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# BOLIVIA

## SELECTED ISSUES

November 28, 2016

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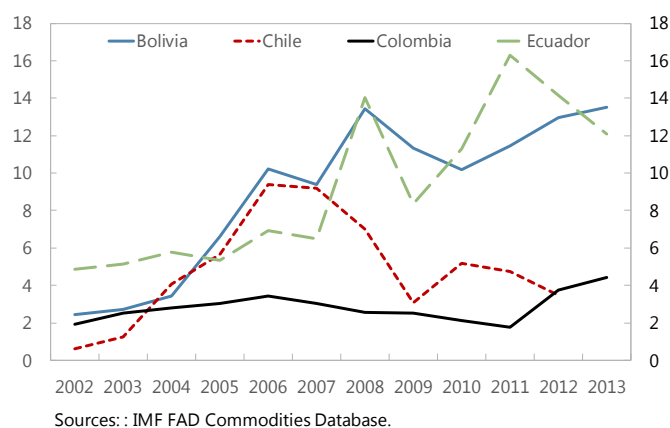
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# EXTRACTIVE INDUSTRIES IN BOLIVIA

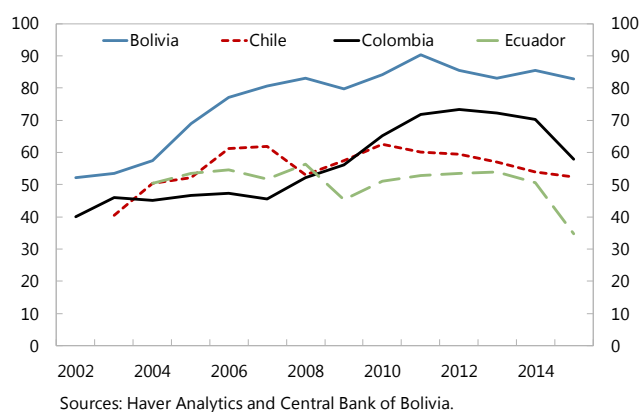
## A. The Importance of Extractive Industries for the Bolivian Economy

1. **Extractive industries play an important role for the Bolivian economy.** In 2015, hydrocarbon and metal mining accounted for a total of about 13 percent of GDP, 80 percent of export revenues and 26 percent of fiscal revenues (down from close to 35 percent in 2014). Figure 1 illustrates the strong growth in hydrocarbon and mining related export and fiscal revenues Bolivia experienced due to large gas discoveries in the late 1990s, higher natural resource prices during much of the 2000s, and changes in extractive sector taxation. Even relative to peer commodity exporters in the region, the importance of the extractive sector for Bolivia stands out.

**Figure 1a. Fiscal Revenues from Natural Resources**  
(In percent of GDP)



**Figure 1b. Natural Resource Exports in Selected LAC**  
(In percent of total exports)



CHL: Copper, silver, iron, gold, molybdenum, lithium, sea salts. COL: Coal, petroleum, ferro-nickel, gold, emeralds. ECU: Crude petroleum. BOL: All minerals and hydrocarbon exports.

2. **Sections II–III of this note take stock of the hydrocarbon, energy, and mineral sectors, while section IV concludes with an overview of policy priorities.** Bolivia is a country with great potential, both in metals and hydrocarbons, but higher investments in exploration are crucial in both sectors. The sections also look at the recent efforts by the government to develop downstream sectors (e.g. petrochemicals). While it is difficult to assess the profitability of some of the projects, they could potentially make a substantial contribution to Bolivian exports by the early 2020s. Financing for these projects and the role of direct central bank credit should be carefully studied given their large scale.

## B. The Hydrocarbon Sector

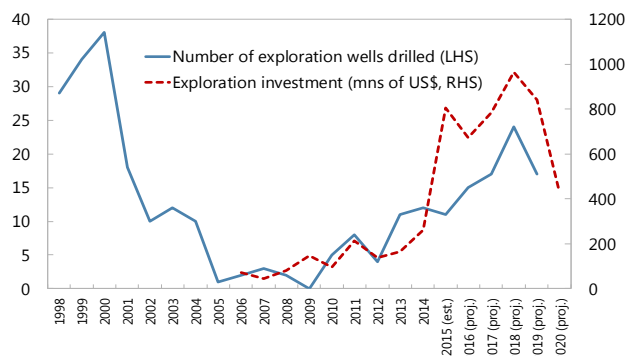
### Reserves, Exploration and Production

3. **In the late 1990s Bolivia discovered very important natural gas reserves.** It was among the single largest discoveries of natural gas in Latin America at the time. The discoveries allowed the country to increase gas production 8-fold between 1999 and 2015, making Bolivia a key gas supplier in the region.<sup>1</sup>

4. **At the same time as production of the *megacampes* discovered in the 1990s was ramped up, exploration activity fell: the last significant discovery (the *Incahuasi* field) was made in 2004.** The lack of exploration is highlighted in Figure 2 which shows how exploratory well drilling (a good proxy for exploratory activity) declined sharply in the early 2000s and has only recovered recently, in line with a pickup in exploration investment. As a consequence, gas reserves have fallen (Figure 3), and Bolivia is now faced with the twin challenges of urgently encouraging exploratory activity to rebuild reserves in a low price environment and stabilizing or even increasing production to meet rising internal demand and contractual obligations with Argentina and Brazil.

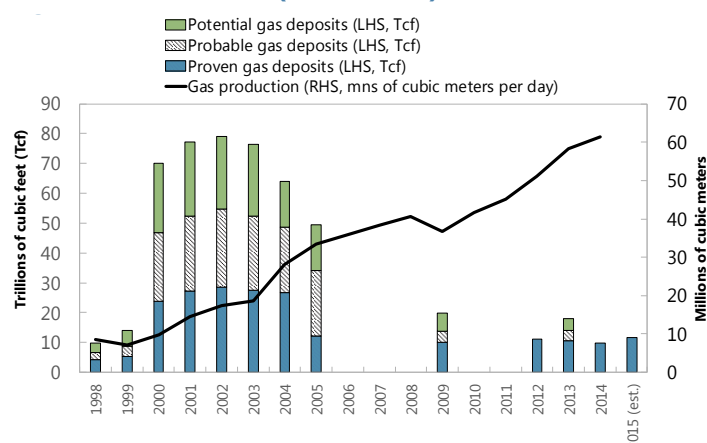
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<sup>1</sup> Oil accounts for a relatively small fraction of Bolivian hydrocarbon production and reserves have roughly halved since 2011 according to the EIA. Current reserves stand at 210 million barrels.

**Figure 2. Hydrocarbon Exploration Activity in Bolivia**

Sources: Yacimientos Petrolíferos Fiscales Bolivianos (YPFB), International Monetary Fund (IMF) and Agencia Nacional de Hidrocarburos (ANH).

Note: Data is for the sector as a whole. Total planned investment for 2016 was US\$ 2,411 million, and exploration investment accounted for roughly 28 percent of total investment. For 2016, the scheduled total investment by YPBF headquarters, YPBF subsidiaries and private operators was 905.6, 942.7 and 562.6, respectively.

**Figure 3. Gas Production and Reserves in Bolivia (1998–2015)**

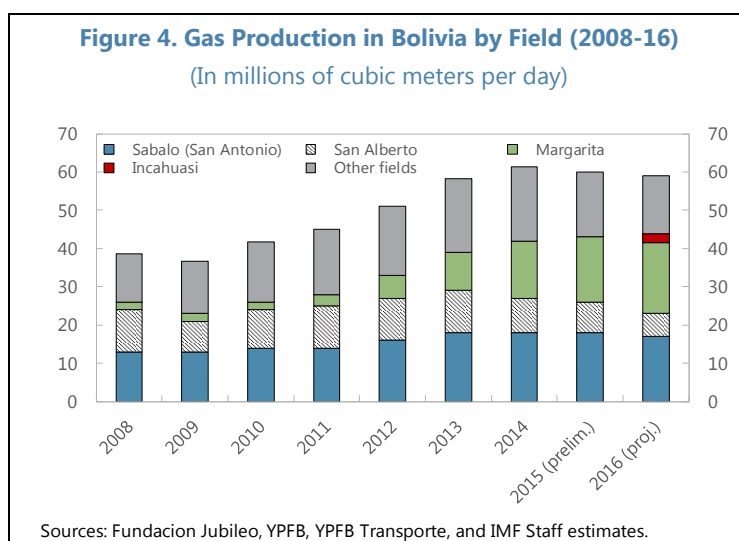
Sources: Camara Boliviana de Hidrocarburos y Energía (CBHE), Energy Information Agency (EIA), YPFB, Instituto Nacional de Estadística (INE), Standard & Poor's (S&P).

Notes: Proven reserves were revised downwards in 2005. For 2012, 2014 and 2015, the figures are estimates from different sources and are not officially certified amounts. For those years no data on probable or potential deposits is available. The next official certification is tentatively scheduled for 2017.

5. **In 2015 and 2016, production from existing fields has started to decline, as some of the megacampes are approaching the end of their production cycle (Figure 4).** In particular, *San Alberto's* production has nearly halved from a peak in 2013 with the decline considered to be

irreversible.<sup>2</sup> Similarly, *Sabalo*, for many years the largest contributor to Bolivian gas production, has plateaued and is expected to start declining over the next few years.

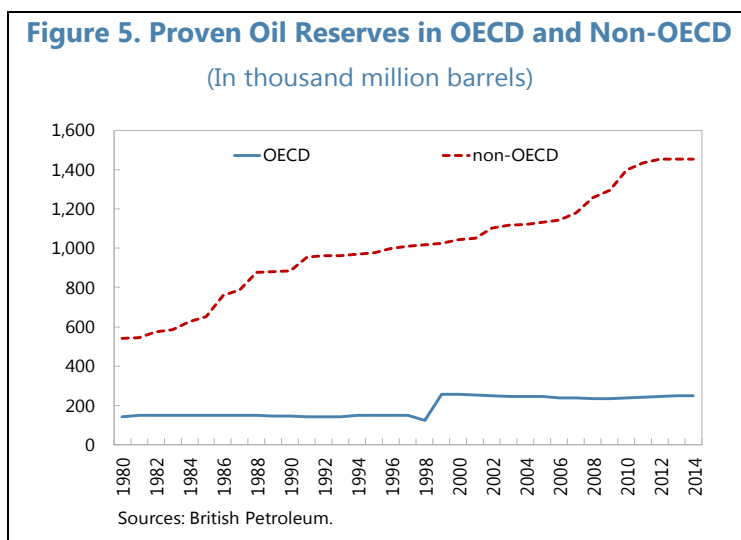
6. **Total production volumes are being supported by the entry into production in August 2016 of the *Incahuasi* field.** *Incahuasi* is expected to produce 6.5 millions of cubic meters (mmcm) per day in 2017 and might eventually increase production to over 13mmcm, becoming a key field. At present, apart from *Incahuasi*, no new major fields are scheduled to come onstream.



7. **Current natural gas reserves would last for roughly 10 years without additional discoveries.** At end-2013, proven gas reserves in Bolivia stood at 10.45 trillion cubic feet (Tcf) with another 7.65 Tcf either probable or potential (Figure 3). As of late 2014, the U.S. Energy Information Administration (EIA) estimates proven reserves at 9.9 Tcf, the reduction being broadly in line with minimal additional discoveries given that production for 2014 was 61.3 Million Cubic Meters per Day (mmcm) or about 0.79 Tcf per year. With constant production and no discoveries current reserves would thus last until sometime in the mid-2020s.

8. **Bolivia remains an underexplored country with vast potential, and recent increases in exploration go in the right direction.** In terms of worldwide hydrocarbon deposits, all theories linked to the idea of reduced reserves (i.e., “peak oil”) have been repeatedly proven wrong. Quite to the contrary, worldwide reserves have in fact continuously grown as progress in technology among other factors has allowed ever more exploration (Figure 5). The authorities are taking the exploration effort seriously, significantly increasing the state oil company’s (Yacimientos Petrolíferos Fiscales Bolivianos - YPFB) investment in exploration. Figure 2 illustrates how exploration activity has picked up recently and how the authorities envisage it increasing further over the coming years.

<sup>2</sup> See Fundacion Jubileo ‘El sector de hidrocarburos hoy’ (2016).



9. **A few large exploratory projects are being developed in Bolivia, which have the potential for large discoveries.**<sup>3</sup> A number of important greenfield exploration projects by three large international players (*Huacareta* by BG-Shell; *Acero* by Total; and *San Telmo* by Petrobras) are in the pipeline. In addition, there is potential for a discovery in the traditional production zone (*Boyuy* and *Boycobo* by Repsol and *Rio Grande* and *Aguarague* by YPFB Andina).<sup>4</sup> All these (and others) have the potential to add to Bolivia's reserves and production.<sup>5</sup> Given that *Boyuy* might be fairly large and is in a traditional zone, it could be the first to come on stream and substantially add to production. Exploratory drilling is scheduled for 2017–18 and production could start as early as 2019 if the drilling is successful. The timeline for the projects in non-traditional zones is significantly longer, with discovery results not to be expected before 2018–19 and production at some point in the mid-2020s if drilling is successful.

10. **However, it is important to stress that exploration is a highly uncertain activity.** For any potential project, luck plays an important role: "No other business so starkly and extremely defines the meaning of risk and reward and the profound impact of chance and fate." (Yergin, 2008). Even drilling in a well-established area (i.e., a wildcat well<sup>6</sup>) can have a probability as low as 10 percent of yielding viable oil, while drilling in less known areas (i.e., a rank wildcat<sup>7</sup>) has an even smaller chance. The high risk of exploration drilling, particularly in trying to find completely new fields, was recently highlighted by the unsuccessful drilling in *Lliquimuni* after years of geological analysis. Each of the

<sup>3</sup> The number of potential fields and sub-fields being explored is large with many of them small. Here we aim to give an overview of the most important ones.

<sup>4</sup> Greenfield exploration (exploration in non-traditional zones with no prior production) have a much longer development period than those in traditional zone given that the complete infrastructure necessary for production (pipelines, plants, etc.) has to be built from scratch.

<sup>5</sup> In total, the exploration envelope encompasses around 35 TCF. Considering the high risk of exploration, YPFB estimates expected total discoveries from this envelope at 7.5 TCF.

<sup>6</sup> A well drilled a mile or more from an area of existing production.

<sup>7</sup> A well drilled in an area where there is no existing production.



abovementioned projects probably has a chance of success of somewhere between 20–30 percent, so that ex ante one would expect perhaps 1–2 of them to come to fruition.

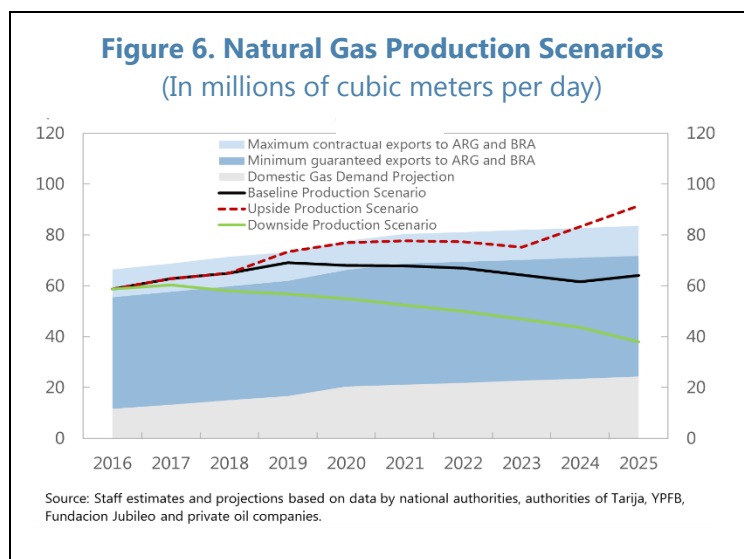
11. **In aggregate, it is uncertain to what degree Bolivia will be able to satisfy growing internal and external demand over the coming decade.** Using all available information on the likely production curve of individual fields, as well as on the exploration pipeline and field extensions expected to come on-stream, three production scenarios for the period 2016–25 were constructed: (i) a baseline scenario; (ii) an upside scenario; and (iii) a downside scenario. The results are shown in Figure 6 together with a projection for internal demand and the contractual minimum and maximum stipulated in the export contracts with Brazil and Argentina.<sup>8</sup>

- Under the baseline scenario, gas production is expected to increase again over the next few years and peak in 2019, before falling back. As the graph shows, even in the baseline scenario, there is a risk that Bolivia will struggle to fulfill the minimum contractual exports while at the same time covering increasing domestic demand, starting in 2021.<sup>9</sup>
- In the upside scenario, the same assumptions as under the baseline apply except that it is assumed that *Incahuasi* produces at the maximum amount currently envisaged, decline in older fields is limited, a new field such as *Boyuy* is confirmed and comes on stream without delays and later on one or two more greenfield discoveries are confirmed. In this scenario, Bolivia can fulfill baseline demand comfortably and even cover (close to) maximum demand most of the time. In the medium-term, Bolivia's ability to replenish reserves and meet growing internal and external demand thus depends to a large degree on the exploratory success of a few key projects.
- The downside scenario assumes accelerating falls in production from existing fields and no new discoveries. It is not a likely scenario but illustrates a lower bound for future gas production.

12. **The key to reducing the probability of a true downside scenario is to sustain and increase exploration investment now.** To guarantee the necessary amounts, efficiency, and know-how, attracting foreign private participation is crucial, and the government should try and create incentives for foreign investors to take as much risk as possible by setting the right incentives and providing an environment conducive to investment.

<sup>8</sup> It is assumed that the Brazilian contract is renewed in 2019 with the same volumes as now. Negotiations on the renewal are currently ongoing. Details of the assumptions underlying the graph can be found in Appendix A.

<sup>9</sup> The subsection on industrialization discusses some of the projects expected to significantly increase domestic gas demand.



## Taxation

13. **The tax burden in Bolivia is high.** The effective royalty rate is 50 percent—an 18 percent royalty plus a 32 percent direct tax on hydrocarbons. Such high royalty rates act as an implicit depletion incentive, as it discourages exploration and development in the sector. A given field has to be profitable enough to transfer 50 percent of its gross revenues to the state, recoup costs, pay YPFB its stake, and then generate a profit in order to be commercially viable. Some estimates place the average effective tax rate for certain projects at up to 93 percent (including state taxes, state participation and other levies), one of the highest in the world.

14. **A new investment law (December 2015) and an accompanying decree (July 2016) were recently passed to try and incentivise much needed FDI in the sector.** The law provides incentives for crude oil and ultra-light oil (i.e., condensates) in terms of a monetary value, on a dollar per barrel of production basis, which may be paid in cash or in tax credit notes.<sup>10</sup>

15. **The law provides for the creation of a hydrocarbon exploration and exploitation investment promotion fund to finance the cash incentives.** To this end, 12 percent of the revenue collected from the IDH, before any distribution to local governments, will be deposited in a designated account at the Bolivian Central Bank for the newly created fund.<sup>11</sup> Any positive balance in the account after incentives are paid will be distributed to the local government beneficiaries of the IDH in the proportions provided for in the law. On the other hand, if the balance in the fund is insufficient to finance the incentives, the government will issue tax credit notes. Table 1 presents a summary of the incentives for different hydrocarbons and field types.

<sup>10</sup> Gas production is indirectly stimulated given that condensates and gas are usually produced together.

<sup>11</sup> Article 351 (IV) of the Constitution prohibits the reimbursement of taxes and royalties paid by private companies arising from exploitation of natural resources. However, under most contracts taxes and royalties are paid by YPFB.

16. **The incentives could be interpreted as an attempt to reduce the IDH rate for eligible projects.** Since 12 percent of the proceeds from the IDH will be used to finance the incentive, the IDH is effectively reduced from 32 to 28.16 percent for eligible projects.<sup>12</sup> Moreover, the effect of the royalty, at a rate of 18 percent, and the IDH, both of which are imposed on the same tax base, will decrease from 50 to 46.16 percent. It is important to note, however, that the fiscal effect of the incentive could be larger as the law provides for the option to use tax credit notes when 12 percent of IDH proceeds is insufficient to finance the incentives. Private sector investors agreed that the law offers an improvement in incentives for production (and is thus likely to stimulate maximum production from existing fields). However, it is much less clear whether it can do much to stimulate exploration.

17. **Bolivia's high effective royalty rates may be adversely affecting private sector investments.** Unless a project is profitable enough to transfer 50 (or 46.16) percent of its gross revenue to the state, recover its costs, share its revenues with YPFB, and achieve its required rate of return, the project will not be developed. The two main effects of such an implicit depletion policy, especially in an environment of low prices, are that: (i) investment in exploration and development is reduced; and (ii) large quantities of known resources are left in the ground, undeveloped. Since the reduction in the effective royalty rate is relatively minor, the measure is unlikely to significantly attract additional investment into the sector.

Table 1. Oil and Condensate Incentives					
	Crude Oil Production		Condensate Production		
Zone of field location	Traditional	Non-traditional	Traditional		No-traditional
Field maturity	New and existing		New	Existing	New
Minimum incentive	\$30/bbl	\$35/bbl	\$30/bbl	\$0/bbl	\$35/bbl
Maximum incentive	\$50/bbl	\$55/bbl	\$50/bbl	\$30/bbl	\$55/bbl
Payment mechanism	Tax credit notes	Cash			
Term limit	No limit		20 years	10 years	25 years
Start of exploration work	No requirement		1 <sup>st</sup> 4 years of contract	Jan 2019	1 <sup>st</sup> 5 years of contract
Source: IMF staff based on 2015 hydrocarbon incentives law.					

<sup>12</sup> That is,  $0.32 \times (1 - 0.12) = 0.2816$

## Industrialization Projects

### *Downstream products*

18. **A cornerstone of the government's growth agenda is the development of a downstream hydrocarbon sector.**<sup>13</sup> Table 2 lists the key projects overseen by YPFB while Table 3 lists additional projects which are not yet at an advanced stage. As a pre-cursor to its industrialization projects, the government built two liquid gas separation plants which extract butane and other elements from natural gas – thereby reducing rich natural gas into more normal natural gas but giving crucial inputs for the production of fertilizers and plastic, for example.

19. **Two liquid gas separation plants (*Rio Grande* and *Gran Chaco*) as well as a mini LNG (liquefied natural gas) plant**<sup>14</sup> **have been operational since early 2016.** The latter two have been inaugurated recently (August 2015 and February 2016, respectively). While the LNG plant will mainly affect internal energy consumption, the *Gran Chaco* plant could provide a boost to exports and provide inputs for other downstream products. Currently, the *Gran Chaco* plant is operating at only about 30 percent of capacity.

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<sup>13</sup> To this end, the “Empresa Boliviana de Industrialización de Hidrocarburos (EBIH)” was created with an initial 300mn USD loan from the Central Bank. While the EIBH was meant to directly oversee some industrialization projects, in practice it seems that its role has been very limited and YPFB is responsible for all important projects.

<sup>14</sup> Natural gas is cooled to extreme low temperature to make it liquid at atmospheric pressure and -160 ° C . Subsequently it is transported in cryogenic tanks to different parts of the country in which small regasification stations are installed. This mini-LNG project is essentially an attempt to extend the number of households with access to natural gas.

Table 2. YPFB Executed Industrialization Projects

YPFB executed project	Progress	Estimated Start of Production	Projected production	Other information	Concerns
Rio Grande liquid separation plant	Operational as of August 2013	Production started August 2013	The plant purifies raw natural gas. As a side product various substances with commercial use are gained. Processes roughly 5.6 millions of cubic meters per day.	80% of production for internal use. US\$ 160 million financing from BCB.	
Gran Chaco liquid separation plant	Operational as of August 2015	Production started August 2015	The plant purifies raw natural gas. As a side product various substances with commercial use are gained. Can process as much as 32 millions of cubic meters per day.	Cost of project US\$688 million. Financed with BCB credits. Exports to Peru and Paraguay of LPG. Ethane and LPG for internal use as an input for downstream industry.	Government expected (in 2014) that net profits would be US\$ 400 million per year. But current export revenues are only about US\$ 60 million. This could rise to about US\$ 120 million over a few years.
LNG	Operational as of February 2016	Production started in February 2016		Cost of project US\$445 million (205 for the factory and 220 for distribution networks). Part BCB financed. The project will allow delivery of gas to areas of the country not served well previously. Aim is to push domestic energy use towards natural gas.	Supposedly US\$ 40 million revenues per year but not clear from whom
Ammonia and urea plant	Close to completion as of August 2016 (had been scheduled for early 2016)	Early 2017 but delays in railway construction (only 30-40% complete) could pose significant problems.	420,000 metric tonnes of ammonia and 650,000 metric tonnes of urea. 80% expected to be exported.	Cost of project 955 million USD, financed by CB loans to YPFB.	No information on commercial terms for sale of products
Polyethylene plant	Construction scheduled to start in early 2017	Late 2021	600,000 metric tonnes of polieethynel and 200,000 metric tonnes of propylene	Projected cost of project is 2,089 million USD with 1,847 million to come directly from the CB. There is currently no public information on market studies which justify the project.	No information on commercial terms for sale of products. No information on market studies and cost-benefit analysis..

Sources: YPFB, Fundacion Jubileo, BNamericas, and press reports.

20. **The so-far completed projects are starting to positively impact Bolivia's trade balance, albeit marginally.** Since 2013 Bolivia has been self-sufficient in LPG. In 2014, 66 percent of total Bolivian LPG production was used to satisfy internal demand. In 2015 LPG export revenues, with *Gran Chaco* operating at less than 30 percent, were roughly US\$40 million and preliminary data indicate that a slightly larger amount is expected for 2016 (exports of roughly 200,000 metric tons to Paraguay—78 percent of total exports—and Peru). If gas production volumes allow, YPFB expects *Gran Chaco* to operate at 60 percent by 2019 and 85 percent in 2020, generating export revenues for LPG sales of roughly US\$110 million per year.

21. **The two largest projects are still being built.** The two large industrialization projects currently being developed and which can be expected to be completed over the next few years, are an Ammonia and Urea plant (fertilizers) and a Polyethylene plant (plastic). At roughly US\$900 million and US\$2,100 million, respectively, they are the two most expensive projects being realized in Bolivia to date. Both projects will be financed by direct central bank lending to YPFB.

**Table 3. EBIH Executed Industrialization Projects**

EBIH Projects	Progress
Tuberías y accesorios para gas natural – El Alto	Cost estimated at US\$ 14 million. Project to be initiated during 2017.
Planta Petrocasas – Caracollo	The Petrocasas project calls for the construction of a plant that will produce PVC panels to be used in the construction of low-cost polyethylene homes. Technical and environmental study completed. Not clear when completion expected.
Complejo Petroquímico del Metanol	Early phase of the project. Market studies underway. Estimated cost roughly 700mn USD. Gross revenue per year could be of the order of 125mn USD.
Planta de Producción de PVC	Early phase of the project. Estimated cost of 525mn USD.
Planta de Producción de Aromáticos	Early phase of the project. Funds being collected for extending the PVC market study.
Planta de Óxido de Etileno – Glicoles	Early phase of the project.
Planta de Producción Cloro – Soda	Additional funds being collected to finance the engineering study.
Planta de Producción de Acrílicos	Early phase of the project.

Sources: Fundacion Jubileo, EBIH, BNamericas, and press reports.

22. **YPFB estimates that the Ammonia and Urea plant will be completed by early 2017.** It is expected to be operational very shortly after completion and will generate export revenues of roughly US\$120 million in 2017, which would rise to US\$190 million by 2019 when the plant operates at full capacity. However, the location of the plant (in Cochabamba, far from the primary potential export market Brazil) has raised some doubts over its viability as an important source for export revenue. To connect the plant to its export market, an expensive railway is being built.

23. **The Polyethylene plant will start construction in 2017 and is meant to be operational by 2021.** Given the size and cost of the project, some doubts have been raised about its commercial viability with export markets not yet guaranteed. YPFB projects export revenues of roughly US\$700 million should the plant operate at full capacity with guaranteed export markets. One concern for all downstream projects is that they will substantially add to internal gas demand. A fairly conservative estimate for the above listed projects is that they will add 4 million cubic meters per day to internal demand.

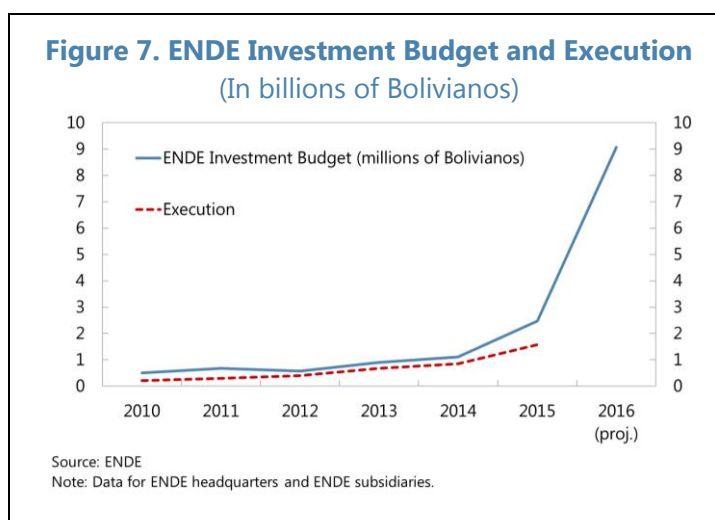
### ***Electricity***

24. **The authorities have invested substantially in electricity generation to satisfy growing internal demand and to transform gas into a higher value export via new thermoelectrical plants.**<sup>15</sup> As a result of these projects, electricity generation is now skewed more heavily towards thermal energy than in the past (in 2015, thermal energy accounted for 70 percent compared to 53 percent in 2006) and generating capacity has increased substantially since 2009. Three thermoelectric plants have been completed over the past years, adding a total of 470 MW of generating capacity—an increase in thermal electricity production by 75 percent.

25. **Going forward, the authorities envisage rotating the energy supply back towards hydroelectricity while further expanding energy supply.** To achieve this, investments are projected to be increased sharply, with the national electricity company's (ENDE) investment budget set at Bs 9 billion for 2016 (see Figure 7), 84 percent of which are directed towards increasing generation capacity.

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<sup>15</sup> The electricity sector was nationalized effective as of 1, May 2010.



26. **The authorities envisage both demand growth and very substantial growth in supply.** They envisage supply growth excluding the hydro mega-projects to cover internal growth in demand and generate some excess supply to be exported to Argentina. As Table 4 highlights, most projects being implemented have direct financing initially coming from the central bank to ENDE. Total costs over the next five years are estimated at US\$2,500 million. Much of the investment will be done by ENDE subsidiaries.

**Table 4. Energy Generation Projects Recently Completed or in Construction**

Energy generation: recently completed or in construction	Progress	Estimated Start of Production	Project capacity	Estimated cost	Other comments
Proyecto Termoelectrico de Entre Rios	Completed	Summer 2010	110 MW		
Planta Termoelectrica del Sur	Completed	2014	160 MW		
Planta Termoelectrica Warnes	Completed	Autumn 2015	200 MW		
Proyecto Eolico Qollpana	In Construction	Summer 2016	24 MW		
Proyecto Hidroelectrico Misicuni	In Construction	2017	120 MW	US\$ 137 million	Financing from IDB and TGN
					Financing from BCB.
Proyecto Planta Solar Uyuni	In Construction	2017	60 MW	US\$ 94 million	
Proyecto Planta Solar Oruro	In Construction	Summer 2017	50 MW	US\$ 54.5 million	Financing from FINPRO
Proyecto Hidroelectrico San Jose	In Construction	Apr-18	124 MW	US\$ 245 million	Financing from IDB and CAF
Ampliacion Planta Termoelectrica Entre Rios	Contract signed	Late 2019	380 MW	US\$ 463 million	Financing from BCB.
					Financing from BCB. Transmission line to Argentina (Yaguacua-Tartagal-San Juancito) being built during the same time
Ampliacion Planta Termoelectrica del Sur	Contract signed	Late 2019	320 MW	US\$ 463 million	
Ampliacion Planta Termoelectrica Warnes	Financing from BCB obtained	Late 2019	280 MW	US\$ 406 million	Financing from BCB.
Proyecto Hidroelectrico Miguias	In Construction	2020	200 MW	US\$ 448 million	Financing from BCB.
Proyecto Geotermico Laguna Colorada	In Construction	2021	100 MW		Pilot project with 5MW capacity to be completed by 2017

Source: ENDE and Vice-Ministry for Electricity.

27. **The largest projects over the next few years are all thermal energy projects which will increase internal demand for gas further.** A conservative estimate suggests additional demand of about 3 million cubic meters per day, even though the authorities believe that enhanced efficiencies will completely offset the greater generation.

28. **For the medium-term, it is possible to make an informed projection on the demand-supply balance and the potential for limited exports.** Figure 8 shows time series of energy demand and supply for Bolivia. Using those projects which are already under construction or



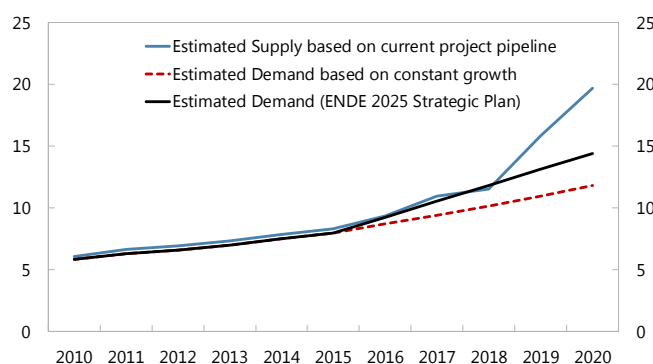
scheduled to start construction soon and be completed by 2020, and assuming all projects are completed on time, a projected supply schedule for 2016–20 was constructed. The demand was projected using the authorities' projection for 2016 and assuming a growth rate of 7 percent thereafter (average for 2011–16).<sup>16</sup> As an alternative, the demand growth assumed in ENDE's strategic plan was also plotted (see Table 5).

**Table 5. Projected Increase in Demand (ENDE Strategic Plan)**

ENDE STRATEGIC PLAN Demand Increases in MW	2016-20	2020-25	2016-25
<b>Estimated Increase in Electricity Demand to achieve full coverage by 2025</b>	<b>71</b>	<b>74</b>	<b>145</b>
<b>Estimated Increase in Electricity Demand for agroindustrial sector development</b>	<b>3.7</b>	<b>0.6</b>	<b>4.3</b>
<b>Estimated Increase in Electricity Demand for industrial development</b>	<b>87</b>	<b>134</b>	<b>221</b>
of which Planta industrial Kallutaca	14	0	14
of which Febrica de cemento Quiburi	3	2	5
of which empresa de aluminio Bolivia	1	0	1
of which Fabrica de cemento Caracollo	3	2	5
of which Fabrica de cemento Tacamba	20	0	20
of which Parque industrial Oruro	15	0	15
of which other	31	131	162
<b>Estimated Increase in Electricity Demand for mining projects</b>	<b>181</b>	<b>98</b>	<b>279</b>
of which Mutun	98	98	196
of which lithium	39	0	39
of which other	44	0	44
<b>Estimated Increase in Electricity Demand for transport projects</b>	<b>255</b>	<b>0</b>	<b>255</b>
<b>Estimated Increase in Electricity Demand for SIN - SA inetconnection and organic growth</b>	<b>389</b>	<b>499</b>	<b>888</b>
<b>Total</b>	<b>986.7</b>	<b>805.6</b>	<b>1792.3</b>

Source: ENDE Strategic Plan.

**Figure 8. Bolivia Energy Supply and Demand Projections**  
(In millions of MWh)



Sources: ENDE, Vice-Ministry of Electricity, CNDC, and IMF staff estimates.

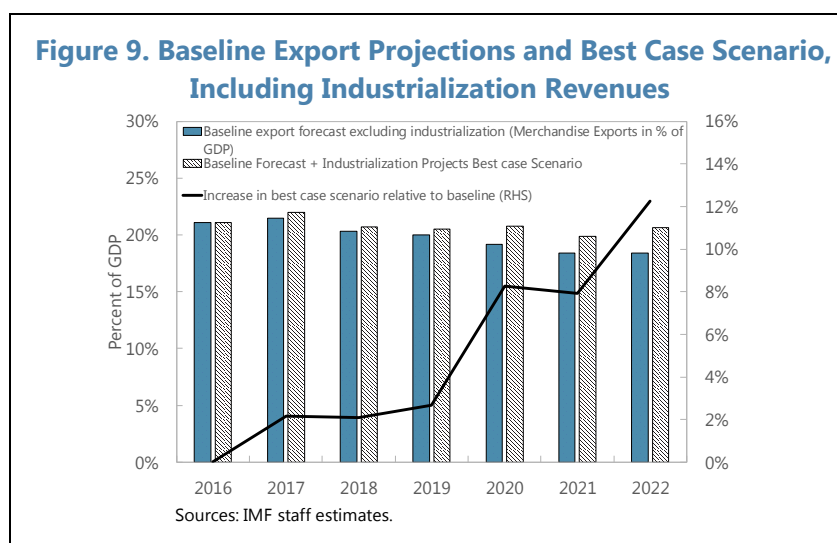
29. **By 2020 a fairly substantial excess supply capacity of around 1000 MW is envisaged.** This excess (thermal energy) could potentially be exported (an interconnection is currently being built and also scheduled to be ready by 2019) and could lead to export revenues of around

<sup>16</sup> A MW is a unit of power while a MWh is a unit of energy. One MWh is one MW of energy flowing for one hour. To convert available capacity (measured in MW) to actual energy production (measured in MWh) the following approximation (which roughly holds historically in Bolivia) is used: 1MW of available capacity produces 6,370 MWh of electricity per year.

US\$500 million per year. Given the uncertainty surrounding completion of projects on time, the above figures would appear to be upper bounds, however.

30. **Longer-term, the authorities have a portfolio of ambitious hydroelectric projects, which would require investment of over US\$10 billion.** Electricity produced from the hydro mega-projects would then be used for large-scale electricity exports. The horizon for these huge projects is not before 2025, and their success is contingent on a number of factors (signing of agreements with neighbors, huge investments, successful feasibility studies, environmental concerns, etc.).<sup>17</sup>

31. **In a best case scenario, industrialization projects (electricity and petrochemicals) could increase export revenues by over 10 percent by 2021.** It is hard to assess the prospects for some of the projects (both on the downstream hydrocarbon and the electricity side) given the difficulty of assessing potential export markets, construction progress, the availability of natural gas, and uncertainty related to price developments. Figure 9 shows a best case scenario in terms of export revenues from downstream hydrocarbons and electricity exports, taking the authorities' projections for those projects which are currently being implemented.



## C. The Mineral Sector

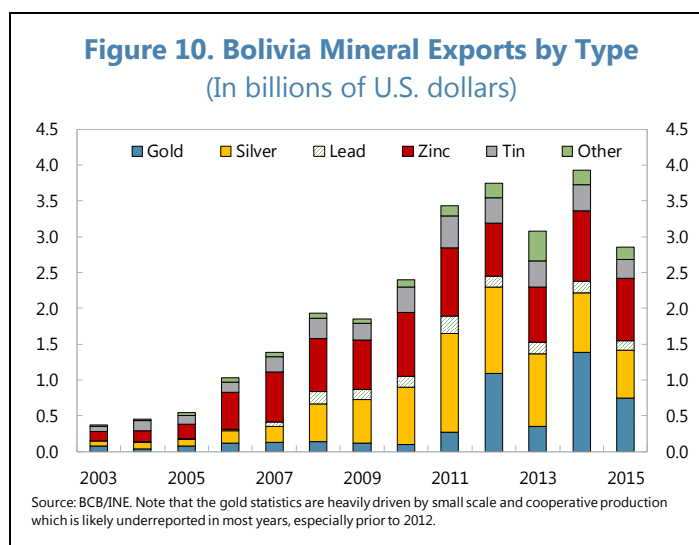
### Reserves, Exploration, and Production

32. **Minerals are Bolivia's second largest export item.** The main minerals and metals produced in Bolivia are silver, zinc, tin, and gold. In 2014, mining generated export revenues of close to US\$4 billion, falling to US\$2.8 billion in 2015 due to lower prices and volumes. Export values have risen dramatically over the last 15 years (Figure 10), but most of the increase in value is due to higher prices, rather than quantities.

<sup>17</sup> For the Cachuela Esperanza project a contract with Brazil was signed in Spring 2016 to conduct a joint feasibility study.

33. **There are currently four relatively large privately operated mines in production in Bolivia, in addition to smaller private projects, the state-owned mines, and the cooperatives.**

The cooperatives account for up to 30–40 percent of total production value, mostly in gold production. Since cooperatives do not engage in exploration activity and only pay minimal taxes, their importance for the sector and the economy takes place largely through their impact on employment, which was estimated at over 100,000 workers in 2012. Aside from the cooperatives, output growth came nearly exclusively from the entry into production of a large mine at San Cristobal (in 2007–08), which produces zinc, lead and silver. The mine had been producing partially since the 1980s, but the steep increase in international prices made it viable to bring it to full capacity.

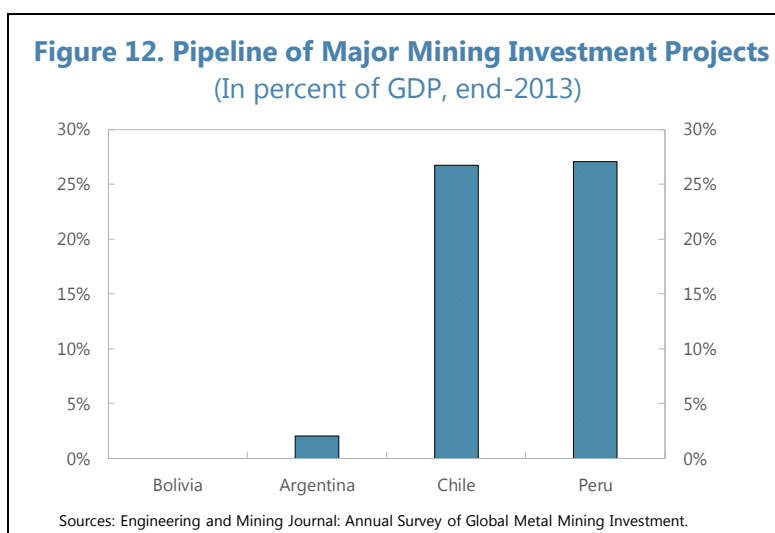
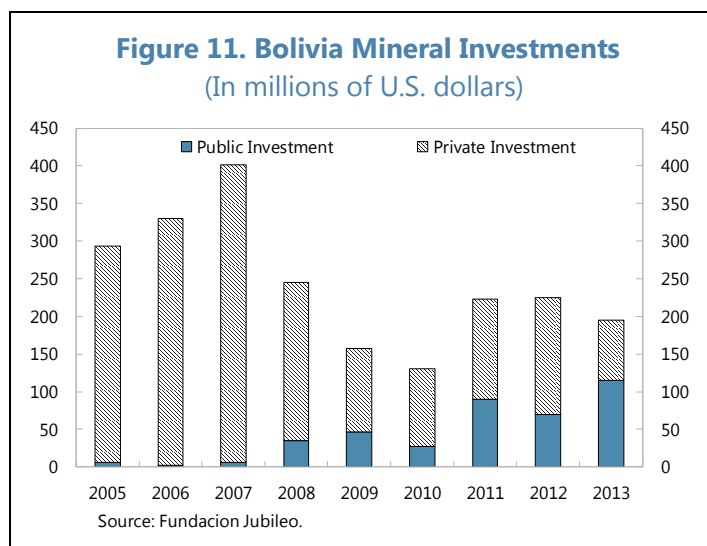


34. **Due to a high tax burden and perceived uncertainty over the government's policy, investment in the sector has been very low over the past years.** The slightly higher numbers for 2005–07 are linked to the final stages of the development of the *San Cristobal* mine. Since then, private investment has virtually come to a halt, except for minimum outlays for existing projects (Figure 11). Similarly, while public investment has picked up slightly, the absolute level is still very low. In comparison, other mineral rich countries in Latin America (notably Chile and Peru) have become key destinations for mining investment (Figure 12).

35. **As a consequence, exploration activity over the past years has not delivered any substantial results.** The last discovery was the *Maliku Khota* silver mine (in 2006).<sup>18</sup> According to an annual survey of mining companies conducted by the Fraser Institute, Bolivia ranked in the bottom 10 percent of locations in terms of overall investment attractiveness in the years 2011–13. While the ranking recently improved somewhat, Bolivia remains at a position of 95 out of 109 in terms of the respondent's policy perceptions. The only exploration project currently under discussion is the potential of a new deposit close to *San Cristobal*. The company is expected to make a decision on

<sup>18</sup> The mine was being developed by a Canadian company, but after unrest the government nationalized the mine in 2012.

whether to go ahead in the next 2–3 years. Given that true large-scale mines have a development period (after discovery) of up to 20 years and can easily require over US\$1 billion of investment, increasing mining exploration and setting incentives for FDI in the sector should be absolute priorities.



36. **The only three unexploited, important, and currently known deposits are all under the control of the state.** They are the iron ore mine, *Mutún*, the lithium and potassium reserves in *Salar de Uyuni* and the silver mine, *Malku Khota*. All three deposits constitute potential world-class mines but require very large investments and know-how which might be beyond the reach of the state company COMIBOL.

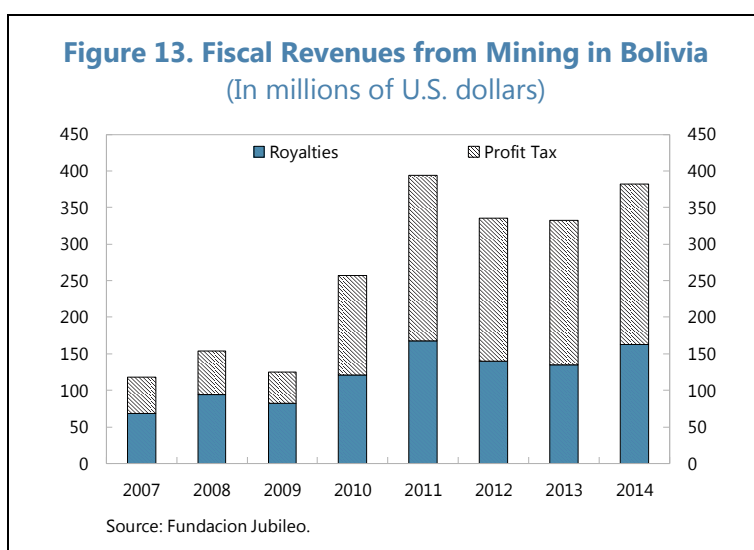
- **Mutún:** It is estimated to contain 40,000 million tonnes of 50 percent grade iron ore which might in fact make it the single largest iron ore mine the world. However, due to the infrastructure requirements and location, it is unlikely that the mine is viable at current prices. Some estimates indicate that even at prices of US\$130/tonne of iron ore (compared to current

prices of around US\$60–70/tonne), the full-scale development of *Mutún* was not viable. Major factors complicating the development are the need to build a mine-specific power station of 100–200MW and the need for a railroad to the coast to be able to export the huge quantities of iron ore. The government started to produce small quantities of iron ore at *Mutún* in 2013. An investment of at least US\$2 billion would likely be necessary to make substantial progress and the time-horizon would be sometime in the mid-2020s. In the event that *Mutún* could be fully developed, it would likely offer a huge boost to exports (of as much as US\$3.5 billion per year).

- **Salar de Uyuni:** The reserves contain over half of the world's lithium reserves as well as very sizeable potassium reserves. This project requires very large investments but completion appears more likely than in the case of *Mutún*. US\$1 billion credit line (from the central bank) is to be invested by 2019. In August 2015, a contract with a foreign company was signed to build a lithium carbonate plant. Recent progress appears to have been fast, with potassium salt production to begin by 2019 and lithium carbonate production to start by 2020. Once operational, expected revenue could be around US\$200 million per year.
- **Malku Khota:** *Malku Khota* is currently under arbitration. Disagreement between the private operator of the mine and local communities had led to violence and the mine was subsequently nationalized. Currently, it is not clear what the exact progress in the arbitration process is.

## Taxation

37. **Despite a relatively high government take, mining generates substantially less fiscal revenues for the state than do hydrocarbons.** The two main types of revenues are a royalty applied directly to revenues as well as the standard corporate income tax with an increased rate relative to other sectors. Total fiscal revenues from mining were only slightly below US\$400 million in 2014 even though they more than doubled over the past years (see Figure 13). Nevertheless, the government take in Bolivia is relatively higher than in most peer countries.



38. **The government approved a new mineral and metallurgy law in 2014.** The fiscal regime proposed in the new mining law retains most of the features of the previous regime. The new regime comprises: (i) “patents” or surface rental fees; (ii) sliding scale royalties linked to the price of minerals; (iii) the standard corporate income tax (CIT), a CIT surcharge that is triggered when mineral prices are higher than certain specified thresholds; (iv) and a dividend withholding tax on distributions to non-residents.

39. **The law introduces a new type of association contract in which the state participation should be at least 55 percent.** These contracts are signed by the state mining company and a private investor. The state participation is carried by the contractor through the exploration phase. If the project advances to an exploitation phase, the state has to repay its share of exploration costs.

40. **The level of state participation is very high, especially for mining projects.** Therefore, association contracts are likely to be attractive only in the case of highly profitable projects. The law provides for a competitive bidding process when the state wants to develop a project through association contracts. This is a welcome step, although the specific details are left to be defined prior to the bidding process.

## Industrialization

41. **Industrialization projects in the mineral sector are more limited than in the hydrocarbon sector, but lithium batteries could potentially provide an important boost to exports.** A number of smaller projects were launched by state-owned COMIBOL. Among them, a rehabilitated bismuth refinery and a copper smelter in *Corocoro* inaugurated in October 2009. The two headline industrialization projects linked to the mining sector are the development of a steel mill in *Mutún* and the production of lithium batteries.

- For the steel mill, a contract was signed with a Chinese company in March 2016 to build the mill over the coming 30 months. The cost was set at US\$422 million, 85 percent to be financed by an international loan. The mill is scheduled to process 650,000 tonnes of raw iron ore (an amount that could be produced by the iron ore mine even without full-scale operations). It will produce 250,000 tonnes of sponge iron (86,000 to be exported) and 150,000 tonnes of steel for construction, competing with Argentinian and Brazilian imports for the US\$400 million domestic steel market.
- Production of lithium batteries would deliver a large boost to exports but is facing important technological and human capital constraints. Bolivia will most likely have to associate with a foreign partner for the production to go ahead.

## D. Policy Priorities in Bolivia

42. **Policy priorities in the extractive sector center around the need to stimulate investment, and in particular, exploration investment.** More generally, efforts should be made in reducing legal uncertainties, strengthening institutions, and bringing wage growth in line with

productivity growth. On the taxation side, a number of concrete options should be explored to make Bolivia a more attractive location for extractive sector FDI.

43. **In the hydrocarbons sector, as suggested by previous IMF TA advice, a number of options exist to attract additional FDI.** One option for Bolivia would be to maintain the existing royalty system, but convert the IDH into a profit-based tax for new projects. Bolivia could also introduce incentives directly linked to the level of investment in the sector. For example, investment in exploration could be immediately expensed for IDH purposes, while an accelerated depreciation scheme could be made available for development expenditures. An alternative would be to offer a one-time uplift for exploration and development costs, allowing the investor to recover a higher amount than what was originally invested. Yet another option would be to allow expenditures from failed exploration to be deducted against revenue from successful projects for IDH purposes.

44. **The current price policy for hydrocarbons sold to the domestic market could be reviewed.** The current domestic price of US\$27.11/bbl was last modified in 2004, and warrants review. A price that better reflects the international price for crude oil and adjusts automatically to changes in the global market may be desirable, especially if the aim is to encourage investment in the sector.

45. **In the metal mining sector, most of the recommendations made by the IMF in previous TA missions continue to be relevant.** In particular, a number of adjustments to the royalty system could be made (e.g., the royalty system could be simplified by introducing fixed, single rates for different minerals; the mineral price structure upon which royalties are determined could be reviewed; the royalty base could be modified to take into account the actual value of the mineral in Bolivia, either FOB or at the mine gate; and the royalty rate reduction incentive for minerals processed in, or sold to, the domestic market could be reviewed). Measures to directly stimulate investment, such as accelerated depreciation schemes, could be considered. Lastly, the CIT surcharge linked to mineral prices could be replaced with a profit-based instrument that responds to underlying profitability, and the dividend withholding tax rate on distributions to non-residents could be reduced.

46. **On the industrialization side, projects should be carefully analyzed and evaluated.** Cost-benefit studies of individual projects should be undertaken to assess whether they are economically viable using market-based prices for inputs. Additionally, projects should be chosen to maximize positive spillovers to the rest of the economy, and the opportunity cost of the large investments should be assessed.

## Appendix I. Details on the Assumptions Underlying the Natural Gas Production Scenarios

The assumptions on gas production volumes draw on discussions with the Ministry of Hydrocarbons, YPFB, private oil and gas companies, the Bolivian hydrocarbons chamber CBHE, Fundación Jubileo as well as private analysts. Additionally, some assumptions are drawn from sectoral studies produced by the World Bank, Fundación Jubileo, and the Brazilian Industry Association (CNI).

**Baseline Scenario:** Production in *San Alberto*, *Sabalo* and *Itau* is stabilized for the next three years. They then start declining at 5 percent per year for *Sabalo* and 10 percent per year for *Itau* and *San Alberto*, which are already showing greater strain. By 2025, *San Alberto* and *Itau* are not viable anymore and stop producing. *Margarita*'s production is flat for 7 years and then starts to decline at 5 percent per year. *Incahuasi* is ramped up as planned with the following phases coming onstream: fourth well is connected in 2018, full second phase in 2019. One new discovery is confirmed over the next years and comes online in 2024 (e.g. *Huacareta*).

**Downside Scenario:** Difference with baseline: *San Alberto* and *Itau* continue to decline at 5 percent per year. Decline accelerates to 10 percent per year in 2020. *Margarita* is stable for only 4 years and then declines by 5 percent per year. Decline accelerates to 10 percent by 2023. Other fields decline at a rate of 10 percent from 2016. The second phase of *Incahuasi* does not come onstream. No new fields are discovered in time to begin production by 2025.

**Upside Scenario:** Difference with baseline: output of small fields is stabilized after 2016. *Boyuy* field is confirmed, starts production in 2019 and reaches 9 million cubic meters per day by 2020. Two new greenfield discoveries are confirmed (e.g. *Huacareta* and *Acero*) and come onstream by 2024.

Lastly, the domestic gas demand projections assume 5 percent organic growth per year (a conservative assumption given historic growth of 7–8 percent). Additionally, the following gas demand for large projects is assumed:

Gas Consumption by Project	MMcm per day
Rio Grande	0.3
Gran Chaco	1.5
Urea	1.3
LNG	0.3
Termoelectrica del Sur	2



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