices, which led them to prioritize the level of production over other criteria such as efficiency.

In fact, copper production rose 19% between 2000 and 2014. However, this required 79% more energy, 157% more labor, and 178% more capital. This explosive growth in the use of inputs to achieve a modest

increase in production entailed a heavy fall in productivity, which, according to some studies, was around 70% during the super cycle. However, this measure does not take into account that during the period, the ore's grade deteriorated significantly, which meant mining, loading and processing an additional 40% of mineral to achieve the same amount of fine copper. Nor does it take into account the long gestation period of capital investment, which makes the investment yield its fruits up to 5-7 years later. Adjusting for the factors mentioned above, which are external to management, our best estimate displays a mining TFP deterioration of around -1% per year, much less than the general estimate. Nonetheless, this is an unsatisfactory result, since productivity is expected to improve over time.

The fall in productivity since 2000 occurred both in mines with higher and lower productivity. In fact, the price surge induced all companies to favor production and thus take advantage of the high margins, even at the expense of productivity.

Given the significant gaps in productivity encountered, it is evident that there is room for improvement within companies. There are differences in productivity amongst mine sites, even after correcting for geological and geographic factors. For example, according to observations from the sample of large-scale mining companies in Chapter 3 of this report, in the year 2000, the least productive operations required 82 working hours to move a kiloton of material, but 162 working hours in 2014. The median-productivity mining companies went from 26 (2000) to 63 (2014) working hours per kiloton moved; while the high-productivity group went from 19 (2000) to 22 (2014) working hours per kiloton moved. This labor productivity indicator and the total productivity measures not only confirm the gaps at different levels between these three groups, but also their tendency to worsen productive performance. According to our estimates, total factor productivity at mine site level fell between 0.7% and 1.6% per year between 2000 and 2014.

A particularly important aspect of this study was the detailed comparative analysis (presented in Chapter 3) of the productive performance of 12 Chilean mining operations (75% of the national production) and seven international mines, specially selected for being of international best practice (benchmarking). The capital's productivity was measured with information obtained from each operation for all 12 months of 2015, considering the intensity of equipment use (time of use), and labor productivity (person-hours per kiloton moved). The sample accounts for 35% of the world's copper production and 50% of the production of deposits that yield over 100,000 tons per year. This sample generates confidence regarding the representativeness and value of the analysis.

More than 500 people in the mining industry were interviewed for this study. They included operators, supervisors, executives, analysts, civil servants, members of civil society and industry experts. A series of open public hearings were held in the cities of Antofagasta, Iquique, Calama, La Serena, Copiapó, Sierra Gorda, Coquimbo, and Santiago. Over 700 people attended: from civil society, business, regional authorities, and workers. Likewise, mines considered as "best practice" were visited in Australia, Canada, the United States, Sweden and Peru, and in each case the opinion of executives, workers and experts were taken into account. Correspondingly, meetings were also held with government and industry bodies. To our knowledge, no other study of this magnitude exists worldwide.

The "benchmarking" analysis for the 2015 productivity indicators confirms the marked heterogeneity between local mines: the most efficient operation of the national sample required an average of 43 working-hours to move a thousand tons of material, while the less effective one required 115 working-hours for the same job. The average

national sample was 67 working hours to move a kiloton of material<sup>3</sup>. That is to say, there are differences of more than 100% in labor productivity within different mines in the Chilean large-scale mining industry (over 100,000 tons of annual copper). External factors, common to all companies, such as regulations, do not explain these differences. Likewise, this analysis takes into account factors such as distance, the slope of the open pit, load capacity in trucks and the ore's grade. Therefore, the bulk of the differences in productivity is attributable to reasons pertaining the mine itself, and especially, to the management of personnel and assets, and the design and adherence to the mining plan.

When comparing the Chilean sample with the international sample, the results are even more troublesome. The average working hours required by the world's best practice sites to move a kiloton of material (30 working-hours) is less than half the national average (67 working-hours). On average, the mines of the national sample required more than double the working-hours to perform the same task as the international sample during the year 2015. Moreover, the best performance local operation requires 44% more working-hours than the average of the best international mines. In Chile, 1.8 people work at the plant and support areas for each person that works within the pit itself, while in the international mines that ratio is 1.3. These differences may be capturing institutional, regulatory, or generalized gaps common to the Chilean industry, such as human capital, and suggest that there is room for productivity improvement through public interventions.

Concerning capital use, Chilean mines exhibit substantial differences amongst those of best international practice. For example, regarding transport, the international mines use the equipment an additional 10% of hours a day, and there are differences of 80% between the best and the worst in Chile. At the plant level, the international sample uses 13%

---

<sup>3</sup> It is important to note that the least productive mines present a significant deviation from the sample median (53), and therefore distort the national average (67).

more the milling asset, and there are differences of 25% between the best and the worst in Chile.

In short, there is room for improvement. First, to raise the productivity of the worst Chilean mines to the level of the best in the country, which concerns the companies themselves. Second, to bring the national average closer to the international one which requires both public and regulatory policy improvements.

Accounting for 65% of mining employment, suppliers and contractors have an impact on the productivity of the industry. Their importance is fundamental since mining companies focus their attention on the business core: ownership, operation, and management of the deposits, and have outsourced several functions to their suppliers. Therefore, a significant part of the industry's success depends on the suppliers' productivity and competitiveness.

In short, the bulk of short-term productivity gains will depend on factors manageable by the mining companies themselves (a "private good"). However, an important part will be based on better public and regulatory policies (a "public good") as well as factors determined by the companies' relations with each other and with their suppliers and contractors (a "club or sectorial good"). Approaching the global frontier of efficiency will require everybody's effort, and benefit all.

The future of the Chilean copper mining industry, and in particular, the materialization of the 7.5 million metric tons of annual production projected for 2035 according to the National Mining Program Alta Ley, depend on the convergence of several factors: (i) a better internal management; (ii) the availability of land for exploration and exploitation, (iii) the increase in exploration expenditure, (iv) the emergence of new projects and the expansion of existing mines, (v) water and energy availability, (vi) a strategic relationship with suppliers, (vii) and the industry's ability to operate with a "social license", among others. Issues regarding taxation and environmental permits go beyond the scope of

this study, but it would be desirable in both cases to carry out a similar benchmark analysis with the best practice jurisdictions.

In organizational terms, many aspects differ from the countries that exhibit best practices. The rotation of senior executives has entailed little adherence to a consistent strategic plan in the medium term. At the domestic level, there are significant differences in labor practices. However, compared to the international referents, we observe that there are higher hierarchical layers, little mobility between levels, less span of control, remuneration with an emphasis on production over productivity, among other aspects.

Concerning exploration, Chile has lost its appeal with respect to other mining destinations. In areas such as public and relevant geological information, Chile has lagged behind regarding the perception of policies towards the sector or the availability of land to explore. Chile's participation in the exploration market (18% in the case of copper) is less than its involvement in production and reserves (30%), which threatens the sustainability of our future leadership. Notwithstanding technological advances that maximize the worth of this potential and the expansion of current projects, in the long term the ability to generate wealth will be based on the discovery and development of new deposits and, therefore, is directly linked to the exploration efforts.

The current system of mining concessions should be improved in line with international best practices. Non-mining agents use the concessions for speculative purposes, which, on the one hand, directly affects the sector by reducing the availability of land, and on the other, indirectly affects strategic resources such as water and energy. In several regions of mining interest, the concession area for exploration or exploitation exceeds the total area of the respective territory, due to the overlap of concessions. This means that a company cannot request new concessions unless they overlap them and wait for the predecessors to abandon them. On a larger scale, there are no

available spaces to explore in the country's main metallogenic zones, which constitute an important barrier of entry for the discovery of new deposits. The low cost of the protection obligations of the Chilean system, consisting of low-cost patents that do not require or encourage the execution of exploration or exploitation activities or investments aggravates the situation. Reference countries impose a mixed protection system, which includes a patent and the demonstrable execution of mining labors.

As for water and energy, the sector has adjusted itself regarding the cost and availability of these strategic resources. Both resources are efficiently used, in conjunction with the increase in the use of seawater, which is expected to equal the use of continental water by 2026. There is room for improvement around the use of seawater, linked to regulatory policies and better industry coordination to share infrastructure and take advantage of economies of scale.

Suppliers will be decisive in the competitiveness of the industry and, if successful, the public-private programs that support them will contribute to greater knowledge and innovation. They can also constitute a new and important source of export within the global value chain in mining.

It is important to develop interoperability standards that allow the exchange of data and test spaces to facilitate innovation and scaling up. On the other hand, there is room for improvement regarding homologation of requirements to suppliers and contractors, reducing accreditation times and costs.

The feasibility of increasing production through new projects or expansion of existing ones relies heavily on the acceptance of companies and their activities within the surrounding communities: namely, the so-called "social license to operate." A better relationship with communities implies greater legitimacy, less conflict, and lower costs. This is all the more relevant as the mining activity approaches the country's central regions, where half the known reserves are found.

However, these areas have higher population density, more competition with other activities and the complexity of potential conflicts.

The sector has evolved favorably concerning job security, where accident rates and fatality register declining trends. This trend has enabled the mining industry to have the lowest accident rates in the country's economy. When comparing the sample of twelve Chilean mines with the benchmarked countries, we find similar accident rates occurring per million hours worked. At the firm level, the best Chilean operation has a better indicator than the international operations considered, and only three national mines present rates higher than the international sample, confirming that the Chilean large-scale mining industry has converged in recent years towards the best global practices in this area. There was also a substantial fall in fatalities: in 2000, just one fatal accident was recorded for every 2,289 employed, in 2014, one for every 6,960 employed. In other words, one fatal accident is recorded for every 132 million tons of material moved in 2000, versus one for every 342 million tons in 2014. The challenge to reduce the fatality rate persists, which, despite all the progress, is still the highest among sectors of the economy.

According to the Labor Directorate, 85% of the workers of the large-scale mining industry work 12-hour days, with shifts of 7x7 or 4x4. 80% evaluate them positively and prefer the 7x7 shift. However, mining companies, subcontractors, and suppliers must request the Labor Directorate's authorization, despite all previous agreements between companies and workers, for authorities to consider these workdays exceptional. This process may take up to 40 days and is required for all new employees or contractors. Approximately 6,000 requests for exceptional workdays are processed a year (half of the country's yearly requests) in Antofagasta and Calama, which constitutes a significant burden for the Directorate.

Concerning human capital, the sector's requirements are unsatisfactorily met both qualitatively and quantitatively. There is an excess of supply of professionals, who in turn receive training of small relevance to the sector. On the other hand, there is an excessive demand for technicians and operators, who in turn find it difficult to train or certify their competencies adequately. Industry efforts are moving in the right direction, but they require greater speed and commitment. Public-private coordination is crucial in this area.

Chile's future mining industry will tend to develop on a medium scale. The deposits discovered during the last decade correspond to smaller deposits, and half of the country's reserves are located in the central zone, where implementing large mining projects is more difficult due to higher population density, and increased competition for the land. Hence, the sector's objective and the country's priority must be the convergence of a medium-scale mining industry towards world frontier regarding operational practices, sustainability, and relationships with the communities. The current medium-scale mining sector presents critical gaps at the national level, and its productivity has deteriorated in recent years at rates that double the annual fall in productivity in the large-scale mining industry, and at the same time trebles the accumulated fall.

## **Main Recommendations**

The study results are a set of 53 specific recommendations in the areas of public and regulatory policies (a "public good") and sectoral policies, which require the joint action of everybody in the sector, including mining companies, contractors, suppliers and communities (a "club or sectorial good"). Also, a series of suggestions based on good practices for business management (a "private good") arose during the development of this report. We must point out that all recommendations were unanimously approved.

### **(i) Good practices for company management (a "private good")**

Although it exceeds this Commission's mandate, this study identified good practices regarding problems that are manageable by each company or mine. Converging towards these "good practices" are the best short-term opportunities for the sector, and do not require government intervention.

Productivity is recurrently perceived as a central, crosscutting theme and a continuous and long-term process that arose in the interviews. It is viewed as a pillar of the operational philosophy of best practices. This vision is characterized by the search of a "global optimum" in the maximization of the deposit's efficiency as a whole and not by the vision of "silos" or isolated improvements around the productive processes, characteristic of several operations in Chile, aiming at a "local optimum." With a goal of maintaining this effort in time, the selected best practice mines try to minimize the rotation of senior executives, a common practice in Chile: in recent years; the industry suffered successive changes in short periods. With long-term vision and a stable executive level to maintain company strategies, international enterprises focus on their overall productivity and not on the productivity of productive processes. Again, this has been identified as common practice in Chilean mines, where bonuses depends on isolated processes and has little or no part attached to the entire operation. This generates substantial efficiency losses in the passage from one process to another. Companies must reduce the rotation of top executives, seek global optimization, and use bonuses and compensation mechanisms linked to profits and global indicators, to converge towards these management practices.

Two aspects are evident when visiting international best practice mines and interviewing their teams: 1) the use of technology and 2) the autonomy and initiative with which operators work. Regarding the first point, the operating stations or the level of both technology and equipment at the control centers do not differ with those existing in

Chile. However, the best practice mines use them intensely, while in Chile they seem to be underutilized. In local mines, a common anecdote is that processes that may be automatically operated are used in manual mode, thus maximizing labor without increasing the production, and therefore reducing the productivity. Therefore, the difference between Chile and international operations would not be the availability of technology, but its usage. It is worth mentioning the use of operational data to generate information, which minimizes failures thanks to their predictive capacity, and the associated intervention mechanisms, are key in preventive maintenance processes. The combination of a real-time monitoring system, systematic analysis of hydraulic parts, and single fleet management seem to maximize the efficiency of mobile equipment in the mining area. A global vision, as opposed to an isolated one, allows a maintenance operator to remove a truck for preventive inspection (based on analysis information and sensors), without a mine supervisor having to worry about a production bonus.

A second relevant point concerns the staff's autonomy and initiative. Chile has between six to eight hierarchical layers, versus four or five in the best international mines. The span of control in Chile is small, due to a larger amount of top layers, with fewer workers per supervisor, contrary to the international trend. This is evidence of a control-based management culture, which reduces initiative, restricts autonomy, dilutes responsibilities between layers, and raises costs. Greater emphasis on autonomy and empowerment of operators would reduce the hierarchical layers and increase the breadth of control. This obviously requires more significant instruction, especially to multi-functional workers, and requires training supervisors in areas such as leadership and team management. In Chile, time is not only lost in meetings oriented to "control," but also, the supervisors' time is spent on administrative tasks (paperwork) at the expense of spending time in better planning and organization. This should be a primary focus for the

mining companies, even though it is partly associated with the internal reaction to the authority's regulation demands.

In addition to greater autonomy, the best international companies seek to identify and empower their workers, who may be promoted to supervision posts and even to management after duly training. However, this does not happen in Chile: and the absence of a meritocratic culture is not exclusive to the mining sector. In addition to more autonomy and career potential, the selected international mine workers are multifunctional in areas for which they have been certified (and where they do not assume risks that they cannot control). For multifunctionality to work, continuous training programs are required in technical and soft skills and remunerated accordingly. The Mining Competencies Council of the Mining Council (Consejo de Competencias Mineras of the Consejo Minero) has identified these aspects: profiles are recommended, competencies are defined, and certification is proposed. Nevertheless, the application is still incipient.

#### (ii) Good practices in public policy (a "public good")

This set of recommendations refers to six major action areas where government intervention is required, in either public management improvements or regulatory changes.

First, improve the unnecessarily long and cumbersome process of approving or rejecting large projects. The process should be shortened to a proposed goal of three years. A step forward would be to implement the measures of the Presidential Advisory Commission for the Environmental Impact Assessment System, SEIA, which mostly requires changes in particular, and specific regulations rather than changes in generally applicable legislation. At the sectoral level, it is urgent to establish a clear road map of the permits and times needed for the approval of desalination plant projects. The coordination of these processes is a highly complex task for all those involved; however, it must be a priority in the State given the enormous economic impact of



the delays. The formal implementation of a Large Projects Office, similar to the Canadian model, where a public executive accompanies the project and its processes and works through with parallel and non-sequential procedures, with prompt responses, should be a priority in government. This office seeks to facilitate regulation compliance, not its evasion. If it is possible to respond in three years or less in Australia and Canada - countries that have stricter environmental, safety and community consultation requirements than Chile - any greater delay than this in Chile is pure public sector inefficiency.

Secondly, enhance our future development and sustainability in Chile's share in the copper market. The country must attract investment by making mining exploration in general more attractive. In fact, Chile's share in exploration spending is about half of our share of production or reserves. Attracting more investment in exploration requires reforming the mining concessions system to increase the availability of land, and eliminate speculative practices currently allowed. The relevant geological information available to public should also be increased. We propose a mixed protection system, with ascending value of the patent and concessionaire requirements that directly encourage the activity. Patents must be the same for all kinds of minerals and with higher value, so as to meet international levels. The concessionaire may discount from the patent the worth spent in obtaining geological information and mining investment, but they will be ascendant progressively in case he does not exploit the mining property. We also propose to modify the term of concession for exploration to three years renewable twice, with the resignation of part of the area granted at each renewal. For the exploration concession's renewal, relevant geological information must be submitted to the State, as well as minimum work plans. The consecutive requests for mining concessions (a common practice in Chile) from related persons or in successive periods of time must be eliminated. Application for an exploitation concession should require mineralization evidence and minimum work plans. Under a new regime, a temporary limit on the 30-year exploitation concession should

be established, which can be renewed with priority for the same period repeatedly and indefinitely. Sernageomin must be reinforced, and endowed with the capacity required to inspect the proposed modifications.

Third, to facilitate operational continuity through agreements between companies and workers. We suggest re-establishing the option of "adaptability pacts," on which there was a majority agreement in Congress in the context of the 2016 Labor Reform, extending the possibility of exceptional work-days without the need for approval by the Labor Directorate: in 4x3 shifts, 4x4 and 7x7 shifts.

Fourth, generate a more flexible and robust labor market, for the benefit of both workers and companies. The sector would benefit from establishing a "mining passport" that provides mobility to workers between jobs and companies and covers aspects of safety, health, and labor competencies. Along with security certifications, for pre-occupational and professional health certification, any currently valid health exams should be accepted, to reduce duplication of examinations and its costs. Likewise, it would be useful if the Labor Directorate facilitated the extension of exceptional workdays of the constituent companies to the contractors and the incorporation of information technologies to the authorization process.

Fifth, enhance human resource. This resource is as valuable as the natural resource, but unlike the geological data, the human resource can be better utilized, trained and strengthened. In this, the companies, the industry as a whole, and the Government share responsibilities. The mining labor market has qualitative and quantitative shortcomings. The Mining Council's Mining Competencies Council defined a set of competencies and skills required for functions and trades in the sector. This framework should be institutionalized in the definition of content and expertise of the industry's careers, both in instruction and training. This is particularly important for medium-sized mining, which focuses its

search for human capital in high schools and technical training centers. The skills acquired by workers, including through training carried out by the companies, should be certified by Chile Valora, or by private entities, in particular for the workers who have multifunctional positions.

Sixth, improve the sector's safety, with the aim of reducing fatalities. As evidenced by the information analyzed, the greatest gaps concerning the best global practices were recorded in labor productivity measures. The challenge of the industry is to improve its safety indicators while raising production and productivity, an achievable challenge in the light of global best practices. Sernageomin should facilitate the incorporation and exit to the Registry of the Basic Induction Homologated Course in Mining, which would broaden the program and allow extending the accreditation of necessary safety requirements common to all mines. Due to the characteristics of the country, the impact on health in the long term due to working at high altitudes should be monitored.

### iii) Recommendations for joint action in the sector (a "club or sectorial good")

In addition to the areas of intervention for companies and government, an ecosystem that facilitates the relationship between businesses, suppliers, contractors, workers, communities, universities, research centers, etc. would strengthen the entire sector. This is the sector's responsibility, but the articulating role of the State is essential in catalyzing events, improving coordination, and correcting asymmetries. Recommendations destined to enhance collaboration arose in six areas of action, which have the characteristics of a sectoral public good or, in other words, a "club good." As they are actions that benefit the industry as a whole, no single company can provide them.

First, innovation can be enhanced through several identified actions. The sector would benefit from shared testing, piloting and training facilities. Abandoned sites or periods with idle capacity in medium-sized mining could fill this need. Interoperability between communications and

information systems should be maximized in all mining processes with instruments linking supplying companies and mining companies through standard protocols.

Second, explore the possibility of sharing private infrastructure and generating economies of scale, particularly in new seawater desalination projects, or in transport infrastructure and their intermodal integration. Incorporating medium-sized mining into these private agglomeration processes would generate additional gains.

Third, work on improving the inefficiencies in the relationship between companies and their contractors. The primary deficit is the absence of approved and **homologous** requirements for admission to the mines. The establishment of common standards between mines, companies, and contractors would reduce time, capital and operational costs, and increase the productive capacity of the mines, benefitting companies, and their suppliers.

Fourth, expand private sector-level interventions that benefit from public support. The National Mining Program Alta Ley is a good example, specifically the development of world-class suppliers and the Open Innovation Platform between Alta Ley and Fundación Chile. These efforts should continue and public-private partnership actions should extend to other areas of mutual interest.

Fifth, develop and strengthen the medium-sized mining. Significant progress is expected in the future medium-sized mining industry, and a development and deepening of a capital market should be a priority. It would be important to expand financial instruments to ensure the mine closure. Joint Guarantee Funds, similar to those established in Western Australia, are a good model to consider. In addition to being less expensive than warranty bills, they would take care of recovering abandoned tailings and dumps.

Sixth, promote a better relationship between mining companies and communities, with a continuous consultation system from the on-start. A

set of participation guides for large projects produced by the authority (similar to those implemented in the Ministry of Energy) would favor a model of permanent dialogue. Likewise, progress in the implementation of the measures of the Presidential Advisory Commission for the Environmental Impact Assessment System (SEIA) would accelerate the proposals of establishing early relationships, indigenous consultation and strengthening of citizen participation. In the case of disputes, establish a system of conflict resolution, such as that promoted by Valor Minero, where those involved can request mediation, arbitration or conciliation, as well as create a certification entity that enables and enhances the organizations participating in the dialogue processes. Given the direct relationship between local authorities and companies, implementation of the Presidential Advisory Council against Conflicts of Interest, Influence Peddling and Corruption Processes, regarding funds received by local governments, is recommended to establish a better institutional framework, with greater transparency and efficiency.

This report is the first of its kind carried out in the country, and it should not be the last. Its value lies not only on the provision of information but also in generating a constructive and objective dialogue on which companies, workers, and authorities can advance. For this reason, the Chilean Copper Commission (Cochilco), or any other agency that the Government may consider, produce frequent productivity indicators, and comparative studies similar to ours. Advancement to this study would be complementing it with one study pertaining medium-sized mining companies, comparing their performance with international operations, and laying an baseline analysis of their evolution. Similar comparisons with countries of best practice regarding the tax system, SEIA, and the set of licenses and permits required to undertake a mining project would allow Chile's attractiveness to be monitored in comparison to its competitors.