Oil & gas research principles

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Executive summary

Valuing oil and gas companies requires both a clear understanding of the potential value of each asset within a portfolio, and an ability to rigorously risk these to reflect asset specific, company and macroeconomic uncertainties. This document introduces the principles by which Edison conducts its research into such companies, our approach to identifying the key criteria that drive our risk weightings, and the process by which we define the macroeconomic assumptions that ultimately drive our company valuations.

Six evaluation criteria we look for

Our analysis focuses on the strategy and evaluation criteria unique to each company and which can affect the ability of management teams to crystallise value for shareholders. The six criteria we focus on are 1) experienced management teams and partners, 2) evidence of good subsurface understanding, 3) balanced portfolios with upside potential, 4) clear monetisation routes, 5) an ability to mitigate fluctuations in fiscal regime (eg tax losses or access to field allowances), strong safety records and mitigation of decommissioning liabilities, and 6) whether companies are financially prudent, have reasonable operating costs and can fund their commitments in the coming year.

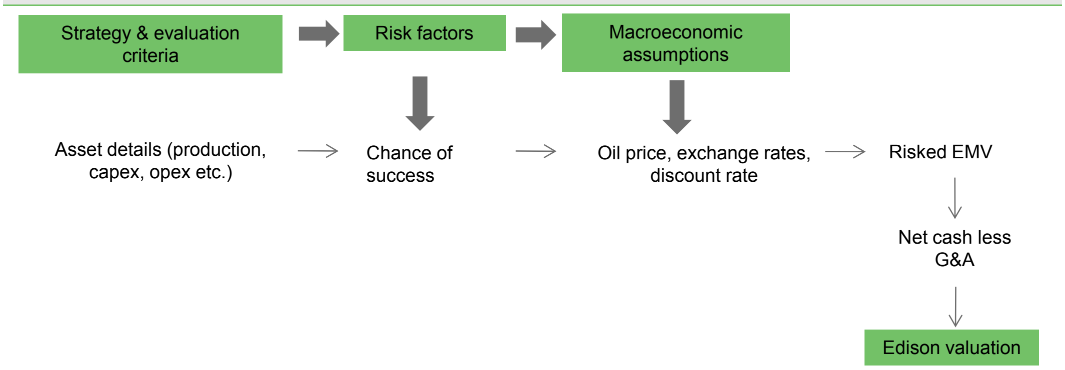
Evaluation criteria drive risk factors

We draw clear links between our evaluation criteria and risk factors both at an individual asset level and at a company level. This in turn drives the chance of success we apply to each asset within a company's portfolio, depending on the stage of development each asset is positioned at from wildcat exploration through to production.

Cautious macro assumptions ensure prudent valuations

We remain cautious when determining macroeconomic assumptions in order not to artificially inflate valuations. We continually strive to base our oil and gas price assumptions on robust macro fundamentals rather than short-term bubbles. Our current $80/bbl price assumption reflects this longer-term view. We also apply our evaluation criteria to our discount rate assumptions for each company, based on capital structure and access to funding. Our evaluation criteria, risk factors and macro assumptions all then flow through into our company valuations as shown below.

Exhibit 1: Valuation model



Source: Edison Investment Research

Introduction

Oil and gas investments, by their nature, carry elements of risk that are unique to the industry. A robust research approach is therefore required both to evaluate oil and gas company strategies, management and assets, and in turn to develop a suitably risk-weighted valuation for each company under coverage.

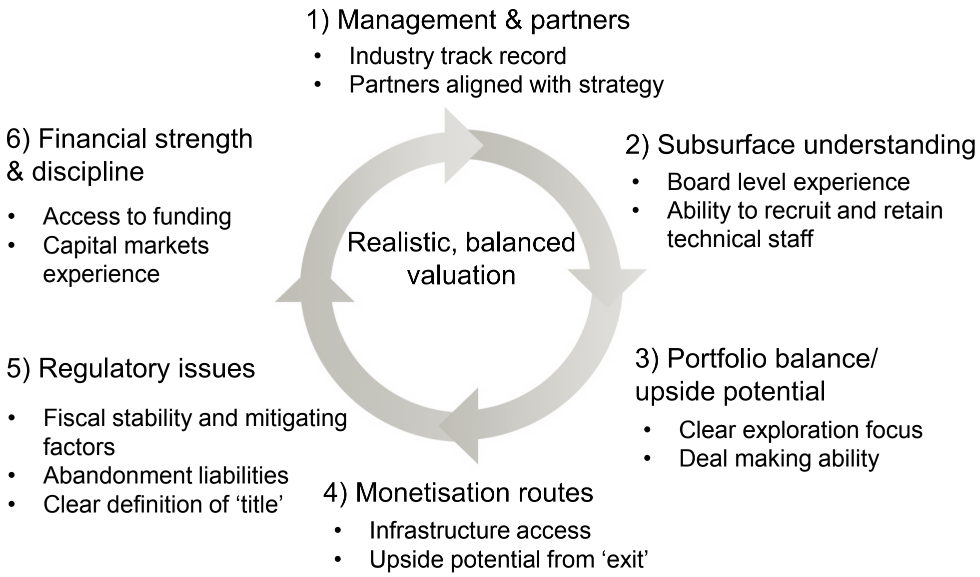
At Edison Investment Research our approach is to apply systematic evaluation criteria when assessing companies in order to capture all the key risks and mitigating factors that can affect a company's ability to monetise its assets. This evaluation then allows us to most realistically risk-weight asset-derived valuations based on consistent macroeconomic assumptions, in order to provide investors with clear line of sight to both share price upside potential and the catalysts we see as being most critical to realising this upside.

Strategy and evaluation criteria

Irrespective of where an oil and gas company operates it must negotiate numerous challenges in order to monetise its intangible leads, plays, resources and reserves into hard cash. These include issues with licence and title, geological interpretation, exploration and appraisal drilling, fund-raising and partnering, commercial development, and ultimately project or deal execution. Investors reward companies that can best manage these challenges based on the quality of their people and partners, the quality of their assets, and the ability of companies to negotiate capital markets and regulatory uncertainties.

Over many years the Edison oil and gas team has developed evaluation criteria to capture all the major risks and mitigating factors that must be considered when researching and valuing companies. These were originally published in Golden Barrels in October 2007, and then more recently updated in the North Sea sector report, Northern Lights, in March 2011. The six criteria we focus on are summarised below.

Exhibit 2: Evaluation criteria



Source: Edison Investment Research

1. **Management & partners**: We look for management teams with impressive track records of managing their asset portfolios. We look at equity partners and consider if they are suitably sized to help contribute to projects without the impediments of strategy conflict, insufficient financial or technical strength, or where they are simply too big to develop assets at the requisite pace. We further look for a track record of attracting supportive partners, especially where abandonment liabilities and/or infrastructure access are issues.
2. **Subsurface understanding/complexity**: We look for management with geology/subsurface experience up to board level, especially where the company is exploration focused or where field developments are complicated. We also consider whether companies can recruit and retain a strong subsurface team to support its exploration and development programme. And ultimately we look for indicators that a company can demonstrate commerciality or a compelling route to commerciality for its leads, prospects and discoveries.
3. **Portfolio balance/upside potential**: We look for asset portfolios that both complement the expertise of the company and provide balance as well as upside potential to the shareholder. We consider a well balanced portfolio of exploration assets alongside production, development and appraisal assets to be essential for a business in which core assets are, by their nature, depleting. We focus mainly on a 12-18 month exploration drilling outlook, believing that longer-term targets do not normally provide upside support to share price. We also look at how companies operate in the M&A environment and how best they can leverage this.
4. **Monetisation routes**: We assess which companies need to access infrastructure to develop assets, and if so what are the key constraints, ie tariff, ullage, contract length etc. We again look at partners and infrastructure providers to determine what competing issues may affect companies gaining access to infrastructure on reasonable terms. If field development is not part of a company's core strategy we look for a track record of disposals in order to crystallise value generation.
5. **Regulatory issues**: We carefully consider licence and title issues for assets, especially when looking at companies operating in developing countries. Where taxation is punitive we look for companies that have substantial tax losses or at least have access to tax concessions such as field allowances in the UK. In a post-Macondo world, we look for players that demonstrate they have exceptional safety records, have strong technical teams and have strong balance sheets. In mature provinces we look for clear understanding of decommissioning liabilities, preferring companies where abandonment costs are either not material, are far off in the future, or where deals have been negotiated such that previous owners maintain the liability.
6. **Financial strength/discipline**: The oil industry is subject to a number of variables, from disappointing exploration through to fluctuating oil prices. First and foremost we look at finance teams who understand this and operate on a prudent basis. As a rule of thumb, we look at whether companies can fund their programmes in the coming 12 months. We also look at whether a company's cost of extraction per barrel is reasonable.

Valuation principles

Our core valuation methodology is based on an expected monetary value (EMV) using discounted cash flow models (DCF) to calculate an NPV per barrel of oil equivalent for each field on a net working interest basis. This is normally based on independently calculated or company derived proven plus probable (2P) reserves or best estimate (2C) contingent resources as defined by the Society of Petroleum Engineers (SPE). EMV is then calculated based on the risk-weighted potential netback from successful exploitation of these hydrocarbon reserves/resources less any capex at risk in the event of development failure. The formula for this is shown in exhibit 3:

Exhibit 3: EMV calculation

$$\text{EMV (\$m)} = \frac{\text{net NPV (\$m)}}{\text{net production (mmboe)}} \times \text{reserves (mmboe)} \times \text{CoS (\%)} - \text{net capex at risk (\$m)} \times (1 - \text{CoS (\%)})$$

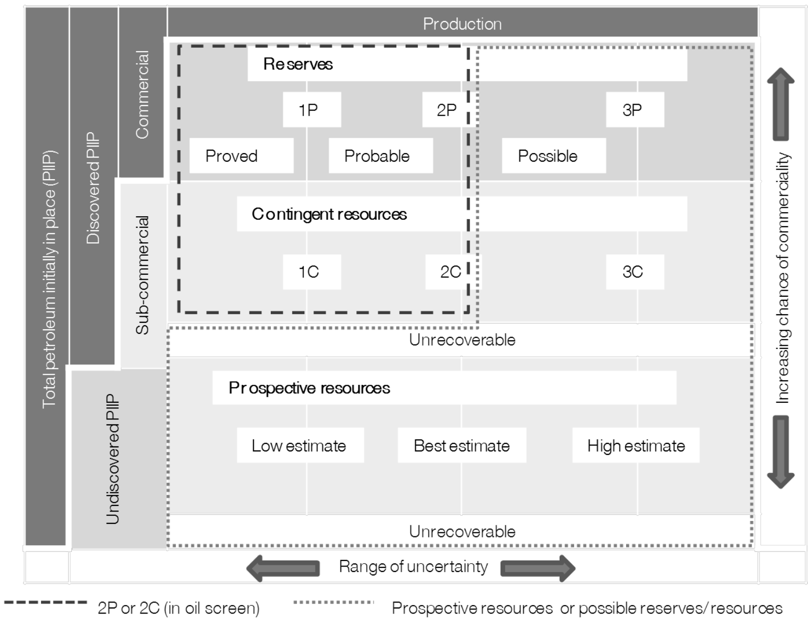
Source: Edison Investment Research

When company data is provided we check the reasonableness of development and operating costs noting the relationship between crude oil prices, activity levels and the unit price for both shooting seismic and drilling. When company data is not available we apply industry analogues to populate our NPV calculations. NPV calculations are updated systematically to eliminate the impact of sunk capex, revenues and costs, while reasonable assumptions are also made as appropriate for abandonment costs/liabilities that will be incurred as fields approach their economic limit.

We generally do not include possible reserves (P3) or high estimate contingent resources in our core valuation. We also exclude prospective resources in our valuation until they have at least been moved into the contingent resource category.

A graphical representation of the reserves/resources generally considered in our core valuation is shown in Exhibit 4.

Exhibit 4: SPE resource classification framework



Source: Society of Petroleum Engineers, Edison Investment Research

Having calculated EMV for each core field we then adjust for net cash or debt and the discounted cost of future general and administration (G&A) expenses. When cumulative tax losses are known, or when tax losses across numerous fields can be pooled (such as in the UK North Sea) we also include the EMV impact of this in our core valuation. The resulting net asset valuation (core NAV) is then calculated both on a total and on a per share basis as shown in Exhibit 5.

Exhibit 5: Typical valuation table

FD Shares (m)	113					Unrisked reserves/resources				
$/£	1.60							Netback		
Assets	**Country/ licence**	**WI %**	**Hydroc. fluid**	**Net capex at risk $m**	**CoS %**	**gross mmboe**	**net mmboe**	**NPV/ boe $/boe**	**EMV $m**	**Value/sh p**
In production										
Asset 1		100%	Oil		100%	3.2	3.2	14.2	45.5	25.1
Asset 2		50%	Oil		100%	24.4	12.2	16.3	199.0	109.7
Under development										
Asset 3 (post FID)		80%	Oil/gas		80%	8.3	6.6	8.8	46.3	25.5
Asset 4 (post-appraisal)		20%	Oil		50%	16.5	3.3	14.2	23.5	12.9
Total									314.2	173.2
Cash/(net debt)									(79.5)	(43.8)
G&A									(27.1)	(14.9)
Pooling of tax losses									69.2	38.1
Core NAV								Total	277	153
Exploration/appraisal (near-term drilling targets only)										
Asset 5 (pre-appraisal)		30%	Oil	(7.2)	40%	13.0	3.9	10.8	12.5	6.9
Asset 6 (exploration)		30%	Gas	(9.6)	17%	18.7	5.6	12.7	4.1	2.3
Asset 7 (exploration)		45%	Oil	(20)	9%	160.9	72.4	5.5	17.6	9.7
RENAV								Total	311	171

Source: Edison Investment Research

Exploration upside

In addition to our core NAV calculation we include the risk-weighted potential for upside from the company's exploration and early stage appraisal activities under our risked exploration net asset valuation (RENAV).

Within this category we only consider assets where there is a firm commitment from the company to develop them within the next 12 months, either through exploration/appraisal drilling or through a commitment to shoot seismic or progress field assessment activities. As such we would not consider drill or drop concessions until a commitment is made to drill. In all cases the assessment of potential EMV from exploration/appraisal assets is heavily risk weighted, to consider not only the geological risk of failure but also the numerous commercial, technical and financial hurdles that need to be overcome before a field can be considered ready for development.

Risk factors

We reflect the inherent risks associated with the discovery, appraisal, development and production of oil and gas assets within our valuation methodology by applying individual chances of success for each field within our core NAV and RENAV calculations. These will vary significantly based on the particular circumstances of the field in question, the stage of development, and the relative experience of the company's management and technical teams and partners in executing oil and gas developments within the geopolitical regimes in which they operate. Key to this assessment of risk factors are the conclusions from the analysis of our evaluation criteria presented earlier.

- **Production/development**: We generally consider that assets already in production have no substantial risk of failure. This is particularly the case when considering reserves audited by a competent person as these already have been subject to an economic evaluation. Development assets, post final investment decision (FID), again are generally considered low risk, although we will often include a consideration within the risk factors for the potential for delays in completion of the development and for cost overruns.
- **Post-appraisal (pre-FID)**: Many smaller oil and gas companies leverage their share price by "proving-up" discoveries in the expectation they can be sold or substantially farmed-down to a

larger operator prior to development and full-field exploitation. However, it is our experience that this process can often be troublesome with many companies struggling to either fund or support the necessary elements required to successfully move assets through the appraisal and pre-development activities. Assigning high chances of success to early development assets is both foolish and can be misleading to investors. It also provides no opportunity for companies to demonstrate the progress being made in developing their asset bases. News flow is the key driver for share price gains among smaller oil and gas companies and we would always focus companies and investors alike on laying out the news 'catalysts' that will drive the share price. A cautious approach to risking less developed post appraisal assets generally benefits companies and investors alike in the long term, rewarding them with upside as valuable development work is progressed and reported back to the market.

- **Pre-appraisal (post-discovery)**: Discoveries that have still to be appraised require further risk weighting, largely to reflect the chance that the initial resource expectations from a hydrocarbon discovery turn out to be substantially lower than anticipated. Generally these would also only be included in our risked exploration valuation (RENAV). When dealing with pre-appraisal assets we focus our attention on geological risks as well as commercial and technical challenges. A proven track record from management along with strong sub-surface expertise is a key requirement for boosting the chance of success of these assets. Strong partners and a fiscal regime that encourages oil and gas development are also important.
- **Exploration (pre-discovery)**: Geological risk factors are the key considerations when considering the prospective value of undiscovered leads, plays and resources. These are derived from a consideration of the probabilities of the presence of reservoir, presence of trap and presence of hydrocarbon system (source rock and kitchen). We only value assets where there is a commitment to pursue exploration, either through drilling or through shooting seismic or progressing field assessment activities. Any issues regarding title and licence obligations, access to drilling rigs, funding and partner alignment will feature heavily in our risk weighting of exploration assets. In saying this, a company with both an extensive portfolio of exploration assets and a strong management team can be expected to deliver significant value with the drill bit and we would expect to reflect this in our RENAV.

As can be expected the definition of risk factors can be subjective. It is above all for this reason that we are rigorous in our application of our evaluation criteria explained earlier, highlighting both the risks and the mitigating factors offered by management teams as they seek to develop their assets.

Assumptions and sensitivities

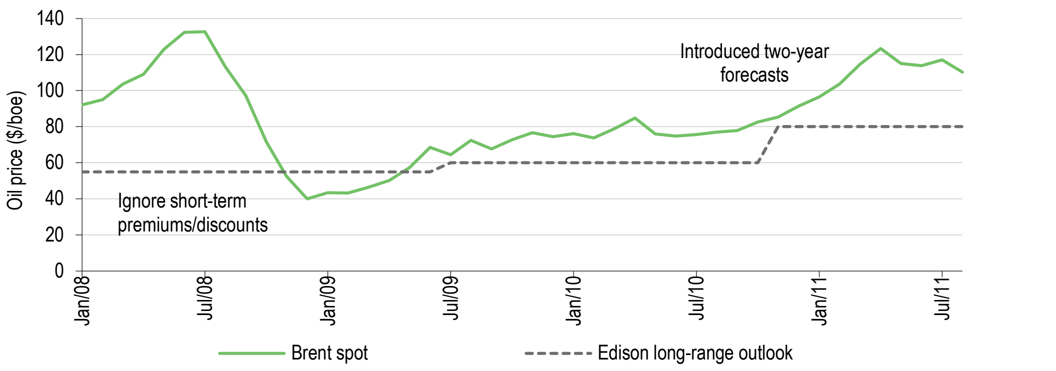
To ensure consistency across Edison's oil and gas research products we consistently apply a methodology for defining macroeconomic assumptions that will affect company valuation.

Assumptions

Our research always explicitly states our assumptions such that investors can clearly understand the valuation methodology and adjust for this based on different financial or economic outlooks.

- **Crude oil and gas prices**: Our valuations are based on oil and gas price outlooks that balance downward pressure risk from falling prices while recognising that capital market valuations are largely driven by near-term forecasts and forward curves. We apply a long-term real oil price outlook, to the nearest $10/boe, based on forward supply curves, with a view to understanding any disconnects between this and the long-term marginal cost of extraction. Pronounced contango or backwardated forward curves would generally imply a disconnect between spot and long-term pricing. Where there is uncertainty or volatility we will always tend to a more conservative outlook to avoid over-inflating valuations. We do not include perceived short-term premiums or discounts to our long-term outlook, believing these normally 'correct' over a relatively short period of time (months rather than years). Our long-term outlook is reviewed periodically (usually quarterly) and updated only if there is a substantial reason to believe changes in forward pricing are due to movement in fundamental macroeconomic assumptions. Our current base-case real oil price assumption is $80/boe inflating at 2% per annum. Our gas price assumption is country dependent, with a current forecast of $4.5/mmscf in the US, and 60p/therm in the UK.

Exhibit 6: Edison long-term oil price outlook history



Source: EIA, Edison Investment Research

Embedded in our valuations is a short-term (two-year) forecast of oil and gas prices based on Edison's house view of supply demand fundamentals. These are updated every two months and published under our oil and gas macro outlook available at www.edisoninvestmentresearch.co.uk/research/sector-commentary. We do not forecast longer-term oil and gas prices, believing that supply demand movements more than two years out cannot be accurately predicted.

Finally, our valuations occasionally incorporate specific discounts or premiums to benchmark oil and gas prices that reflect geographic or product quality issues associated with the most likely route to sale for a company's products. Any assumed discounts or premiums will be clearly stated in our research.

- **Discount rates**: We apply a discount rate to our NPV calculations to reflect the cost of capital associated with the company under coverage. Smaller, less developed companies that have no access to debt markets will generally carry a higher discount rate. Companies that struggle to raise equity at reasonable costs/discounts will also carry a higher rate. Companies that are well capitalised, are fully funded, or have access to reserves-based lending (and hence have proven and probable reserves in their asset base) will generally enjoy a lower cost of capital and this will be reflected in our discount rate for valuation purposes. The rate applied is clearly stated in our research reports.
- **Exchange rates**: We do not forecast exchange rates and hence will generally use recent average rates in our valuation models. We look for evidence of hedging when there is significant exchange rate exposure and will generally highlight this sensitivity where appropriate.

Sensitivities

In addition to laying out our core NAV and RENAV calculations in detail, we also believe in offering investors the tools to make their own assumptions regarding key model inputs. To do this we will generally include a sensitivity table in our reports that shows the relative impact of both oil and/or gas price assumptions and the discount rate on our valuations. This useful tool provides investors with the ability to make their own assumptions while not having to revert to accessing company models. An example of the core NAV sensitivity for the valuation in Exhibit 5 is shown below in Exhibit 7.

Exhibit 7: Typical core NAV sensitivity table

Core NAV	Discount rate				
Oil ($/boe)	10%	12.5%	15%	17.5%	20%
40	12	12	12	11	10
60	88	84	79	75	71
80	162	153	144	136	129
100	236	221	208	196	186

Source: Edison Investment Research

Financials

Having laid out our valuation, our research notes finally provide typically a two-year forward looking financial outlook. In the case of exploration-focused companies we highlight the investment profile and compare this with both current capitalisation and access to funding. We particularly focus on whether companies have the ability to fund the next 12-month work programme through either current cash or clearly available funding. We are also clear in our assumptions regarding timing of both investment and production, as these can have a significant impact on net present value derived valuation calculations.

If companies are already in production we highlight the revenue and cash flow generation and compare this with funding requirements. We also consider the potential for shortfall in revenues based on either production outages or changes in macroeconomic outlook.

Appendices

Appendix 1: Supplementary reports

In addition to our client research coverage, the Edison oil and gas team publishes regular sector, industry and macroeconomic reports that provide insights for both investors and industry alike.

Sector reports

www.edisoninvestmentresearch.co.uk/research/sector/research

Edison sector reports provide investors with focused research on a particular sub-sector of the oil and gas industry. *Northern lights* focuses on North Sea independents, highlighting those that can mitigate risk and can best crystallise value from their assets. *Golden barrels* highlights companies with exploration geared upside with operational qualities that optimise the balance between risk and reward.

Seismic reflections

http://www.edisoninvestmentresearch.com/research/sector-commentary/

Our fortnightly *Seismic reflections* provides both topical commentary as well as a focus on E&P stock market movers both in the short and medium term. The report also contains our EV/(2P+2C) oil screen, which provides readers with an up to date snapshot of relative valuations across a wide range of E&P companies, an invaluable tool when assessing potential valuation anomalies within the sector.

Macro outlook

www.edisoninvestmentresearch.co.uk/research/sector-commentary

Given the importance of macroeconomics on E&P valuations, the Edison oil and gas team issues a 12-24 month outlook of global oil and gas markets every two months. This sets out our interpretation of global supply/demand balances, economic growth forecasts, derivative pricing and investment sentiment on oil and gas prices.

Insight

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 on 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 8: 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 Newsflow	
First key point	Sector positioning	Sensitivities	Key financial ratio analysis
Second key point	Sensitivities (brief)	Management / Market positioning	
Third key point	Financials (brief)	Valuation	
Valuation	Valuation (brief)	Financials	
1 page		8-9 pages	2 pages

Source: Edison Investment Research

Edison publishes a full initiation style Outlook note on client companies every year. We see this as critical 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.

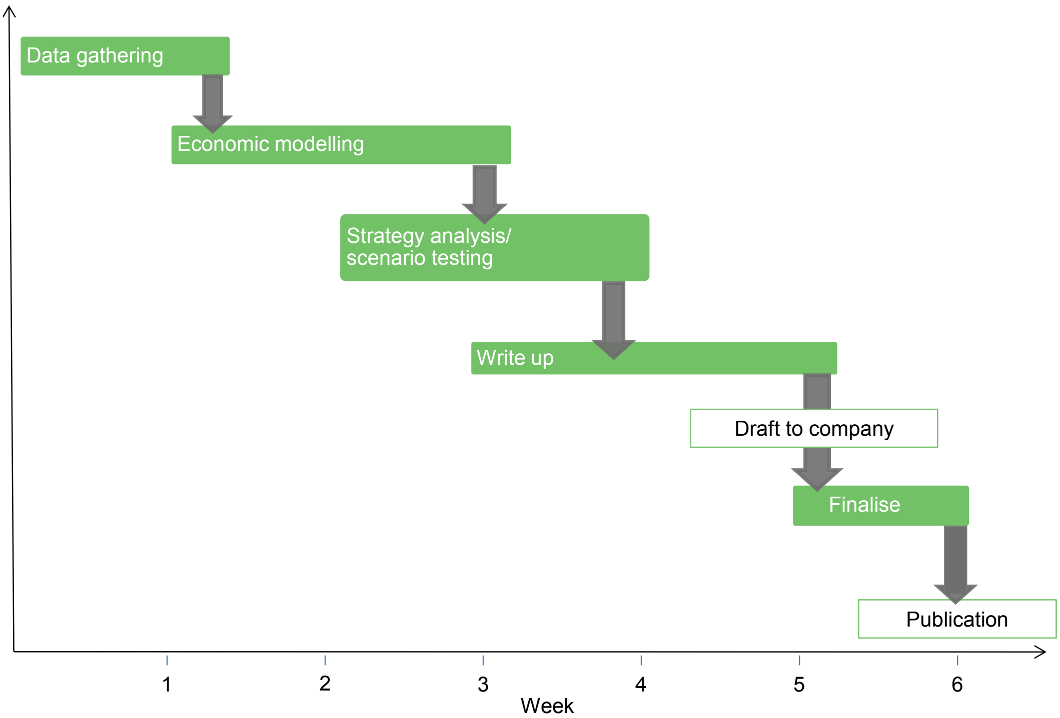
In addition to our Outlook notes, the Edison oil and gas team publishes approximately three additional Update research notes every year on each company under coverage. These more focused notes will typically be between two and eight pages and focus on a particular area of operation or strategic intent. Update notes also provide an opportunity for Edison to update its valuation and financial models.

In addition to Update notes, the team will respond to market sensitive news flow with one page Flash notes as required. In the case of E&P companies Flash notes are often linked to the success (or failure) of key drilling campaigns, which often have a significant bearing on both valuation and share price performance.

Appendix 3: Initiation pipeline/data pack

Edison Outlook initiation notes generally take a minimum of six weeks to prepare from commissioning to publication. Sufficient time is required to properly gather information, build robust economic and financial models and scenario test different strategic options relating to development plans prior to 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 in order to publish promptly and to ensure that research conclusions remain relevant.

Exhibit 9: Initiation pipeline



Source: Edison Investment Research

It is essential that Edison's analysts are working off accurate, up to date information when compiling research. Our data needs vary depending on the company in question, but would typically include:

- Up to date investor presentations
- Company economic models if available
- Copies of Competent Persons Reports (CPRs) and other relevant technical reports
- Bios of the key management team members
- 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.

bbl(s) = barrel(s)

bcf = billion cubic feet of gas (bscf = billion standard cubic feet)

bcm = billion cubic metres of gas (bscm = billion standard cubic metres)

boe = barrels of oil equivalent

boepd = barrels of oil equivalent per day

bopd = barrels of oil per day

CoS = chance of success

GIIP = gas initially in place

mbbls = thousand barrels of oil

mbblpd = thousand barrels of oil per day

mboe = thousand barrels of oil equivalent

mboepd = thousand barrels of oil equivalent per day

mmbbls = million barrels of oil

mmboe = million barrels of oil equivalent

mmcf = million cubic feet (mmscf = million standard cubic feet)

mmcfd = million cubic feet per day (mmscfd = million standard cubic feet per day)

MT = metric tonnes

OGIP = original gas in place

OOIP = original oil in place

STOOIP = stock tank original oil in place (or STOIIP = stock tank oil initially in place)

t = metric tonne

tcf = trillion cubic feet (tscf = trillion standard cubic feet)

tcm = trillion cubic metres (tscm = trillion standard cubic metres)

toe = metric tonnes of oil equivalent

tpd = metric tonnes per day

1P = proven reserves

2C = best estimate contingent resources

2P = sum of proven plus probable reserves

3P = sum of proven plus probable plus possible reserves

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