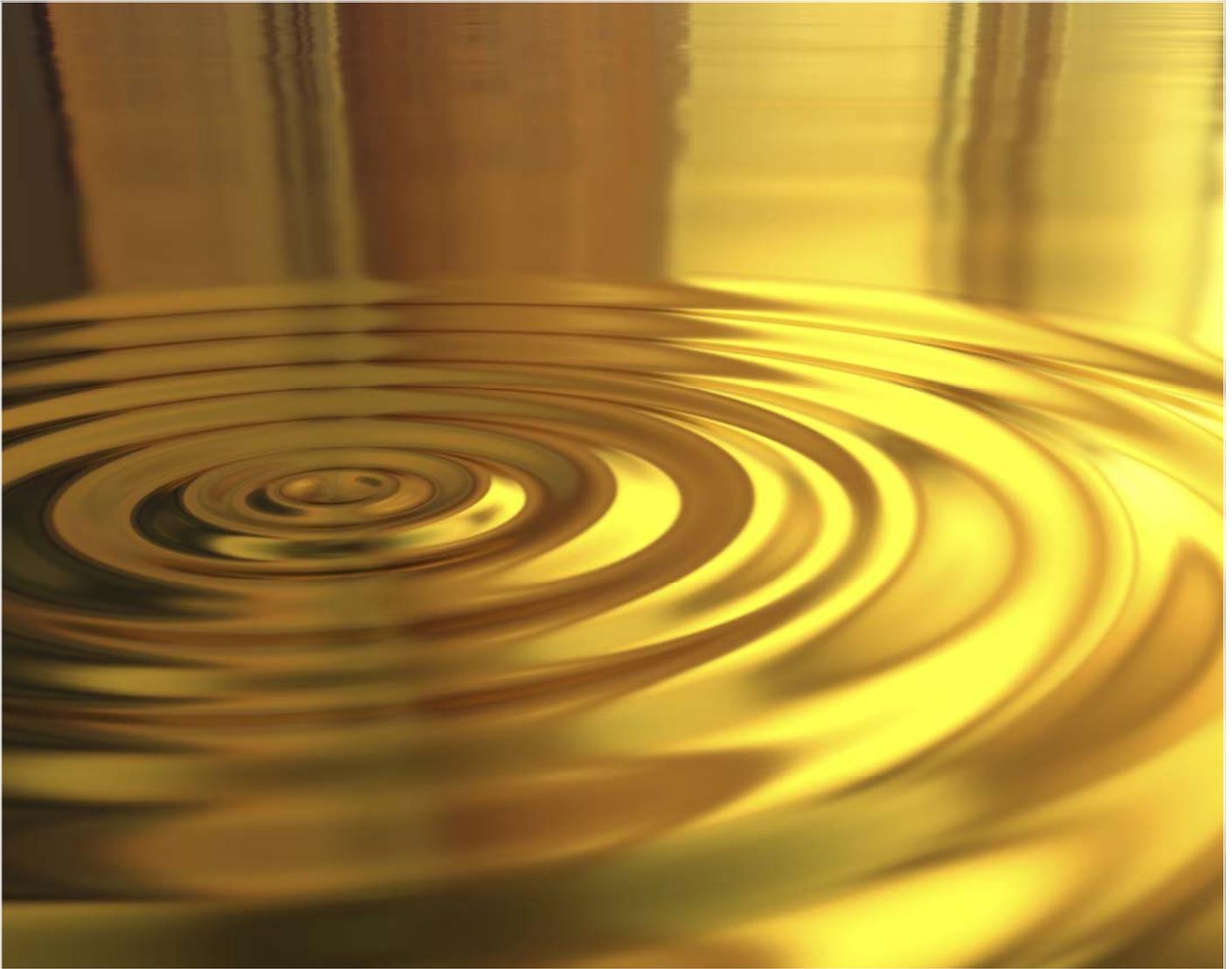




EDISON



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Mining Research Principles

Finding fundamental value

January 2016

Published by Edison Investment Research

Welcome to Edison's mining principles

We are proud of the quality of our research – it is the lifeblood of our business. This is perhaps the reason we are one of the foremost global research providers just 13 years after our company started in June 2003. From this quality research foundation, we aim to continue to grow in the breadth, depth and quality of the services we offer to our corporate clients and investors.

In engaging Edison, you are employing a team of experienced equity analysts with backgrounds in industry, conventional sell-side analysis and buy-side asset managers. As such, we believe we provide a strong reference to the markets/investors and as a consequence a strong proposition for company management.

We value collaboration in the research process and are proud of the close working relationships we generate with our clients. This collaborative approach has many advantages but has limits. **Above all, the independence and objectivity of our research is critical to the value we offer clients – promotional or weak research does neither party any good in the long term. Our clients are engaging our services and not buying an outcome.**

Executive summary

Valuing mining companies requires both a clear understanding of the potential value of each asset within a portfolio, and an ability to rigorously test the valuation of these assets against a variety of assumptions. This document introduces the principles by which we conduct our research into such companies, our approach to identifying the key criteria that drive our valuations, and the process by which we define the macroeconomic assumptions that ultimately drive our company valuations.

Valuation overview

Within the mining industry, we recognise there is a wide variety of companies – from single-asset, early-stage explorers to those with significant production revenues from a wide portfolio of assets. Each type requires a particular type and depth of analysis and (potentially) a different valuation method. Either way, however, our published/corporate research is primarily designed to be used by investors to make investment decisions regarding publicly traded companies. Similar, but not necessarily identical, methods are used to value pre-IPO and private companies (see page 13).

Mining valuation exceptionality

While every ore body is different and every mining company is just as unique, mining companies may typically be classified into one of four types: pre-resource, resource, pre-production and production. Each production or development asset and resource is therefore modelled. Accuracy and fidelity to current cost assumptions and fiscal regimes is critical to properly understanding the value (or potential value) of a company as well as the underlying investment thesis. In general, the assets of any company are deemed to be its reserves and resources. Its reserves will typically be valued with respect to a proposed mining schedule and resultant cash flows, while its resources will be valued according to an in-situ resource multiple. Frequently, a sensitivity analysis will be provided to demonstrate the effect of resource conversion into reserves on valuation. Other sensitivities include commodity price, capex and opex assumptions and equity dilution as well as the discount rate, among others.

Distinguishing shareholders from stakeholders

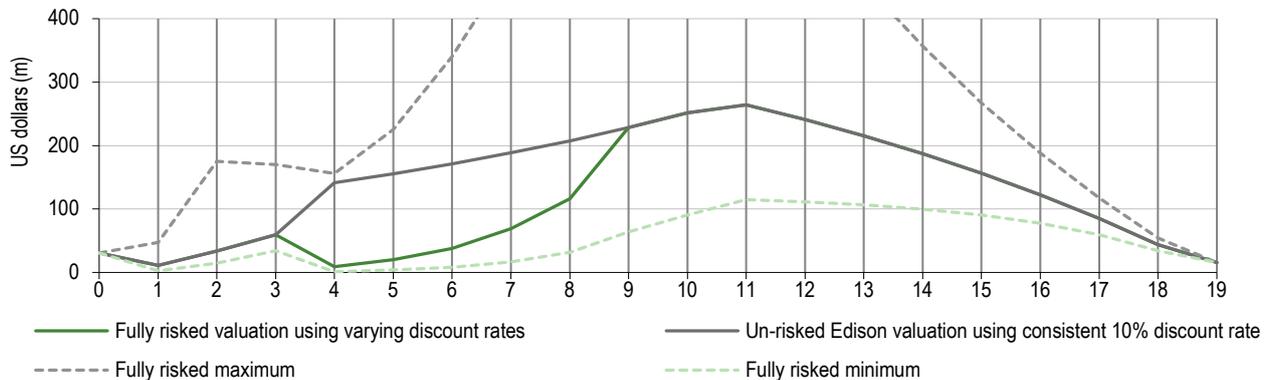
To make the analysis as relevant to secondary market equity investors as possible, the valuation is derived from estimates of future potential dividend flows to investors (see pages 10 and 14-15 for discussion and definitions) – rather than cash flows to stakeholders – thereby distinguishing between returns to shareholders as opposed to loan providers. Hence, full provision is made for likely potential future equity dilution. To be as objective as possible, the financial modelling of any mining company will attempt to reflect likely future developments as closely as possible. Hence, dividends are discounted to the year in which the report is written and not the year in which initial development capital is expended.

Objectivity

Risks are many and varied within the mining industry and include, but are not limited to, sovereign, geological, engineering, metallurgical, macroeconomic, commodity price, currency, management, environmental, political, permitting and financing risk. Much of this may be summed up within the overall phrase ‘development risk’. To be as objective as possible, the subjective quantification of qualitative risks is eschewed. We therefore state risks and, where we can quantify them, we do. We do not, however, engage in the subjective science of trying to quantify the unquantifiable (see page 14). As a result, dividends (or cash flows, where relevant) are discounted at a standard, real

discount rate of 10% per year. As such, our valuations should be seen as being indicative of what a company's share price could attain, rather than what it is (or should be) worth, today. The following chart compares our headline valuation with the equivalent mean fully risked valuation for a notional gold mining company, NonSuch Gold Ltd, over time and within the context of its potential maximum and minimum valuations:

Exhibit 1: Notional Edison valuation vs fully-risked valuation



Source: Edison Investment Research

Note that the years into which the x-axis is divided correspond to the following stages of development:

- 0 – Initial capital
- 1 – Inferred resource delineated
- 2 – Resource upgraded to include indicated resources
- 3 – Resource upgraded to include measured resources
- 4 – Scoping study
- 5 – Pre-feasibility study (PFS)
- 6 – Bankable or definitive feasibility study (BFS/DFS)
- 7 – Financed (50:50 debt:equity typically assumed)
- 8 – Capital expenditure and development
- 9 – First production
- 10 – Full production
- 11 – Debt repaid

Independence and accuracy

Accurate modelling of the mine schedule allows us to produce complete financial forecasts on a quarterly or half-yearly basis and produce other analyses that we believe are critical to a full understanding of the company. Sensitivities to commodity prices, costs, capex and discount rates are provided. In certain circumstances, we can also take a view on a company's potential future valuation as well. For exploration juniors, we are also prepared to make independent resource estimates from drill data. These analyses are not taken lightly, but with reference to IRRs, NPVs and historical data. In the light of the industry's historical performance, we are unapologetic about taking a sceptical stance when looking at timing and cost assumptions and aver that there should be compelling reasons for companies' anticipating bringing discoveries to development quicker and cheaper than their industry peers.

Introduction

Our published/corporate research is designed with the express intention of providing potential investors with the information that they need to make a valid investment decision regarding the shares of publicly traded companies. Note that, with a few exceptions, junior mining companies tend to be single asset companies and the following principles are generally written within that context (multi asset companies are considered on page 12).

Valuation principles

While every ore body is different and every mining company just as unique, mining companies may typically be classified into one of four types:

- pre-resource
- resource
- pre-production and development
- production

A consideration of the valuation techniques applied to each of these scenarios is provided below (albeit non-sequentially, with resource companies being considered before pre-resource companies).

Resource companies

This category considers companies that have a resource, which has typically been defined to JORC, NI 43-101 or SAMREC standards, which is then sub-divided into measured, indicated and inferred categories. Significantly, however, the company will not have a development plan for the resource – ie there will be no scoping study, pre-feasibility study (PFS) or bankable or definitive feasibility study (BFS/DFS).

In this case, we value the company relative to its assets, being its resource plus cash:

- Cash is deemed to be historical or forecast (near-term) cash on the balance sheet plus non-core marketable securities and near cash, to which the effects of major post-balance sheet date events (eg acquisitions, disposals, fund raisings and/or material capex) are then added. Ordinarily, 'restricted cash' is also considered to be part of a company's cash holdings.
- A company's resource, by contrast, is valued with respect to both its size and scale and (where appropriate) the categorisation of the resource. To this end, we maintain a database regarding the valuation of resources, which we publish from time to time. At the time of writing, the most recent of these publications was [Gold – The value of gold and other metals](#), published in February 2015, and readers are directed to this publication (and its predecessors) for a fuller explanation behind the methodologies employed and the philosophy and thinking behind the methodology. In essence, however, the valuations in these publications are market derived, comparing a company's enterprise value (EV) with its resources to derive a resource multiple for each company. For each commodity, these are then averaged, both geometrically and arithmetically, to derive global average resource multiples for different commodities (expressed in both US dollars and as a percentage of the prevailing spot price at the time of the analysis). Note that companies that have invested in developing their resources (eg late-stage development and producing companies) are specifically excluded from this sample since, in these instances, the resource multiples thus derived will include both the intrinsic and exploration value of a resource plus the value of subsequent development investment, whereas for a resource company, only the intrinsic and exploration value of the resource is of interest (see [Gold – New benchmarks for old](#), published in November 2012, for a fuller explanation of this concept). For some commodities, if the sample is large enough and if there are sufficient

companies with Inferred resources only and with indicated & inferred resources only, it is possible to further sub-divide the methodology to derive discrete resource multiples for inferred resources, indicated resources and measured resources. In such instances and at their discretion, the analyst may use this data to further refine their valuation of a company and/or project or they may use the combined, average resource multiple. our most recent resource multiple values were published in [*Gold – The value of gold and other metals*](#), in February 2015, and are reproduced in the following table:


Exhibit 2: Selected metals' and minerals' in-situ values, costs of discovery etc (August 2014)

| Resource multiple | AIM gold | Canada gold | Australia gold | Global gold (geometric) | Global gold (arithmetic) | Silver | Uranium | Iron Ore | Copper | Nickel | PTe Coal (Thermal) | Coal (Metallurgical) | Zinc | Vanadium | Tungsten (Explorers) |
|-------------------|----------|-------------|----------------|-------------------------|--------------------------|--------|---------|----------|----------|-----------|--------------------|----------------------|--------|----------|----------------------|
| Measured | 24.07 | 48.08 | -88.18 | -11.32 | -5.34 | -0.98 | 4.04 | -0.096 | 141.95 | -39.14 | 33.53 | | -7.88 | 1677.73 | 931.24 |
| Indicated | 16.38 | -0.80 | 75.24 | 19.83 | 30.27 | 1.12 | 0.13 | 0.231 | 23.08 | 36.49 | 8.82 | | 20.86 | 71.97 | 329.59 ¹ |
| Inferred | 12.60 | 3.35 | 8.99 | 4.51 | 8.31 | 0.04 | 0.08 | 0.005 | 39.82 | 10.40 | 0.70 | | 6.71 | 33.03 | 54.76 ¹ |
| Total/Average | 15.55 | 9.78 | 4.50 | 10.06 | 9.94 | 0.85 | 0.25 | 0.055 | 42.01 | 14.25 | 4.71 | 0.007 | 9.22 | 466.64 | 244.84 |
| Price (Aug '14) | 1,313.94 | 1,313.94 | 1,313.94 | 1,313.94 | 1,313.94 | 20.94 | 28.30 | 95.75 | 7,150.00 | 19,400.00 | 1,491.13 | 72.00 | 110.00 | 2,387.50 | 12,213.61 |
| Unit | \$/oz | \$/oz | \$/oz | \$/oz | \$/oz | \$/oz | \$/lb | \$/t | \$/t | \$/t | \$/oz | \$/t | \$/t | \$/t | \$/t |

| Percentages of spot | AIM gold | Canada gold | Australia gold | Global gold (geometric) | Global gold (arithmetic) | Silver | Uranium | Iron Ore | Copper | Nickel | PTe Coal (Thermal) | Coal (Metallurgical) | Zinc | Vanadium | Tungsten (Explorers) |
|---------------------|----------|-------------|----------------|-------------------------|--------------------------|--------|---------|----------|--------|--------|--------------------|----------------------|-------|----------|----------------------|
| Measured | 1.83% | 3.66% | -6.71% | -0.86% | -0.41% | -4.67% | 14.26% | -0.10% | 1.99% | -0.20% | 2.25% | 0.00% | 0.00% | -0.33% | 13.74% |
| Indicated | 1.25% | -0.06% | 5.73% | 1.51% | 2.30% | 5.33% | 0.45% | 0.24% | 0.32% | 0.19% | 0.59% | 0.00% | 0.00% | 0.87% | 0.59% |
| Inferred | 0.96% | 0.26% | 0.68% | 0.34% | 0.63% | 0.18% | 0.30% | 0.01% | 0.56% | 0.05% | 0.05% | 0.00% | 0.00% | 0.28% | 0.27% |
| Total/Average | 1.18% | 0.74% | 0.34% | 0.77% | 0.76% | 4.06% | 0.88% | 0.06% | 0.59% | 0.07% | 0.32% | 0.01% | 0.13% | 0.39% | 3.82% |

| Costs of discovery | AIM gold | Canada gold | Australia gold | Global gold (geometric) | Global gold (arithmetic) | Silver | Uranium | Iron Ore | Copper | Nickel | PTe Coal (Thermal) | Coal (Metallurgical) | Zinc | Vanadium | Tungsten (Explorers) |
|--------------------|----------|-------------|----------------|-------------------------|--------------------------|--------|---------|----------|--------|--------|--------------------|----------------------|------|----------|----------------------|
| Measured | 36.82 | 36.82 | 36.82 | 36.82 | 36.82 | | 1.37 | | | | 4.18 | | | | |
| Indicated | 10.5 | 10.5 | 10.5 | 10.5 | 10.5 | | 0.92 | | | | 1.26 | | | | |
| Inferred | 7.16 | 7.16 | 7.16 | 7.16 | 7.16 | | 0.09 | | | | 0.9 | | | | |
| Total/Average | 8.81 | 8.81 | 8.81 | 8.81 | 8.81 | | 1.02 | | | | 0.9 | | | | |
| Percentages | 0.67% | 0.67% | 0.67% | 0.67% | 0.67% | | 3.60% | | | | 0.06% | | | | |

| Return on upgrade | AIM gold | Canada gold | Australia gold | Global gold (geometric) | Global gold (arithmetic) | Silver | Uranium | Iron Ore | Copper | Nickel | PTe Coal (Thermal) | Coal (Metallurgical) | Zinc | Vanadium | Tungsten (Explorers) |
|-------------------|----------|-------------|----------------|-------------------------|--------------------------|--------|---------|----------|--------|--------|--------------------|----------------------|------|----------|----------------------|
| Measured | -70.8 | 85.7 | -720.9 | -218.4 | -235.3 | | 768.5 | | | | 746.1 | | | | |
| Indicated | 13.1 | -224.2 | 1,883.7 | 358.5 | 557.5 | | -94.8 | | | | 2,156.6 | | | | |
| Inferred | 76.0 | -53.2 | 25.5 | -37.0 | 16.1 | | -6.1 | | | | -22.2 | | | | |

| | AIM gold | Canada gold | Australia gold | Global gold (geometric) | Global gold (arithmetic) | Silver | Uranium | Iron Ore | Copper | Nickel | PTe Coal (Thermal) | Coal (Metallurgical) | Zinc | Vanadium | Tungsten (Explorers) |
|---------------------|----------|-------------|----------------|-------------------------|--------------------------|--------|---------|----------|--------|--------|--------------------|----------------------|------|----------|----------------------|
| Number of Companies | 19 | 19 | 14 | 52 | 52 | 12 | 29 | 21 | 15 | 9 | 7 | 6 | 3 | 4 | 3 |

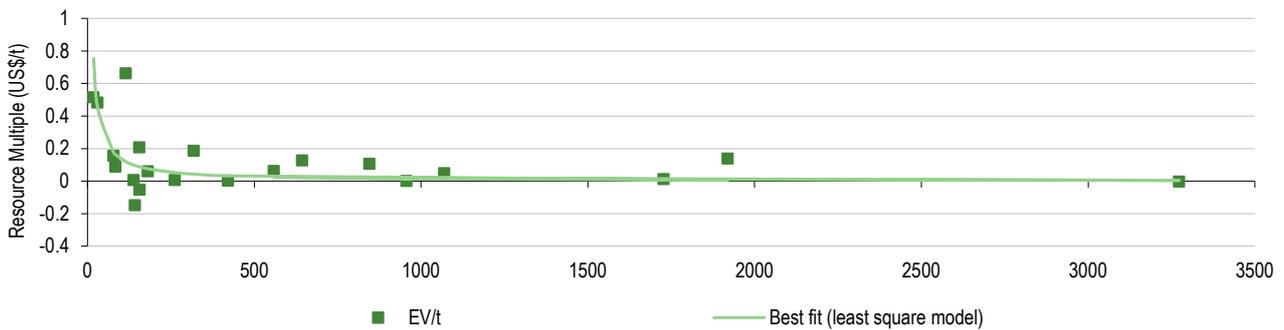
Source: Edison Investment Research. Note: PTe costs of discovery on the Bushveld Igneous Complex assumed to equate gold cost of discovery in the Witwatersrand basin.

Note that the market-derived, in-situ values shown above are periodically updated.

Once global average resource multiples have been determined, they may be adjusted for other factors such as sovereign risk, metallurgical risk, depth, continuity etc, if a suitable sample of companies operating under similar circumstances can be identified to make a meaningful comparison. Alternatively, the company and/or project may be valued with respect to global averages, with the risks noted qualitatively. In each case, however, the basis of valuation will be clearly stated.

In addition to the existing resource, a number of commodities exhibit evidence of the discounting of future discoveries. These include, but are not necessarily limited to, junior uranium companies, iron ore companies and (possibly) copper companies, among others (see [Gold – The value of gold and other metals](#), published in February 2015 and below for iron ore companies).

Exhibit 3: Iron ore sector relationship between resource multiple (y-axis) and resource size (Mt, x-axis)

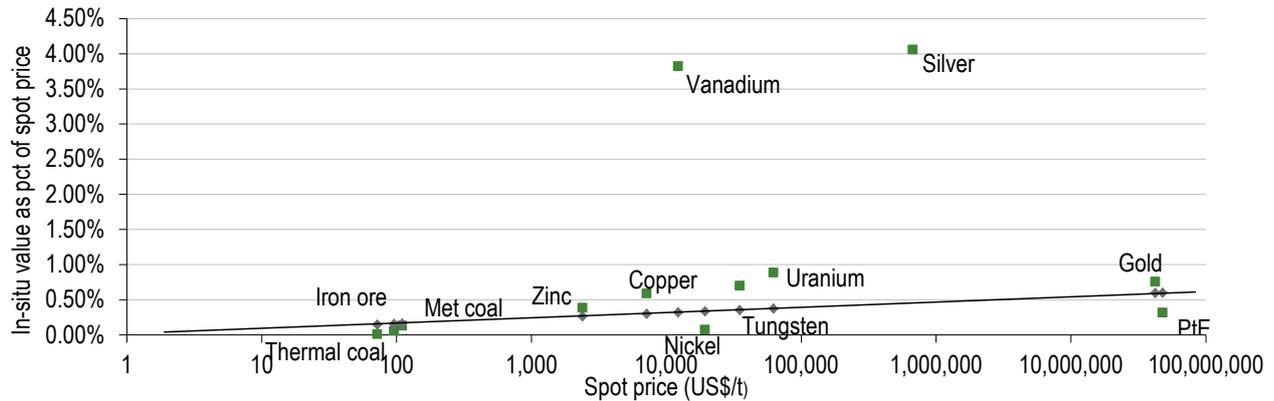


Source: Edison Investment Research

In these instances, a discussion may also be included regarding the valuation of the company with respect to both its existing resource and potential future resources within the context of the company's ability to fund the required exploration.

For some commodities (eg gold and uranium), we have also derived global average costs of discovery, on both a differentiated (ie by resource category: measured, indicated and inferred) and an undifferentiated basis. Where relevant, the valuation of a company or resource may also be calculated with respect to the implied cost of discovery (at the global average) of those resources. Note that, for all companies (including development and production companies), a comparison may be made between 'book value' and the share price.

In a very small number of instances, no in-situ resource multiple may be available. In these cases, a resource multiple will be estimated with respect to the spot price of the commodity in question, according to the graph below:

Exhibit 4: Edison average in-situ resource values as a percent of commodity price (selected commodities)


Source: Edison Investment Research

Pre-resource companies

Pre-resource companies present a difficulty in that there is typically no asset to value other than cash (which is tangible, factual and objective) and management (which is intangible and subjective). In these cases, the valuation upside of the company often lies in the future and is contingent on exploration success (which may also be subjective).

To research companies such as these, we may:

- Value the JORC resource that management estimates could be delineated.
- Make an independent estimate of the resource that could be delineated and value that (this approach will take into account available information; however, given that it will almost invariably, and of necessity, not be conducted in a manner compliant with the JORC – or any other – code, it will be heavily caveated, typically to an accuracy of $\pm 75\%$).
- Calculate the resource that needs to be delineated to justify a company's current valuation, within the context of its existing assets (typically cash) and management expertise; investors and corporates should note however that we will not (unless under very extenuating circumstances) attempt to 'value' management, given the inherent subjectivity of such an exercise, although we are prepared to provide a qualitative account of its strengths and weaknesses to allow investors to make an informed investment decision for themselves.

One further valuation methodology that we occasionally use for pre-resource companies is the Kilburn method. In essence, this involves applying a factor to past investment on a mineral prospect, depending on its proximity, disposition and orientation relative to existing known mineralisation.

Development companies (single asset)

Companies in development are those that have a scoping study, a pre-feasibility study, a bankable feasibility study, are funded and/or are expending capital to develop their project – ie everything between a resource company and a producing company.

In these instances, the assets of the company are deemed to be its reserve (being that portion of a resource that is expected to be mined) and its resource exclusive of reserves (ie that portion of the resource which is not, at the time of writing, expected to be mined).

Reserve valuation

We will make the most recent, available technical report (be it a scoping study, PFS or BFS/DFS) the basis for its valuation of the reserve.

One of a number of modifications to the study may then be made:

Commodity price. In formulating our financial model, we will apply our own commodity price forecasts to production in order to generate a forecast future revenue stream. These commodity price forecasts will typically be real price forecasts (see Costs, below). They will be also fully disclosed (or referenced). We calculate our commodity price forecasts by a variety of methodologies, depending on the commodity in question (see page 13). These may be published separately (eg [Gold – The value of gold and other metals](#).) or within the context of the research report on the company in question. Near-term commodity price forecasts are typically made with respect to the prevailing spot price and are subject to revision from time to time.

Costs. In instances in which additional costs (or additional cost inflation) are identified, which have not been included in the technical report (either capex or opex), these will be added. Again, costs will typically be expressed in real, as opposed to nominal, terms and the subsequent financial modelling will then be conducted on a 'real' basis (see Discount rates, below).

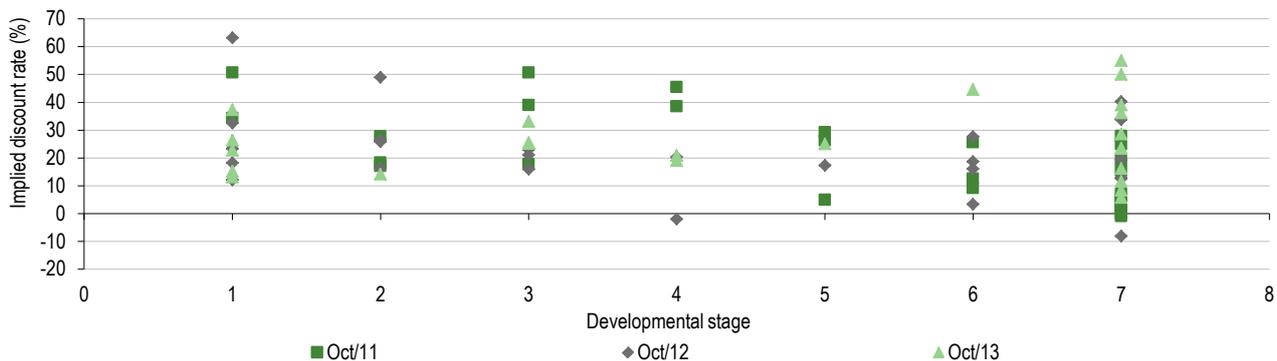
Timing. Whereas scoping studies, PFSs and BFSs typically discount cash flows back to the year of first capital expenditure, our valuations (performed from the perspective of a potential secondary market investor) are typically discounted back to the financial year in which the report is written (or, if otherwise, will be explicitly stated as such). Towards the end of any financial year, however, a view may be taken on the applicability of discounting dividends and/or cash flows to the start of the following year. For example, a report written in early December 2014 on a company with a December year end, may discount dividends back to 1 January 2015 etc.

Dilution. Since the report considers a valuation from the perspective of a potential secondary market investor, it typically discounts resulting dividend flows to shareholders, rather than cash flows to stakeholders (ie returns to equity holders are specifically distinguished from returns to loan providers). Where appropriate therefore (eg pre-funding companies), estimated future equity dilution will also be taken into account. In the first instance (and in the absence of any other guidance) 50:50 debt:equity funding of the project and/or company will be assumed. The price of future equity funding will typically be assumed to be the currently prevailing share price (although a sensitivity analysis with respect to the price will typically also be provided – see page 12).

Dividends. For the purposes of the analysis, 'dividends' are assumed to be the maximum potential, future distributions to the providers of equity capital (after allowing for dilution – see above), after the appropriate payments to the providers of loan finance (ie principal and interest) have been satisfied. Note that estimated, future expenses related to investment (eg exploration expenditure) are typically excluded from this calculation on the basis that such expenditure is presumed to be value adding (ie its value should be at least as great as the investment made to create the associated asset).

Discount rate. The cost of equity, at which dividends are then discounted, is set at a (real) level of 10% to reflect the approximate cost of equity, generally. Note that our mining financial models are typically constructed on the basis of 'real' costs. In rare instances, nominal costs may be used, in which case the discount rate will also be adjusted to reflect the assumed level of inflation in the financial model.

Specific risks (typically a company's/project's stage of development, sovereign, geological, engineering, metallurgical, management, environmental and permitting risks etc) are usually discussed qualitatively, but not quantitatively, owing to the subjectivity inherent in any such quantification. Inasmuch as there may a difference between the standardised valuation (which applies a real discount rate of 10% to future dividend flows) and a 'fully risked' valuation, some idea of the degree and extent of this difference (both positive and negative) may be imputed from comparison with the observed market discount rates we calculated in our report, [Gold – US\\$2070 by 2020](#), published in November 2013 and reproduced below:

Exhibit 5: Implied discount rates for companies at varying stages of development (Oct 11, Oct 12 & Oct 13)


Source: Edison Investment Research

Note that, for the purposes of the above analysis, the following numerical monikers have been used:

- 1 – Scoping study
- 2 – Pre-feasibility study (PFS)
- 3 – Bankable or definitive feasibility study (BFS/DFS)
- 4 – Development (ie funded and in the process of construction)
- 5 – Production ramp-up
- 6 – Production from a subsidiary asset (ie not the main asset)
- 7 – Full production from the main asset

Readers should note that our real 10% discount rate is appropriate on a ‘fully risked’ basis across all stages of development and all time frames (albeit not exclusively) – ie companies can be found at all stages of development and across all time frames, to which the market is implicitly applying a ‘fully risked’ real 10% discount rate.

The application of discount rates that reflect technical, sovereign and stage of development risks is, by its nature, inherently subjective. As a result, such discount rates and their resulting valuations are not typically included in our publicly published research, which seeks to be objective, rather than subjective. However, such research (ie subjective and fully risked) may be available by arrangement on a bespoke basis (see Alternative products, page 15).

On account of its unique methodology, we are also able to provide an indication of future valuations (under a number of circumstances) which it is happy to disclose in its reports, where appropriate.

Resource valuation

Resources (exclusive of reserves) are valued on the same basis as for ‘Resource companies’ (see above), except that they may also be discounted for time (at the same 10% real discount rate) where, in the opinion of the analyst, the value of the resources may not be accessible to the company until a later date.

Sensitivities

Within (but not limited to) our Outlook/initiation reports, we will typically provide valuation sensitivity analyses with respect to future commodity prices, costs, the discount rate and capital expenditure as well as the likely degree of future dilution as a function of the price at which new shares are likely to be issued. Eg:

Exhibit 6: Effect of fund raisings on company shares in issue and valuations per share at varying equity fund raising prices

| | | | | | | | | |
|---|--------|--------|--------|--------|--------|--------|--------|--------|
| Shares in issue (millions) | 190.1 | 190.1 | 190.1 | 190.1 | 190.1 | 190.1 | 190.1 | 190.1 |
| Funds to be raised (£m) | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 |
| Market price at time of raising (pence) | 15.00 | 17.50 | 20.00 | 25.00 | 30.00 | 35.00 | 40.00 | 50.00 |
| Discounted price (pence) | 14.10 | 16.45 | 18.80 | 23.50 | 28.20 | 32.90 | 37.60 | 47.00 |
| New shares issued (millions) | 56.7 | 48.6 | 42.6 | 34.0 | 28.4 | 24.3 | 21.3 | 17.0 |
| Total shares in issue (millions) | 246.9 | 238.8 | 232.7 | 224.2 | 218.5 | 214.5 | 211.4 | 207.2 |
| Post-funding valuation (US\$m) | 377.25 | 377.25 | 377.25 | 377.25 | 377.25 | 377.25 | 377.25 | 377.25 |
| Post-funding valuation (US cents per share) | 152.81 | 158.00 | 162.12 | 168.28 | 172.65 | 175.91 | 178.44 | 182.10 |
| Post-funding valuation (Pence per share) | 96.71 | 100.00 | 102.61 | 106.51 | 109.27 | 111.34 | 112.94 | 115.26 |

Source: Edison Investment Research

If appropriate, we may also provide a sensitivity analysis with respect to the life of mining operations (ie ordinarily assuming some future conversion of resources to reserves).

Production companies

The valuation of production companies is identical to that of development companies, with the exception of the fact that there is ordinarily no requirement for additional equity funding and therefore there is no need to assume future equity dilution. Either way, all assumptions regarding assumed future dilution (or not) will be fully disclosed. The absence of any requirement for future equity funding coupled with a potential absence of debt also creates the possibility that such companies may be valued via the discounting of cash flows, as opposed to the discounting of dividend flows (see page 14). In these instances, standard capital asset pricing model (CAPM) techniques for the estimation of the costs of equity (in particular) may also be applied.

Multi-asset companies

Multi-asset companies are considered according to the same methodologies as those considered above, except where the number of their assets and the success of their exploration activities and/or the prevailing value of their equity means that they may no longer be considered as the owners of depleting assets, but replenishing (or replenishable) ones. In these cases, in addition to the methodologies considered previously, we may also consider valuing companies with respect to the financial multiples (eg PE, yield, EV/EBITDA etc) of comparable peers.

Commodity price forecasts

From a valuation perspective, mining assets are typically most sensitive to changes in commodity prices. We forecast commodity prices via a number of different methodologies including, but not limited to:

- Supply and demand. In the case of platinum, for example, demand is split between industrial (effectively auto-catalysts) and jewellery. Auto-catalyst demand can be correlated with forecast global car manufacturing numbers (derived from an external source). By contrast jewellery demand is inversely correlated with price. Supply is modelled on a mine-by-mine basis. The price of platinum is therefore derived from the difference between forecast auto-catalyst demand and supply. Jewellery demand is then calculated with respect to the derived price. Investment demand is typically assumed to be nil so as not to prejudice the outcome initially, but may be subsequently included as a sensitivity (typically exacerbating the existing supply-demand gap).
- Cyclical variation relative to a benchmark price and subsequent macroeconomic developments. In the case of gold, a historical analysis of supply suggests that it is inelastic to price (or elastic only with a considerable delay), with the result that any supply demand gap is regulated by a flexible, but reactive (jewellery) recycling industry. At the same time, jewellery fabrication itself is inversely correlated to price. Hence the price of gold tends to be determined by investment demand – which becomes self-perpetuating. As a result, gold does not yield itself to conventional supply-demand analyses, such as the one used to estimate platinum prices (above). In recognition of this, we estimate the future price of gold via two methods. The first involves observing past cycles with respect to its US\$35/oz price indexed from January 1934 (the date when gold was first fixed at this price by the Roosevelt administration) and projecting a similar cycle into the future. The second involves correlating the price of gold to the US monetary base. Strictly speaking, the correlation should probably be with the value of the US's official gold holdings; since these have barely changed since 1972; however, the correlation reduces easily to one between the gold price and the US monetary base. Past deviations from the price derived according to the correlation are then calculated. In the future, the monetary base is assumed to increase at its long-term rate and the same cyclical deviations are assumed in the future as occurred in the past. At the current time, a rationalisation of the difference between the two results is provided in the form of an analysis studying the relationship between the monetary base and inflation. The two results will then be manipulated to generate a single forecast (nominal) price, which is then discounted back into current money terms at the long-term US inflation rate.
- Oil price correlation. A number of metals and minerals (eg copper, nickel and iron ore, among others) exhibit a strong correlation with the oil price. The orthodox interpretation of this phenomenon is that the price of oil determines the absolute level of the industry's cost curve and that material deviations from the price implied by the correlation over extended periods of time would therefore expose the industry and investors to excessive profits or losses and thereby distort asset allocation. In these cases, the long-term price of a metal or mineral will be derived from a long-term regression analysis between that metal or mineral and the oil price. The long-term price will be the price that corresponds with Edison's oil division's long-term oil price (US\$70/bbl at the time of writing).
- Correlation with other metals. In a number of instances, the particular dynamics of a market mean the price of a metal or mineral correlates better with another metal than with the oil price. This is often true of by-products (eg silver with respect to gold and palladium with respect to platinum). In these cases, a long-term regression is performed between the two metals and the long-term price of the by-product (eg silver or palladium) is determined with respect to the forecast price of the main product (gold or platinum – see above).

- Spot price. In instances in which relatively little information is available for a particular metal, and/or if its effect is small within the context of an overall company valuation (eg rhodium), the prevailing spot price may be used as the long-term price for that metal. Note that a sensitivity analysis of the valuation conducted at the prevailing spot price is almost invariably carried out as a standard valuation exercise for all companies within an initiation/Outlook report.

In instances in which markets are not transparent, we may also seek input and guidance from an appropriately placed source (eg lithium and rare earth elements). Commodity prices may be expressed in either real or nominal terms, but will be fully disclosed either way.

Miscellaneous

Non-JORC resource reporting

While we maintain detailed databases on the in-situ valuations of resources reported under the JORC code or similar (eg SAMREC, NI 43-101), we do not do so for resources reported under alternative codes (eg Russia's GKZ code). In instances such as these, we are prepared to estimate a conversion from another system into the JORC code, but will state that such assumptions are prone to high levels of error and that the resulting valuation is very much contingent on conversion occurring and whether or not it is effectively and efficiently concluded.

Foreign exchange

Normally, given that our financial models are typically constructed on a real, non-inflationary basis, foreign exchange rates are deemed to be those prevailing at the time and no account is taken of likely future appreciation or depreciation (typically against the US dollar).

Discounted cash flows

We believe that the valuation methodologies expounded so far in this document are the most appropriate for established, listed and (in particular) cash consumptive companies. In instances in which either a company is not cash-consumptive and/or its share price is unknown (eg a pre-IPO company or a private company), it may be necessary or more appropriate to derive a valuation by means of a discounted cash-flow (DCF) analysis instead.

The DCF methodology is therefore typically employed in the valuation of projects, which are likely to be fully funded internally by a company from existing cash flows or resources. When performed as such, this will be fully disclosed to the reader as well as the reasons for the adoption of such a methodology. Notwithstanding, the real 10% cost of equity that we use to discount dividends in our headline methodology, discounted cash-flow valuations and analyses are typically also performed at a 10% real discount rate. Where possible and appropriate, a rationalisation between the discounted cash-flow analysis (using a 10% discount rate) and the discounted dividend flow analysis (using a 10% discount rate) will be provided.

Note that, the difference between a valuation derived by DCF as opposed to discounted dividend flow is typically not significant, as demonstrated in the following example:

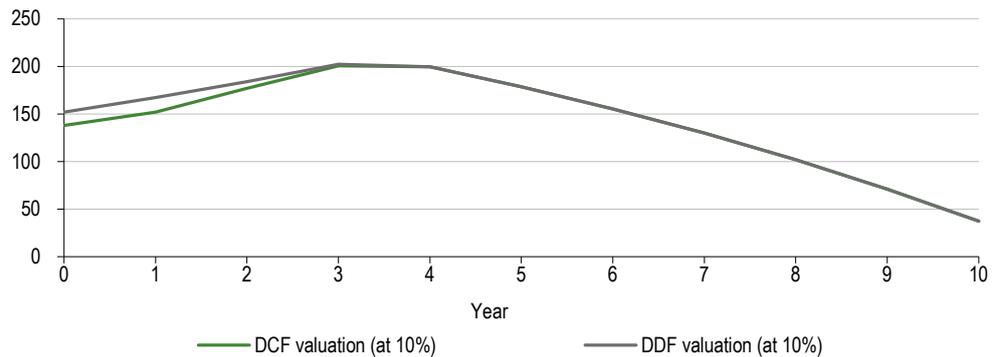
Exhibit 7: Empirical comparison between DCF and discounted dividend flow valuation methodologies

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | NPV ₁₀ | Comment |
|-----------------------------|------|------|-----|-----|----|----|----|----|----|----|----|-------------------|---------------|
| Cash-flow | -100 | 41 | 41 | 41 | 41 | 41 | 41 | 41 | 41 | 41 | 41 | 138 | DCF valuation |
| Cash at start | 0 | -100 | -59 | -18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Cash at end before dividend | -100 | -59 | -18 | 23 | 41 | 41 | 41 | 41 | 41 | 41 | 41 | | |
| Dividend | 0 | 0 | 0 | 23 | 41 | 41 | 41 | 41 | 41 | 41 | 41 | 152 | DDF valuation |
| Cash at end | -100 | -59 | -18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |

Source: Edison Investment Research. Note: DDF = discounted dividend flow.

In this instance (chosen to approximate the cash flows and [maximum potential] dividend flows from a 100koz gold producer in millions of US dollars) the difference between the DCF and the DDF is 10.1%. Note that the value of the undiscounted cash-flows and dividend flows is identical in each instance, at 310.

When conducted sequentially, it should be noted that the values derived from the DCF and DDF valuations converge once all debt has been paid off, as shown in the following graph (derived from the data in Exhibit 7):

Exhibit 8: DCF and DDF valuation methodologies compared


Source: Edison Investment Research

Accounting principles and minority interests

In cases in which a company owns the majority of its asset (or is its operator), we will assume the application of 'fully consolidated' accounting principles, with the value of any minority interest being subtracted from the value of the fully consolidated asset or cash-flow. Occasionally (eg if a company has a 50% interest in a project and has indicated that it intends to use proportional consolidation as an accounting approach), we will also use this method. In rare instances (eg if a company owns a large, minority interest in a project), the equity method of accounting will be applied.

For all companies, the valuation of their assets will be adjusted to reflect their percentage ownership (or future ownership) of their assets. For resources, this involves applying a pro-rata interest to the gross value of the orebody (as previously described). For reserves, this involves applying a minority interest to post-tax earnings and dividends.

Alternative products

The above methodologies are applied to companies for which we perform public, contracted research services. Within this context, the application of a 10% real discount rate in particular is designed to be expressly objective; it is also the rate typically used in technical documents, such as pre-feasibility and bankable feasibility studies (as well as 5%, 8% and, occasionally, 12%). As discussed previously, the aim of this publicly available research is not so much to justify the existing share price (or valuation) of an asset as it is to indicate where it might rise (or fall) to in the event that management is able to faithfully execute the mining plan designed for it. In addition to this service, however, we also provide (typically private) subjective and fully risked research for clients, which is designed to assess the immediate value and marketability of any mining asset. This research service is typically private and is available by arrangement on a bespoke basis.

Appendices

[Appendix 1](#) [Supplementary reports](#)

[Appendix 2](#) [Research note structures](#)

[Appendix 3](#) [Initiation pipeline and data pack](#)

[Appendix 4](#) [Glossary](#)

Appendix 1: Supplementary reports

In addition to our [client research coverage](#), the Edison mining team publishes sector, industry and macroeconomic reports that provide insights for both investors and industry alike.

Sector reports

<http://www.edisoninvestmentresearch.com/research/team/resources-mining>

Gold Sector M&A report | Nov 2015



Given the importance of macroeconomics on mining company valuations, the Edison mining team publishes sector reports approximately once a year. These typically focus on one specific commodity (eg gold, uranium etc) and set out our interpretation of the factors and forces driving that commodity's price. It will also typically update investors on our estimate of the global average value of in-situ resources for a variety of commodities.

Bauxite report | Aug 2015



Tungsten report | Mar 2015



www.edisoninvestmentresearch.co.uk



Our monthly book contains up to date company profiles, investment summaries and industry outlooks for all companies under Edison research coverage. We consider the latest investment critical news flow, provide up to date forecasts, and highlight the all important potential catalysts that are key to driving share prices in the E&P sector.

Appendix 2: Research note structure

Edison Outlook initiation notes typically follow a consistent 12-page structure, designed to provide different readers with exactly the level of detailed information required for their investment activities. We encapsulate the investment story in one succinct paragraph, expand this to one page to include all the key strategic drivers of value, provide a brief overview of strategy sensitivities, financial and valuation details over a further one or two pages, and then draw out in detail the key features of the company's assets, management teams, strategy, valuation and financial outlook over a remaining eight to nine pages. We do not believe investors generally benefit from notes longer than 12 pages and will always endeavour to capture the entire investment proposal within the 12-page framework.

Exhibit 4: Outlook note structure

| Front page: Sell the story | Investment summary: Summarise the story | Company description Set out the story | Financial analysis |
|------------------------------------|--|--|---|
| Company title etc | Company description | Evaluation of strategy | Historical/ forecast financial results |
| Summary of the investment story | Strategy (brief) | Assets Technology | |
| First key point | Sector positioning | Newsflow | Key financial ratio analysis |
| Second key point | Sensitivities (brief) | Sensitivities | |
| Third key point | Financials (brief) | Management Market positioning | |
| Valuation | Valuation (brief) | Valuation | |
| 1 page | | Financials | |
| | | 8-9 pages | 2 pages |

Source: Edison Investment Research

Ideally, we will publish a full initiation-style Outlook note on client companies every year to remind investors of each company's strategy, competitive advantages, sensitivities and overall asset portfolio. Investor sentiment can too often be caught up with particular issues relating to a company, and we find that an initiation style note on an annual basis helps put the wider issues into context, and beyond the prevalent short-termism of average brokers.

A typical Outlook note will include sections on history, geography, geology, reserves & resources, mining & processing, assumptions, valuation, sensitivities and financials.

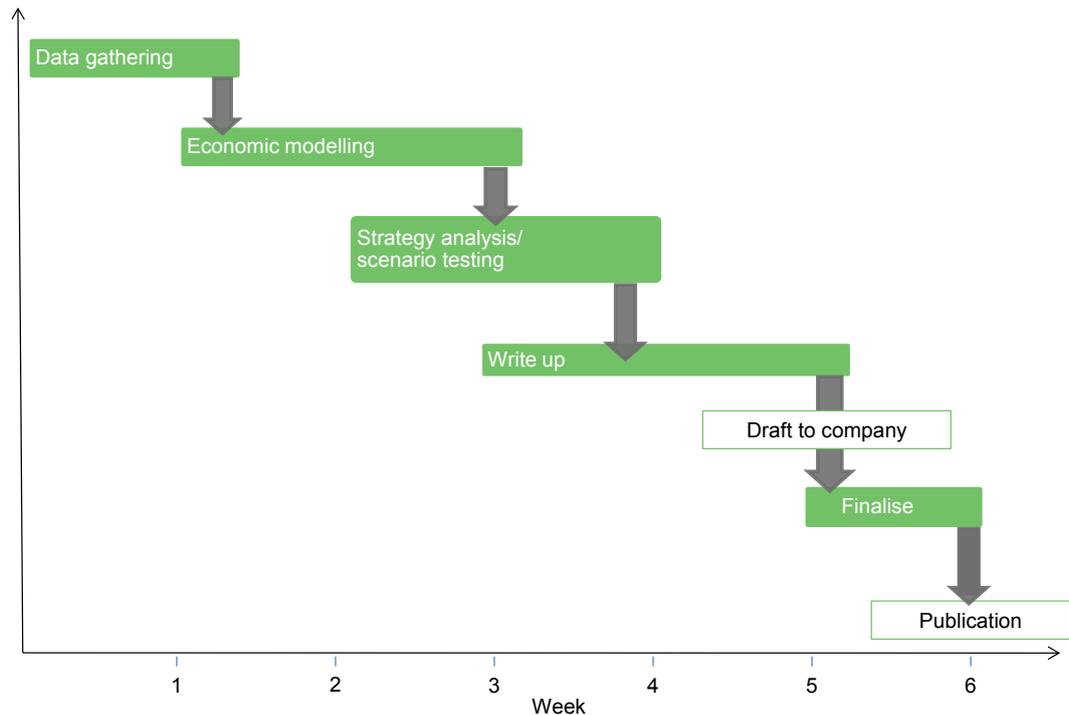
In addition to our Outlook notes, our mining team publishes approximately three additional Update research notes every year on each company under coverage. These more-focused notes will typically be between two and 10 pages long and look at a particular area of operation or strategic intent. Update notes also provide an opportunity for us to update our valuation and financial models.

In addition to Update notes, the team will respond to market sensitive newsflow with one-page notes and Flash notes as required.

Appendix 3: Initiation pipeline and data pack

Edison Outlook initiation notes generally take a minimum of six weeks from commissioning to publication. Sufficient time is required to gather information properly, build robust economic and financial models and scenario test different strategic options relating to development plans before actual write up of the research report. We aim to provide the company with a draft of the initiation report approximately one week before publication. Rapid company feedback is required in the final week to publish promptly and to ensure that research conclusions remain relevant.

Exhibit 5: Initiation pipeline



Source: Edison Investment Research

It is essential that our analysts are using accurate, up-to-date information when compiling research. Our data needs vary from company to company, but typically include:

- up-to-date investor presentations
- company economic models
- copies of technical reports (eg scoping study, pre-feasibility study, bankable feasibility study and competent person's reports (CPR's) and other relevant material
- biographies of key management team members and personnel
- a copy of reported or *pro-forma* financial statements for the previous three years
- a copy of the current shareholder register

Appendix 4: Glossary of terms

We use the following abbreviations in our research.

Ag = silver

Au = gold

AgE/AuE = gold equivalent/silver equivalent (write in full on first mention)

BFS = bankable feasibility study

Bnlb = billion pounds (weight)

CIF = cost insurance freight

CIL = carbon in leach

CIP = carbon in pulp

Cu = copper

DFS = definitive feasibility study

DSO = direct shipping ore

E = equivalent, eg CuE, P₂O₅E

Element symbols should be periodic table symbols

FOB = free on board

g/t = grams per tonne

Imperial ton = 2,240lbs

JORC = Joint Ore Reserves Committee

kg = kilograms

koz pa = thousands of ounces per annum

lb = pound (weight)

Mlb = million pounds (weight)

Moz = million ounces

Moz pa = millions of ounces per annum

Mt = million tonnes

Mtpa = million tonnes per annum

mtu = metric tonne unit (1mtu=10kg)

mtupa = metric tonne unit per annum

Tonnes are assumed to be metric unless stated otherwise.

Metric tonne = 1,000kg = 2,205lbs

NI43-101 = Canadian National Instrument for ore resource and reserve reporting

PGMs = platinum group metals

PEA = preliminary economic assessment

PFS = pre-feasibility study

Pt = platinum

tpa = tonnes per annum

tpd = tonnes per day

tpm = tonnes of ore per month

tpq = tonnes per quarter

REEs = rare earth elements

RIP = resin in pulp

SAMREC = South African code for the Reporting of Mineral Resources

Short ton = 2,000lbs

SX-EW = Solvent extraction electro-winning

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