Lao PDR Development Report 2010

Natural Resource Management for Sustainable Development

BACKGROUND PAPER
Economic Assessment of the Future of the Lao Mining Sector

This paper has been prepared by Morten Larsen. It is partly based on advisory work prepared by Jennifer Cook Clark and separately delivered to the Ministry of Energy Mines in 2008, and on the advisory work conducted by Robert Parsons which was presented to Government of Lao PDR in September, 2008. The review of metals markets relies on work prepared by Delphin Tshimena and Craig Andrews.

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Acronyms

ASM	Artisanal and Small-scale Mining
AusAID	Australian Government Overseas Aide Program
DGEO	Department of Geology
DOM	Department of Mines
ETR	Effective tax rate
GOL	Government of Lao PDR
IDA	International Development Association
JORC	Joint Ore Reserves Committee
LXML	Lane Xang Minerals Limited
MEM	Ministry of Energy and Mines
MEPA	Mineral Exploration and Production Agreement
NT2	Nam Theun 2
PBM	Phou Bia Mining
PDR	People's Democratic Republic
SLACO	Sino-Lao Aluminum Corporation
TA	Technical Assistance
UNIDO	United Nations Industrial Development Organization

Background

Lao People's Democratic Republic enjoys a strategically advantageous location to further develop the mining industry which has already thrived over the past decade. The country is located in the Greater Mekong Sub-region where numerous geological belts with very promising mineral potential for commercial extraction have been located in recent years. A number of these discoveries have already developed to become successful international industrial-scale mine operations, thus confirming the potential for broad-scale commercial extraction as the mineralizations get further explored. Two mid-size copper and gold exploitations have commenced operation over the past six years, both of which with substantial success.

There are also other key resources that could help sustain a dynamic mining industry with high value addition in the future. In addition to prospective mineralizations, other crucial resources, including energy and water, are accessible within the country thanks to the Mekong River and its tributaries which hold hydropower potential in excess of 20 times the current power production. This means that the economy could potentially sustain processing industries which would add value to the primary resource value and generate additional economic activity in downstream industries of the value chain (the recent commissioning of a copper wire manufacturer is one of the first steps towards extending the value chain). Notwithstanding, a complete value-chain of up and down-stream industries will take years, if not decades, to develop considering the absence of a national history of mine operations. Still, Lao PDR has reasonably good infrastructure to accommodate import of required supplies as well as exportation of mineral products. For minerals that are shipped in bulk, and where transportation costs are a key parameter of competitiveness, Lao PDR's proximity to the commodity-hungry markets in China and India may provide a competitive advantage that can be exploited in the years to come.

Indeed, Lao PDR has experienced a short but eventful history of industrial mining as production value has multiplied close to hundred-fold from around US$ eight million in 2002 to US$ 600-700 million in 2007 and 2008. Government revenue from taxes, royalties and fees exceeded US$ 120 million in 2007 and approximately US$ 90 million in 2008, adding some 20 percent to total government receipts (excluding grants). Yet, the industry has not escaped the abrupt global downturn of commodity prices, nor have the investors been able to realize the ambitious expansion plans that were in the pipeline mid-year 2008. The industry's revenue streams started to fall dramatically in the second part of 2008 and is expected to remain suppressed for subsequent years given lower world-market prices, cut-backs in production and delayed investment.

Despite the economic slowdown which accelerated during 2008, investor interest in the Lao mining sector remains strong, expressed in the about 150 active licenses to exploration and mine operations. On the other hand, actual investment in exploration activities, which are so crucial for sustained mining, has seen a substantial contraction. This will inevitably delay what appeared until recently to be a certain investment boom, but the longer term prospects are still positive in consideration of the successful operations which have proven the commercial viability of mine operations in Lao PDR.

Appreciation of the economic potential of the mineral resources is recent, , and was first examined on a national scale in 2003 with the Review of the Mining Sector (World Bank, 2003). Various assessments have followed in subsequent years with gradual, upward adjustment of output as well as revenue projections in response to the surge in metal prices over the period 2003-07 and in recognition of the very successful commencement of the Lao mining industry.

The recent contraction in operation and investment has brought the short-term prospects back to a level that comes very close to the original projections of 2003 Review. Nonetheless, the underlying industry structure has changed fundamentally, for that reason the following review of the mining sector and the industry was initiated to reassess the economic potential of the industry.

The objectives of this study are twofold:

- To prepare projections of production volumes for mineral commodities in Lao PDR and estimate the fiscal receipts and benefit streams that will accrue to government and local communities;

- To assess the impact of the mining industry on the national economic development in terms of employment and potential emergence of supporting industries.

THE HISTORY OF THE LAO MINING SECTOR

Geo-science and mineral database

Despite the formation of a cluster of enterprises extracting tin, the mining industry never expanded beyond extraction of the primary resource in limited quantities which was subsequently shipped to smelters and processing industries outside Lao PDR. While large-scale mining has a very short history in Lao PDR, the mineral potential of the country was confirmed at a much earlier date as the French colonial administration started geological surveys of the country in the first decades of the 20th century. During the 1920s substantial excavation and panning of cassiterite/tin commenced along Nam Pathene River in the central part of Lao PDR together with coal extraction at various locations of the country. Geological surveys continued throughout pre- and post-independence with substantial support provided by survey and research teams from the former Soviet Union and Eastern Europe. However, limited data has been retained. As the economy opened in the 1990s exploration work gained a much stronger commercial focus as Western companies entered the country with the intent to identify and develop commercial-scale mining. Prospective areas which had been identified by earlier surveys became subject to much more detailed exploration work. In parallel, international organizations financed initial mapping of geological and mineral occurrences.

There is no uniform system that records basic geological information. By law, all investors and exploration teams are required to submit all results of exploration and mapping activities to the Department of Geology (DGEO) for public disclosure after termination of the concession. While this principle of data collection has been enforced in most cases, the sector agencies lack financial and human resources to internalize the geological work into a systematic and comprehensive national database. In consequence, the scale and scope of basic geological information is relatively comprehensive but little or no effort is made to update existing data, and data from different sources is not consolidated or cross-checked. Since different survey teams use different methodologies and definitions, a large part of the existing data lacks certainty and accuracy because of missing analysis of ore values, location, deposit type and other basic information which is required to verify and further process the information. It applies to a number of the surveys that prospecting target areas are not clearly demarcated and information is missing with regard to prospecting methods and scale of the surveys. Therefore, these survey reports are of little interest to investors.

Company-level exploration work is not sufficient to have a strategic approach to the development of the mining sector. It is a poor substitute for the coordinated geo-scientific surveys which should ideally be undertaken to map the national geological resources to a level of detail which would compare to standards of other countries which actively promote their mineral industry. Unfortunately, the financial resources of tens of millions of US dollars which would be required have not been available. Indeed, for the past couple of years large fiscal contributions have been registered from the mine operators, but to date, political priorities have not allowed this revenue to be reinvested in geo-science. The proposed Bank-financed technical assistance project to the Lao mining sector will, amongst others, support the Department of Geology in collecting, analyzing and disseminating geo-scientific information.

The structure of the national mining industry

The mining industry extracts several minerals. The tin operations which commenced under French colonial rule have remained active to date albeit at a reduced scale with a total of a few hundred people employed either directly by the companies or as artisanal miners who are panning the tailings of the commercial operations. The current production is in the form of cassiterite in concentrate which is shipped to Thailand. The value of production in recent years has hovered around US$1 to 3 million and with limited tax returns accruing to local or central government. Mining of gem stones was the first mineralization (after tin) to be developed at industrial, though small, scale as the economy liberalized during the 1990s. Quarrying of sand, construction material and gypsum also evolved during the 1990s as domestic demand increased in response to the expansion of construction works and the emerging industrial sector. With the turn of the century, the mining industry experienced a qualitative and quantitative shift as medium and large-scale international mine operators entered the Lao industry alongside the existing national operations.

The mining industry remains segmented in three groups which operate more or less independently of each other:

1. **Small-scale, domestic operators** (private and state-owned enterprises) active in quarrying as well as small-scale and artisanal/small-scale mining;
2. **Small to medium-scale operators** which tend to be partnerships of national and regional companies targeting exploitation of already confirmed deposits which require minimum capital injections and geo-scientific analysis;
3. **Industrial/ large-scale, international mine operators** dominated by smaller (junior) and mid-size companies from Australia, Europe and North America but also increasingly regional corporations which have already gained a foothold in the construction and hydropower sector.

Small scale mining

The small-scale domestic mining industry is still largely restricted to (i) small-scale quarrying, (ii) alluvial mining, or (iii) small-scale mining of precious stones and metals. The domestic industry still holds little importance in economic and fiscal terms since employment is limited and tax payments are negligible. Besides suffering from a very restricted pool of experienced mine professionals, the weak financial sector is an important constraining factor in development of a domestic industry. While minor in scale of production, adverse impacts have been significant in local communities affected by tailings and spillage of chemicals.

Artisanal/alluvial mining, especially gold panning, is widespread in rural communities which may be producing up to US$25 million of gold a year. The soaring commodity prices which have prevailed in recent years have multiplied the number of people in rural areas who engaged in mining/panning as a supplement to the traditional income source from farming. Gold panning is the most prevalent activity but precious stones and cassiterite/tin are also widely extracted. Precise numbers are not available but estimates (MINDECO, 2006, and Grontmij Carl Bro, 2009) assess that the vast number of part-time and seasonal miners would convert to a number of full-time employments between 15,000 and 50,000. Surveys indicate that as much as 75 percent of the artisanal miners are women. Production values are inherently difficult to estimate but both national evidence and international surveys estimate that gold panners can extract up to one ounce (31 grams) of gold per year. At a selling price of US$500-600 per ounce, the annual production value from artisanal miners could be in the order of between US$8 and 25 million.

With the high commodity prices, a significant number of traders from neighboring countries have become active in (largely undeclared) trade of chemicals and minerals. A UNIDO survey of mercury use and contamination in Northern provinces did not reveal any high incidence of usage. However, follow-up surveys in other parts of the country as well as anecdotal information indicate that mercury usage has increased in recent years. Mercury is often introduced by traders who, in turn, buy the extracted minerals at discounted prices. With the recent drop in commodity prices the artisanal industry (except the buoyant gold market) will shrink markedly.

Medium- and small- scale partnerships

Medium and small-scale partnerships may be below the GOL radar in terms of tax and collection and production estimates. Partnerships are generally domestic enterprises or military companies that partner with investors from China, Vietnam, Thailand and other countries. These are generally small in size and conduct exploration as well as exploitation under contracts which are directly negotiated and often not subjected to transparent review. Local processing is often limited, instead raw ore or preliminary concentrates are shipped across the borders for further processing in neighboring countries. Technologies are usually simple but monitoring is weak, and lack of education and experience of handling of chemicals have led to harmful incidents. The absence of oversight also means that production volumes and ore grades are not systematically reported. As a result, little is known about actual tax payments as well as practices of benefit-sharing and compensation.

Extraction processes are labor-intensive, often manual, which have generated local un-skilled employment, although in some cases companies rely on imported workers from China or Vietnam. The dramatic downturn in metal prices over the past year has forced a number of the operations to close down. Thus, the negative employment effect is expected to impact disposable income in rural communities.

Industrial/ large-scale operators

Industrial/ large-scale international mine operators are the main contributors of tax revenues as well as local employment and community development. Two such operators have entered full-scale operation of copper/gold deposits. Combined production value of Lane Xang Minerals Limited (LXML) and Phou Bia Mining (PBM) reached US$550 million in 2007 and came close to US$700 million in 2008, representing more than 90 percent of total production value of the Lao mining industry. Other investors have commenced small-scale operation or exploration work, although exploration work is constrained by the lack of certainty of “finder’s

right" that is dictated by the current Mining Law. Large-scale investors from neighboring countries have also entered this category, this is best represented by the Sino-Lao Aluminum Corporation (SLACO) and Minmetals which purchased the LXML operations.

Although large-scale production started only in 2003, fiscal impact has become significant, with total government revenue from taxes and fees exceeding US$120 million in 2007. Company statements reveal that GOL benefits will reach fairly similar levels for 2008 but declined in 2009. The drop in revenue is entirely ascribed to the downturn of commodity prices, copper in particular, as the combined national production volume increased as the production expansions at both operations took full effect in 2009.

The adverse economic climate unraveling during 2008 forced both LXML and PBM to suspend previously planned expansion initiatives which would have further increased their output. The turbulence in global financial markets meant that both mine operators were restricted from accessing credit to sustain continued exploration although prospective sites had been identified which would have provided the ore body to continue mining. In consequence, 2010 is expected to see the first cuts in production as original gold deposits will be almost depleted. Thus, 2009 is projected to mark the peak in production volume before what will be at least a couple years with slowly declining production. LXML, which was owned by OZ Minerals, experienced turbulent events during late 2008 and early 2009 as OZ Minerals sought to restructure the corporation in response to liquidity constraints. In 2009, it was sold to China Minmetals, reducing the risk of further disruptions in operations. PBM has also received a capital injection through issuance of new shares purchased by Guangdong Rising Assets. Both acquisitions are expected to lead to renewed possibilities for realizing at least parts of the abandoned expansion plans. The following table reports the past production values by commodity.

Table 1. Mineral production in Lao PDR

Commodity *(default: tons)*	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Copper					30,500	70,800	72,500	100,000
Gold (oz)			180,000	155,000	225,000	230,000	170,000	160,000
Silver (oz)					109,500	203,500	144,600	300,000
Zinc	2,845	1,345	3,069	2,000		6,259	12,446	10,400
Tin	816	610	593	137	119	790	810	673
Barite	4,400	12,965	18,070	10,470	950	10,000	2,400	2,500
Clay	54,324	117,572	37,220	58,718				
Gypsum	121,220	119,514	101,727	244,145	119,019	163,000	250,954	322,304
Limestone (m3)	173,769	483,507	139,341	190,440		310,000	357,500	277,082
Salt	2,635	5,410	16,130					
Granodiorite (m3)	6,292	1,425	25,445	3,340	5,132			
Sand (m3)	105,847	309,619	229,176	161,981		539,000	923,000	1,030,000
Gravel (m3)	132,469	223,616	219,708	39,563		826,000	700,00	890,000
Anthracite	17,572					46,100	72,000	104,400
Lignite	122,942	233,823	212,819	298,761	332,934	240,529	489,238	452,146
Gemstone (kg)			460.6	142.5				
Lead							2,600	2,805

Source:Department of Mines

Future trends

Present operations have demonstrated that cost-effective extraction is feasible in Lao PDR. Cash cost parameters position both of the present operations in the top-half of cost-competitive copper operations in the world (with cash costs in the order of 0.9 US$/lbs). As in the case of the future potential for increased gold exploitation, the country is in possession of a promising resource base which can be explored and exploited once credit market conditions improve.

Although the prospectivity looks strong, the sector is facing a "generation gap" since exploration of new deposits have been limited. Partly, the uncertainties that are embedded in the Mining Law of 1997 with regard to exploration companies' right to exploit a deposit once confirmed, are to blame. The next "generation" of mine investments has yet to emerge, and with a development timeframe of seven to ten years, green-field development of new mine sites will take years to materialize. Besides investors from "traditional" mining countries, first of all Australia, a number of regional investors have entered the sector after successful entrance in the construction and hydropower industry in Lao PDR. In the present climate of severely restrained access to capital and credit markets, financing from China and possibly other nations in the region appears more likely in the short term. On the other hand, a considerable uncertainty continues to surround the actual resource potential of the mine sites in question. The dramatic drops in commodity prices have also added doubt to investment opportunities which appeared profitable in the beginning of 2008.

Bauxite, alumina and aluminum

Up to seven investors are reported to explore bauxite in the southern provinces of Laos. Experimental mining has commenced at one site (Sawang Mine) and another development has completed feasibility studies and commenced detailed design and development, SLACO. The political interest in the development is reported to be very strong, but based on available information, a number of uncertainties remain to be addressed with regard to (i) confirmed geological resource base, (ii) supply of key resources, (iii) cost competitiveness, and (iv) social and environmental impacts.

Even though promising bauxite deposits exist, considerable uncertainty persists with regard to quantity and quality of these resources. Available reports do not clearly differentiate between reserves, confirmed resources or inferred resources, and a large number of deposits appear to be inferred on the basis of a somewhat smaller number of actual samples and detailed analyses. This limitation raises questions about both the commercial viability of the proposed investments as well as the duration/sustainability of operations.

The case for sufficient bauxite mining is further weakened by the uncertainties and ramifications that relate to the feasibility of in-country smelting. In case of a positive outcome of the investment reviews, the most likely development scenario would see alumina refining develop in Lao PDR since export of unrefined bauxite is likely to be constrained by transportation costs. Smelting of aluminum is also being considered, but the smelting process is conditioned by availability of large amounts of constant and cost-competitive power. Based on the production process, to make smelting profitable, power costs should not exceed US cents 2.5 per kWh, compared to the estimated production cost in Lao PDR of US cents 5-7 per kWh. Moreover, global smelting capacity is currently exceeding global demand, and a number of smelters are at advanced stages of development, should the economic conditions improve world-wide. Finally, investors are cognizant of the fact that the value added in the smelting process is much lower than in alumina refining. As an illustrative example, Guinea, which has very rich bauxite reserves (at ore grades of 50-60 percent, compared to the 30-40 percent range identified in Lao PDR) is listed as the fourth-largest exporter of bauxite in the world, yet limited refining and no smelting capacity exists in the country.

More fundamentally, key inputs in the alumina refining process are currently missing or unaffordable. Experience shows that bauxite constitutes approximately 25-35 percent of the costs for alumina refining. Fuel and power inputs will usually represent around 30 percent of costs while caustic soda constitutes another 20 percent. Availability of these key inputs combined with transport constraints in the southern part of the country pose a challenge to alumina refinery operators.

Bauxite and alumina/aluminum mining has extremely dangerous, widespread, and hard to contain environmental and social impacts. Management of environmental and social impacts poses high demands on developers and operators. The mining and washing of bauxite will require expansive concession areas which would be stripped for open-pit mining of shallow deposits and for construction of adequate tailings dams. Bauxite washing produces vast amounts of muddy waste water which requires containment and treatment while the subsequent alumina refining process produces a highly toxic by-product called red mud. Consequently, the process of initial planning and approval of construction plans would have to be sustained through comprehensive management of the continuing build-up of tailings. Existing documentation of the proposed

operations leaves numerous open questions with regard to environmental and social risk profiles, mitigation plans and associated costs.

Review of production estimates

Projections based on information currently available are not reliable and need updating. Table 2 below compares the key conclusions and projections from four sector-wide assessments, two of which financed by the Bank and the other two undertaken by GOL. A number of observations are relevant:

- Projections of realized mine potential are best defined in terms of annual production volume and capacity, and not in financial terms since price volatilities can mask other more fundamental trends. The current situation provides a very clear illustration of this point since the combined mineral export value for 2007 was at a level close to 2008 despite a 50 percent increase in copper production and 25 percent increase in gold production in 2008, the two dominant commodities. Even an additional 33 percent increase in gold and copper volumes which are planned 2009 are not likely to compensate for the low metal prices which have sustained during the first quarter of 2009 and are expected to prevail throughout the year.
- Projections based on the number of mines are difficult to convert to volumes of production, because the size of a commercially viable mine may vary ten-fold within the specific commodity and even more across commodities.
- Projections have seen an upwards revision over time in response to the high grade mineralizations which both PBM and LXML have achieved, plus the increased appetite for minerals and mining investments among neighboring countries.

Table 2. Projections of annual production of Lao mining sector

Year	Title (Author)	2010	2015	2020
2003	***Country Economic Memorandum (World Bank)***	***Base case (2005):*** Gold: 130,000 oz Copper: 53,000 tons ***Base case plus :*** Gold: 230,000 oz Copper: 330,000 t. ***Speculative case*** : As above plus Potash : 2 mn. tonnes	No detailed consideration of time perspective, although "Base case +" and "Speculative case" would not be expected until 2010	
2005	***National Social and Economic Development Plan (GOL)***	Gold: 420,000 oz Copper: 50,000 t.	No projections beyond 2010	
2006	***Plan for Sustainable Development of the Mining Sector in Lao PDR (Mindeco)***	17.5 percent growth p.a. (total ore reserves are listed in Section 5. Projections)	The starting point is expected to be as current capacity in 2008	
2007	***Mining Sector Strategy (MEM)***	Gold: 320,000 oz (5 operating mines) Copper: 189,000 t. (3 oper. mines) Lead-zinc: (1 oper. mine) Iron: (1 oper. mine) Potash: 50,000 t. (1 oper. mine) Coal: 4 oper. mines Gem stones: 200,000 carat	Potash: 1 mn t.	Gold: 420,000 oz (15 mines) Copper: 100,000 t. (11 mines) Lead-zinc: (5 mines) Iron: 500,000 t. (5 mines) Potash : 1 mn t. (4 mines) Coal: (9 mines) Bauxite/ aluminum: 400,000 t. (5 mines)
2008	Current capacity	Gold: 160,000 oz (2 oper. mines) Copper: 134,000 t. (2 oper. mines) Lead-zinc: (1 oper. mine) Coal: (2 oper. mines) Gem stones: 70,000 carats Potash: Experimental operations suspended		

Source:World Bank staff

Projections

In comparison to other countries in the region, Lao PDR holds a very limited resource base of *confirmed, measured mineral resources*. In Lao PDR, the issue of geological uncertainty plays a dominant role in the assessment of the sector since geological exploration of the Lao territory to date has been very limited (besides the two concession areas held by PBM and LXML which have entered exploitation). This means that although promising, the long-term resource base remains unconfirmed. This is not to say that the resource potential is weak, rather, *knowledge acquired until now* can only confirm resources as listed in the table below. However, it can rightly be argued that in light of the modest exploration activities (compared to activities in e.g. Indonesia, Malaysia, etc.), the success rate and the current scale of the Lao industry is rather phenomenal. In consequence, developers express very high expectations to additional discoveries as exploration works in the country increase in future.

The estimates of the resource base differ greatly from one source to another. The following table lists the estimates of the resource base prepared under a previous sector assessment (Mindeco, 2006). These estimates are compared to the combined official figures which PBM and LXML have reported to the Australian Stock Exchange as part of their reporting obligations (no other resource estimates using conventional definitions of grade have been available). It should be noted that although the JORC code of ***measured mineral resource*** is supposed to represent a conservative estimate of a resource that holds "*reasonable prospects for eventual economic extraction"*, some doubt has arisen in recent years over inflated resource reportings which have turned out not to be economically feasible. On the other hand, mineral resource estimates will arguably remain prone to large margins of error since the nature of geological science is associated with a great degree of uncertainty about the sub-surface characteristics – despite all efforts to specify precise definitions and standards. Notwithstanding, the company reports should allow certainty that the mineral resource base which is known today will allow continued exploitation at current capacity for at least 15 years into the future for both operations (except the LXML's depletion of gold reserves). Future discoveries (as anticipated by the Mindeco study) would further extend the mine life of operations or justify new developments

Table 3. Mineral resource stock estimate

Mineral	Mindeco Study, 2006	Company reports 1st Quarter 2009 (JORC code)
Copper (tons)	4,973,000	1,530,000
Gold (ounces)	5,960,000	1,170,000
Silver (ounces)	N/A	10,600,000
Tin (tons)	41,000	

Source: World Bank staff

Substantial exploration and analysis have yet to be completed before the national mineral resource base can be further refined. Other *ore reserves* have been reported (iron ore, bauxite, zinc, and others), however, the grade/ mineral content have not been determined, hence the quantity of mineral resources cannot be inferred. More importantly, the economic feasibility of mineral extraction cannot be determined since it naturally makes a large difference to operational costs and revenue whether an ore body contains 35 percent of bauxite or 60 percent of bauxite.

Other risk dimensions listed below set the stage for interpreting the prospectivity and potential trajectory of the sector, even though they do not provide an exhaustive list. In order to counter the inevitable fluctuation in commodity prices, the present analysis will attempt to project likely scenarios for volumes as well as prices. All figures are presented in constant 2008 values.

Table 4. Risks in the mining sector

Risk category	Comments	Lao context
Geological risk	All exploitation of natural resources, minerals in particular, is associated with a great degree of uncertainty about the sub-surface characteristics. Conditions can change rapidly. Certain risks may decrease over time as the quality of a nation's geo-science information base increases and mining techniques get customized to the local requirements.	The geo-science knowledge base in Lao PDR is still relatively limited, and the country has a very short-lived history of industrial-scale mining. Chances for finding new, highly prospective ore bodies are good, but the country will inevitably face the constraint of scarcity in the extraction of non-renewable resources. Ore bodies will become more difficult to reach, and existing mine sites will reach lower-grade ore bodies. A case in point are the current operations in Lao PDR which can expect challenges as mining goes deeper and hard-rock mining will commence.
Operational risk	Besides the geological risks operations may also be affected by break-down of machinery, whether caused by malfunction, incorrect operation or wear-and-tear. Inefficient use of equipment represents another risk factor which can derail production forecast and financial projections. Sub-optimal management decisions (investment decisions, sales strategy, etc.) may also be categorized under this item.	Comprehensive scrutiny of developers and operators is the best instrument available for authorities to mitigate the operational risk. Authorities may consider variables such as operational experience, financial capacity, local experience and partnerships, etc when reviewing and approving investment proposal.
Supply risk	The disruption of supply channels looms as a constant threat for mine operations at isolated locations. Such supply disruptions may affect power supply, transport routes, key inputs such as explosives, chemicals, fuel, spare parts and labor.	The Lao geography poses challenges for developers because infrastructure services are limited or completely absent in many areas of the country where mineral occurrences are most likely to be found. The prevalence of unexploded ordinance poses a special risk in Lao PDR.
Environmental risks	The risk of accidents causing environmental damages prevails even when the most comprehensive mitigation and management plans are in place. These accidents may directly disrupt operations or operations may be interrupted in the interest of avoiding further impacts on the surroundings.	Lao authorities can further enhance capacities in project review and inspection so as to minimize the risk of environmental accidents.

Market risk	Market risks are associated with price volatility and changes in demand patterns for mineral commodities and end products. The history of commodity prices confirms the high volatility of commodity prices.	Market risks are usually beyond the control of both government and mine operator. Lao PDR may have a locational advantage in the market of bulk commodities where transportation costs constitute a large part of the final costs.
Investment risk	From the investors' perspective it is central to consider the risk of devalued, delayed, stranded, or even lost assets. Common risk factors include changes in regulatory regimes or outright nationalization of assets. Benchmark surveys include "Doing Business", "Frasier Institute's Report" and others.	Lao PDR continues to make great strides towards improved investment conditions. The growing number of successful investments in the country is a comforting signal to potential investors. Nonetheless, opacity in review and approval procedures remains a concern for many investors.
Financial risk	Recent events in global financial and credit markets illustrate all too well the volatility of financial and credit markets. Financial services are required not only for initial investment but also for plant expansion and for uninterrupted operation.	Lao PDR has very little control over global events but may experience significant impacts. The perceived high risk profile which most investors associate to Lao PDR can cause severe contraction in financial flows when investors and financiers retract to "safe havens" as finance dries up or is available at a higher premium.
Force majeure (acts of war or civil unrest, natural or man-made catastrophes)	Mine operations are vulnerable to unforeseen events which are beyond the control of contractual parties because the large amounts of sunk costs which are invested in immobile assets.	Lao PDR is located in a region which has enjoyed stability for a prolonged period. Nonetheless, the absence of access to the sea brings Lao PDR in a vulnerable situation vis-à-vis neighboring countries. This was exemplified by the recent incidents in Thailand which is the transit point of choice for most investors.

Source: World Bank staff

The projections are structured along three scenarios: (i) low, (ii) base and (iii) high cases of global economic activity and derived impacts in the mining sector. The underlying assumptions are detailed in Annex 1. As explained in the introductory sections, the mine operations in Lao PDR have already been severely impacted by the economic downturn since virtually all expansion plans have been deferred as a consequence of the credit crisis. Additionally, various operations with high operational costs have stopped in response to the low commodity prices. Further plant closures are not expected since the two remaining large-scale operations both report cash costs below the global median cost. In other words, both operations are positioned in the top-half of international cost-competitiveness. For that reason the low case scenario is predominantly focused on negative price fluctuations rather than reduction in production figures.

Low case annual production

Table 5. Low case scenario assumptions

Parameter	Copper	Gold	Others
Production/ Export value US$ p.a. (17 year average)	438,000,000	44,500,000	***ASM:*** 10-17 mill ***National industry:*** 37-55 mill
Production volume p.a.	***=>2020:*** 134,000 tons ***2020*** =>: 67,000 tons	***2009:*** 160,000 oz ***2010*** =>: 65,000 oz	***ASM gold***: 35,000 oz reducing to 20,000 oz
Fiscal receipts p.a. (incl. dividends) US$ (17 year average)	64,000,000	2,300,000	N/A
National jobs	3,000	1,000	***ASM***: appr. 35,000 or more ***Nat'l industry***: 11,000
Total average fiscal receipts p.a. US$ 66,500,000			

Source: World Bank staff

The low case scenario is based on expectations of a slow recovery of the global economy which would result in commodity prices which are 20 percent lower than forecasts. Appetite for investment in the mining sector would be low and Lao PDR would face difficulties in attracting investment. Production volumes for copper would remain constant while gold production would fall in 2010 as LXML ceases its gold operations. No new entrants of significant size and duration would be expected. The production value and fiscal receipts are presented in average annual figures although some variations would occur over time with dramatic drops in tax payments in coming years in response to low world market prices. The average fiscal receipt by Government would be in the order of US$ 66.5 million per year. Chart 1 on the following page illustrates the expected fluctuations. Even in the low case, commodity prices are expected to recover to historical trend levels within three to five years, and fiscal receipts can be expected to register a slow increase. Copper is by far the dominant contributor to GOL revenue. In light of the historical and present difficulties of tax collection from small-scale operator, no tax income is assumed from these operations, which may also face increasing difficulties of staying competitive under the current market and price conditions. Small-scale and alluvial miners are only accounted for in terms of assumed production and employment estimates. Total full-time employment is estimated at some 46,000 workers, of which three quarters would originate from low-paid ASM activities.

Chart 1. Production/export values by commodity – low case

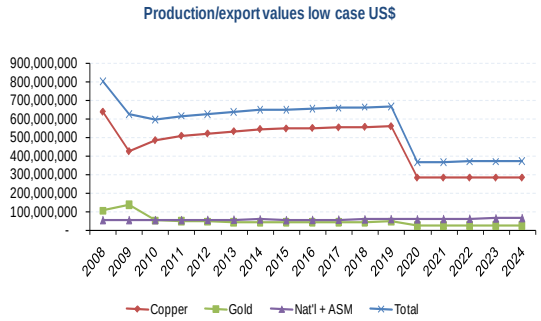


Chart 2. Fiscal receipts – Copper low case

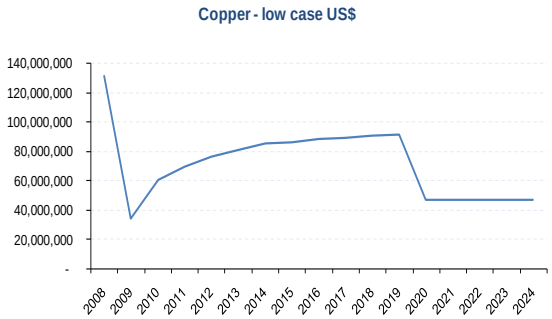
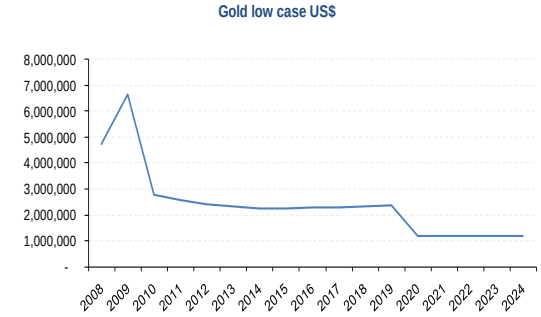


Chart 3. Fiscal receipts – Gold low case



Source: World Bank staff

Base case annual production

Table 6. Low case scenario assumptions

Parameter	Copper	Gold	Others
Production/export value US$ p.a. (17 year average)	913,000,000	64,000,000	***ASM***: 17.5-19 mill ***Nat'l industry***: 37 increasing to 90 mill ***Alumina*** 2015: 250 mill ***Zinc*** 2020: 46 mill
Production volume p.a.	=> ***2015***: 134,000 t ***2015-20***: 240,000 t ***2020-24***: 300,000 t	***2009***: 160,000 oz ***2010***: 75,000 oz ***2015-20***: 160,000 oz ***2020-24***: 205,000 oz	***ASM gold***: 35,000 oz ***Alumina*** 2015: 1 mill tons ***Zinc*** 2020: 30,000 t
Fiscal receipts p.a. (incl. dividends) US$ (17 year average)	150,000,000	6,300,000	***Alumina:*** 5.3 mil ***Zinc:*** 1.7 mill
National jobs	3,000 – 4,500	1,000 – 1,700	***ASM***: appr. 35,000 ***Nat'l industry***: appr. 10,000 – 20,000 ***Alumina:*** 600-1,000
Total average fiscal receipts p.a. US$ 163,400,000			

Source: WB staff

The base case scenario is founded on business plans for existing operations as expected until the financial turbulence erupted at global scale and metal prices plunged in second half of 2008. Thus, the base case is roughly a scenario of expansion plans as expected until late 2008 but with implementation delayed by two to four years. Moreover, the base case assumes that new medium-scale copper and gold exploitations will commence between 2015 to 2020, and that an alumina refinery similar to the configuration which is currently under investigation will become operational by 2015. Estimated fiscal receipts, at US$ 163.4 million p.a., would be almost three times the low case scenario. As in the low case the average production values and fiscal receipts mask a more volatile time series with low earnings in early years and a gradual recovery in the medium term. The number of artisanal and small-scale miners is assumed constant on the basis of a resource potential which is not expected to expand. Any change in the scale and scope of ASM operations will not impact the macro level because of the informal nature of the industry. However, changes in ASM activities would directly impact employment levels and disposable income in rural areas. The employment effect is expected to remain in the vicinity of 50,000 workers.

Chart 4. Production/export values by commodity – base case

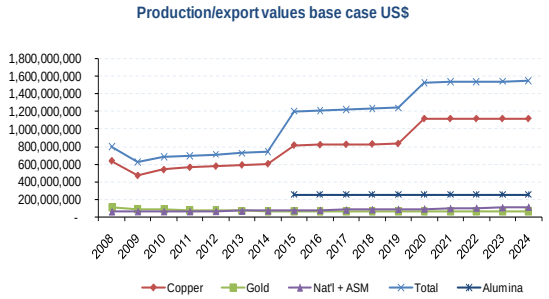


Chart 5. Fiscal receipts – Copper base case

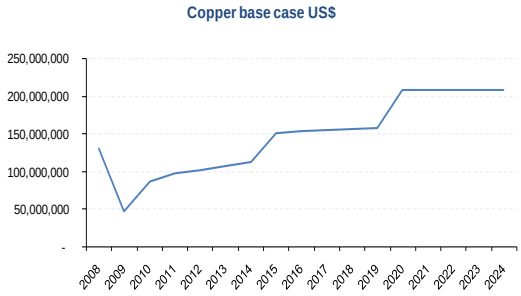
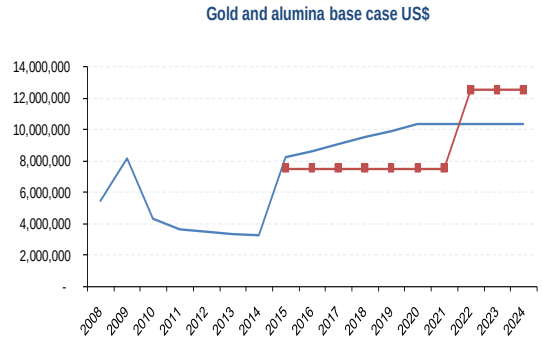


Chart 6. Fiscal receipts – Gold and alumina base case



Source: World Bank staff

High case annual production

Table 7. Low case scenario assumptions

Parameter	Copper	Gold	Others
Production/ Export value US$ p.a. (17 year average)	1,103,000,000	158,000,000	***ASM***: 7-18 mill ***Nat'l industry***: 38 - 107 mill ***Alumina*** 2015: 200-250 mill ***Zinc*** 2015: ***Gypsum*** 2015: 5 mill ***Potash*** 2020: 250 mill
Production volume p.a.	=> ***2015***: 134,000 t ***2015-20***: 250,000 t ***2020-24***: 300,000 t	=> ***2015***: 160,000 oz ***2015-20***: 175,000 oz ***2020-24***: 235,000 oz	***Alumina: '***15: 1 mill t ***ASM gold***: 35,000 oz declining to 20,000 oz ***Alumina*** 2015: 1 mill t. ***Zinc*** 2015: 30,000 t. ***Gypsum*** 2015: 100,000 t. ***Potash*** 2020: 1 mill t.
Fiscal receipts p.a. (incl. dividends) US$ (17 year average)	209,000,000	17,800,000	***Alumina:*** 6,4 mill ***Zinc***: 4 mill ***Gypsum***: 0.4 mill ***Potash***: 6.8 mill
National jobs	3,500 – 6,500	1,000 – 2,000	***ASM***: 35,000 ***Nat'l industry***: appr. 10,000 – 25,000 ***Alumina:*** 600-1,000 ***Others***: 1,500
Total average fiscal receipts p.a. US$ 244,300,000			

Source: World Bank staff

The high case scenario assumes that metal prices will stabilize at a level 20 percent higher than forecasts. This would generally imply a "price plateau" which is 50-100 percent higher than the trend level of 1985-2005 but still markedly below the "super-cycle" peak level which was attained during 2007 and 2008. It is assumed that investor interest and sources of finance will return to Lao PDR within one to two years. Accordingly, all operations will resume to their full expansion program, in addition hypothetical small and medium-scale operations will develop after 2015 at relatively competitive costs of operation. New mineral commodities which have shown good potential (alumina, zinc, gypsum and potash) will also come into commercial operation with a five to ten year timeframe. It should be noted that even the high case scenario will experience a slow acceleration in the short term because of the long "gestation time" for mine investments which means that the initial rebound is largely based on (a) existing plants + (b) small-scale opportunistic operators who are able to mobilize more quickly than larger-scale operations. The Lao PDR has a "generation gap" in mine developments since virtually no new exploration takes place at present, nor has it taken place in the past few years. Exploration has predominantly centered around the two existing operations. It is general industry practice that a medium/ larger-scale mine operation will take at least seven years to develop: around four years of comprehensive exploration, followed by feasibility study and mine development which take around 18 months, respectively. This also assumes a favorable investment climate. The annual average Government receipts would be in the area of US$ 244 million, while the workforce could exceed 60,000 people, or some 2 to four percent of the total national workforce.

In the high case scenario, the bauxite industry is assumed to take off. This would significantly increase export revenues, but the fiscal impact would be limited because of tax holidays covering the first seven years of operation, i.e. beyond 2020. Even after transferring to full tax obligations, the combined fiscal receipts from alumina refining are not expected to exceed US$ 10 million per year because of preferential tax status and world-market price below past years' historical highs, and possibly transfer pricing below actual market price, as suggested in the current mine/refinery configuration. Alumina and aluminum prices saw drops in the order of 70 percent during second half of 2008 before moderate recoveries in the first part of 2009. Price and cost estimates are derived from Government and company studies.

Chart 7. Production/export values by commodity – high case

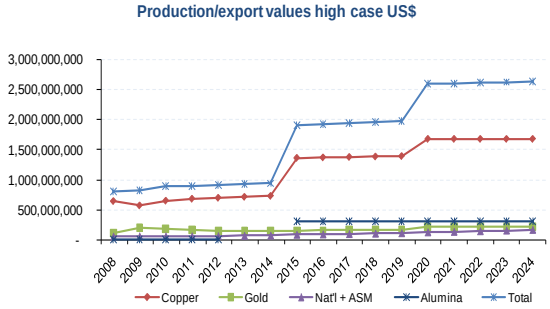


Chart 8. Fiscal receipts – Copper high case

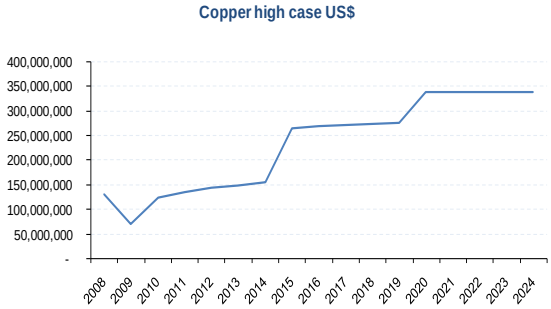
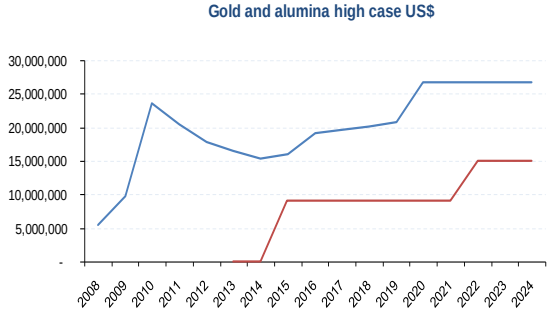


Chart 9. Fiscal receipts – Gold and alumina high case



Source: World Bank staff

Derived impacts of mine operations

There has been substantial economic impact on the local communities from the existing mine operations. Concise data are difficult to produce as the economic ripple effects dissipate and are not easily distinguished from other factors. Still, various social and economic surveys conducted by the mine companies and surveys by GOL and the World Bank (MINDECO, 2006 and Grontmij, 2009) provide substantial evidence to track the performance of the local economies surrounding the mine operations in Lao PDR. These indicators will be discussed in turn.

Employment in the formal mining operations in Lao PDR is currently estimated to some 15,000 full-time positions, although this number may be declining in the short term as a result of the global recession. Additionally, some 35,000 full-time positions are found in the informal sector of ASM operators/ alluvial miners (derived from a much larger number of seasonal

workers). The production values of these operations are captured in the previous section, but staff salaries represent a more important indicator at the level of the individual family and are also important drivers for economic activities at local level through increased demand. In terms of personal income tax, actual collection of personal income tax from mine employees may be limited to a smaller number than the 15,000 formal employments, but confirmed information from the two large-scale operations reports income tax payments of almost US$5 million for a combined workforce of almost 5,000 persons.

Mine operations have a direct knock-on effect in terms of employment generation in supporting sectors and as a consequence of increased economic activity in the vicinity of the mine (consumables, services, entertainment, etc.). The exact impact is difficult to gauge by definition, but the multitude of international studies produce estimates of the employment multiplier which ranges from four to eight additional positions for each employee at the mine. There is a clear pattern of an upward shift in **disposable** income among all layers of workers once a mining operation enters the community: (i) a significant proportion (if not majority) of households without formal wage-earnings will start to have one or more wage-earners in the household, (ii) salaried workers will usually see an increase in their earnings, and (iii) outside workers and professionals are attracted by higher wages.[1]

Infrastructure provisions are another benefit which will usually follow with mine developments. However, these benefits should not be overstated as infrastructure improvements would normally be limited to localized improvements in the vicinity of the mines including roads, electricity and communication systems. An additional benefit which is relevant to Lao PDR is the clearance of unexploded ordinance (UXO) which is a precondition for exploration and excavation work in many parts of the country.

Social services have improved markedly in mine-affected areas where social surveys have been conducted. Schools, clinics, community centers, etc. have been primary recipients of community investment from mine operators which see these investments either as self-interest for provision of reliable services to employees or as parts of the mine operators' obligations toward community development.

Community Development Funds will become a standard requirement for mine investors under the revised Minerals Law. However, the formula for contributions has yet to be developed, and the operational procedures need streamlining since current practice includes examples of both community-controlled models and models where the mine developer transfers funds to provincial governments without any clear mechanisms for involvement of the affected villages. See also Gibson and Carlsson Rex (2010).

Suppliers' sales and services might represent the most important economic impact derived from mine operations. To understand the order of magnitude a simple calculation shows that a copper operation would have cash costs in the vicinity of US$0.9-1.1 per pound of copper produced. Assuming a 50:50 ratio between in-house and out-sourced operating costs, the impact of a medium-sized copper operation with 60,000 tons capacity would be as follows:

[1] It should be noted that this premise ignores the potential negative effects caused by loss of traditional livelihoods, the disruptive consequences of mine closure, etc. These are discussed in Fenton et al. (2010) and Gibson and Carlsson Rex (2010).

Table 8. Annual cash cost calculation for copper production

Pounds per ton:	**2,205**
Total cash costs:	0.9 * 2,205 * 60,000 = **US$ 119,070,000**
Suppliers' and sub-contractors' annual revenue:	120,000,000 * 50 percent = **US$ 60,000,000**

Source: World Bank staff

Equivalent simulations of a model gold operation at 50,000 ounces p.a. are presented below under the assumption that cash costs are US$ 600 per ounce of gold.

Table 9. Annual cash cost calculation for gold production

Pounds per ton:	**2,205**
Total cash costs:	600 * 50,000 = **US$ 30,000,000**
Suppliers' and sub-contractors' annual revenue:	30,000,000* 50 percent = **US$ 15,000,000**

Source: World Bank staff

Although a large part of these costs are tied to imports of fuels, explosives and chemicals where little value is added domestically in Lao PDR, other services have seen a surge in activity in recent years. These services include geological surveys, mapping and GIS consultants, earth-moving contractors, catering services, and others. Additionally, the construction industry continues to benefit from plant expansions, renovations, maintenance, and possibly green-field constructions in the years to come. In tabular form, the derived benefits which were reported or estimated in 2008 can be summarized as follows in Table X:

Table 10. Derived benefits of mine operations

Direct employment	15,000 (+ appr. 35,000 ASM workers)
Derived employment (ratio: 1:4 to 1:8)	60,000 to 120,000
Personal income tax	US$ 5,000,000 p.a.
Infrastructure service	Roads, Electricity, Communication, Markets
Social services	Schools, Clinics, Sports facilities, Community centers
Community development funds	Approximately US$ 1 million per year
Value of suppliers' and sub-contractors operational services (excl. construction)	Copper: US$ 90,000,000 p.a. Gold: US$ 22,000,000
Supplier service categories	• Fuel supply • Earth moving contractors • Geological survey and mapping consultants • Machinery (rental, operation and maintenance) • Utilities • Catering service

Source: World Bank staff

Minerals law

Every country develops its own enabling environment for the mining sector, but there are common practices and principles which generally apply which have proven successful in stimulating new investment and in ensuring that it achieves the maximum development impact. Usually enshrined in the Minerals/Mining Law, the key elements of a successful mining legal and regulatory regime include:

- *Private access to mineral rights* which is embedded in a coherent legal framework that addresses the concerns related to, amongst others, access to land, investment regulation, import/export issues, social and environmental requirements, and taxation, but at the same time is not prohibitively restrictive to potential investors. It is important that the mining legislation is seamlessly integrated into the overall legal framework and that different pieces of regulation are not mutually exclusive with regard to mineral exploitation.
- *An open sector with the same rules for all*. In principle, all investors, foreign or domestic, should be subject to the same rules, terms and conditions.
- *Security of mining tenure.* International experience shows that domestic and foreign companies would not invest in exploration unless they have exclusive rights to explore for mineral substances within the title area.

- *Appropriately adapted environmental and social requirements.* The issue of appropriate environmental protection requirements is of pre-eminent importance, not only for the country to maintain its ecological heritage and social tranquility but also to provide security and guidance to companies which may wish to invest.
- *Competitive and stable economic conditions.* Taxation of the mining sector is a critical issue for investors since it impacts the return that an investor can expect from investment. One important consideration is naturally that the tax rates should not be punitively high compared to neighboring or comparable countries. However, another important consideration is the stability and transparency of the tax regime which will eventually allow the investor to calculate returns with necessary certainty without facing the risk of changing requirements.

Implementation of the revised Minerals Law

Promulgation of the revised Minerals Law and associated regulation would provide an important signal to investors of GOL's commitment to development of the national mining industry. In December 2008, the National Assembly gave its approval to the draft Minerals Law which was promulgated by the President in December, 2009. Notwithstanding, Implementing Decree and detailed regulation to clarify the legal text have yet to be drafted and issued. This brings in doubt the momentum behind the law revision and GOL's intent to address the shortcomings of the existing Mining Law of 1997 which has proven entirely unsuccessful in defining the foundation for the national mining industry. Three concerns illustrate this point: (i) The two industrial-scale mine operations which have successfully developed in Lao PDR are agreed on the basis of Mineral Exploration and Production Agreements (MEPA) which precede the 1997 Mining Law, and whilst parts of the MEPA have been renegotiated neither investors nor GOL have seen any incentive to bring the agreements into compliance with the 1997 law, (ii) no mine operation has been agreed under the auspices of the existing legislation, (iii) a host of other agreements with smaller mine operations have been agreed on terms which bear no or little resemblance to the law of 1997. In sum, the existing legislation represents a major obstacle to the development of the mining industry.

At the same time, the Law would need to be supported by detailed implementing regulation to cover the operational procedures. At present stage, the regulatory framework for the sector is limited and leaves gaps in numerous areas ranging from performance and investment requirements for prospecting and exploration work, requirements for environmental and social safeguards, emission standards, etc. Various pieces of technical assistance supported by international agencies are separately targeting priority issues. The planned TA project to the mining and hydropower sectors, which is supported by IDA and AusAID would systematically list needs and activities to be carried out. The key issues to be addressed in the legislation and regulation are summarized in the following paragraphs (these issues have been identified and discussed in detail with GOL by technical experts during the drafting process of the law).

Finder's right

Finder's right is an important component of investor's decision to undertake a project in a particular country. In the event of a successful discovery and mine development, which is in the range of one in 100 to one in 1,000, the "gestation time" from earliest prospecting to first mineral throughput is usually ten years or more. Development costs are measured in millions of dollars and increase progressively in the later stages of exploration and mine/plant construction.

Considering that investors have no certainty of seeing the mine development materializes until successful completion of feasibility studies and financial close, the industry holds a very high risk-profile among investors. In light of these characteristics, the cardinal principle of any mining legislation is the right to progress automatically (provided an environmental and social assessment is undertaken and approved by the government) from exploration to mining or to sell/transfer the right to mining. No local or international investor will take the substantial risk and expense to explore for minerals without the assurance that in the event of a discovery the investor will have priority to be able to mine the deposit.

The previous Mining Law is discretionary where the transition from one development stage to the next is concerned. This uncertainty has been a major stumbling block for prospectors' and developers' ability to raise finance for exploration in Lao PDR. The long approval processes which have dominated and delayed a number of investments in mining and hydropower in Lao PDR are casting further doubt on investors' security of title and certainty of controlling sunk costs. If Laos wanted to attract potential investors, the principle of "finder's right" would need to be legislated and demonstrated in practice.

First-come first-served

Centralizing the coordination for all mining license activities in the Department of Mines and clearly establishing the "first-in-time" priority for the issuance of exploration licenses should be a feature of the revised Mining Law. The principle of "first-in-time" priority for the issuance of exploration licenses is standard practice in mining legislation. This is necessary in order to set an objective principle to grant exploration licenses and to avoid excessive government discretionary authority. Moreover, clear principles avoid the risk of lengthy legal battles between competing developers which are disputing title ownership. Generally, there are objective technical and financial criteria to pre-qualify applicants, but these criteria should be set at a minimum in order to encourage large and small companies to explore and hopefully to find mineral deposits.

If the government wishes to encourage investment in the mining sector, it must provide a dedicated focal point for all information and licensing functions (mining cadastre functions). It should include an office where maps, forms, legislation and all other relevant information can be picked up readily by industry representatives. It should have dedicated and skilled staff who can officially register applications with time and date in the order the applications were received. Information and computer technologies must be available to ensure consistent granting of titles which avoids overlap with existing land titles be they for the purpose of mining, hydropower, agro-development, etc.

The revised Minerals Law will reportedly centralize the coordination for all mining license activities in the Department of Mines. This move would mark an important change to past practice where a plethora of local and central agencies have granted licenses for various purposes pertaining to mining. The first step in the direction of a consolidation of DOM's authority was the moratorium on issuance of gold mining licenses which took effect in late 2007. Besides adoption of the revised Minerals Law, the next steps would involve additional resources to the DOM in order to develop and maintain a mining cadastre system, and as part of this standardize exploration and mining licenses in compliance with the revised law.

Government equity participation

GOL has expressed its clear intent to continue, or even increase, its direct participation in large-scale mine operations. Presently, GOL holds a 10 percent equity share in LXML as well

as PBM. While there are no signals of increased GOL shareholding in the two existing operations, new projects may be considered with a view to increasing GOL participation. The logic appeared sound until 2008 when revenues and dividends dropped dramatically as metal prices tumbled. In the years prior to 2008 GOL had managed to pay back the credit for the 10 percent equity in LXML and even recoup the first dividends. However, under the new reality dictated by the current crisis, future dividend payments from LXML and PBM seem more distant as revenues have dropped and companies prioritize debt minimization over dividend payments.

Equity is more risky and is likely to be less profitable as a source of revenue, than taxation. Government's involvement in projects through equity participation may not result in significant dividend flows under normal circumstances, and that such dividends are more reliably collected through appropriate royalty and tax regimes which are consistently applied every year (as opposed to dividend payments which may be forgone during years of expansion or other discrete corporate decisions). The merit of dividends is further questioned by the additional risk which the state must accept by being a shareholder since the state not only shares the profits of the good years but also the potential losses during difficult times, thus putting scarce government funds at unnecessary risk. This financial obligation is not only confined to initial investment costs since GOL, as a shareholder, may be required to inject additional cash into a company which is facing acute financial distress. During the present economic crisis numerous mining companies have indeed raised this request to their shareholders.

Under these circumstances, investing in equity in risky projects bears high opportunity costs when other development needs are imminent. It is questionable what is the merit of GOL contributing scarce public funds to a risk-prone commercial activity, such as mining, in comparison to other traditional obligations of the state to provide and sustain social services, such as education health care, infrastructure, etc.

Government equity participation does not necessarily result in greater control over the project or give the government an effective role in decision making. The Lao government, as any other government, is already empowered to conduct audits of the company's accounts and to inspect mining operations to conform to applicable rules and regulations. Additionally, the government would only have a minority equity shareholding position, which would not give it control over operations or dividend policies. The equity participation could also put GOL at risk for lawsuits or other legal action in the event of unforeseen accidents or environmental problems. GOL could also face the issue of losing all or a portion of its designated participation in the event that it is unable to pay for the shares. Finally, there is a significant conflict of interest where the government is at the same time shareholder and regulator. As shareholder in the mine, the government is obviously interested in obtaining the maximum profits for the venture. At the same time, the government has the obligation to protect the rights of citizens living around the mine, the workers at the mine, and to protect the environment. In other countries, governments have had difficulty and problems of credibility to reconcile these two functions and to resolve the inherent conflict of interest.

Fiscal regime and taxation policy considerations

Tax level and Effective Tax Rate

It is essential to maintain an effective tax rate (Box 1) that attracts investors but also provides maximum possible revenue to GOL. As revenues from Lao mining operations have surged in recent years, relevant questions have been raised concerning the fairness of profit and

benefit sharing between project owners and GOL. Separate studies have assessed the actual profit-sharing in the Lao projects to be around 50:50 percent, subject to the year of calculation and the scope of profits to be included.

Box 1. Effective Tax Rate (ETR) in the solid minerals sector

An effective tax rate is equal to all payments transferred from a company to authorities in the form of taxes/royalties/dividends, as a share of company's gross profits (sales revenue minus variable costs of production/sales/marketing, plus depreciation and financing costs). In other words, ETR represents the "government take" as a proportion of the overall profits received from the natural resource under the project.

When it comes to the sharing of the profits from natural resource projects, there is a large difference between gas/petroleum projects and mining projects. Petroleum projects typically result in ETR of 60-80 percent. A major part of the profit is transferred to the government due to the very high profitability of the operations in the oil industry, thus leaving the initial developer with still very high return on investment. In other words, the nature of the petroleum industry allows a much higher return on every dollar invested. The range of ETR for mining projects is usually between 40 percent-50 percent, and can be explained by the significant technical and economic differences in the two industries.

The ETR is one of the key parameters that drive investor's decision to engage, because it impacts on rate of return to investment. Surveys of investors' decision parameters indicate that the key determinants for engaging in mining development rank in the following order (source?):

1. Good geological prospectivity, mining tradition and potential;
2. Clear mining rights and title (mining legislation);
3. Attractive and competitive fiscal conditions (tax legislation);
4. Ownership and control of operations (mining legislation);
5. Political stability and transparency of governance (government institutions);
6. Availability of infrastructure.

Based on international experience in the solid minerals sector, GOL's ETR of 50 percent is a competitive benefit sharing arrangement. Table 3 shows that as of 2002, the ETR ranged between 30-60 percent, with the median around 45 percent. The table also shows that countries that demand an ETR of above 60 percent are those with either a very long and successful mining tradition (such as Canada) or countries that wish to deter investment in mining altogether. Countries with shorter mining history and a perceived higher risk profile (as defined by Doing Business surveys, Fraser Institute's survey of the mining sector, etc.) usually charge lower ETR, to compensate for those risks.

Table 11. Foreign investor internal rate of return and total effective tax rate for a model copper mine

Country	Investor's internal rate of return (percent)	Total effective tax rate (percent)
Lowest taxing quartile		
Sweden	15.7	28.6
Chile	15.0	36.6
Argentina	13.9	40.0
Papua New Guinea (2003)	13.8	42.7
Zimbabwe	13.5	39.8
Philippines	13.5	45.3

2nd lowest taxing quartile		
South Africa	13.5	45.0
Greenland	13.0	50.2
Kazakhstan	12.9	46.1
W. Australia	12.7	36.4
China	12.7	41.7
United States (Arizona)	12.6	49.9
2nd highest taxing quartile		
Indonesia (7th, COW)	12.5	46.1
Tanzania	12.4	47.8
Ghana	11.9	54.4
Peru	11.7	46.5
Bolivia	11.4	43.1
Mexico	11.3	49.9
Highest taxing quartile		
Indonesia (non-COW 2002)	11.2	52.2
Poland	11.0	49.6
Papua New Guinea (1999)	10.8	57.8
Ontario, Canada	10.1	63.8
Uzbekistan	9.3	62.9
Côte d'Ivoire	8.9	62.4
Burkina Faso	3.3	83.9

Source: Otto 2002.

Note: government equity participation is not taken into consideration for calculation of IRR or ETR. In the majority of cases cited above government does not participate as an equity partner, and in the cases where government participates, it does so on market terms which are equal to other partners.

Tax package

ETR of 50 percent can result from different tax packages. The decision to adopt one or another package will depend on the relative risk and collection challenges related to the types of fiscal instrument. For example, Table 11 illustrates how an ETR of 53.4 percent is achieved through a combination of 35 percent profits tax, 4 percent royalty, 10 percent government equity participation, and 10 percent dividend withholding tax.

Table 12. Illustrative calculation of "government share" or "effective tax rate"

		Project cash flow (US$)	Government cash flow (US$)
A	Sales	1000.0	
B	Operating costs	-650.0	
C	Operating profit (A-B)	350.0	
D	Royalty (4 percent of A)	-40.0	40.0
E	Taxable profit (C-D)	310.0	
F	Profits tax (35 percent of E)	-108.5	108.5
G	Available for shareholders (E-F)	201.5	
H	Dividend to government (10 percent of G)	-20.2	20.2
I	Dividend to investor (G-H)	181.3	
J	Dividend withholding tax (10 percent of I)	-18.1	18.1
K	Net distribution to investor (I-J)	163.2	
L	Total government cash flow		186.8
M	**Effective tax rate (L/C)**		**53.4 percent**

Source: Parsons, 2008.

If the fiscal regime is intended to be internationally competitive, it will on average provide the investor with an internationally competitive rate of return on their investment. Parsons (2008) calculates that such rate of return will be around 16.5 percent. Table 5 illustrates several fiscal packages that would allow to arrive to this rate of return in Laos. This would imply a 35 percent profit tax to be combined with 4 percent royalty rates, for example.

Table 13. The impact of different "tax packages" on project economics

	Case A	Case B	Case C	Case D
Profit tax	35 percent	32 percent	32 percent	30 percent
Royalty	4 percent	5 percent	4 percent	5.5 percent
Customs duty	0 percent	0 percent	5 percent	0 percent
Investor's rate of return	16.5 percent	16.5 percent	16.5 percent	16.5 percent

Source: Parsons, 2008.

Another way to make the package more attractive is to reduce up-front costs to investor, shifting the fiscal burden into later stages of the project when start-up risks have materialized. The government could provide internationally competitive fixed costs, such as land and registration fees, but charge slightly higher rates of tax or royalty later on. The current land fee in Laos is equal to US$2/hectare, which means that a significant part of scarce, risk-willing exploration capital is deferred to tax payments, thus delaying the geological data compilation in Laos. In comparison, in the Democratic Republic of Congo, land fee is around US$0.02/hectare and escalates to $0.04 during the four years of exploration. Accordingly, an exploration area of 100,000 hectares (medium-sized exploration area to international standards) would cost US$2,000-4,000 in land fees in DRC compared to US$ 200,000 in Laos. While at the beginning of the project this is a high amount, it would be easier to charge it later in the process when investor is receiving revenues from the project.

Conclusions and recommendations

Lao PDR has already asserted itself as an attractive destination of mine investments. Present operations have demonstrated that cost-effective extraction is feasible in Lao PDR. Cash cost parameters position the existing operations in the top-half of cost-competitive copper operations in the world (with cash costs in the order of 0.9US$/lbs). In consequence, the country is in possession of a promising resource base which can be explored and exploited once global demand and credit market conditions improve.

Although the prospectivity looks strong, the sector is facing a "generation gap" since exploration of new deposits have been limited. This has been a function of the uncertainties that are embedded in the Mining Law of 1997 with regard to exploration companies' right to exploit a deposit once confirmed. In the present context, investors are not secured this fundamental right, and as a result no new investors have shown the willingness to commit large upfront investments which are required to confirm and develop a resource. Bauxite mining could potentially become one exception to the generation gap since a number of exploration activities are on-going. However, the production of bauxite would require many additional production inputs, which are currently unavailable, and is associated with environmental and social costs that may be prohibitively high for development. The government should not subsidize the private sector if this turns out to be the case.

Formal mining industry in Lao PDR employs around 15,000 people. Some 35,000 full-time workers are engaged in seasonal artisanal mining and predominantly pan gold. There is limited nationwide evidence of the multiplier effects of present mining industries (although individual companies have reported up to four-fold increases in disposable income in project-affected communities), but international experience indicates that one position at a mine site would generate up to four new employments in the surrounding economy. If the high case were to materialize, the sector could employ more than 34,000 workers in the formal sector.

The dramatic drops in commodity prices and availability of finance after the financial crisis illustrate the volatile nature of the mining industry caused by external factors which are beyond the control of Government of Lao PDR. In order to mitigate these impacts, GOL has several actions at its disposal that could attract potential investors:

- Implement the revised Minerals Law and associated regulation;
- Firmly establish the principle of "finder's right" which provide explorers and developers the assurance of a return on the investment in case of successful discovery and development;
- Clearly define GOL's position on government equity participation in mine operations;
- Clearly define the entire "tax package" to allow investors a better understanding of the potential "effective tax rate" that they will be facing;

- Ensure that the “effective tax rate” continues to position Lao PDR within the range of competitive investment destinations for the mining industry;
- Apply the tax package on non-discretionary basis among all investors.
- Continue to support the formation of skilled labor force and the new generation mine professionals which are expected to realize the great potential of the industry.

References

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Annex 1: Assumptions

I. Price assumptions

Commodity	*Reference*
Copper	World Bank projections
Gold	World Bank projections
Silver	World Bank projections
Zinc	World Bank projections
Potash	World Bank projections
Alumina	250 US$/ton
Gypsum	50US$/ton
Low case	***- 10 percent***
High case	***+ 20 percent***

II. Production assumptions

Copper	*2009 – 14*	*2015 – 19*	*2020 – 24*
Low case (tons)	LXML: 67,000 PBM: 67,000	LXML: 67,000 PBM: 67,000	LXML: 33,500 PBM: 33,500
Base case (tons)	LXML: 67,000 PBM: 67,000	LXML: 80,000 PBM: 100,000 Med. mine: 60,000	LXML: 100,000 PBM: 130,000 Med. mine: 60,000 Small mine: 10,000
High case (tons)	LXML: 67,000 PBM: 67,000	LXML: 80,000 PBM: 100,000 Med. mine: 60,000 Small mine: 10,000	LXML: 100,000 PBM: 130,000 Med. mine: 60,000 Small mine: 10,000

Gold	*2009 – 14*	*2015 – 19*	*2020 – 24*
Low case (ounces)	LXML ‘09: 95,000 PBM: 75,000	LXML ‘10=>: 0 PBM: 65,000	LXML: 0 PBM: 32,500
Base case (ounces)	LXML ‘09: 95,000 PBM: 75,000	LXML: 95,000 PBM: 65,000	LXML: 95,000 PBM: 65,000 Med. mine: 45,000
High case (ounces)	LXML: 95,000 PBM: 75,000	LXML: 95,000 PBM: 65,000 Small mine: 15,000	LXML: 95,000 PBM: 80,000 Med. mine: 45,000 Small mine: 15,000

Other minerals	*2009 – 14*	*2015 – 19*	*2020 – 24*
Low case (tons)	N/A	N/A	N/A
Base case (tons)	N/A	Alumina: 1,000,000	Alumina: 1,000,000 Zinc: 30,000
High case (tons)	N/A	Alumina: 1,000,000 Zinc: 30,000 Gypsum: 100,000	Alumina: 1,000,000 Zinc: 30,000 Potash:1,000,000 Gypsum: 100,000

National and regional small businesses	*2009 – 14*	*2015 – 19*	*2020 – 24*
Low case US$ mill	37,500	3 percent increase p.a.	3 percent increase p.a.
Base case US$ mill	37,500	7 percent increase p.a.	7 percent increase p.a.
High case US$ mill	37,500	10 percent increase p.a.	10 percent increase p.a.

Artisanal and Small-scale Mining	*2009 – 14*	*2015 – 20*	*2020 – 24*
Low case ounces	35,000	25,000	20,000
Base case ounces	35,000	35,000	35,000
High case ounces	35,000	50,000	60,000

III. Cost assumptions

Company	*Copper (US$/lb)*	*Gold (US$/oz)*
LXML	**Cash cost:** 0.9 **Depreciation + amortization:** 0.2	**Cash cost:** => 2010: 600 2010-15: 500 2015 =>: 400 **Depreciation:** 30
PBM	**Cash cost:** 0.9 **Depreciation + amortization:** 0.2	Precious metals credited against copper cash costs
Medium-scale model company	**Cash cost:** 1.1 **Depreciation + amortization:** 0.25	**Cash cost:** 425
Small-scale model company	Only royalty payment is assumed (no profit/income tax)	Only royalty payment is assumed (no profit/income tax)
Alumina refining	Profit tax assumption based on feasibility study figures	
Zinc and gypsum	Fiscal receipts: 12.5 percent of total revenue (2.5 percent royalty included)	
Potash	Fiscal receipts: 9.5 percent of total revenue (2.5 percent royalty included)	

Annex 2. Long term commodity prices

Metal prices have seen sharp declines after all time highs in 2008. International metals prices rose substantially from 2000 until first and for some metals second quarter of 2008 at which time most metals had reached historical high prices, in nominal terms, and in some cases matching or exceeding the highest real levels seen in the last thirty years. This "Super-cycle" came to an abrupt end in the second half of 2008 as prices dropped by 50 percent or even more across the board and even continued the decline during the first months of 2009. By end of April 2009, there are signs (although far from conclusive) that prices are bottoming out since some metals have recovered small parts of the losses. For some metal groups, however, the decline appears to continue although at a slower pace. Gold represents an exceptional case where the high price has been sustained throughout the collapse of other commodity prices. It should be noted, however, that despite the recent losses the price level of most metals are still substantially higher than the long-term trend (see charts at end of this annex). This is thanks to soaring prices realized in previous years.

Table 2A. Price volatility of reference metals

Commodity	High (month, 2008)	April 15, 2009	Percentage decline
Copper	8,685 US$/t (April)	4,750 US$/t	45.3 percent
Gold	940 US$/oz (July)	891 US$/oz	5.2 percent
Silver	19.22 US$/oz (March)	12.82 US$/oz	33.3 percent
Aluminum	3,071 US$/t (July)	1,467 US$/t	52.2 percent
Zinc	4,410 US$/t (December, 2006)	1,448 US$/t	67.2 percent
Nickel	31,225 US$/t (March)	12,375 US$/t	60.4 percent

The sharp decline in metal price is linked to the economic and financial crisis. The slow-down in manufacturing and construction has resulted in much lower demands for metals and other commodities. The recent reversal of price declines can also partly be attributed to moderate improvements in economic activity, but perhaps more importantly, key players, led by China have increased stocks of metal supplies in recent months. This means that unless public sector and eventually private sector demands pick up, a further backlash in demand and prices cannot be ruled out by once metal stocks have been filled up.

Chinese demand growth was a major factor behind the "super-cycle". In recent years, analysts have pointed to the fact that Asia, China in particular, accounted for the majority of growth in demand for metals. For some metals (iron ore and copper), Chinese demand growth has single-handedly reversed a trend which would otherwise have led to a decline in global demand for these base metals. Over the fifteen years since 1990, Chinese metals demand growth has averaged 10 percent per year, and in the last five years it has accelerated to 17 percent annually before a deceleration in 2008. The country is now the world's single largest user of almost all metals. Chinese metal demand has been driven by fast growth in industrial production, and investment in infrastructure, construction, and manufacturing.

Over the same period, China also made substantial investments in metals mining and processing and its own production has grown strongly. It is the world's largest miner or refiner of a number of metals and, by any measure, one of the world's leading mining countries.

In products such as copper and iron ore, where its production of processed metal or ore has lagged growth in its demand, it has emerged as major source of demand for refined metals and raw materials on world markets. India represents the second market in rapid expansion with similar characteristics to the Chinese industrial development but with a later and lower starting point. It should also be noted that India has been equally hit by the economic slowdown of recent years.

The high prices brought high rewards but also sharp cost increases. High prices and profits until 2008 brought in their wake a number of issues that the industry now needs to deal with. In anticipation of sustained price levels, a large number of new investments and expansions were initiated in recent years leading to inflation of development and construction costs, as the mining supply and service industries have been pushed up against capacity constraints at the same time as their own costs have risen as a result of a global increase in commodity and labor prices.

Fiscal terms and conditions were renegotiated to capture some of the windfall profits for the resource-rich countries. High prices and profits also attracted the attention of some governments who, in the face of large profits being earned by investors, came to feel that they were not receiving an adequate share of the benefits from the development of their national resources.

Cost profiles are now in the process of realignment with the collapse in prices. In the face of the price collapse and adverse economic conditions mine operators are now struggling to reduce costs in order to recover parts of the profit margin, but in many cases as a requirement simply to survive. However, costs are likely to be somewhat above previous lows as a portion of the increase in costs remains permanent.

Financial costs are now weighing very heavily on new investors as well as existing operators. Investors in new mine developments have seen their profit margins erode and may face the choice between starting operations which are unprofitable at this point in time or alternatively abandoning or deferring operations, thus receiving zero return on the substantial amounts of sunk costs in the mine site.

Given the cash-based nature of the mining industry, existing operators are required to hold large sums of working capital. With the financial crisis, this capital has become extremely scarce and costly. The combination of pressures has forced a number of mine operators to request deferment of (eroded) tax payments or reduction in tax obligations to host countries as a strategy for survival.

Longer term metals demand growth remains positive. Assuming that the economic contraction will abate and eventually reverse, the fundamentals for the metals markets remain relatively strong. Partly as a result of China's and India's growth, developing countries now account for close to 50 percent of global demand for metals. Developed country metals demand growth leveled off some time ago and is likely to grow only slowly or even contract in the future although it will vary by metal. The potential for long-term demand growth from developing countries, however, is very large. Metals use is strongly correlated with economic growth, particularly growth in industrial production, and associated developments such urbanization and rising incomes. If developing countries are to return solid growth rates (even at a lower level than what has been seen since 2000) and continue the trend of urban migration, their metals use will tend to rise to similar levels. Today, metals consumption per head in developing countries, whose population in aggregate is more than five times as large as the total of the developed countries, is often one quarter or less than that of the rich countries. This means that even with efficiency

gains, the growth of demand for metals is likely to be accelerating rather than decelerating over the next decades.

Developing new supplies will be challenging. For more than thirty years, the world's mining industry has been able to supply growing amounts of metals to world markets at gradually falling real costs. It has been able to do this despite declining ore grades and tighter environmental and social constraints on its operations. A broad-based and diverse range of incremental improvements in mine operation and processing, including large open pit mining operations that helped realize economies of scale, were responsible for ensuring declining costs. In addition, major breakthroughs have occurred, such as the introduction of leaching technology in the production of copper, and, more recently, the development of pressure acid leaching for the recovery of nickel from laterite deposits.

Looking forward, the potential, absolute size of future demand growth in the industry will be larger than ever. For the foreseeable future the resource base is not likely to be a major constraint. But, the industry is likely to face continuing challenges in terms of higher energy costs, potentially higher exploration costs, declining ore grades, and increasing environmental and social constraints, including water issues. In some areas (such as southern part of Africa) the competing demands for resources from the increasingly affluent and urbanized population has caused disruptions to mine operations because of power and water shortages. There may also be less scope for reaping gains from major economies of scale due to a growing share of large open pit mines, and new mines may more often be located in remote locations with greater infrastructure costs.

But the trend level of metals prices will remain a good yard stick of future prices and demands. Considering the various resource constraints, it is possible that the trend decline in real prices that has been the market rule until the turn of the century could be stopped and reversed to some extent. Real prices, though, look unlikely to stay substantially above past long-term trend levels for sustained periods since the industry has managed during the recent "super-cycle" to build up an inventory of both known, but unexploited, mineral resources and plant capacity which can respond to renewed demands for metals.

Chart 2A. Refined Metals Prices 1993 – 2009