

Labrador mining and power: how much and where from?

Department of Natural Resources
November 2012



Key Factors

- \$10-15 billion of investment in Labrador mining projects may be realized over the next decade but this is dependent in part on the availability and cost of power.
- If these projects proceed they will bring major economic benefits to the province, through employment and taxation revenue (both direct and indirect), as well as provide opportunities for service industries.
- Estimation of future power needs for planned mining developments is challenging, particularly as many projects have not advanced to the stage where firm requests for power have been made.
- Based on projects already in construction or near sanction, existing generating capacity in Labrador may be exhausted by 2015-17.
- Muskrat Falls could be an important source of power for mining developments post-2017, and sanctioning of the project may assist mining companies in making positive investment decisions. Availability of power will encourage investment in the province rather than in competing jurisdictions.
- Muskrat Falls could provide power for future mining developments (or export markets if mining developments are slow to proceed) as well as providing sufficient power for the Island of Newfoundland. The Isolated Island option, with refurbishment or replacement of the Holyrood Generating Station or any other isolated alternative, will not supply the power needed for Labrador mining developments.
- In the longer term, mining developments may absorb all residual power from the Muskrat Falls development. Further power may be needed.

Introduction

The provincial minerals sector in 2012 is forecast to operate at record levels, with mineral shipments and mineral industry employment at all-time highs. It is poised for major expansion, particularly in Labrador, with a number of advanced projects, proposed expansions of existing projects and new discoveries.

The Government of Newfoundland and Labrador will use our electricity resources to actively pursue new industrial development in the province, particularly Labrador.

Energy Plan, 2007

\$10-15 billion of investment in mine development may be realized over the next ten years based on announced plans, feasibility studies, and preliminary economic assessments of prospective deposits.

Mining is an energy intensive industry, and it is important to understand the possible power requirements of these Labrador developments, based on current publically available estimates, and A reliable, competitively priced supply of power is

information from the companies involved. essential for these projects to advance.

Background

Newfoundland and Labrador has thirteen operating mines producing a variety of commodities. The four largest mines are those of IOC (Labrador City, iron ore); the Scully Mine of Cliffs Natural Resources (Wabush, iron ore); Vale's Voisey's Bay mine (northern Labrador, nickel, copper and cobalt); and Teck's Duck Pond operation (central Newfoundland, copper and zinc). Two new mining operations opened in 2011 - Labrador Iron Mines (LIM) iron ore mine in the Menihek region; and the Rambler Mines and Metals Ming copper-gold mine near Baie Verte. Two more mines are under construction in 2012 (Tata Steel Minerals Canada iron ore mine in the Menihek area; and Newspaper's fluorspar mine in St. Lawrence).

The gross value of mineral shipments for 2011 was \$4.6 billion and is forecast to be \$4.1 billion in 2012. Iron ore (67%) and nickel (19%) account for most of the value of mineral production.

In 2011-12, the minerals industry in Newfoundland and Labrador contributed \$343 million to the province's tax revenues from direct mining taxation, with a much larger contribution from corporate and indirect taxation. Direct employment in the mining sector rose to 6755 person-years in 2011, and is forecast to be close to 7700 person-years in 2012. Company expenditures on mineral exploration were at a record high of \$172 million in 2011, with similar levels forecast for 2012. The majority of exploration will be for iron ore, but gold and other commodities are generating significant interest.

Future trends

The future of the minerals sector is closely tied to the demand and prices paid for commodities, and these primarily are dependent on the global economy. Long-term trends in global demand for metals suggest a steady growth, driven by economic growth in Asia. China and India are experiencing growth in urban centres and an increasingly wealthy population, resulting in demand for the basic commodities that fuel construction, in particular iron ore for steel making.

"...we expect iron ore prices to remain at elevated levels over the medium term, providing a constructive backdrop for the development of iron ore projects globally. While a number of prospective projects exist in Africa, the Labrador Trough boasts the benefit of having some rail and port infrastructure in place. In addition, the Trough has a tested and proven iron ore product that has been accepted by the Chinese and global markets."

RBC Capital Markets – RBC Prospector September, 2011

It is difficult to forecast long-term trends in commodity pricing as metal prices can be volatile and cyclical. The economic growth in Asia is leading analysts to suggest that commodity prices may be less volatile over the next decade. Based on the expectation of continued high demand, mining companies are planning major investments in Newfoundland and Labrador over the next decade.

The Voisey's Bay mine will continue to produce nickel, copper and cobalt, with secondary processing at the Long Harbour plant starting in 2013-14. A possible transition to underground mining could extend mine life past 2021.

Iron ore is the main commodity driving development in Labrador, and prices have risen steeply in the last five years. Iron ore

Iron ore prices used in economic evaluations of iron ore deposits in Labrador Trough

Project	Date	Iron ore price/tonne
Alderon	2010	C \$115 (concentrate)
Tata Steel Canada LabMag pre-feasibility	2006	C \$75 (pellets)
Tata Steel Canada Direct Shipping project	2010	US \$100 (sinter fines)
Bloom Lake (PQ)	2008	US \$71 (concentrate)

prices are normally expressed as the cost in US dollars/tonne of iron ore concentrate delivered to China. Iron ore mines produce a variety of products. In addition to iron ore concentrate, Labrador mines produce a pelletized form of ore that is easy to transport, and commands a premium price when sold. The current market favours concentrate production where ore types allow its production. Prices reached a peak of close to \$180/tonne of concentrate in February 2011 before falling to \$150/tonne in early 2012. As of September 2012, prices were close to \$100/tonne. Prices historically were much lower, below \$50/tonne prior to 2004.



The consensus of industry analysts is that the long-term price for iron ore will be controlled by the operating costs in Chinese mines, the largest current producer of iron ore. Over half the iron ore mines in China have operating costs at around \$100/tonne, and in order to sustain domestic industry the Chinese government is unlikely to allow prices to fall back much below this figure. Forecasts are available from a number of analysts but the

consensus is that long term iron ore prices will be in the order of \$90-110/tonne . Figures similar to these are used in published preliminary economic assessments for projects in development. Chinese growth may be slowing (9.1% in 2011 following a peak of over 14% in 2007), with consequent pressure on commodity prices. If this trend is accurate, then iron ore prices are expected to decline towards the long-term levels forecast by the World Bank as illustrated in the chart above.

Companies are proceeding with developments in the Labrador Trough based on positive economic assessments arising from these long-term forecasts. Proposed developments include expansion of IOC's operations, the Kami project of Alderon Iron Ore Corp and Tata Steel Minerals Canada's Lab Mag project. If the projects go ahead, they could result in iron ore production increasing from 23 million tonnes/year in 2011 to over 80 million tonnes/year by 2020. Even at this rate of extraction, iron ore production can be sustained for at least another fifty years due to the size of the iron ore deposits in the Labrador Trough.

In addition to these developments in western Labrador, Grand River Iron Sands (GRIS) is planning a mineral sands project to produce pig iron in the Goose Bay area and Paladin's Michelin project aims to mine uranium in the Central Mineral Belt.

Process of developing a mineral deposit

The process of developing a mine can be protracted and consists of achieving a series of milestones prior to a final decision to start construction. These milestones represent a progressively increasing likelihood that the mineral deposit will be developed into a mine. Projects in Labrador are at various states in development and understanding where they sit on this progression assists in understanding the degree of certainty that power will be required to service them.

The initial stage in developing a mine deposit is exploration and discovery. The focus of this stage is to find minerals of economic value in sufficient quantities that might translate into a mine. No consideration of the size of the resource is made at this stage or the economics of its development.

Once significant mineralization is discovered, then advanced exploration takes place, aimed at defining an economic resource (i.e., confirming that there is enough of the mineral of interest to support a mine). The result of this is a technical report on the resource, developed according to a standard set by the Canadian Securities Administrators called the “National Instruments 43-101” or NI 43-101. This clearly defines the quantities and grade of the minerals, along with the degree to which it has been delineated. Minerals are considered “resources” until a pre-feasibility study is completed.

Scoping studies or preliminary economic assessments are an initial financial appraisal of a mineral resource. They will involve a preliminary mine plan and are the basis for determining whether to proceed forward with further exploration and more detailed engineering work. Order of magnitude studies are developed using known costs from similar projects completed elsewhere and are accurate to within 40-50%. Such studies are used to secure partners or financing for future work.

A 43-101 compliant Preliminary Feasibility Study is a comprehensive study of a range of options for the technical and economic viability of a mineral project that has advanced to a stage where a preferred mining method is established and an effective method of mineral processing is determined.

A 43-101 compliant Feasibility Study is a comprehensive technical and economic study of the selected development option for a project that includes appropriately detailed assessments of realistically assumed mining, processing, metallurgical, economic, marketing, legal, environmental, social and governmental considerations together with any other relevant operational factors and detailed financial analysis, that are necessary

to demonstrate that extraction is reasonably justified (economically mineable). The results of the study may reasonably serve as the basis for a final decision by a proponent or financial institution to proceed with, or finance, the development of the project.

Development will take place following identification of financial resources to proceed and appropriate permitting. Permitting also forms an important milestone, with the most important stage to accomplish being release from the environmental assessment process. Projects register for environmental assessment at various stages in development, but generally in conjunction with a final feasibility study, when the elements and size of the project are clearly defined.

As projects progress along this development path, the probability that the project will proceed to a mine increases. Thus, a relatively small number of projects that produce a 43-101 compliant resource estimate proceed to a preliminary feasibility study, and of those not all progress to feasibility stage. A positive feasibility study does not guarantee construction of a mine, but greatly increases the likelihood of development.

Mining and power

Mining is highly reliant on electrical power, with the amount of power required dependent on mining method and process. Power is required at all stages from drilling, blasting, excavating, crushing and grinding, transportation of ore and waste material, dewatering and concentrating. Further processing – pellet manufacture, smelting – also requires energy, again with the amount dependent on the process used.

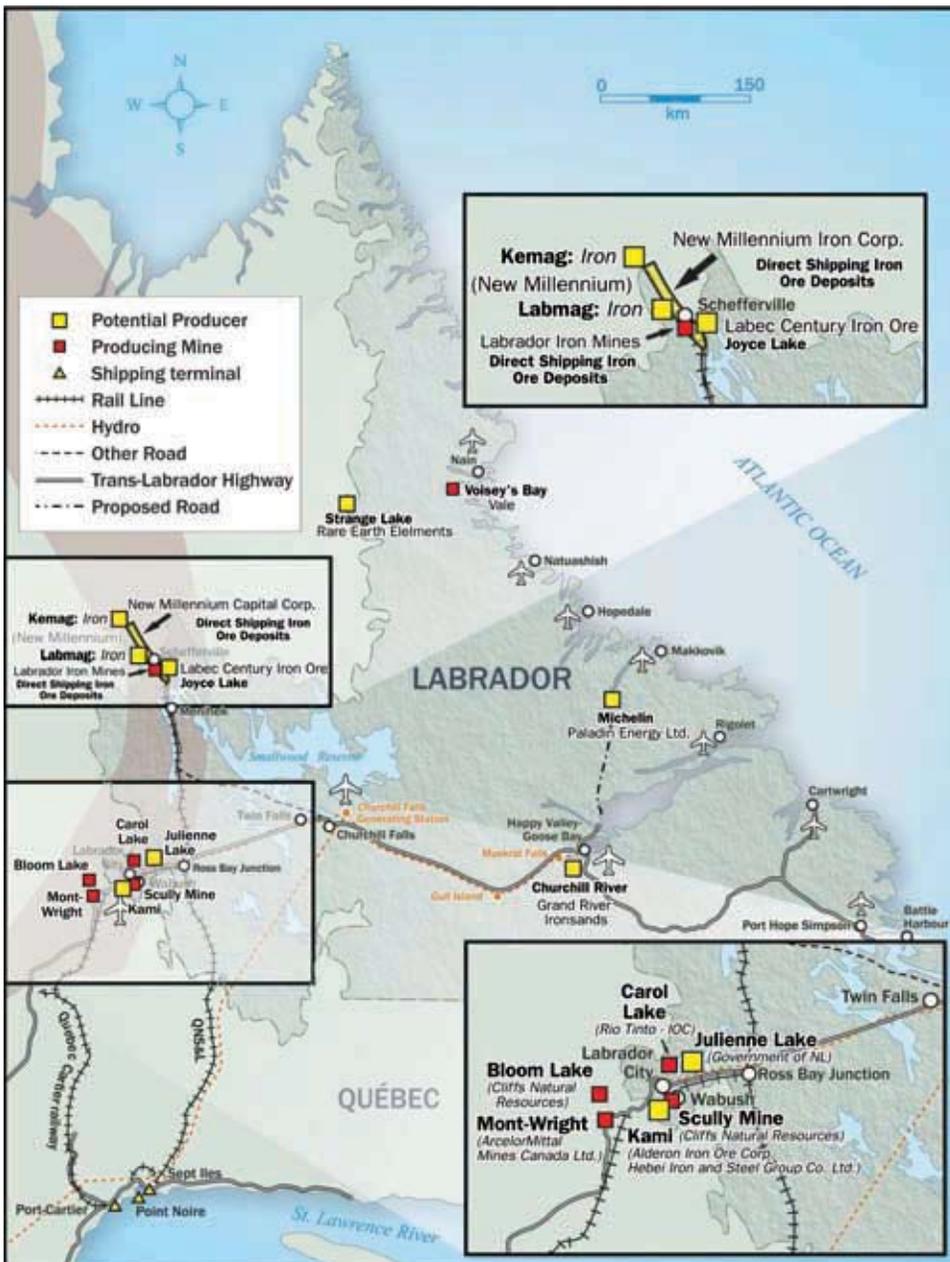
“The availability of electrical grid power to an iron ore project site is essential as the amount required can in be in the range of 60 to 600 MW, which is well beyond what can be provided by conventional diesel-powered generators. Most current iron ore operations have access to electricity provided by hydroelectric or natural gas-fired power plants. Depending on the distance from the existing power grid to a project’s location, the amount of new hydro lines that needs to be constructed can be considerable.”

National Bank Financial Coverage of Iron Ore in the Labrador Trough – March 2, 2012

Estimation of future power needs for planned mining developments can be challenging, particularly as many projects have not advanced to the stage where firm requests for power have been made.

Mines in remote locations are dependent on independent means of generating electricity - the Voisey’s Bay mine uses diesel generation for its power needs. The economics of mining is greatly improved if the mine has access to grid electricity at a reasonable price. Availability of hydroelectric power in Labrador greatly improves the viability of proposed developments.

In the iron ore industry an approximation of power needs can be made based on the amount of iron ore the project plans to produce. A figure of 10-13 megawatts (MW) for annual production of each million tonnes of concentrate is used in this report, where definite power requests have not been made public. This estimate is based on an analysis of power requirements for existing projects. This higher figure is used for iron ore types that require more grinding – for instance the ores in the Menihek area, whereas the lower figure is typical of the ores in the Labrador City area. Some projects are mining “direct shipping” iron ore. This is a high grade soft ore that requires only minimal processing so power requirements are less.



Mining projects

To evaluate future power requirements projects are considered according to stage in development; existing, in construction, feasibility complete, in feasibility/environmental assessment, pre-feasibility complete. Those in construction are nearly certain to need power with a firm time at which power will be required. Those moving through the feasibility process are considered to have a high probability of proceeding if iron ore markets remain robust, although uncertainty regarding construction schedules, environmental assessment and financing makes the date at which power might be required harder to confirm. Projects in pre-feasibility require significant amounts of work before power needs can be confirmed, and the date at which power might be needed is uncertain.

In outlining potential power needs for iron ore developments, unless the developer has made a public statement regarding requirements, the benchmark of 10 MW/million tonnes concentrate in the southern Trough, and 13 MW/million tonnes of concentrate in the northern Trough is used. A standard pellet plant requires approximately 80 MW of power.

Existing mines

Voisey's Bay

Vale Newfoundland and Labrador Limited (VNL) operates the Voisey's Bay mine in northern Labrador, 35 kilometres southwest of Nain. It is an open pit mine that processes ore to a concentrate on-site which is then shipped for processing. During 2011, VNL produced over 48,000 tonnes of nickel, 37,000 tonnes of copper, and 1137 tonnes of cobalt.

- Current power supply: diesel generators
- Current power usage: 15 MW

Wabush Mines

Wabush Mines consists of an open pit mine producing iron ore for a concentrating plant at Wabush, and a pellet plant and shipping facilities in Point Noire, Quebec. Wabush Mines is 100% owned and operated by Cliffs Natural Resources Inc.

Wabush Mines produced about 3.1 million tonnes of iron concentrate in 2011 and, depending on market conditions, will gradually increase annual production to 5.5 million tonnes over the next four to five years. Employment at the mine site is expected to increase from 460 person – years currently

to about 500 in support of the planned gradual production increases. Manganese reduction technology is being implemented and will extend mine life by 10 years or more (2031).

- Current power supply: Labrador interconnected system
- Current peak power usage: 53.6 MW

Iron Ore Company of Canada Carol Lake

IOC started producing iron ore from its Carol Lake (Labrador West) project in 1962. Canada's largest iron ore pellet producer operates several open pits, a concentrator, a pellet plant at Carol Lake, port facilities in Sept-Iles, Québec, and a 420-kilometre rail line that links the mines and the port. Its current capacity is 16.5 million tonnes of concentrate annually (increasing to 22.0 million tonnes per annum (mta) with the current approved concentrate expansion programme).

- Current power supply: Labrador interconnected system
- Current power usage: 222 MW

Labrador Iron Mines Ltd.

LIM was the first new iron ore producer in the province since 1965 when it shipped iron ore in 2011. LIM operates seasonally, shutting down from November to May, and is ramping up to 2 million tonnes/year production. LIM are mining ores amenable to direct shipping with minimal processing. Power in 2011 was supplied through diesel generators but negotiations are underway to obtain power from the Menihek hydro facility. Ore is shipped from the Menihek area to Sept-Iles via rail.

- Current power supply: diesel (may be largely replaced by Menihek hydro power in 2013)
- Current power requirement: 5.5 MW

In construction

IOCC Concentrate Expansion Program

In 2008, IOC announced a 3-phase Concentrate Expansion Program (CEP). Phase I is focused on increasing production by relieving bottlenecks in mine supply to the concentrator and primary grinding capacity, while Phase 2 will increase production through increasing magnetite recovery. Phase I of the expansion is currently undergoing operational testing and commissioning. Phase II construction will continue through 2012 with commissioning expected by Quarter 1 (Q1), 2013. It is expected to increase total concentrate capacity to 22.0 million tonnes.

Phase III is currently under study but is likely to consist of a production increment of 4-6 million tonnes per annum and may be operational toward the end of 2016, increasing power requirements to 300 MW.

- Additional power requirement: Phase II 38 MW; Phase III – 40 MW (Source: IOCC)
- Date required: 2013 (Phase II); 2014-16 (Phase III, estimate)

Tata Steel Minerals Canada

TSMC is a joint venture company owned by Tata Steel of India (80%) and New Millennium Iron Corp., a Canadian publicly listed junior mining company (20%). TSMC's project in northwestern Labrador/Quebec is developing iron deposits very similar to those of Labrador Iron Mines Limited.

TSMC's Elross Lake project is split into two phases and each has been released from environmental assessment. Construction of the work camp began in Quarter 2 (Q2), 2011. Site clearing for the plant is currently underway.

TSMC expects to begin commissioning and ramp-up of the plant in Quarter 3 (Q3), 2012 with full processing capacity expected between November, 2012 and January 2013. 5 1/2 million tonnes of ore per year will be processed to produce about 4 million tonnes of iron concentrate.

- Power requirement: 8 MW (company pre-feasibility study)
- Source: Diesel

Feasibility complete

LIM Expansion

LIM submitted a formal request to Nalcor Energy for electricity supply from Menihek for its Labrador mining operations in the area beginning in April 2012. LIM has indicated a requirement for 8 MW from mid-April to mid-November. Diesel generators would continue to be maintained as backup/supplemental power supply option to Menihek power supply.

Expansion plans involve a new mine at the Houston deposits by 2013. This expansion project is now through the environmental assessment process. A further 2 MW may be required for this expansion.

- Additional power requirement: 10 MW (estimate based on company requests)
- Source: Menihek power station/diesel

Undergoing feasibility studies/environmental assessment

Alderon Iron Ore Corp – Kami project

Alderon Iron Ore Corporation (Alderon) is developing the Kamistatusset (Kami) iron ore project in Labrador West. The project is located 5 km southwest of Wabush Mines.

A 2011 preliminary economic assessment suggested that the project can economically support an operation that would produce 8 million tonnes of iron concentrate per year grading 65.5% iron and the mine would have a life of 15 years. The assessment was based on one of three separate iron ore deposits on the Kami property. Further resource statements and final feasibility studies will include one or both of the remaining two deposits and will contemplate expansion to 16 mta.

Alderon registered the project with provincial and federal environmental regulators in October, 2011 and the company is currently preparing an environmental impact statement. The company expects to complete a definitive feasibility study for the project by Q3, 2012. Mining is planned to start in Q3, 2015. Alderson announced major investment from Chinese steel maker Hebei in April 2012, suggesting that the project is well on track to become a mine.

- Power requirement: 58.3 MW for 8 mta (Source: Preliminary economic assessment) /100-120 MW (source: project registration for environmental assessment). An additional 80 MW might be required if pelletizing takes place.
- Date required: 2015/2018 (based on Alderon schedule available on web site)

Tata Steel Canada Labmag project

This project is undergoing feasibility studies in conjunction with the adjacent Kemag project in Quebec. This is a major taconite iron ore project in the Menihek district. Early stage plans envision a mine producing 22 million tonnes annually. Pelletizing will be required and will require additional power if conducted in Labrador. The feasibility study is to be completed in Quarter 4 (Q4), 2012.

- Power requirements: 235 MW for mining; 63 MW for pellet plant (Source: estimate in 2006 pre-feasibility study)
- Date required: 2016

Vale – Voisey’s Bay underground mine

Vale is undertaking studies on the viability of underground mining at Voisey’s Bay. The current open pit operation will be exhausted in 2020-23. Replacing diesel generation of power with cheaper sources is considered to improve the economics of underground mining. Hydro power could be supplied from the interconnected system or from small scale hydro close to the mine.

- Power requirements: unknown – likely significantly greater than present
- Date required: 2020

Labec Century Iron Ore – Joyce Lake

Labec Century Iron Ore registered the Joyce Lake project for environmental assessment in October 2012. This project, situated in the Menihek area, plans to produce 4 million tonnes a year of direct shipping ore.

- Power requirements: unknown – diesel generation
- Date required: 2014-15

Pre-feasibility study

IOC Labrador West Strategic Development

The IOC is studying the feasibility of expanding concentrate production to 50 million tonnes or more annually. Plans are at an early stage, hence detailed timelines and capital cost estimates are not yet available. Construction and operational employment would be significant if it proceeds. The project would likely proceed in phases, with first production from early phase(s) if sanctioned expected by 2017. Each phase, based on limitations of concentrator throughput is likely to add 8 mta to output, and is estimated here to require an additional 80 MW of power.

- Additional power requirement: 80/160/240 MW, likely required in three phases (estimate based on 8 mta production increments).
- Date required: 2017-2020 (estimate based on IOCC media releases and public statements)

North Atlantic Iron Corporation

GRIS is the proponent of a project to extract iron from mineral sands in the Churchill River basin and manufacture pig iron near Happy Valley-Goose Bay. Petmin of South Africa have partnered with GRIS in forming North Atlantic Iron Corporation to move the project forward. A NI 43-101 resource estimate was completed in April 2012 and further studies to determine feasibility are planned. The project is considering secondary processing via an electric smelting process that would require a substantial amount of power. A second electric furnace could increase power requirements as the project progresses.

- Power requirements: 120-130 MW (source: estimate from company in 2012 presentation to Labrador Expo conference)
- Date required: 2015/2017

Aurora- Paladin Michelin project

The Michelin project of Aurora Energy/Paladin Energy Ltd. consists of an open pit and underground mine that could mine 10,000 tonnes per day of uranium ore. It is located in the Central Mineral Belt of Labrador close to the communities of Postville and Makkovik. A positive preliminary economic assessment was produced in 2009. Progress on the project was slowed by a moratorium on uranium mining put in place by the Nunatsiavut Government in 2008, but this was lifted in early 2012.

- Power requirements: unknown
- Date required: uncertain

Julienne Lake

This is a Crown owned iron ore deposit, approximately 15 km from Labrador City and Wabush. Government has conducted geologic and economic analysis. Preliminary indications are that the deposit could support a 16 million tonne concentrate producing operation. Power requirements and timelines for development are broad estimates.

- Power requirements: 80-160 MW (estimate for a 8 mta-16 mta operation). An additional 80 MW might be required if pelletizing takes place.
- Date required: 2018

Resource estimates

A number of companies are exploring for iron ore in western Labrador and may produce resource estimates in the next 12 months. These include New Millennium Iron and Cap-Ex ventures in the Menihek area; Altius Minerals (joint ventures with Century Minerals, and IOC) in the Labrador City area and Menihek area; and Golden Dory in the eastern Labrador Trough. These projects currently are not sufficiently advanced to be considered in an evaluation of power needs, but may factor into long-term planning.

Québec projects

The Québec-Labrador border divides the Labrador Trough, and comparable iron ore developments located in Québec compete for investment with those in Labrador. Two major mines operate in Québec, ArcelorMittal's long-standing Mont Wright mine, and Cliffs Resources' Bloom Lake mine that opened in 2010, both of which lie close to and west of Labrador City. ArcelorMittal are planning expansion of production up to 24 mta at Mont Wright, and Cliffs are ramping up production at Bloom Lake to 16 mta.

Champion Minerals are entering environmental assessment with their Fire Lake project in the same area. Tata Steel Minerals Canada are conducting a feasibility study on the Kémag deposit, adjacent to the LabMag deposit, and of similar size and scope. Adriana Resources are advancing the Lake Otelunk project, north of Schefferville, with the help of major Chinese investment, and several other projects are advancing to pre-feasibility stage. All these projects require power and final investment decisions may be based on its availability.

Summary Table

Project	Status	Power requirement (MW)	Date required
IOC	In operation	222	
Wabush	In operation	54	
LIM	In operation	5.5 (diesel)	
Voisey's Bay	In operation	15 (diesel)	
Total		296.5	

Project	Status	Power requirement (MW)	Date required
IOC-CEP II	In construction	38	2013
TSC-DSO	In construction	8 (diesel)	2012
Total		46	

Project	Status	Power requirement (MW)	Date required
LIM Phase 2	Released from EA	10	2013
Total		10	

Project	Status	Power requirement (MW)	Date required
IOC-CEP III	In EA	40	2014-16
Alderon – Kami project	In EA	58-120	2015
Total		Maximum of 160	

Project	Status	Power requirement (MW)	Date required
Grand River Iron Sands	Pre-feasibility	120-130	2015-17
Julienne Lake	Pre-feasibility	80-240	2019
Total		Maximum of 370	

Project	Status	Power requirement (MW)	Date required
TSC-LabMag	In feasibility	235-298	2016
IOC strategic expansion phase 1	In feasibility	80	2017-20
Voisey's Bay underground	In feasibility	Unknown	2018-20
IOC expansion phase 2/3	In feasibility	80-160	Unknown
Total		Maximum of 538	

Note: The table summarises information in the preceding section, and should be interpreted on the same basis. In outlining potential power needs for iron ore developments, unless the developer has made a public statement regarding requirements, the benchmark of 10 MW/million tonnes concentrate in the southern Trough, and 13 MW/million tonnes of concentrate in the northern Trough is used. A standard pellet plant requires approximately 80 MW of power.

Power supply

There is currently 525 MW of Churchill Falls generation available to meet demand in Labrador. This includes the 225 MW Twin Falls block and the 300 MW recall block. Demand fluctuates through the year but Labrador industrial customers currently use the full 225 MW Twin Falls block and have contracted for 62 MW of firm capacity from the recall block. After NLH's Labrador rural customers and industrial contracts are supplied, there is 80 MW of firm recall power available. This power is currently being exported by Nalcor until such time that it is required to meet demand in Labrador.

Nalcor's 18.7 MW Menihek hydroelectric generating station supplies the town of Schefferville via a contract with Hydro-Quebec; it is not connected to the main Labrador interconnected system.

New transmission infrastructure will be required between Churchill Falls and Labrador West if there is any growth in industrial demand in the region. The existing transmission lines, owned by the Twin Falls Power Corporation, are operating at full capacity. This is also true for the Goose Bay area, where current transmission from Churchill Falls is also at capacity.

Development of the 824 MW Muskrat Falls project has a target completion date of 2017. The maximum generating capacity of the facility of 824 MW is available to meet the full peak demand of the province (including wintertime demand on the Island) and, in the event that the Maritime Link is sanctioned, to meet the 170 MW capacity commitment to Emera for Nova Scotia Power. About 40% of Muskrat Falls energy will be available to supply industrial customers in Labrador.

The Gull Island development could supply up to 2250 MW of capacity for Labrador industrial uses or export.

Labrador Industrial Rates

Government is developing an industrial rate policy for Labrador. The proposed rate policy will provide reliable and competitively-priced electricity for existing and new industrial customers in Labrador. IOC and Wabush Mines currently obtain power at less than \$5/megawatts hour (Mwh) based on agreements relating to the Twin Falls power facility, which expire in 2014. Competitive pricing on power is particularly important in the Labrador Trough, where developing projects are competing for investment against those in directly adjacent Québec.

Labrador Industrial Benefits

Competitively-priced power for development will facilitate industrial development in Labrador for which the province will realize significant benefits. These benefits are estimated in the 2012 report “Economic Impact Analysis of iron ore mining industry in Labrador 2011-31” by Wade Locke Economic Consulting, and include mining tax, corporate tax, employment, indirect taxation and impact on service industries.

The report provides a comprehensive analysis based on four scenarios similar to those considered in this paper for future power requirements:

- Base Case consisting of current operations with annual production of 26 mta
- Scenario 1: A moderate expansion, taking production to 41 mta over the next decade;

- Scenario 2: Major expansion, taking production to 62.3 mta; and
- Scenario 3: A maximum case with production at 81.1 mta.

The probability of the various scenarios unfolding is tied to demand and price for iron ore. If prices weaken, then the Base Case is considered the most likely. The maximum case would only be likely if iron ore prices were significantly higher than present. Scenarios 1 and 2 represent the most probable future for iron ore in western Labrador. The report also considered three possible long term price models for iron ore concentrate ranging from a low case of \$85/tonne concentrate to a high of \$115/tonne concentrate.

	Base	Moderate expansion	Major expansion	High end
Expenditures (capital and operating) \$billion	40	60	84	123
Employment (person-years/year)	7500	11,300	15,800	24,500
Contribution to GDP (annual average, \$billion)*	2.1-2.9	3.2-4.4	4.9-6.8	6.9-9.3
Taxation revenue (annual average, \$billion)*	0.4-0.5	0.5-0.8	0.9-1.2	1.0-1.5

* Values show range based on assumption of iron ore price used.

The results show that the iron ore industry already is one of the largest sources of employment and revenues for business in Newfoundland and Labrador and represents one of the few significant sources of employment and earnings outside of the Avalon Peninsula. The economic impacts resulting from expansion activities are substantial. With major expansion total employment could double and taxation revenue double or triple depending on iron ore prices. The contribution to provincial Gross Domestic Product is estimated at an average of \$2.1 to \$2.9 billion/year, but could rise to over \$5 billion. For comparison the offshore petroleum industry currently contributes about \$7 billion to GDP, and employs around 7,000 people.

Thus the availability of power may be an important factor in driving development in western Labrador, with a major economic benefit to the province.

Analysis

Industrial expansion in Labrador will be driven by mining, and these developments will require electrical power to proceed. The availability of renewable energy at competitive prices will greatly increase the likelihood of these developments progressing to mines.

The probability of the various proposed projects progressing to active mines varies according to their progress from discovery through to full feasibility studies. Preliminary economic assessments and feasibility studies suggest that most of these projects are profitable based on current forecasts of future iron ore prices, and many of these projects may progress.

Based on what is known of current and future developments, long-term power needs can be estimated; given the level of uncertainty with projects at relatively early stages, three scenarios are considered.

All scenarios involve a degree of speculation as to the outlook for future developments. This should not be interpreted as a commentary on the viability of any single development but as a means of planning for future power requirements. This analysis does not include any consideration of additional residential or commercial demand associated with mining developments. It is likely that this will increase significantly as new developments progress depending on where workers live and from which communities mines are serviced.

Low end

If projects actually in construction or undergoing environmental assessment go ahead with some modest delays in implementation then projections suggest demand increasing to above current supply in 2016-17, and approaching capacity from Muskrat Falls by 2020-21. This scenario might play out if iron ore prices and demand fell below current expectations, resulting in a slow-down in project development and expansion. Demand for power is still likely to increase based on projects currently in construction or environmental assessment only.

Mid range

This projection is based on the first phases of most announced projects going ahead but with delays of 12-24 months in construction with power needs deferred.

It is possible that demand could exceed current supply sometime after 2015, with all Muskrat Falls available capacity possibly needed by 2020. Long-term demand may eventually exceed supply even after Muskrat Falls comes on-stream and options to augment the supply, including wind and small scale hydro developments will be important.

This projection is considered to be the most likely if long-term iron ore prices remain close to or greater than \$100/tonne as forecast by the World Bank. Such pricing will moderate but still encourage growth.

High end

Under this projection, it is assumed that all proposed projects go ahead on the announced time schedule with pelletizing in province for several operations. Although this scenario is considered unlikely, it is included here to indicate maximum possible power requirements. Demand is thus forecast to rapidly increase, with current supply exceeded by 2016. It suggests that over 1400 MW might be required by 2020.

It is considered that this scenario would only play out if iron ore prices remained substantially above current projections, and if projects experienced no significant delays in obtaining financing, in environmental assessment, or in construction.

Most projects however are not sufficiently advanced to plan development on this basis, as firm power requests are not in place. If planning were to take place on the basis of this projection it would involve acceptance of major risk - if iron ore prices were to fall, or projects experience other difficulties in progressing, then development of Gull Island would result in a significant over-build with no access to external markets (see Gull Island report).

Discussion

Planning for providing power to mining developments in Labrador needs to balance the economic opportunities for development with the uncertainty related to future iron ore prices. In the short term, projects currently in construction or near to sanction can be accommodated through recall power, although transmission upgrades may be required. It seems possible, however, even if not all projects progress, that post-2017 most Muskrat Falls residual power will be required to service mining development.

Because a definite request for power can only be made by a company once a development decision is reached and finances are in place, there are challenges in planning power infrastructure to accommodate future needs. This represents a further difficulty in that financing for developments may require firm assurances of power delivery before investment is forthcoming. This interdependency in the decision making process is hard to resolve without acceptance of significant risk by one of the participants involved. Decisions on power development may need to be made in advance of production decisions by mining companies in order to deliver power in a timely manner.

Thus plans for future power generation need to:

- be capable of delivering power to Labrador mining developments who have progressed to a stage where firm power requests have been made;
- be able to accommodate demand on the Island;
- have the flexibility to accommodate at least some of possible future industrial power in Labrador or to export until such time as power is required; and,
- ensure that excess capacity can be readily delivered to export markets if not required in Labrador.

The Muskrat Falls project combined with the Maritime link provides both power for projects currently in construction or near to sanction, plus excess capacity that can either be exported via the Maritime Link or used to service further industrial development in Labrador. If future industrial demand continues to grow then further options to service it can be considered.

Conclusions

\$10-15 billion of capital investment in Labrador mining projects may be realized over the next decade but this is dependent in part on the availability of power.

If these projects go ahead they will bring major economic benefits to the province, through employment and taxation revenue (both direct and indirect), as well as providing opportunities for service industries.

Estimation of future power needs for planned mining developments is challenging, particularly as many projects have not advanced to the stage where firm requests for power have been made.

Based on projects already in construction or near sanction, existing generating capacity in Labrador may be exhausted by 2015-17.

Muskrat Falls therefore will be an important source of power for mining developments post-2017, and sanctioning of the project may assist mining companies in making positive investment decisions. Availability of power will encourage investment in the province rather than in competing jurisdictions.

Muskrat Falls will both provide power for future mining developments (or export markets if mining developments are slow to proceed) as well as providing sufficient power for the Island of Newfoundland. The Isolated Island option, with refurbishment or replacement of the Holyrood Generating Station or use of natural gas, will not supply the power needed for Labrador mining developments.

In the longer term (by 2021) mining developments may absorb all residual power from the Muskrat Falls development, and further power may be needed.

Footnotes

- 1 The chart uses Iron Ore Company of Canada average realized price per tonne for 2003-2011 and then applies World Bank % change expectations (for 62% Fe iron concentrate delivered to China) to the 2011 IOC prices to produce the forecast.
- 2 see www.cim.org/UserFiles/File/CIM_DEFINITON_STANDARDS_Nov_2010.pdf for full definitions

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