

Module 5: Economic Studies (Scoping, PFS, DFS)

Why this matters

Economic studies are the company's formal pitch that a deposit can be turned into a profitable mine. They are also where the most consequential lies-by-omission happen — base case prices set 30% above spot, capex estimates that consistently understate by 30-50%, NPV calculations that ignore real-world ramp problems.

Read every study with the assumption that it represents the company's most optimistic internally-defensible case. Then mentally degrade it.

The three studies, in order

Scoping Study (in Canada: PEA — Preliminary Economic Assessment)

- **Accuracy:** $\pm 35\text{--}50\%$
- **Cost:** \$200k - \$1m
- **Timeline:** 3-6 months
- **Resource categories allowed:** Inferred, Indicated, Measured (yes, Inferred is allowed at this stage — important caveat)
- **Purpose:** "Is this worth taking further?"
- **Output:** rough capex, opex, NPV, IRR, mine plan concept
- **NOT bankable.** Cannot be used to raise project debt.

PFS (Pre-Feasibility Study)

- **Accuracy:** $\pm 20\text{--}25\%$
- **Cost:** \$2m – \$10m
- **Timeline:** 9–18 months
- **Resource categories allowed:** Indicated and Measured only (Inferred excluded from reserves and economics)
- **Purpose:** "Is this technically and economically robust?"
- **Output:** maiden Ore Reserves declared, refined capex/opex, NPV, IRR with sensitivities
- **Bankable for some lenders, but most still want DFS.**

DFS / BFS (Definitive / Bankable Feasibility Study)

- **Accuracy:** $\pm 10\text{--}15\%$
 - **Cost:** \$10m – \$50m+
 - **Timeline:** 12–24 months
 - **Resource categories allowed:** Indicated and Measured only
 - **Purpose:** "This is the project we will build."
 - **Output:** detailed engineering, procurement-ready BOMs, refined reserves, lender-grade economics
 - **Bankable for project finance.** The basis for FID (Final Investment Decision).
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The scoping → PFS resource confidence step-up — why it matters

The progression from Scoping to PFS is not just an accuracy tightening. It's a fundamental change in what categories of resource can carry the economics.

Scoping studies are allowed to use Inferred resources in the production schedule and NPV calculation. This is one reason scoping economics often look better than the equivalent PFS economics on the same deposit — Inferred resources get included in the mine plan that won't survive into the PFS.

PFS and DFS are not allowed to use Inferred resources in reserves or in the economic case (with extremely narrow exceptions). When the project moves from scoping to PFS, all the Inferred tonnage that was carrying production in years 6–15 gets removed, replaced only by what's been upgraded to Indicated or Measured by additional drilling.

The practical consequence is that NPV often falls between scoping and PFS not because the project is worse, but because the rules tightened. A scoping study showing a 15-year mine life on a deposit that's 70% Inferred will become a PFS showing a 6-year mine life on the same deposit unless the company does the infill drilling required to upgrade Inferred → Indicated.

The "PFS-downgraded-to-scoping" tactic

A pattern worth flagging: a company has previously released a scoping study with strong numbers, then quietly re-classifies subsequent work as a "scoping update" rather than progressing to PFS. The reason is usually that the PFS-allowable resource (Indicated + Measured only) wouldn't support the economics the scoping showed.

Another version: a project that has been at PFS-stage in prior announcements gets walked back into a "revised scoping study" without explanation. That's a signal the PFS-grade economics didn't work, and the company is trying to reset to a less rigorous standard.

When you see a study labelled in unusual terms — "preliminary economic update", "scoping refresh", "concept study" — read carefully. The labelling matters because the rules differ. A scoping study with 70% Inferred in the production schedule is a different document from a PFS based only on Indicated and Measured.

Key outputs in every study

NPV (Net Present Value)

The discounted value of all future cash flows from the project, minus initial capex.

- Usually presented as **post-tax NPV at 5-8% discount rate**
- Pre-tax NPV is also often shown — pre-tax NPV is always higher; companies sometimes lead with pre-tax for the bigger number
- Sensitive to commodity price assumption and discount rate

Rule of thumb: project NPV should be at least 2-3x capex for a developer-stage company. NPV = capex means barely worth building.

IRR (Internal Rate of Return)

The discount rate at which NPV = 0. Measures capital efficiency.

- <15% IRR: marginal, hard to finance
- 15–25%: solid project
- 25–40%: strong project
- 40%+: excellent (or assumptions are aggressive)
- 60%+: assumptions are almost certainly aggressive — verify the price deck and capex

Capex

Initial capital expenditure to build the project.

- Pre-production capex: actual build cost
- Sustaining capex: ongoing capital to maintain production through mine life (added separately to AISC)

Always check what's included. Some studies exclude:

- Owner's costs (the company's own salaries, financing fees)
- Working capital
- Contingency below industry-standard levels
- Land acquisition / royalty buyouts
- Power/water infrastructure if "to be provided by third party"

Opex (Operating Cost)

Cost per tonne of ore processed or per unit of metal produced. Usually presented as:

- \$/t ore (mining + processing)
- C1 cash cost (direct production cost per unit)
- AISC (all-in sustaining cost — see below)

AISC (All-In Sustaining Cost)

Originally a World Gold Council metric (2013), now used loosely across commodities. Includes:

- Cash production costs
- Royalties
- Sustaining capex
- Site G&A
- Reclamation accruals

It does NOT include:

- Initial capex

- Exploration capex (unless sustaining)
- Corporate G&A (sometimes)
- Income tax
- Interest expense

Different companies calculate AISC differently. **Compare AISC across companies with caution.**

For a project to be robust, AISC should sit comfortably below the long-term commodity price. AISC at 80% of spot = healthy margin. AISC at 95% of spot = no margin, no resilience.

Payback Period

Years until cumulative cash flow recovers initial capex.

- <2 years: excellent
- 2-4 years: solid
- 4-6 years: marginal
- 6+ years: high risk in a cyclical commodity

Mine Life (LOM — Life of Mine)

Years of production at planned throughput based on current reserves.

- <5 years: short, hard to attract debt
- 7-15 years: typical for mid-tier projects
- 20+ years: tier-1 reliability

LOM extends if exploration adds resources and conversion to reserves continues.

Natural run rate — what plants actually do

A concept that doesn't appear in most studies but matters enormously for how you read them.

Natural run rate is the throughput a plant actually achieves in steady-state operation, independent of nameplate. It's almost always different from nameplate, and the direction of the difference depends on the plant's history.

Below nameplate (most plants in the first 1-3 years):

- Recovery shortfalls require slower throughput
- Bottlenecks in specific circuit components
- Ore hardness exceeds design assumptions
- Mining can't deliver enough ore at design grade

At nameplate (well-engineered plants reaching design after 12–24 months):

- The original design parameters were realistic
- Operations team has worked through commissioning issues

Above nameplate (mature operations with optimisation):

- Bottleneck debottlenecking
- Operator skill has improved beyond design assumptions
- Mining is delivering above-grade ore consistently

The Bellevue Gold case is the canonical example of a plant that operated materially below nameplate for an extended period — design said one tonnes-per-year, actual was meaningfully lower. This delta drives everything: AISC rises (fixed costs across less production), revenue falls, payback extends, dilution risk increases.

How to read announcements about run rate

When a producer or commissioning project reports actual throughput vs nameplate, what you're looking for is:

1. **The trajectory.** Is throughput improving quarter-on-quarter, or stuck below nameplate?
2. **The reason.** "Plant down for scheduled maintenance" vs "ongoing recovery optimisation" vs "ore characteristics different from design" — each implies a different fix and a different timeline.
3. **The forward guidance.** Has management revised guidance down? Multiple guidance revisions in the same direction is a tell.
4. **The cash flow consequence.** AISC at actual throughput vs design is the real margin you can model.

Studies typically don't quantify natural run rate explicitly. You back it out from the production guidance and the historical achievement vs guidance. A project guiding 5 ktpa nameplate but historically achieving 4 ktpa has a natural run rate around 4 ktpa, and the economics need to be re-cut at that level.

Sensitivity tables — where to focus

Every study includes a sensitivity table showing how NPV/IRR changes with input changes:

Sensitivity	-20%	Base	+20%
Commodity price	\$X	\$Y	\$Z
Capex			
Opex			
FX rate			
Discount rate			

Where to focus:

1. **Commodity price assumption.** What price did they use? If the base case price is *above* current spot, the project is more sensitive than it appears at first glance. Recalculate NPV at current spot prices.
2. **Capex sensitivity.** A project with NPV that flips negative on +20% capex is a very fragile project, given that 30-50% capex blowouts are normal.
3. **Discount rate.** Most companies use 5-8%. Use 10% as a stress test for junior/risky projects.

Capex blowout — the pattern that always repeats

Capex estimates almost always rise from study to study, then again from DFS to actual build:

Stage	Typical capex vs final actual
Scoping	40-70% of final actual
PFS	60-85% of final actual
DFS	75-95% of final actual
Final actual	100% (often more)

This is not because companies are stupid. It's because:

- Engineering detail increases over time, finding scope that wasn't visible earlier
- Inflation in steel, copper, labour, EPC contracts

- Permitting conditions add infrastructure (water treatment, dust suppression, road upgrades)
- Currency moves
- Site conditions different from assumed (geotech, hydrology)

Stress-test every DFS by adding 25-35% to capex and see if the project still works at current spot commodity prices.

Capex tactics worth recognising

Plant relocation / refurb capex savings — usually less than advertised

A company acquires a second-hand processing plant from a closed operation, plans to disassemble, transport, and re-erect it on their site, and headlines a major capex saving versus building new.

The reality is usually:

- **Disassembly and transport costs** are larger than headline implies. Cranes, trucking, port logistics, storage at destination — all expensive
- **Component condition** varies. Mills, crushers, and tanks may need refurbishment, replacement liners, new motors. The "refurbished" plant frequently needs \$20-50m of work to be operational
- **Site-specific modifications** — every site has different ore characteristics, climate, layout. The plant has to be re-engineered to match. This is engineering work that wasn't in the headline saving
- **Permitting** for a re-located plant can take longer than for a new build, because regulators look at it as a new installation
- **Lead time** to get it operational is often longer than building new — disassembly takes time, components arrive in the wrong order, re-engineering reveals issues during reassembly

The BML (Bellevue Gold's predecessor approach for some assets) and similar refurb projects in the gold and base metals sector have had mixed track records. Some saved money. Several didn't. The pattern is that the headline saving is usually 60-70% of the eventual reality after refurbishment.

If a company headlines significant capex savings via a refurb, ask:

1. Where was the plant before? What condition?
2. What's the refurbishment scope and budget? Is it included in the headline capex?

3. What's the lead time from acquisition to first ore — and is that realistic?
4. Has the company done this before? What was their track record?

Staged capex deferral

A company splits the project into Phase 1 (low capex) and Phase 2 (higher capex, deferred to later years and supposedly funded from Phase 1 cash flow). The headline NPV often combines both phases.

This looks fundable. In reality:

- **Phase 1 cash flow rarely materialises at the predicted level** because of the natural-run-rate / ramp-up issues described above
- **Phase 2 capex is rarely funded purely from Phase 1 cash flow** — requires another raise or debt facility
- **The headline NPV depends on Phase 2 actually happening** — but Phase 2 frequently gets indefinitely deferred when commodity prices fall, when Phase 1 underperforms, or when management changes
- **Sub-scale operations result** when Phase 2 is permanently deferred — Phase 1 alone rarely has the economics to justify the overheads

The Santana Minerals (SMI) staged approach to its Bendigo-Ophir gold project is a recent example of staged development being announced with the intent to fund expansion from operating cash flow. The honest read on staged capex deferral is: model Phase 1 standalone and treat Phase 2 as optionality, not part of the base case. If Phase 1 NPV alone doesn't justify the build, the headline phased NPV is doing more work than it should be.

Stockpile inclusion in mine plan

Some studies fold low-grade stockpile (rock that's been mined but not processed because it's below cut-off grade for current operations) into the production schedule for late mine life. The rationale is that as commodity prices rise or processing costs fall, the stockpile becomes economic to process.

This can be legitimate. It can also be padding to extend headline mine life and total contained metal. Tells:

- Stockpile economics are based on a future commodity price assumption that's higher than current spot
- The metallurgical recovery on stockpiled material is assumed to be the same as fresh ore (often it's lower because the rock has weathered)
- The stockpile contributes meaningfully to LOM tonnes but minimally to NPV (because it's late in life and discounted)
- The stockpile inclusion is in the body of the announcement but not in the Reserves table

The LGM (an example flagged in industry commentary) included stockpile material in their mine plan in a way that materially extended LOM headlines. When the stockpile was excluded, the project mine life was meaningfully shorter and the economics weaker.

If a study includes a stockpile in the production schedule, ask:

1. What % of total contained metal comes from stockpile vs fresh ore?
 2. What recovery is assumed on the stockpile?
 3. What commodity price is required for stockpile processing to be economic?
 4. Is the stockpile in the Reserve, or is it sitting outside the Reserve as a notional add-on?
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Permitting and environmental — what timelines are normal

A common misread: a "two-year environmental permitting process" gets framed as a delay or a problem.

A two-year environmental baseline study and approval process is normal in Australia for any new mining project of meaningful scale. It is not a delay caused by activism, government incompetence, or company failure. It's the standard regulatory timeline for:

- 12 months of seasonal environmental baseline data (flora, fauna, water, air, noise) — minimum required
- Government agency review of the EIS (Environmental Impact Statement)
- Public consultation periods
- Indigenous Land Use Agreement (ILUA) negotiation if not already in place
- Conditions of approval being negotiated and finalised

Examples like ALM (Alma Metals) and JJ-style projects through the standard permitting cycle take 18–30 months as a matter of course, not as exceptions. The right question isn't "why is permitting taking so long" — it's "is permitting on schedule for a normal Australian permitting timeline?"

When a company guides "first production 2027" for a project that hasn't started baseline environmental work yet in 2026, that timeline is unrealistic regardless of how confident the company sounds. The regulator dictates the floor on this timeline, not the company. Be sceptical of any project guidance that compresses the environmental timeline below 18 months from baseline start to approval.

Hidden games to watch for

1. Optimistic commodity price deck

The most common manipulation. Industry-standard practice is to use the consensus 5-year forward curve or current spot, whichever is more conservative. Some studies use:

- Long-term incentive prices (the price required to justify new supply) — fine in theory, but optimistic
- "Analyst consensus" cherry-picked from bullish forecasts
- Spot price during a temporary price spike

Always recalculate NPV at current spot. If the project doesn't work, the study is selling you a price view, not a project.

2. Aggressive recovery rates

Met testwork on a few drill samples extrapolated to 90%+ recovery. Real plants typically achieve 5–10% below pilot test rates in early years, sometimes never reach pilot rates.

3. Optimistic ramp profile

Assuming nameplate capacity in Year 1 or even Year 2. Most plants ramp slower — especially complex flowsheets. Stress test with a 12–24 month ramp.

4. Excluding pre-production capitalised costs

Owner's team costs during construction, working capital, financing fees can add 10–20% to total capital required to first cash flow.

5. Cherry-picking the best mine plan years for production guidance

"Average annual production: 200 koz Au" might be true over 10 years but Year 1–3 might be 280 koz (high-grade core mined first) and Year 8–10 might be 130 koz. Most analyst valuations rely on the headline number.

6. Single-product NPV when by-products are required

A copper project with by-product gold credits often shows two NPVs — copper-only and copper+gold. The copper+gold NPV is usually headlined. If the gold credit doesn't materialise (lower grade than predicted, lower recovery), the project economics collapse.

7. "Phased development"

Splitting the project into Phase 1 (small, low-capex) and Phase 2 (larger, capex deferred to later years from operating cash flow). Looks fundable. In reality, Phase 2 often gets indefinitely deferred when commodity prices fall, leaving a sub-scale operation. (Covered in detail above.)

What a *good* study looks like

Green flags:

- Base case commodity prices at or below current spot
- Conservative ramp assumption (12+ months to nameplate)
- Adequate contingency (15%+ on capex)
- Met recoveries based on locked-cycle pilot tests, not just bench-scale
- Reasonable strip ratio assumptions through life of mine, not just early years
- Sensitivity to -20% commodity price still shows positive NPV at 8% discount
- AISC well below long-term commodity price
- Published assumptions fully transparent
- Stockpile contribution disclosed clearly if any
- Permitting timeline realistic vs jurisdictional norms
- If refurb plant: refurbishment scope and budget clearly itemised within capex

When you see all of that, the study is being run as engineering, not marketing.

How to read a study in 30 minutes

1. **Read the announcement headline numbers** (NPV, IRR, capex, AISC, LOM)
 2. **Find the commodity price assumption.** Compare to current spot.
 3. **Find the discount rate.** Re-mentally apply 10% if 5–8% used.
 4. **Read the capex breakdown.** Note contingency level and what's excluded.
 5. **Read the sensitivity table.** Stress to -20% commodity price and +25% capex simultaneously. Does NPV survive?
 6. **Read the production schedule.** Is Year 1 production materially higher than LOM average? (High-grading early years.)
 7. **Compare PFS → DFS capex if both are out.** What was the blowout?
 8. **Check who did the study.** Tier-1 consultancy (SRK, AMC, Lycopodium, GR Engineering, etc.) carries more weight than in-house or unknown consultants.
 9. **Check the resource categories used.** Scoping using Inferred — flag. PFS/DFS using only Indicated/Measured — correct.
 10. **Check for stockpile contribution and refurb plant elements** in the mine plan and capex.
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Practical exercise

For any study published on a stock you follow, answer:

1. What commodity price was used vs current spot?
2. What's the NPV/capex ratio?
3. What's the IRR pre-tax and post-tax?
4. What contingency was applied to capex?
5. If you stress capex +25% and price -20%, does NPV stay positive?
6. What's the AISC vs current commodity price?
7. **What % of contained metal in the mine plan comes from Inferred (scoping only) or stockpile?**
8. **What's the natural run rate assumption — does the production schedule assume nameplate in Year 1, or a graduated ramp?**

If those answers don't make the project look investable, the company will need either a commodity price tailwind or an M&A bid to make money for shareholders.

What I'm uncertain about

- "Industry-standard" capex contingency varies (10–25%) and there's genuine disagreement among consultants about the right level.
- AISC methodology variations between companies are significant enough that direct comparisons require careful normalisation. World Gold Council guidance helps for gold;

less standardised for other commodities.

- Specific consultant reputations shift over time. A few prominent names have had project blowouts that hurt their credibility — worth checking recent track record on similar projects.
- Refurb plant track records vary enormously; the 60–70% headline savings rule of thumb is a generalisation, not a hard rule. Some refurbishments have come in close to budget and ramped well.
- Permitting timelines vary by jurisdiction within Australia (WA vs Qld vs NT vs SA) and have been getting longer in recent years. The 18–30 month rule of thumb is a starting point, not a guarantee.

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