TECK TRAIL OPERATIONS LONG-TERM BUSINESS STRATEGIES

by

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Abstract

Trail Operations has survived for over 100 years through continuous efficiency improvements and process innovations. However, in 2008, Trail Operations lost some competitive advantage when one third of the power generating capability from its Waneta Dam was sold to BC Hydro. Trail Operations will be facing a further challenge in about six years time when the stockpile of its other substantial profit generator, the Zinc Residues, is depleted. To counter the combined effects of these financial predicaments in the long-term, several strategies have been considered. The strategy that provided the highest degree of confidence involves the installation of another Slag Fuming Furnace in tandem with a Settling Furnace. This project will open doors for Trail Operations to become "greener" through the enhanced recycling of electronic scraps/wastes and other recyclable materials. This new furnace will also provide steam for conversion into "clean" power as part of the proposed Biomass Power Generation project.

Executive Summary

Trail Operations (Trail) profitability will be significantly impacted after the depletion of the Stockpiled Zinc Residues in 2017.

To date, the impact of the sale of part of the Waneta Dam in 2008 has been somewhat negated by the favourable metal prices. However, another market downturn could trigger a financial crunch forcing metal prices to drop and thereby adversely affecting Trail's viability. A radical change in Trail's current set-up is therefore required to ensure that it can weather market fluctuations leading up to 2017 and beyond. The operating profitability of Trail can improve from -$18 million per year in 2016 Base Case to $44 million per year, an increase of $62 million in 2020 through the installation of the #4 Slag Fuming Furnace, a Settling Furnace, increased treatment of electronic scraps, and the conversion of biomass and excess steam into power.

The installation of the #4 Slag Fuming Furnace and the Settling Furnace will improve the operating profits for Trail by about $4 million per year. However, it will also provide the capability to increase the treatment of electronic wastes and scraps adding another $44 million per year to the bottom line. The installation of the Biomass Power Generator Project will improve profitability by a further $16 million dollars per year by 2020. These strategies will admittedly result in impurities such as increased fluorine, chlorine, bromine and tin entering into the processing streams. However, the cost of remedial processes to manage these impurities is included in the project's capital cost. It is assumed that the impact of such contaminants will be minimal.

Several sensitivities were run to evaluate potential risks. For example, a drop in the metal prices by 1% per year would reduce the total operating profits from $44 million in 2020 to $7 million in 2020. Likewise, an increase in metals prices by 1% per year would increase the total operating profits to $85 million in 2020. In addition, an increase in the operating costs and wages by 1% per annum reduces operating profit from $85 million to $49 million in 2020. The above projects carry a total price tag of approximately $230 million in new capital. This capital must be invested in a timely manner to ensure that Trail can sustain market downturns, can become more "green", and can remain a viable entity leading to 2017 and beyond.

Dedication

To Saman, and children.

Acknowledgements

- To Teck Resources Senior Management
- To Senior Management, Trail Operations
- To Faculty of Business Administration Staff, SFU
- To Colleagues, Trail Operations
- To Classmates (MBA Cohort)

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Glossary

Biomass	Biomass is solar energy captured in plant material through the process of photosynthesis. Biomass examples include household wastes, food industry wastes and agricultural residues.
Black Copper	Impure copper containing black (impurities) areas
Concentrates	Zinc and lead bearing feeds
Char	A term used for charcoal derived from the burning of biomass
Electronic Scrap	Mother boards from discarded and obsolete electrical devices
Electronic Waste	Discarded and obsolete electrical devises less mother boards
ETP Stock Residues	Low-grade material produced by the Effluent treatment Plant.
Ferrous Granules	Final product sold to the cement industry
Fuming Furnace	Furnaces that convert metal sulphides into metal oxides
Furnace	A vessel in which materials are melted.
Green	Sustainable, and environmentally friendly facility
KIVCET Smelter	A furnace that produces lead bullion and Ferrous Granules
Margin	Revenue less costs
Refinery	A place where metals are purified to high grade
Roaster	A column in which zinc sulphide is converted to zinc oxide (“Calcine”)
Settling Furnace	A furnace in which metals are separated through settling.

Stocked Zinc Residue	Written off material stockpiled at Trail awaiting processing through the smelter. This material is a source of zinc, lead, indium and germanium at no acquisition cost
Teck	Teck Resources Limited., a diversified resource company
Waneta Dam	A hydroelectric dam owned by Trail

1: Trail Operations, Trail, BC

1.1 Introduction

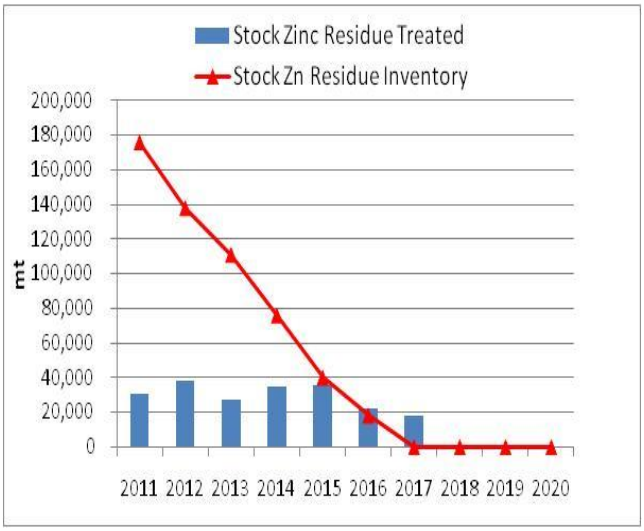
Trail Operations, Trail, British Columbia is a complex metallurgical operation located about 700 km South East of the port of Vancouver. Trail Operation's metallurgical processes receive about 1,000,000 metric tonnes of new feed materials annually that are processed through its integrated smelting, roasting, leaching and refining operations.

Trail Operations (Trail) began its operation in 1902 and treated a large majority of the zinc and lead concentrates from local mines such as the Sullivan Mine in Kimberley, B.C. The Kimberley Mine was shut down in 2002 due to lack of reserves, forcing Trail to look for alternate feeds from mines as far as South America and Australia, and resulting in higher distribution costs. Other feeds to Trail include internally generated recycled materials and old stockpiles, together with the recycling of external scraps and electronic wastes in substantial quantities. There is very little manufacturing industry in British Columbia and Alberta that consumes Trail's refined products. Therefore, Trail incurs higher transportation costs to ship its refined products to customers in Canada, the United States, Europe and Asia.

Figure 1: Trail Operations, Trail, BC (photo by author)

Trail's strength lies in its ability to convert most metals contained in the input feeds into products in an efficient and environmentally safe manner. This forte is evidenced by the large number of finished products sold by Trail that include base metals (zinc and lead), precious metals (silver and gold), speciality metals (indium and germanium), Chemicals (Copper sulphate, Copper Arsenate and Sodium Arsenate), Sulphur Products (Ammonium Sulphate Fertilizers, Sulphuric Acid, Liquid Sulphur Dioxide and Molten Sulphur) and Ferrous Granules (FG).

Trail's assets also include a hydroelectric dam, the Waneta Dam, and its transmission system. This dam has been a source of cheap power for Trail enabling it to maintain its competitive advantage and viability as a low cost producer. The 2008 credit crunch forced Teck Resources Limited, Trail's parent company, to sell one third of the Waneta Dam to BC Hydro as part of its strategic survival measures. The power generated by the remaining two thirds of the dam in Trails' possession, is sufficient to meet Trail's demand but provides only limited sales of excess power, causing a decline in margin of about $40 million per year. Trail has made significant changes to its processes and technologies in order to remain current. One of the major shifts in 1997 was the installation of a new lead smelter, the KIVCET. The introduction of the KIVCET into the process allowed Trail to accelerate the treatment of legacy stockpiled materials such as the Stocked Zinc Residues (SZR). These residues not only help optimize the smelter treatment capacity but also contain value metals that make a significant financial contribution to Trail's bottom line. It is estimated that the SZR inventory will run out in about 5-6 years resulting in an annual margin loss of about $40 million. A graph of SZR treatment and inventory is shown in Graph 1:



Graph 1 *(Source: by author)*

1.2 Project Objective

Trail is actively looking into ways to mitigate the total loss in margin of about $80 million per year from the sale of part of the Waneta Dam in 2008 and the projected depletion of the SZR in 2017.

The objective of this project is to develop a Business Model that will evaluate the combined effect of future strategies and whether these can generate $100 million per year in differential margins by 2020.

1.3 Project Scope

The current mode of operation in Trail is maintained i.e. it will continue to produce up to 305,000 tonnes per annum of Refined Zinc. The metal recoveries and capital expenditures shown in this report are approximates.

All graphs included in this report have been generated by the Long Range Business Model and are based on estimated data.

1.4 Current Strategies

1.4.1 Trail Today – Base Case

The Base Case assumes that Trail continues to run without any major new capital injection and the SZR run out in 2017. The prices of metals remain unchanged from 2014 onwards.

1.4.2 The #4 Slag Fuming and the Settling Furnace (#4SFF and the SF)

Currently about 1/2 of the FG (containing Zinc, lead, germanium, indium, copper, and tin etc.) are sold without further processing due to a Fuming Furnace capacity constraint. The #4SFF and the SF will provide the ability to treat all Ferrous Granules production.

1.4.3 Increase Recycling of Electronic Waste

The installation of the $4SFF and the SF will greatly increase Trail's ability to process electronic wastes and scraps from 13,000 tonnes per annum (tpa) in 2014 to 40,000 tpa by 2017.

1.4.4 The Biomass Power Generation

The Biomass Power Generation project will allow Trail to produce "green" power from the burning of the biogas obtained from biomass together with power generation from the use of excess steam produced by Trail's metallurgical plants. The power produced from the steam will be classified as "clean" power and sold at a premium price to BC Hydro.

1.4.5 The Pend Oreille Mine Restart

Restart of this mine could provide between $5-10 million/year depending upon the metal prices and the synergies between various concentrate treatments in Trail. However, the 3-4 years of life remaining for this mine mean that this is not a long-term solution. This mine is owned by Teck and currently on care and maintenance.

1.4.6 Treat additional Lead Batteries

Lead batteries are clean lead feeds due to high lead and low deleterious elements content. The additional recycling of this material will create an opportunity for the smelter to blend with other feeds that have higher impurity content.

1.4.7 Increase Red Dog Zinc Concentrate

Trail treats about 280,000 metric tonnes per annum (mtpa) of Red Dog Zinc Concentrates. This material is a preferred concentrate for Trail due to its good quality. A 20,000 mtpa increase in treatment at Trail would result in a margin benefit of about $1 million per year. There are other benefits associated with the good quality of the Red Dog Zinc Concentrate but these not included in this study.

1.4.8 Other Residue treatment Options

The treatment of 8,000 mtpa Nystar Germanium Concentrate through the smelter has been included in the LBM.

1.5 Metallurgical and Financial Models

Trail utilises a complex linear programming based optimization model called the Optimet. This model is a great tool to determine the best operating mode for Trail within defined metallurgical constraints but does not carry out a detailed financial evaluation. The financial picture is calculated by entering data manually into various financial models by the Finance Group.

As part of this project, a Long-term Business Model (LBM) will be developed to evaluate the combined financial impacts of various business strategies being proposed for Trail. The advantage of such a LBM would be that it will have a metallurgical front-end integrated with a detailed financial model. The metallurgical part will handle feed purchases, material treatments, recoveries and derived finished metal productions, and will then feed all results into the financial model. A combined metallurgical and financial model will provide added flexibility to the users to be able to evaluate multiple scenarios very quickly. Also, the outputs from the LBM will be in alignment with a template used by the Corporate Head Office for transition into their business model.

Once developed, the LBM will be used to analyse selected strategies mentioned above to determine whether Trail can achieve its goal of $100 million per year margin by the year 2020. The validation of this LBM was accomplished by the Financial Group who compared its results with the 2011 Plan (prepared by the traditional financial methods) and found results to be satisfactory.

1.6 Risk Analysis

The projected cash increases for Trail will be generated from a combination of strategies that will carry various degrees of known and unknown threats. Some of these risks could be associated with the new inputs into the process while the other threats may be linked to marketing the additional production or introducing new products into the market. An overall risk scan will be carried out for each strategy to ascertain potential

internal and external threat variables and how best to minimize their impact. The outcome will be a framework that will identify such variables at an early stage, such that effective remedial measures can be instituted in a timely manner.

2: The Long-Term Business Model (LBM)

2.1 Introduction

As mentioned earlier, Trail routinely uses a complex linear programming based optimization model, the Optimet, that maximizes revenues within defined metallurgical constraints. The high-level financial analyses performed by Optimet are not sufficient to justify a new project that requires a large capital investment. Therefore, a LBM was developed with a metallurgical front-end to evaluate and quantify the financial benefits accurately. The LBM has the capability to run multiple sensitivities based on volume, pricing, exchange rate, and financial ratios. A snapshot of the LBM is shown in Appendix A.

2.2 The LBM Structure

The LBM has two integrated sections:

1) Metallurgical

2) Financial

The metallurgical Section of the LBM contains:

a. Concentrate feeds (Local, South American and International), Ferrous Granules, Zinc Residues, Effluent Treatment Plant Residues, Fluorescent Bulbs + Cathode Ray Tube Glass, Zinc Alkaline Batteries, Electronic Wastes and Scraps. Note that Trail does not treat lithium and Nickel Cadmium batteries. The mercury contained in the fluorescent bulbs is quite negligible and is recovered from the process as Calomel or Mercury Chloride. The fluorescent bulbs provide silica to control smelter metallurgy.

b. Compositions for feeds namely zinc, lead, silver, gold, germanium, indium, cadmium, sulphur and copper. Other compositions can be added, if required.

c. Process recoveries for each metal. There is a facility to add separate recoveries for the #4SFFSF and the SF and for Electronic Scraps and Wastes. Other recoveries can be added, if desired.

d. Final products include Refined Zinc, Refined Lead, Silver, Gold, Indium, Germanium, Cadmium, Copper Cake, Copper Matte, Copper Sulphate, Copper Arsenate, Black Copper, Sodium Antimonate, Elemental Sulphur, Sulphuric Acid, Liquid Sulphur Dioxide, Ammonium Sulphate Fertilisers by Grade, and Ferrous Granules.

e. Other smaller volume products like Calomel (or Mercury Chloride, Hg_2Cl_2) and Thallium Dichromate (Tl_2CrO_4) etc. have been excluded from the model due to their negligible impact on a financial evaluation.

f. Includes plant shut down impact. For example, a major Smelter shutdown is scheduled to occur every three years i.e. 2013, 2016 and 2019 and so on.

g. The final products have a capacity limit and any overflows can be controlled by varying the feeds. The model assumes no metallurgical constraints from the time that the feeds are processed and converted into final products.

The Financial Section of the LBM contains:

h. Revenues from refined products

    i. Based on exchange rates and metal prices forecast provided by Corporate Head Office.

    ii. A fixed revenue of $38 million is assumed for products not included in the LBM.

i. Expenditures

These include:

    i. Feed acquisition costs

ii. Operating costs (consumables, repairs, contract supplies, energy, administration, major rehabilitation and expenses etc.)

iii. Carbon Tax

iv. Selling and distribution costs

v. Depreciation

vi. Routine capital expenditure

vii. Taxation

j. Income

i. The two main parameters calculated in the Income Statement are the Operating Profit (OP) and Earnings (ER). These will be used extensively in the project report to determine Trail's operating viability in the long-term. The other details will not be added in the project report, due to confidentiality.

The Senior Supervisor, Dr. L Meredith has seen the detailed business model and concurs with the sensitive nature of the information and data. It has been agreed with Dr. Meredith that a few snapshots (no data) of the LBM will be included in the Appendix.

ii. Net Present Values (NPV) are calculated

iii. A form control button has been added to automatically calculate individual operating profits and earnings for each strategy.

k. Balance Sheet

i. Includes current assets, liabilities, fixed assets, and work in process.

ii. Return of Assets are calculated at various rates

l. Concentrate terms

    i. These contain concentrate terms pertaining to payable metals and metals prices for zinc, lead, silver, gold, indium and germanium. This report calculates concentrate cost at the prevailing metal prices and the US$-Canadian $ exchange rate.

m. Power sales

    i. This section of the model deals with revenue generation from excess power sales. Power is not a large revenue generator after the sale of a third of the Waneta Dam.

n. Economic drivers

    The model can run various sensitivities based on the following drivers:

    i. Exchange rate

    Operating Cost Escalation Factor. Note that a 1% change in OCE rate is assumed to increase the Administration, Energy, and other costs by 0.5%. This is done to show that such costs do not necessarily move in line with the change in the OCE rate.

    ii. Wage escalation

    iii. Metal prices

    iv. Transportation rates can be added easily, if needed

o. Sensitivities

    i. Scroll bars have been added to run several sensitivities for each or a combination of the economic drivers.

2.3 Risk Analysis

A high-level risk analysis will be done for all scenarios.

3: Trail Operations - Base Case

3.1 Introduction

The lead and zinc concentrates fed to Trail have changed considerably over the past several years, resulting in a large proportion now emanating from off-shore at considerable distribution costs. These concentrates are blended with the SZR and other fluxes to meet the desired KIVCET smelter metallurgy. The smelter metallurgy will be affected when the SZR stockpile is depleted in 2017 resulting in reduced concentrate treatment. In order to have a clear understanding of the challenge faced by Trail, the LBM was run without any process improvements, to establish a starting Base Case.

3.2 Business Model

The following operating parameters were entered in the LBM as a Base Case:

1. Input feeds to the Base Model were taken from the 10-Year Metallurgical Forecast provided by the Optimet Model.

2. After the SZR depletion in2017, large amounts of Ferrous Granules will be recycled in the smelter to optimize feeds capacity and manage its metallurgy.

3. The metal recoveries are based on historical and test data.

4. A replacement and maintenance allowance of $25 million per year is included in the expenditure. Additionally, the smelter is scheduled to take a major shut down every three years, at an average additional cost of $15 million. For this reason, a notable change in the operating revenue will be seen every third year starting in 2013. In addition to the higher expenditures on the smelter during the major shut down years, the revenues are further affected by the lower treatment of SZR due to reduced smelter capacity.

5. The long-term metal prices used are as advised by the Corporate Head Office (see 3.3).

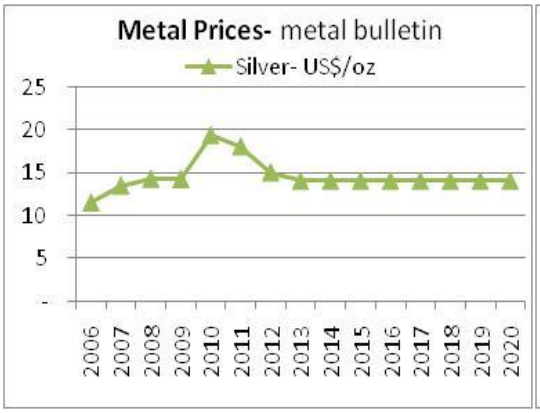
6. In view of the stagnant metal prices from 2015 onwards, the operating cost escalation rate and the wage increase will be kept at zero to avoid revenue distortion. These factors will be modified when sensitivities are run in the LBM.

3.3 Metal Prices

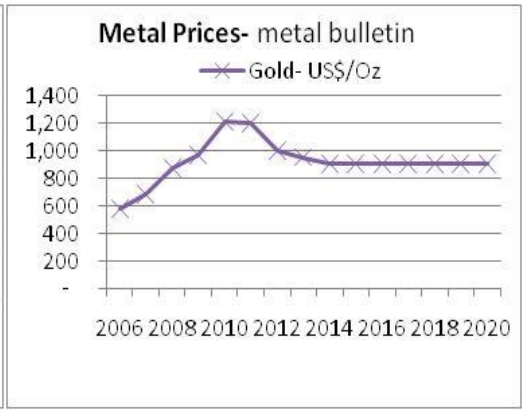
Actual prices for 2006-2010 are averages from the London Metal Exchange (LME) and the Metal Bulletin (MB). The zinc and lead actual prices and forecasts from 2011 onwards are used in all scenarios and are shown on Graph 2. Note that prices are stagnant from 2014 onwards.

Graph 2

The forecasts for silver and gold used in the LBM from 2011 to 2020 are as shown in Graph 3 and Graph 4.

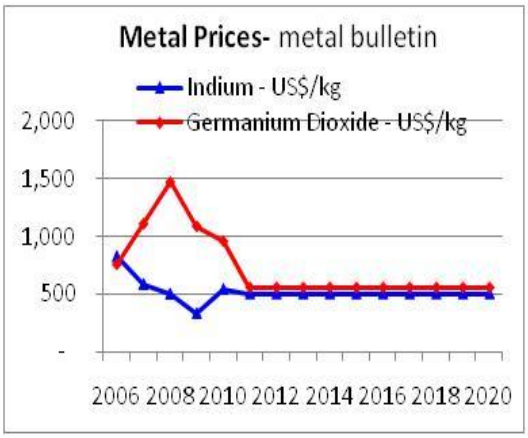


Graph 3

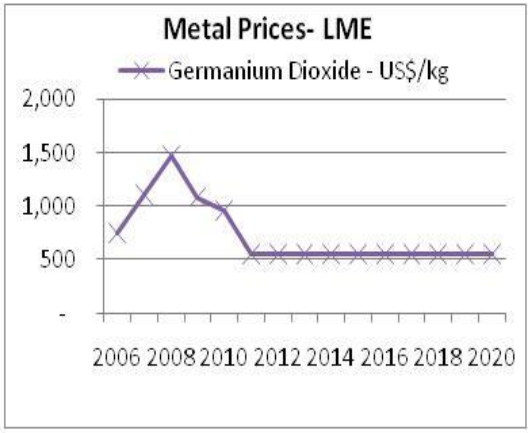


Graph 4

The forecast prices for Indium and Germanium Dioxide used in the LBM for 2011 to 2020 are shown in Graph 5 and Graph 6. The 2006 to 2010 prices are actual.

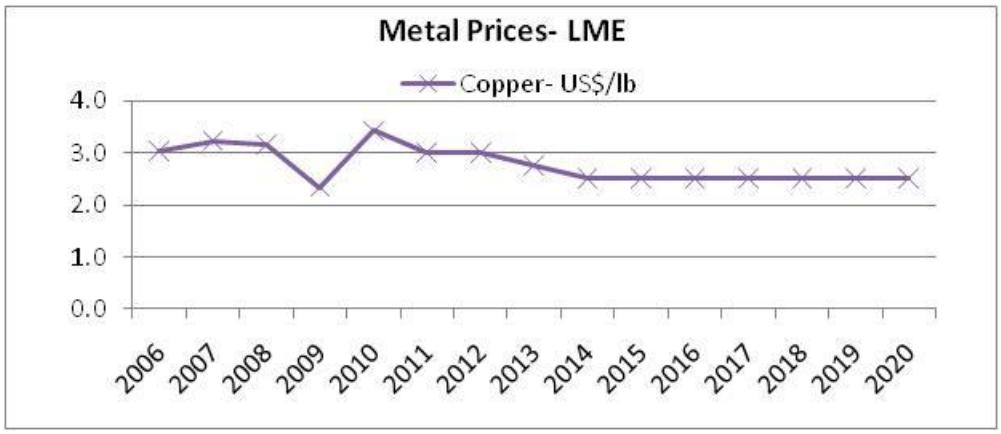


Graph 5



Graph 6

The actual prices of copper for 2006 to 2010 and the forecast prices for 2011- 2020 are shown in Graph 7.



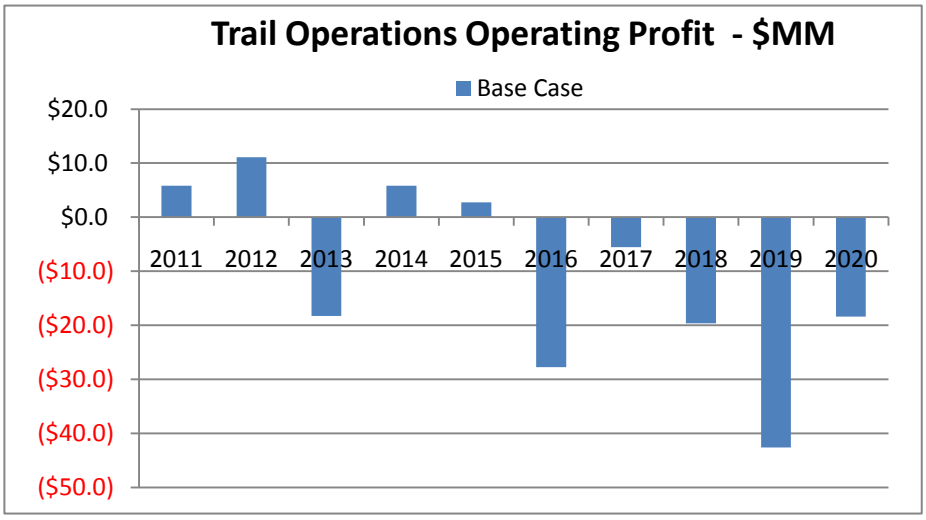
Graph 7

The above forecast prices have been provided by the Corporate Head Office for use in the long-term planning. As seen in Graph 5 to Graph 7, the current metal prices for 2010 are above the forecasts for 2011 to 2020. So, there is a reasonable probability that metal prices may remain higher in the future. However, for prudence, it is safer to use the conservative prices in the LBM to make allowance for any unforeseen market downturns.

Various sensitivities will be discussed later in this report to evaluate the financial impact of potential risks.

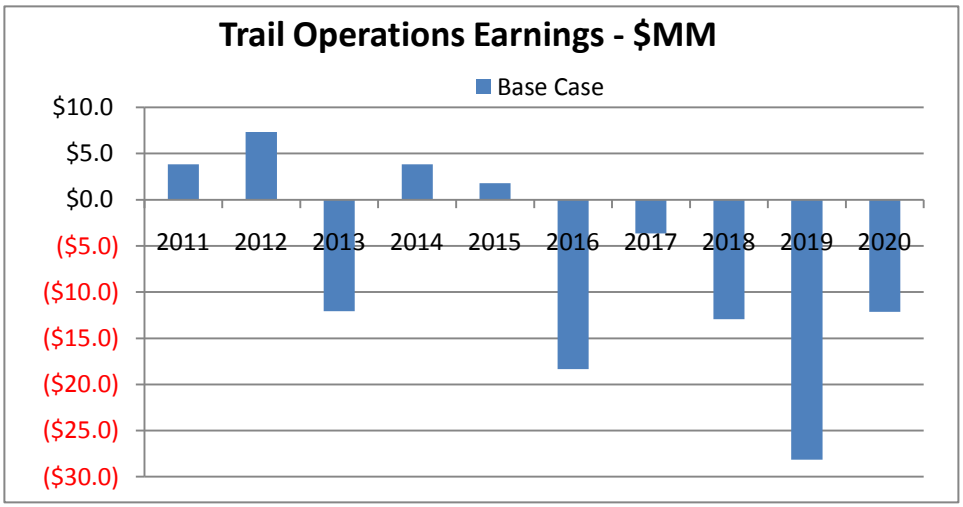
3.4 Business Analysis

As seen in Graph 8, the operating profits in 2012 are slightly higher than 2011 due to a change in the concentrate feed mix. Thereafter, the operating profit drops due to major smelter shutdowns every three years, combined with the lower projected prices of various metals. The OP drops substantially as soon as the treatment of SZR is reduced from 2016 onwards. The impact of SZR depletion from 2017 is quite evident in Graph 8.



Graph 8

The ER was also calculated after making allowance for tax, and is as shown in Graph 9. The trend is no different from that shown in the OP Graph 8. The Graph 9 clearly outline the importance of SZR to Trail and that radical measures are required to keep Trail viable beyond 2017.



Graph 9

3.5 Risk Analysis

The OP and ER for Trail decline sharply as soon as the SZR is depleted in 2017. The operating profits prior to 2017 could be wiped out very quickly with an unscheduled production interruption, a drop in metal prices or continued increases in operating costs. Additionally, the profits are not available to invest in research, innovation and newer technologies such that Trail can stay ahead of the inflation. It should be noted that the profits drop significantly in the years' when the smelter is down for a major rehabilitation and maintenance.

3.5.1 Local Community

Trail provides employment to over 1,450 employees, several hundred contractors, and supports the surrounding communities through taxes and economic injections into community projects. An economic downturn in Trail would also affect these and many other stakeholders.

3.6 Risk Mitigation

Trail has survived many decades due to its ability to innovate and diversify in a timely way, to minimize the adverse impacts of one or more economic drivers. Additionally, Trail is always working towards process and technology improvements to enhance productivity and increase efficiencies. Going forward, a small process improvement may not be enough to keep Trail viable in the medium to long term, and therefore Trail needs major capital projects to remain an on-going business. Trail is currently pursuing several sustainable initiatives to improve its medium to long term profitability. This report will evaluate three major initiatives and two minor possibilities using the LBM. The objective is to develop an operating scenario that will increase Trail's operating profit to approximately $100 million per year by 2020**.**

3.7 Inflation and Other Expenses

The long-range metal prices and the US Dollar to Canadian Dollar exchange rates used in this forecast are as projected by the Corporate Head Office. In the forecast, the metal prices are predicted to drop and stay stagnant from 2014 onwards. If this is the case, and Trail's operating expenses continue to rise then it cannot remain a viable entity beyond 2017 without a major shift in its operating strategy. However, in order to make comparable results in line with stagnant metal prices, the LBM analysis will be carried out at a zero Operation Cost Escalation (OCE) rate. The impact of inflation, price changes and other operating expenditure increases will be covered later in the report under "sensitivities".

4: #4 Slag Fuming Furnace and the Settling Furnace

4.1 Introduction

Trail produces 190,000 metric tonnes (mt) to 200,000 mt of Ferrous Granules (FG) each year containing small amounts of zinc, lead, indium, germanium, silver, gold, copper and other precious metals. About 50%-60% of these FG are processed (fumed) through the #2 Slag Fuming Furnace (#2SFF) to recover the fumable metals (Zn, Pb, In and Ge) while the rest of the metals are lost through the FG sales.

In order to improve the recovery of the fumable metals, Trail is aggressively pursuing the installation of a new Slag Fuming Furnace (#4SFF) that will operate in parallel with the existing #2 Slag Fuming Furnace (#2SFF). This furnace will allow the fuming of the entire tonnage of FG produced by the #3 Slag Fuming Furnace (#3SFF) that operates in tandem with the smelter. The other part of this project includes the installation of a Settling Furnace (SF) downstream to the #2SFF and #4SFF to recover the remaining copper, silver, gold and precious metals.

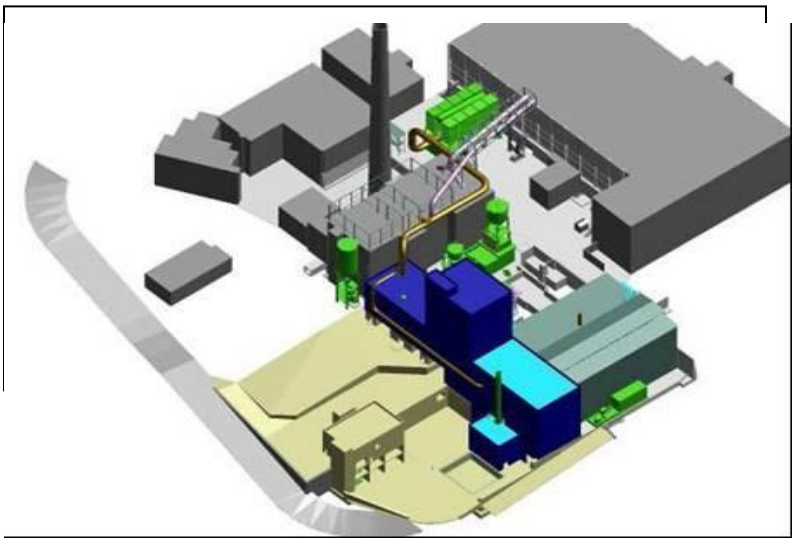


Figure 2: Proposed site for the #4SFF and the SF (grey).

(Source: Business Development, Trail)

Additional benefits of the #4SFF and SF are:

- Enhance Trails' ability to process large volumes of electronic wastes, scraps and other urban ores.

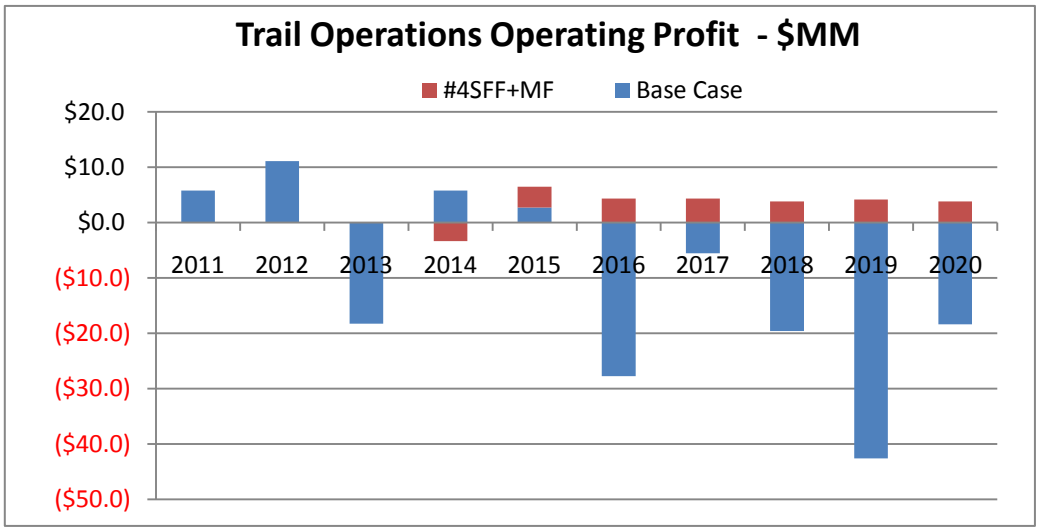
- Additional steam generation that will increase the economics of Trail's Biomass Power Generation project.

- Increased ability to handle copper and other precious metals.

On the downside, like most innovative processes, the treatment of additional materials through the #4SFF and the SF will result in an increase in some impurities into the Trail circuit. To overcome these, a team of technical experts has developed an appropriate course of action. The cost of the remedial measures/processes is included in the total project capital cost.

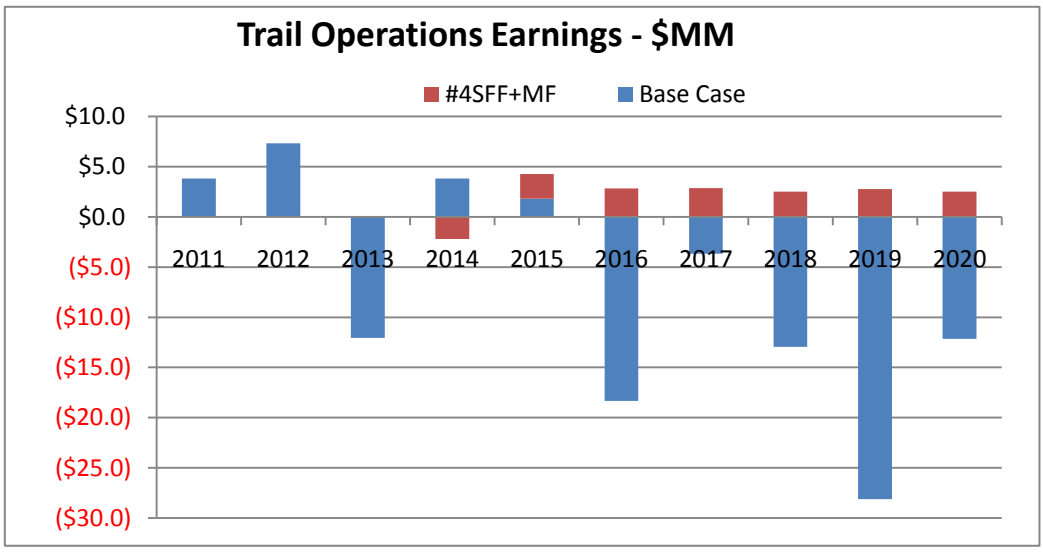
4.2 Business Model

The Business Model includes a facility to add the metallurgical and financial impact of installing the #4SFF and the SF by simply changing a "0" value to "1" in a cell. The impact on Trail's operating income is seen as soon as the $4SFF and the SF is turned on. A capital expenditure for the #4SFF and SF of $180 million is included in the model and assumed to be all spent in 2014. The annual cost of operating both furnaces is estimated at $20 million per year. The impact of $4SFF and SF is shown in Graph 10.



Graph 10

The #4SFF + the SF improves the Trail OP by about $4 million per year which is not enough to reach the total OP target of $100 million per year. The ER are shown in Graph 11 and also improves as a result of #4SFF and the SF installation.



Graph 11

4.3 Business Analysis

It is clear from the results that Trail will need more than the treatment of FG to justify the capital expenditure of $180 million on #4SFF and the SF. The $4 million OP generation from recoverable metals contained in FG is not enough to keep Trail viable in the future.

4.4 Risk Analysis

The major risk is a drop in metal prices. Even a marginal annual drop in metal prices would wipe out the $4 million OP. The enhanced treatment of Ferrous Granules through the #4SFF and the SF also increases the inputs of Fluorine, Chlorine, and Tin into the Trail processes. The technical team from Trail together with assistance from the Research and Development have come up with remedial processes to handle these impurities in a safe and sustainable manner. The projected costs of the remedial measures and processes are included in the total capital cost for the #4SFF and the SF.

The other risks that this project faces will be the achievement of the projected treatment capacity and fuming recoveries. In this regard, training of personnel will be paramount and Trail is looking into this area very closely. Previous experience with the #2SFF has shown that it can take up to one year to stabilize new installations and processes. For this reason, the metals recoveries used in Year 1 are 10% lower than projected. The technologies being used are well accepted and proven, and therefore a one-year period to stabilise is reasonable.

4.5 Market Analysis

A quick market analysis was performed for copper, germanium and indium:

4.5.1 Copper:

According to Goldman Sachs Group Inc., negative sentiments on copper will wear off in the longer-term due to global picture, which shows that the economy is improving. So far, the demand side has been pretty much driven by China, but the economic activity in the more developed economies is also beginning to pick-up. As the emerging markets grow, they have to develop their infrastructure resulting in people migration from a rural to an urban existence. Rural economies use little copper while urban economies use copper in houses, plumbing, wiring, roads, cars and appliances etc. The transition from rural to urban living requires a great deal of copper, and that will keep the price up in the long-term.

4.5.2 Germanium:

The Global Industry Analysts (GIA) announced in October 2010 that the global market for germanium is forecast to exceed 126.4 thousand kilograms by the year 2015 (current production stands around 70,000 – 80,000 kilograms). The expected growth in the world economy and increased use of germanium across various end-use sectors (fibre optics, polymerization catalysts, infrared optics, electronics and solar applications) is likely to fuel the expansion of the market.

4.5.3 Indium:

The main applications for indium are in indium tin oxide (ITO), low melting point alloys and compound semiconductors. The use of ITOs in transparent electrodes for Liquid Crystal display (LCD) screens has been the main driver for the indium growth. The demand continues to grow for flat panel monitors, televisions, and other portable electronic devices. According to GIA, existing primary capacity is in excess of current production so output could meet the forecast growth in demand in the short term. However, if total indium demand grows at the forecast rate of 15% per year to 2015, production would struggle to keep pace causing an increase in indium price.

5: Electronic Scrap (ES)

5.1 Introduction

One of the major advantages of the #4SFF and the SF is that it increases the smelter's ability to handle more copper, and increases the overall fuming recovery of metals. Currently, Trail treats up to 13,000 mtpa of electronic wastes and scraps through the smelter and the slag fumers. With the installation of the #4SFF and the SF, the treatment of the ES will increase significantly and anticipated to reach 40,000 mtpa by 2016 (just before the depletion of the Zinc Residue Stockpile). A market study performed by the Business Development Group and MBA Final Project undertaken by T Salway shows that these tonnes are achievable. The ES contains recoverable copper, silver, gold, lead, precious metals, and bromine.

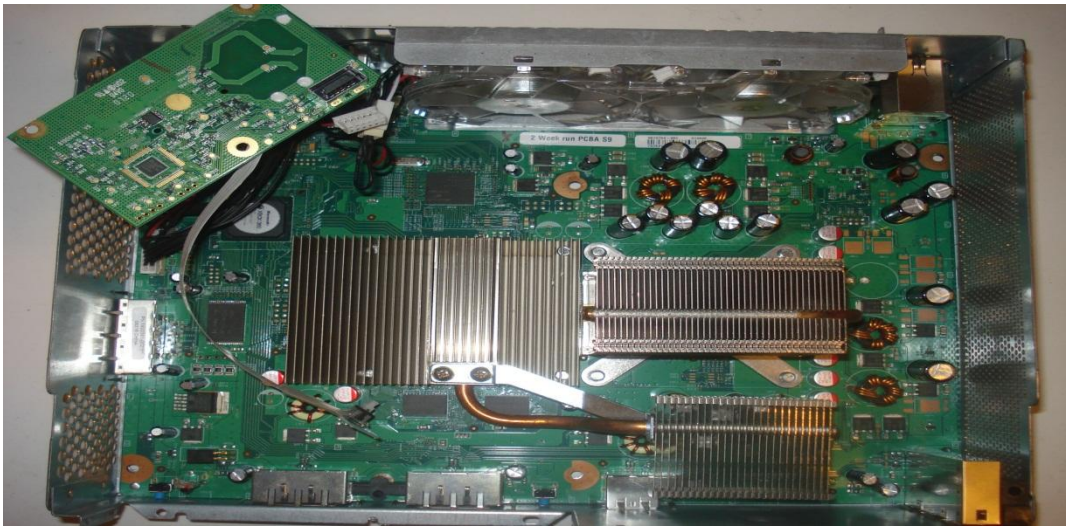


Figure 3: Typical Electronic Scrap *(source: author)*

To process ES, Trail will get a treatment and will generate revenues by recovering the saleable metals contained in them. There is a fee to handle and sort the ES and Wastes and this is included in the Business Model.

5.2 ES History in Trail

In November 2004, a 14-day, 225-tonne trial was successful and 100 percent of the e-scrap was successfully processed in Trail with no measurable increase in the facility's emissions. Since then, Trail has made substantial progress and now has an established stack, effluent and ambient air quality monitoring program. As a result, Trail has been processing thousands of tonnes of discarded electronic equipment from landfills in western Canada and the United States.

5.3 Business Model

A facility exists in the Business Model to treat Electronic Scraps through the #4SFF and the SF. The total projected recoveries from the #4SFF and the SF to finished metals are as follows:

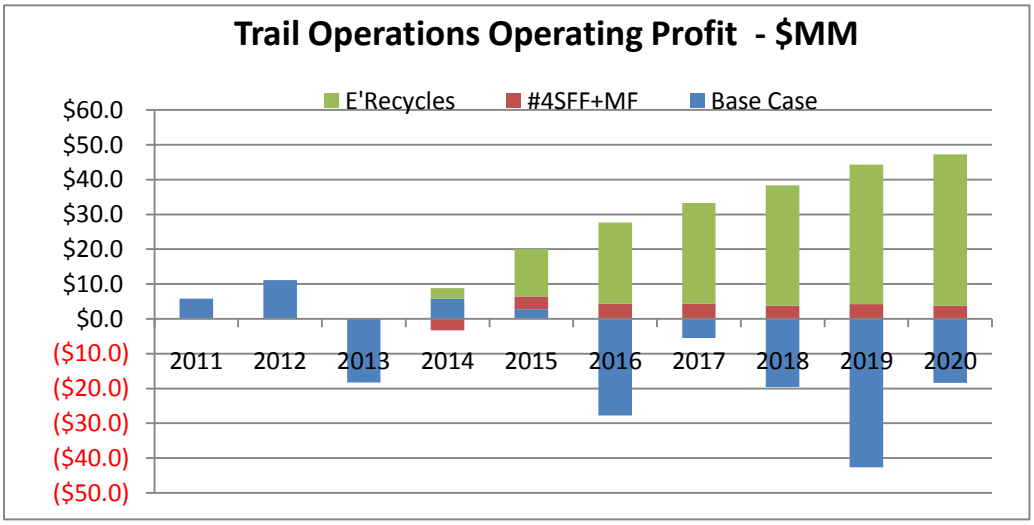
Copper	90%
Gold	90%
Silver	90%
Germanium	80%
Indium	80%

The recovery of copper, gold and silver will take place in the Settling Furnace and test work has been performed to validate these numbers. For prudence, the recoveries used in the LBM are lower than the projections. The revenues generated from the additional metals are added to those generated from the Base Case plus the #4SFF and the SF scenarios.

5.4 Business Analysis

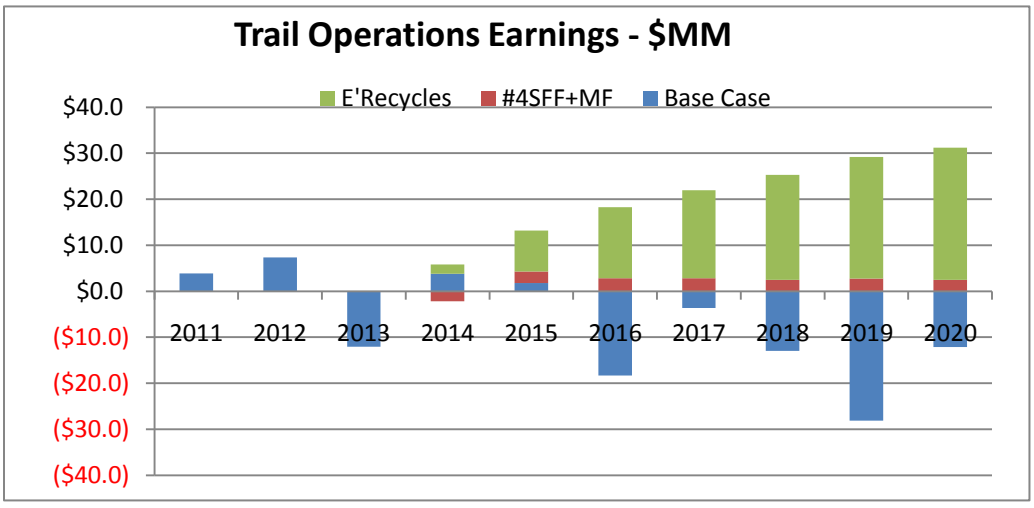
The impact of the revenues generated from the Electronic Scraps on the operating profit is shown in Graph 12. The OP continues to increase from 2015 as the treatment of ES increases gradually to 40,000 mtpa by 2019. The total OP in 2020 reaches $28 million

in 2020 i.e. a contribution to margin of approximately $40 million from ES. There is an opportunity to improve the margins by accelerating the treatment of ES and achieve the 40,000 mtpa target earlier than the projected 2019. The total contribution to OP from the treatment of FG and ES equals $44 million per year.



Graph 12

The impact on ER is shown in Graph 13 and is in line with the OP:



Graph 13

The #4SFF and the SF has a huge price tag of approximately $180 million in new capital but the project payback is about five years with the treatment of 40,000 mtpa ES.

5.5 Risk Analysis

The risks include the increased input of bromine that emanates from the higher treatment of the Electronic Scraps. Bromine creates a hygiene issue and for this reason, the technical team has come up with a solution to deal with it. Other risks include the availability of the ES to Trail as new recycling facilities may will be constructed in the future which could affect availability and treatment charges and tipping fees. A change in regulations by the importing or exporting country could also influence OP.

5.6 Market Analysis

The e-scrap marketplace is evolving and expanding. According to Environment Canada, in 2005 more than 156,000 tonnes of electronic scrap accumulated in Canada and 2.2 million tonnes in the United States. Teck's response is to market its new service and work with partners in and around Trail to deliver efficient e-scrap recycling. The availability of the ES will continue to increase as technology evolves rapidly; what's new today is obsolete tomorrow. The best way to encourage the collection and recycling of electronics is through marketplace education and by prohibiting the dumping of electronics in landfills. As more businesses and consumers become aware of the environmental impact resulting from improper disposal of electronics, recycling companies like Trail will gain credibility in the marketplace. This will result in a growing market to properly address the disposal needs for the ever increasing volume of ES generation.

Trail has committed substantial resources to being part of the ES solution. It looks forward to the day when residents of British Columbia, Western Canada and the Pacific Northwest can drop off their old electronic devices, knowing that these will be processed in an environmentally responsible way. The technology that Trail uses to process ES provides a huge competitive advantage over its competitors.

6: Biomass Power Generation

6.1 Introduction

The Province of British Columbia has committed itself to maintain at least 90% of its electricity generation from clean and renewable energy sources, and to mandate that all new facilities will have net zero greenhouse gas emissions. Biomass, as a "carbon neutral" renewable resource, can make a major contribution towards this goal.

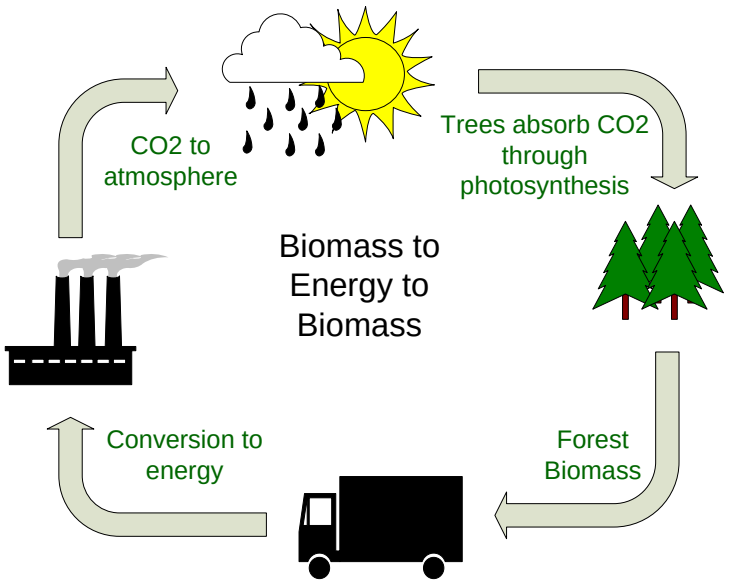


Figure 4: Biomass cycle (source: author)

Trail is considering the installation of a Biogas burner to generate "green power" together with additional power generation from the excess steam produced from its metallurgical processes. The Biogas burning and Clean Energy Generation will also support Trail's energy and greenhouse gas emission reduction goals. Compared to other producers, Trail has three main advantages:

1. Trail is connected into the BC Hydro transmission grid which will avoid the building of a transmission line to sell power to BC Hydro.

2. Trail is already an industrial site; therefore no incremental environmental foot-print would be required.

3. The excess steam is generated by the Trail as a by-product at no additional cost.

6.2 BC Clean Energy Act

The key to making this project viable is the payment and operating provisions of the BC Clean Energy Act.

BC's new Innovative Clean Energy Fund may encourage the development and commercialization of new biomass energy technologies, among others, and the Province's new Bioenergy Strategy is aimed at taking advantage of British Columbia's abundant biomass resources, such as beetle-killed timber, wood waste from sawmills and wood waste landfills, currently unused roadside slash and forest thinning, and agricultural residues.

BC Hydro is also looking to attract new developments in the Biomass area. Biomass is not part of the "Feed-In Tariff" but actually has its own clean call for energy, called the Biomass Call. Since Biomass power is an expensive niche market and as such falls outside the clean call process, it is not expected that it will be in competition with many new suppliers in the near future. A standing offer program to be designed by BC Hydro for small projects up to 10 MW in size may provide opportunities for some new, local biomass projects to obtain favourable economics. Unfortunately, this standing offer program would result in lower prices paid because it is based on competitive call pricing. Therefore, typically the biomass projects are not economic at this pricing level and need to generate >5MW under the Biomass Call.

6.3 Power Generation

In Trail, the main generators of wet steam are:

1. the waste heat boilers connected to the Smelter generating steam at a rate of 24 tonnes per hour (tph),

2. the Slag Fuming Furnaces generating steam at 41 tph and

3. the two Roasters generating steam at 50 tph.

Some steam is consumed internally but it is estimated that Trail vents a total of 9 tph in the winter and about 40 tph in the summer. With the installation of the #4SFF and the SF in 2014, the volume of steam shall increase by an average 24 tph. The Biomass Power Generation project capital cost is estimated at $50 million. This capital cost includes a super heater that will convert wet steam into super heated steam that will minimize turbine erosion. With the installation of the Biomass Power Generating Plant, Trail will be producing green electricity for sale to BC Hydro. The minimum rate of electricity production will be 68,000 MWh combined with a variable portion of 72,000 MWh that will depend upon the time of the year, outside temperature and plant operating mode. The Biomass project will provide a notable prospect for Trail to improve its green image, and maintain its social license to operate.

6.4 Biomass Business Model

The LBM also includes a detailed financial analysis of the biomass power generation at Trail. The Biomass Business Model (BBM) is integrated into the LBM but can also be kept separate so that, if needed, its economic viability can be evaluated independently. For this reason, the Biomass Business Model includes a separate Net Present Value (NPV), internal rate of Return (IRR), Cash Flow, Terminal Value and Operating Profit etc. A scroll bar has been added to enable the running of various price sensitivities. The steam generation used in the model from various Trail sources is shown in the Table 1 below:

	Steam Generation	**Summer – tonnes per hour**	**Winter – tonnes per hour**
	Current	40	9
	#4SFF and SF	32	16
	Total	72	25

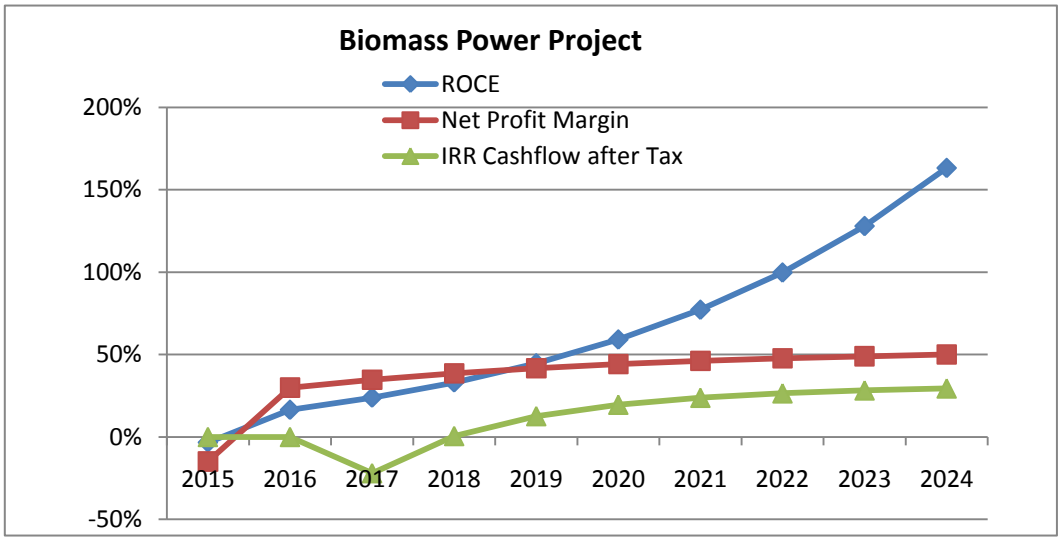
Table 1

6.5 Business Analysis

This project has a payback of four years and contributes about $16 million per year in operating profits to Trail's bottom line at a power price of $180 per megawatts hour (MWh). The price of $180/MWh is based on the existing sale price paid by BC Hydro for the green electricity. The burning of biomass shall also result in a carbon tax credit savings of around $1.5 million per year.

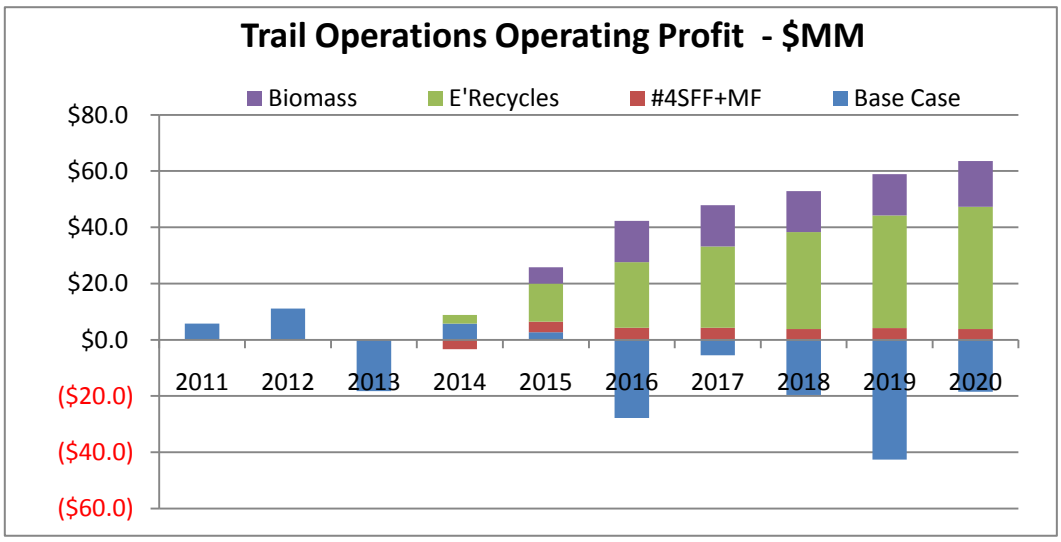
Burning Biomass itself does not result in a carbon tax savings. It would be the sequestering of the char that would provide the savings. In the case of Trail, char could be used in the Fuming Furnaces not only resulting in less coal treatment but also provides a carbon tax savings that would otherwise have to be paid on the coal.

Graph 14 shows that the Net Present Value (NPV) becomes positive in the 5th Year. The Return on Capital Employed (ROCE) becomes positive very quickly but it takes about four years for the Internal Rate of Return (IRR) to become positive:



Graph 14

The total OP is shown in Graph 15 and it continues to rise with contributions from each strategy and reaches close to $44 million in 2020.



Graph 15

6.6 Risk Analysis

One of the risks associated with this project is that the price of power may not be at a premium in the future. This might be due to a change in government policy, or competition from other green producers. Additionally, there may be risks associated with the availability of excess steam, and the availability/pricing of the biomass feed.

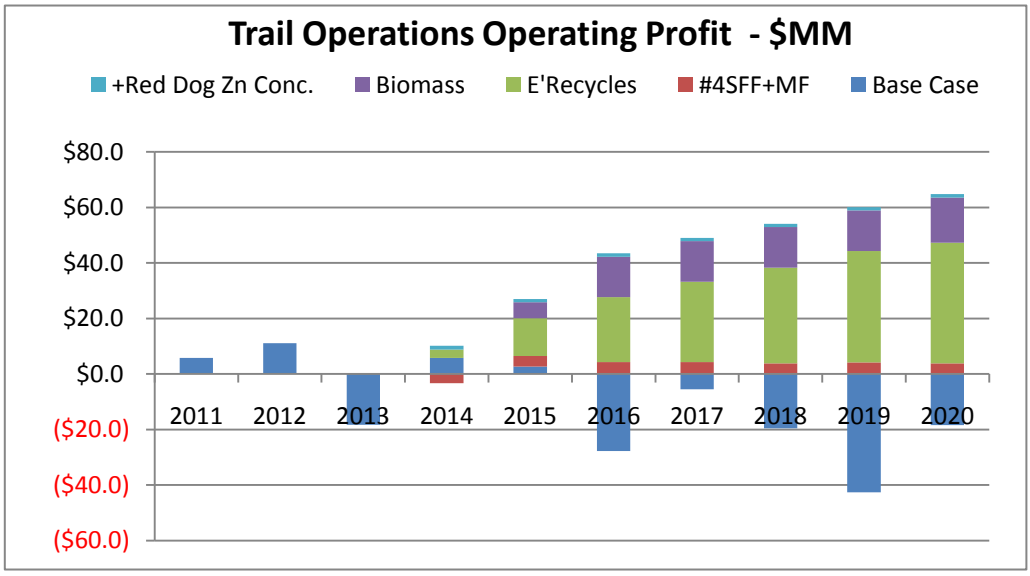
7: Other Feed Options

7.1 Introduction

There are several feed strategies mentioned under Section 1.3 that can make varying level of contributions to Trail bottom line. One strategy that can make some difference to profitability, and provide better impurity management is the increased treatment of Red Dog Zinc concentrate. This concentrate is produced by the Red Dog Mine in Alaska and owned by Teck Resources Limited.

7.2 Business Analysis

The Red Dog Zinc concentrate in the LBM was increased by 20,000 mtpa to 300,000 mtpa from 2014. To ensure that the total feed to the Roasters remain the same, the LBM reduced the treatment of the Clean Zinc Concentrates by the same amount. The differential contribution by Red Dog Zinc Concentrate amounted to $1.4 million per year. The treatment of additional Red Dog Zinc Concentrates adds around $1.4 million per year (see Graph 16) which in the scheme of things is not a substantial contribution to Trail's margin but does make a contribution to better overall impurity management.



Graph 16

7.3 Risk Analysis

Teck also sells the Red Dog Concentrate to other customers around the globe. Therefore, getting additional Red Dog Zinc Concentrate for Trail may not be that easy and has to be on competitive terms. Since this concentrate does not make a sizeable contribution to Trail, this strategy carries a lower risk in terms of OP.

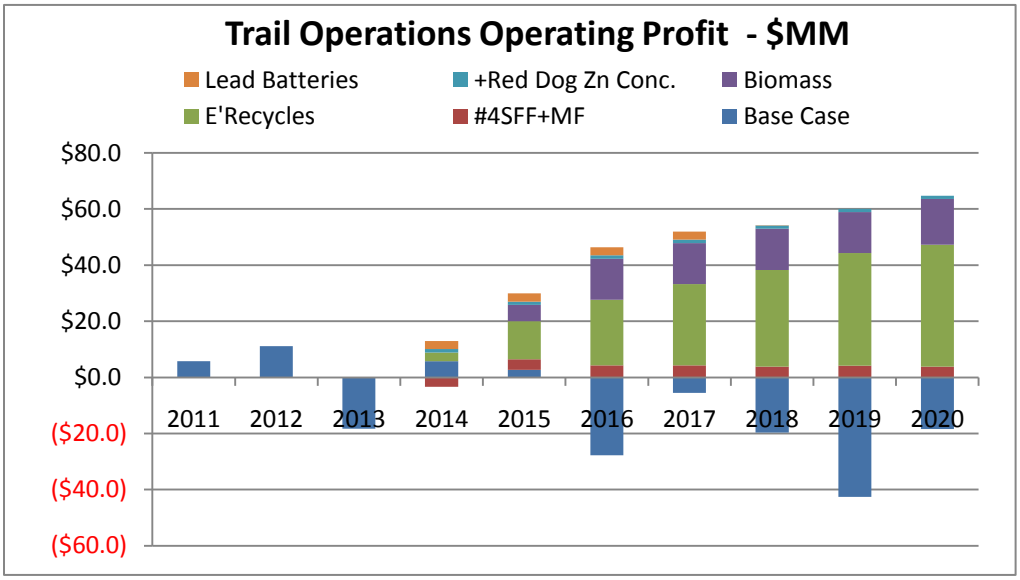
8: Metallurgical Options

8.1 Introduction

To maximize profitability, Trail can also consider metallurgical options like increasing the feed rate for the KIVCET Smelter and maximization of the refined metal production capacities. The production of refined zinc is at maximum in this study, but there is an opportunity to increase refined lead production in some years by treating more lead bearing materials. Lead batteries are clean feeds and provide an opportunity to displace feeds that provide lower profit margins to Trail. Trail has been treating lead batteries in the smelter for many years and therefore increasing treatment should not cause any metallurgical obstacles.

8.2 Business Analysis

The treatment of lead batteries was increased to 30,000 mtpa from 20,000 mtpa in the LBM from 2014 to 2016 when capacity to produce more Refined Lead existed. This option increased operating profit increased by $2.9 million per year (Graph 17).



Graph 17

8.3 Risk Analysis

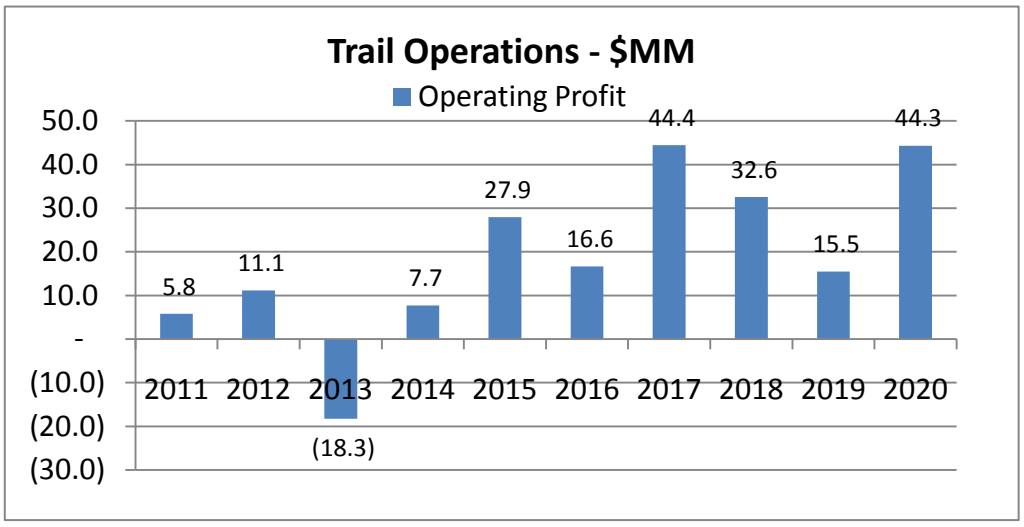
The risk associated with the Lead Batteries is the availability of the additional tonnes due to other competition. A change in regulation could also influence imports.

9: Sensitivities

The above analyses are based on projected long-term prices and exchange rates at zero OCE, but these could change quite easily in the future depending upon market dynamics. It is therefore important to identify the potential risks associated with changes in these factors.

9.1 Total Operating Profit

The total OP from all strategies at the projected long-term metal prices with no change in OCE is shown in Graph 18.



Graph 18

The total operating profits increased from 2014 after the installation of the $4SFF and the SF, the Biomas Power generation in 2015, and the gradual increase in ES treatment from 2014. At the projected treatment of 40,000 mtpa ES, the OP increased to about $44 million in 2020. The OP continues to be lower in years when the Smelter is shut down for major maintenance.

In the LBM, the following economic drivers have been included to evaluate potential risks on the Operating profit:

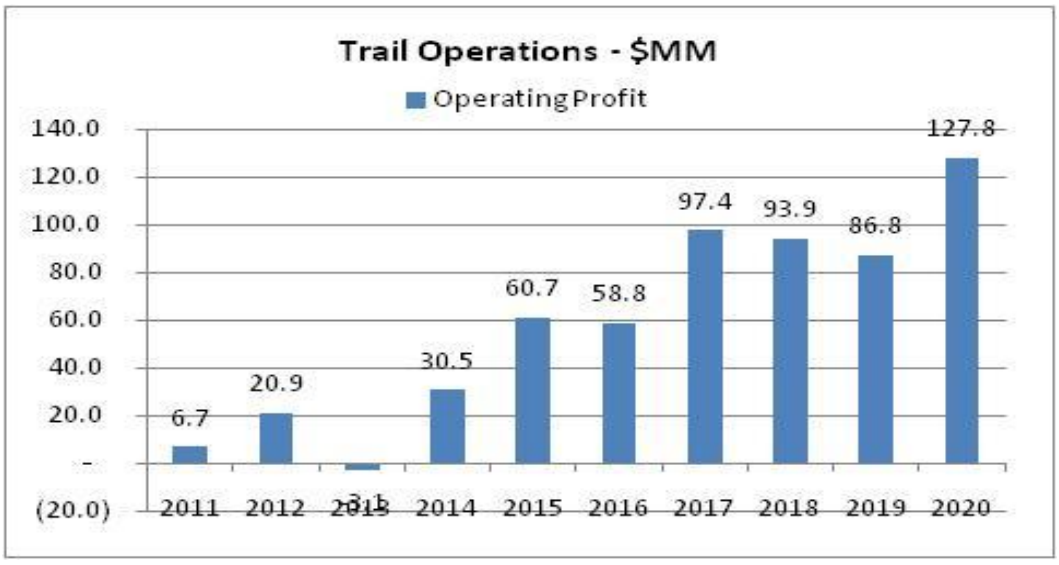
9.2 Metal Prices

Trail's revenues are generated from the sales of its refined metals, whose prices follow the London Metal Exchange (LME) or the Metal Bulletin (MB). Trail does get a modest premium for the Refined Zinc and Refined Lead, and these are included in the revenues calculated by the LBM. The metal prices used in the LBM are stagnant from 2014 onwards, but market conditions and other factors will result in price increases or drops. For example, a modest 2% per year increase over 2011 would result in a gain of $83 million by 2020. The Table 2 shows the metal prices after the 2% per year increase in 2014 and in 2020 versus the average actual prices in March 2011:

	Metals	Base Case Prices	2014 Prices- 2%/year increase	2020 Prices- 2%/year increase	Actual Price March 2011
1	**Zinc -Cents/lb**	90	96	1.08	105
2	**Lead - Cents/lb**	75	77	86	120
3	**Gold - $/Oz**	900	918	1034	1500
4	**Silver - $/Oz**	14	14	16	34
5	**GeO2 - $/kg**	550	584	657	770
6	**Indium - $/kg**	500	531	598	563
7	**Copper - $/lb**	2.5	2.55	2.87	4.0

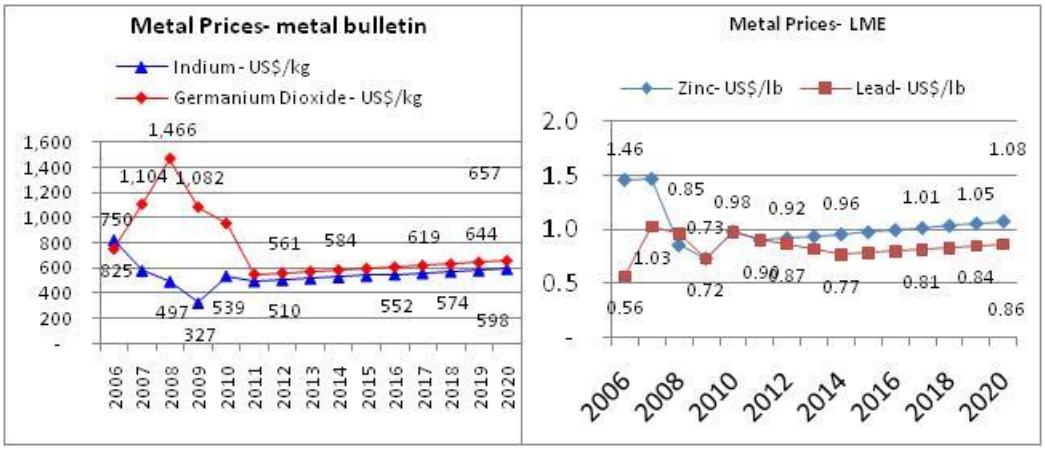
Table 2

A 2% per year price increase is well within the historical average. If such a price increase occurs, the total Operating Profit in 2020 will increase to $128 million, well above the $100 million per year target (Graph 19).



Graph 19

The metal price trends, after the 2% per year increases, are shown in Graph 21 and Graph 22. The Graphs 20 and 21 show that a 2% per year increase is in line with the recent trends and that there is a potential for even higher prices between 2011 and 2020:



Graph 20

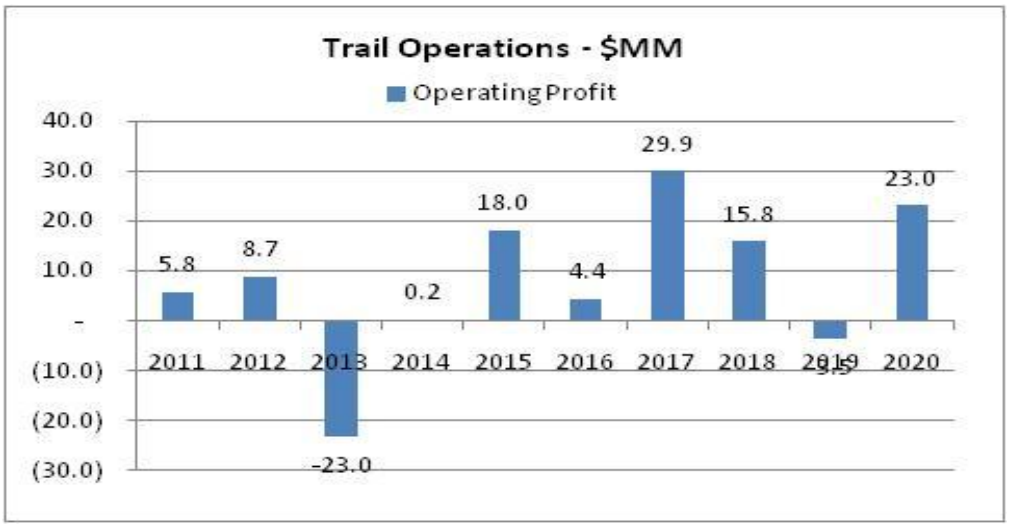
Graph 21

The converse is not sustainable and Trail will lose an average $30 million OP per year beyond 2012 should the price of the metals drop by 2% per year.

9.3 Operating Cost Escalation (OCE)

The current inflation rate in Canada is 2.1% (British Columbia: 1.8%). Inflation rates vary quite significantly around the globe, and in the emerging economies they could be as high as 10-15%.

For the purpose of this project, increasing the OCE by 1% annually from 2012 reduces the OP by approximately $21 million in 2020 to $23.0 million. The metal prices will have to increase by 0.55% per year to bring the OP back to $44 million in 2020. The impact of a 1% annual increase in OCE (no change in metal prices) on OP is shown in Graph 22:



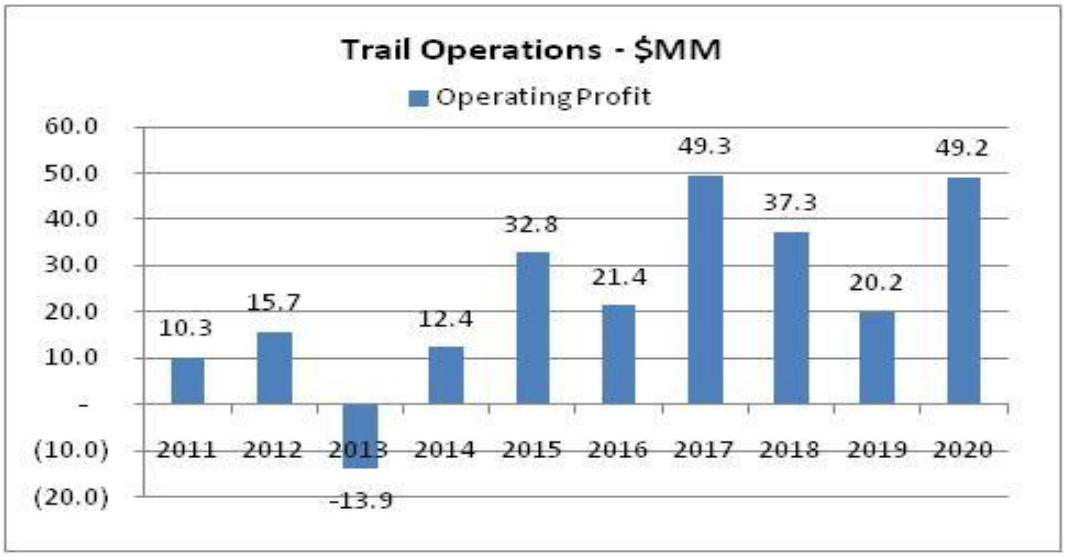
Graph 22

It is clear from Graph 22 that the profitability of Trail will be riskier if the OCE increases beyond 1% per year. Trail does not control metal prices, and therefore has to continue to innovate and invest in new capital to increase revenues and stay ahead of the increasing operating costs.

9.4 Exchange Rate Variation

Trail relies heavily on imports of raw materials and other operating supplies. At the same time, a large majority of its core products are sold in the US and other countries. Therefore, the strength or the weakness of the Canadian dollar (Cdn$) plays an important

role in Trail's profitability. If the Canadian dollar strengthens against the US dollar then the imported operating supplies become cheaper but revenues from metal sales drop. When the Cdn$ - US$ exchange rate dropped by 1 cent to 90 cents in the LBM, Trail gained $5 million per year in OP or $3.2 million per year in ER as shown in Graph 23 :



Graph 23

The profitability of Trail is quite sensitive to changes in the Cdn$-US$ exchange rate. One option that Trail has is to diversify and start selling a higher percentage of its refined products in the emerging economies.

9.5 Biomass Power

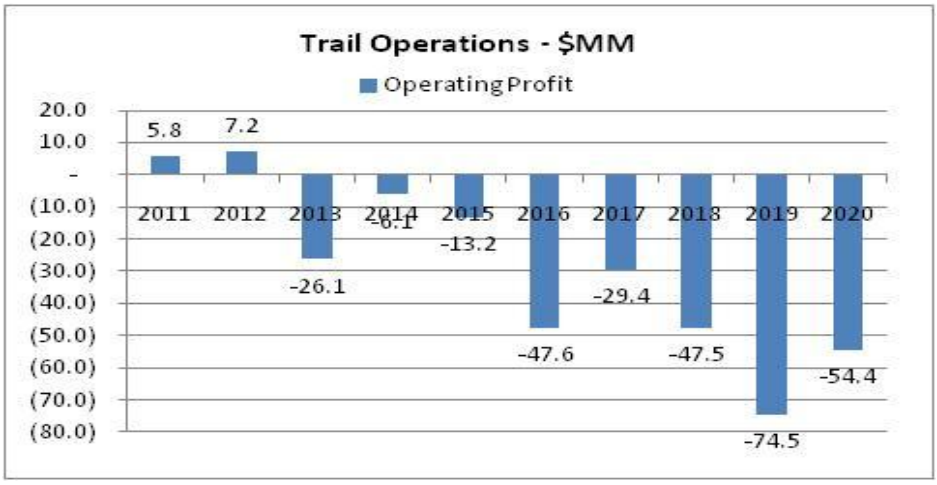
A reduction in the call price of Biomasss power from $180/MWh to $100/MWh would result in a revenue loss of $8.1 million per year.

9.6 Sensitivities for Base Case

9.6.1 OCE and Wage Increase

The Base Case discussed earlier assumed no change in the economic drivers and no installation of the #4SFF and the SF or any other initiatives. However, a 1% annual increase on OCE together with a 1% wage increase will significantly affect OP especially

when the SZR run out. It is clear from Graph 24 that Trail cannot remain viable under such conditions.

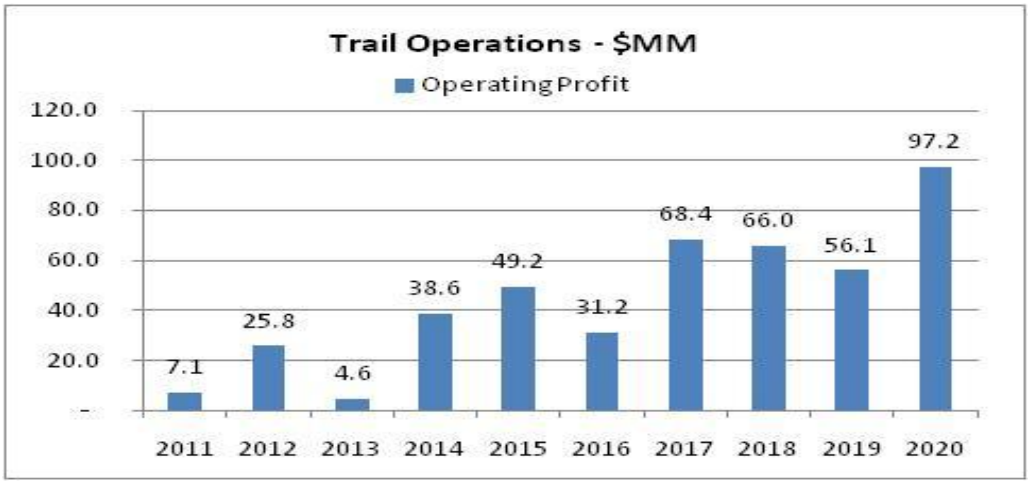


Graph 24

The above situation will be worse if the OCE and the wages increase by 2% each year: The above situation confirms Trail's efforts to install new processes to increase revenue and mitigate increases in Operating Costs.

9.6.2 Metal Price Increase

On the other hand, if metal prices increased by 3% per year then the Base Case becomes quite attractive in the long run, as shown in Graph 25. This increase is enough to provide over $97 million in additional revenues in 2020.



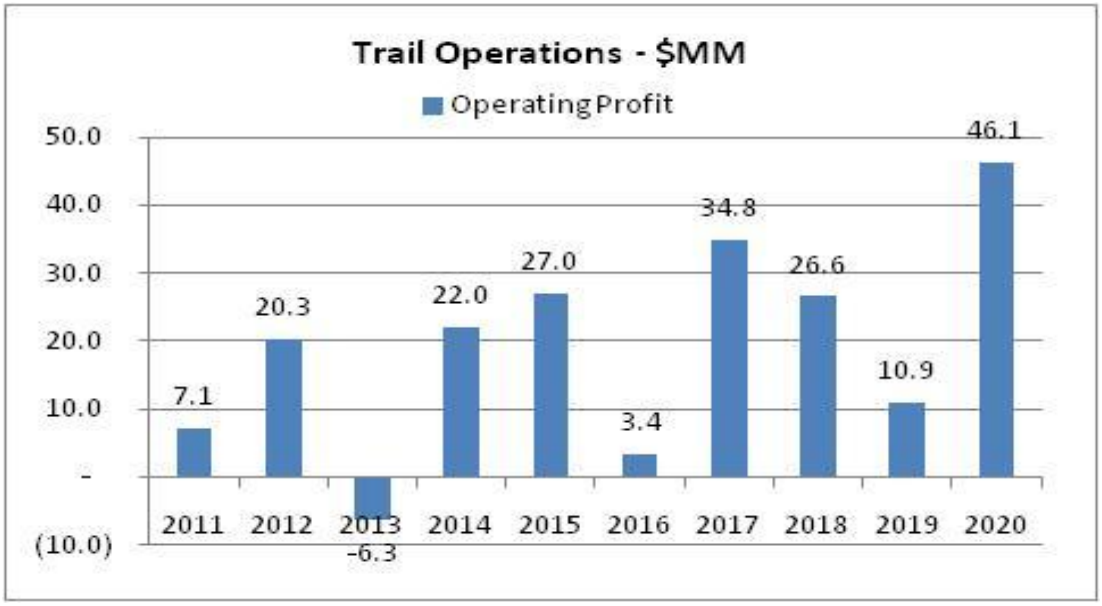
Graph 25

The above scenario will most likely not happen and the OCE plus the wages will rise. Therefore, if the OCE increases by 1% per year, wages increase by 2% per year and metal prices increase by 3% per year (see Table 3), then Trail's OP shall increase to over $46 million in 2020 (Graph 26).

	Metals	Base Prices	2014 Prices- 3%/year increase	2020 Prices- 3%/year increase	Average Price March 2011
1	**Zinc -Cents/lb**	90	98	117	105
2	**Lead - Cents/lb**	75	77	92	120
3	**Gold - $/Oz**	900	927	1107	1500
4	**Silver - $/Oz**	14	14	17	34
5	**GeO2 - $/kg**	550	601	718	1005
6	**Indium - $/kg**	500	546	652	678
7	**Copper - $/lb**	2.5	2.58	3.07	4.0

Table 3

The impact of the above changes to the Base Case is shown in Graph 26 . This scenario is not lucrative but barely manageable with little flexibility to survive a market downturn: Once again, the results in Graph 26 confirm the need to invest in new capital initiatives in Trail.



Graph 26

9.6.3 Exchange Rate

A 1% drop in the Cdn$-US$ exchange rate will generate approximately $5 million in additional revenue. A 1% increase in the exchange rate will have the opposite effect. If the exchange rate continues to strengthen, then the loss in revenues can only be compensated by corresponding price increases. For example, if the exchange rate increases to Cdn$-US$=1, then the metal prices will have to increase by about 2.8% per year to make up the loss.

9.7 Other Factors

Other factors that may affect Trail's profitability include weather conditions, equipment breakdowns, and labour disruptions.

9.8 Trail's Sustainability

Trail plays an important role currently through the recycling of electronic wastes and scraps (urban ores). Trail will be a lot more sustainable and environmentally friendly through the increased recycling of urban ores with the introduction of the #4SFF and the SF. The result would include not just increased profitability but could also cause brand value enhancement with significant bottom line repercussions. For example, increased share values of Teck, better government relations and a potentially huge environmental and sustainability advantage over competitors.

10: Copyright Statement

10.1 Copyright statement

11: Conclusion

The Long-term Trail Operations Strategies Project resulted in the development of an integrated metallurgical and financial model. This model is capable of evaluating Trail's current status and where it wants to be after the implementation of the #4SFF and the SF, and the Biomass Power Generator projects. The implementation of these projects will allow Trail to pursue several other opportunities to increase not only its revenues but also its "green" contribution to sustainability.

Trail OP improved by $60 million in 2020 following the installation of the #4SFF and the SF and the Biomass Power Generation project at the projected base metal prices and Cdn$-US$ exchange rate and no change in OCE. The main driver to the increased revenue being the treatment of 40,000 mtpa of Electronic Wastes and Scraps. **The OP can improve to $100 million in 2020 if metal prices increase by 2.5% per year, the OCE increases by 1% per year, and wages increase by 2% annually**.

The impact of a one cent change in the Cdn$-US$ exchange rate to Trail is about Cdn$3 million in earnings. Going forward, the Cdn$ exchange rate against the currencies of growing economies like China and India may have a bigger impact on Trail versus the US$. The main reason being the exponential growth that will continue to escalate demand for zinc, copper and other metals in these countries.

An average $180/MwH power price has been assumed for green and clean energy in the LBM. The higher price for the green power could also trigger the renewable power producers to try to obtain higher power rates for their electricity. If this happens, Trail can optimize revenues between selling electricity or refined zinc production.

With no new major capital injection, Trail can sustain itself if the price of metals remain at 2010 levels or better, the OCE increases by 0.5% annually, wages increase by 2% annually, and the Cdn$-US$ exchange rate = 1 (Graph 27).

Graph 27

Unfortunately, Trail has no control over metal prices, and hence a strategy without major capital injection is not sustainable. Therefore, Trail urgently requires approximately $230 million in new capital investment to sustain market downturns, generate value for the shareholders and enhance its “green" image. The green image for Trail will also add immense value to Teck’s sustainability efforts.

Unless major capital investments are made in a timely manner, the ever increasing operating costs will make Trail’s survival uncertain beyond 2017.

Appendices

Appendix A: Snap Shots of the Business Model

	Sensitivities Scroll Bars:					
	Price Au	1.0				
	Price Zn	(2.0)				
	Price Pb	(1.0)				
	Price Ag	4.0				
	Price Cu	3.0		Scroll or enter a +ve or -ve number in c		
	Price Ge	3.0		Price In	3	
	US/Cdn exchange rate	1.0		Scroll or enter a +ve or -ve number in c		
	Op Cost Escalation Rate	(2.0)		Scroll or enter a +ve or -ve number in c		
	Wage Escalation Rate	2.0				
	#4SFF ON=1	1	**Do not add or delete cells, linked to VB code.**			
	EScrap ON=1	0				
	BioMass On=1	0				
	Extra Red Dog On=1	0				
	Extra Battery Metallics ON=1	0				

Assumptions Sheet:

Long-Term Base Case		2011	2012	2017	2018	2019	2020
						major	
Feeds						KIV SD?	
Red Dog Zinc Concentrate	t						
North American Zn Concentrate	t						
Bolivian Zn Concentrate	t						
Other Zinc Concentrates (float)	t						
Zinc Feeds							
Red Dog Lead Concentrate	t						
Other Pb Concentrate (float)	t						
Ag>5k ppm Concentrates	t						
Battery Metallics	t						
Other Concs/Residues (Nystar…)	t						
Fluorescent Bulbs+ CRT glass etc							
ETP Stock Residue (70 kt)	t						
Lead Feeds							
Barren Slag (including black sand)							
Current Residue							
Stock Zinc Residue Treated	t						
Total Feeds							
Stock Zn Residue Inventory							
ETP Stock Residue (70 kt)							
Other Feeds							
E'Waste	t						
Zinc Alkaline Batteries	t						
Contained							
Zinc	mt						
Lead	mt						
Silver	mt						
Gold	mt						
Germanium	mt						
Indium	mt						
Cadmium	mt						
Copper	mt						
Sulphur	mt						
Recovery to Sale							
Refined Zinc	%						
Zinc to FG	%						
Zinc to Granular	%						
Refined Lead	%						
Silver	%						
Gold	%						
Germanium	%						
Indium	%						
Cadmium	%						
Cu to CuSO4	%						
Cu to CuAs	%						
Cu to Cu Cake (Sale/#4SFF)	%						
Cu to FG	%						
Cu to PbSO4/OS Matte etc?	%						
Cu to Matte (Sale)	%						
Molten Sulphur	%						
Sulphur to Acid	%						
Sulphur to Liqiuid SO2	%						
Sulphur to Fertilizers	%						

10 Year Forecast		2011	2012	2017	2018	2019	2020
		2011	2012	2017	2018	2019	2020
Economic Drivers							
CDN/US exchange rate							
US/Cdn exchange rate							
Op Cost Escalation Rate							
Wage Escalation Rate							
Discount Rate							
Tax Rate - Metals							
Tax Rate - Wash. State							
Conversion							
Prices							
Zinc LME - US$/lb	$US/lb						
Zinc Payable	%						
Zinc Premia	$US/lb						
Zinc Basic TC	$US/t						
Escalation Base Price	$US/t						
TC Escalation Factor +-	$US/t						
Zinc in Zn Concentrates	%						
Lead LME- US$/lb	$US/lb						
Lead Payable	%						
Lead Premia	$US/lb						
Lead Basic TC (basis $800)	$US/t						
Escalation Base Price	$US/t						
TC Escalation Factor +-	$US/t						
Lead in Pb Concentrates	%						
Silver- US$/oz	$US/oz						
Silver Payable - Average Zn/Pb	%						
Silver Refining Charge	$US/oz						
Gold- US$/Oz	$US/oz						
Gold Payable - Average Zn/Pb	%						
Gold Refining Charge	$US/oz						
Germanium Dioxide - US$/kg	$US/kg						
Indium - US$/kg	$US/kg						
Indium Payable	%						
Cadmium	$US/kg						
Copper - US$/lb	$US/lb						
CuSO4	$US/t						
CuAs	$US/t						
Cu Cake (Sale)	$US/t						
Cu Matte (Sale)	$US/t						
Sodium Antimonate	$US/t						
Molten Sulphur	$US/t						
Acid	$US/t						
Liquid SO2	$US/t						
Fertilizers (CAS+GAS)	$US/t						
FG	$US/t						
Construction Materials	$US/t						
Electronic Waste	$US/t						
Electronic Scrap	$US/t						

10 Year Forecast		2011	2012	2017	2018	2019	2020
Transport Rates							
Red Dog conc	$US/t						
International conc	$US/t						
Metal Distribution Zn+Pb	$US/t						
Metal Distribution Ag+Au	$US/Oz						
Metal Distribution In + Ge	$US/Kg						
Cadmium	$US/t						
CuSO4	$US/t						
CuAs	$US/t						
Cu Cake (Sale)	$US/t						
Cu Matte (Sale)	$US/t						
Sodium Antimonate	$US/t						
Sulphur	US$/t						
Acid	US$/t						
SO2	US$/t						
Fertilizers	US$/t						
Co-Product Distribution	$US/t						
Feed Supply							
Zinc Conc Red Dog	t						
Zinc Conc North American	t						
Zinc Conc International	t						
Lead Conc Red Dog	t						
Lead Conc N_American+Other Stk	t						
Lead Conc International	t						
Barren Slag	t						
Stock Residue	t						
ETP Residue							
Production/Sales							
Zinc	t						
Lead (incl. tolled)	t						
Silver (000's)	oz						
Gold	oz						
Germanium metal	kg						
Indium	kg						
Cadmium	kg						
CuSO4	t						
CuAs	t						
Cu Cake (sale)	t						
Cu Matte (Sale)	t						
Black Copper	t						
Sodium Antimonate	t						
Sulphur	t						
Sulphuric Acid	t						
SO2	t						
Total Fertilizers	t						
Tranzform (Granular)							
Blendable (Regular)							
Standard (Fluid)							
Fe Granules	t						
Construction Material							
Cost of Goods Sold Adjustment	$000						

Revenue Sheet:

	2010	2011	2017	2018	2019	2020
Revenues ($MM - CDN)						
Zinc						
Lead						
Silver						
Gold						
Germanium metal						
Indium						
Cadmium						
CuSO4						
CuAs						
Cu Cake (Sale)						
Cu Matte (Sale)						
Sodium Antimonate						
Black Copper						
Molten Sulphur						
Sulphuric Acid						
Liquid SO2						
Fertilizers						
FG						
Electronic Waste						
Electronic Scrap						
Other Revenues						
Total Metals Revenue						
Expenditures ($MM - CDN)						
Operating Costs - Metals						
Distribution						
Depreciation						
Other Costs/Income (benefits,...)						
Total Expenditures						
Total COGS ($MM - CDN)						
Residue/Slag Consumption (t)						
Stock Residues Draw down / (built-up)						
ETP Residues Draw down / (built-up)						
Contained zinc (recovered)						
Contained Lead						
Contained Silver (000 oz)						
Contained Gold (oz)						
Zinc Acq Cost						
Zinc TC						
ZINC COGS						
Lead Acq Cost						
Lead TC						
Lead COGS						
Silver						
Gold						
PRIMARY Metal Acquisition cost						
Indium + Germanium						
All other product COGS						
TOTAL COGS						

Revenue Sheet continued ...

			2010	2011	2017	2018	2019	2020
Metals Operating Profit								
Base Revenues								
Zinc								
Lead								
Silver								
Gold								
Germanium metal								
Indium								
Cadmium								
CuSO4								
CuAs								
Cu Cake (Sale)								
Cu Matte (Sale)								
Sodium Antimonate								
Black Copper								
Molten Sulphur								
Sulphuric Acid								
Liquid SO2								
Fertilizers								
FG								
Other Revenues								
Total Metals Revenue								
Differential Revenues								
Zinc								
Lead								
Silver								
Gold								
Germanium metal								
Indium								
Cadmium								
CuSO4								
CuAs								
Cu Cake (Sale)								
Cu Matte (Sale)								
Sodium Antimonate								
Black Copper								
Molten Sulphur								
Sulphuric Acid								
Liquid SO2								
Fertilizers								
FG								
Other Revenues								
Total Metals Revenue								
Check								

Trail Operations 10 year Plan - Income

$ Million		2011	2012	2013	2018	2019	2020
Metals							
Revenues							
Cost of Goods							
Operating Costs							
Distribution							
Other							
Selling Costs							
Depreciation							
Metals Profit							
Biomass Op Profit							
Power Depreciation							
Operating Profit							
Taxation - Metals							
Taxation - Power							
Earnings							
Working Capital Changes							
After Tax Cashflow							
Trail OPS NPV							
GraphData							
Revise numbers if Scenario Changed:							
Operating Profit							
Base Case	Base						
#4SFF+MF							
E'Recycles							
Biomass							
+Red Dog Zn Conc.							
Lead Batteries							
Check							
Earnings							
Base Case	Base						
#4SFF+MF							
E'Recycles							
Biomass							
+Red Dog Zn Conc.							
Lead Batteries							

BIOMASS FINANCIAL MODEL (Cdn $)			#4SFF Running			
4-Apr-11		1	2	3	6	
	2014	2015	2016	2017	2020	
		365	366	365	366	
Current Steam (Summer)- t/hr				IRR		
Current Steam (Winter)- t/hr				Cost of Capital		
#4SFF Steam (Summer)- t/hr			Waseem:	Tax rate		
#4SFF Steam (Winter)- t/hr			On 4SFF=1			
#4SFF Running		1	Year:	1		
Labour		1				
Number of Operators		1	1	1	1	
Current Steam (Summer)- t/hr		0	0	0	0	
Current Steam (Winter)- t/hr		0	0	0	0	
#4SFF Steam (Summer)- t/hr		0	Training, Start-up		0	
#4SFF Steam (Winter)- t/hr		0	issues= lower efficiency		0	
Total Steam Generation- t/year		0	0	0	0	
Conversion Efficiency						
Power Generated - MWh						
BioMass Steam -tpy						
BMass Power Generated- MWh						
Firm						
Non-firm						
Power $/MWh						
Revenue from Firm						
Revenue from Non-firm						
Carbon Tax Savings						
Total REVENUE		$0	$0	$0	$0	
FIXED OPERATING COSTS						
Maintenance						
Labour						
Total Fixed		$0	$0	$0	$0	

BIOMASS FINANCIAL MODEL (Cdn $)			#4SFF Running		Continued
4-Apr-11		1	2	3	6
	2014	2015	2016	2017	2020
		365	366	365	366
VARIABLE OPERATING COSTS					
Variable 1					
Variable 2					
Total Variable Costs					
TOTAL OPERATING COSTS					
BioMass Project Cost					
Total Capital Investment - $					
Savings (Cashflow)					
Tax Adjustments:					
Undepriciated Capital Cost					
Capital Cost Allowance					
Net for Tax					
Tax effect					
Cashflow after Tax					
NPV Cashflow after Tax					
IRR Cashflow after Tax					
Operating Profit					
ROCE					
Net Profit Margin					
ROCE Average YTD					
Discount Factor					
Present Value of Cashflow					
TERMINAL VALUE (TV) - Year 10					
TV Growth Rate					
Unadjusted Cashflow after Tax					
CCA Adjustment					
Adjusted Yr10 Cashflow					
Yr11 Cash Flow					
CCA					
TV					
Discount factor- Yr10					
Current value of TV					
Total Cashflow Yr1-Yr10					
BioMass Project Value					

Long-Term Base Case			2011	2012	2017	2018	2019	2020
							major	
Data								
FG Production Factor								
Production								
Refined Zinc	t							
Zinc to Fe Granules	t							
Zinc to Fe Granules (after #4SFF)								
Refined Lead (incl. tolled)	t							
Silver	t							
Silver	OZMM							
Gold	t							
Gold	OZ							
Germanium metal	t							
Indium	t							
Cadmium	t							
CuSO4	t							
CuAs	t							
Cu Cake (Sale)	t							
Cu Matte (Sale)	t							
Black Copper	t							
Sodium Antimonate	t							
Molten Sulphur	t							
Sulphuric Acid	t							
Liquid SO2	t							
Total Fertilizers	t							
Tranzform (Granular)	t							
Blendable (Regular)	t							
Standard (Fluid)	t							
Ferrous Granules	t							
#4SFF + Melting Furnace								
Zinc Recovery								
Lead Recovery								
Silver Recovery								
Gold Recovery								
Germanium Recovery								
Indium Recovery								
Copper Recovery								
#3SFF Slag -> FG	###							
Zn~	%							
Pb~	%							
Ag~	ppm							
Au~	ppm							
In~	ppm							
Ge~	ppm							
Cu~	%							
Recovered: Zn	t							
Pb	t							
Ag	TOz							
Au	Toz							
In	t							
Ge	t							
Cu	t							
ELECTRONIC RECYLES								
EScrap								
Zn~	%Zn							
Pb~	%Pb							
Ag~	ppm							
Au~	ppm							
In~	ppm							
Ge~	ppm							
Cu~	%Cu							
Recovered: Zn	t							
Pb	t							
Ag	TOz							
Au	Toz							
In	t							
Ge	t							
Cu	t							
Cu Cake	t							
Contained Cu	t							
Recovered Cu								

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6. Jim Milne, Manager Financial Reporting Systems, Trail
7. Les Hand, Accountant Financial Systems, Trail
8. Tammy Salway, Raw Materials Engineer, Trail
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