



decisions with confidence

Petroleum Reserves and Resources for Energy Engineers and Investors

Why Understanding PRMS is Critical for your Banks, Investors, and Project Finance

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- Reservoir Engineer with 25 years of global experience in the upstream hydrocarbon industry. Expertise in asset valuation, due diligence assessment for M&A and project finance requirements, and reserves assessment.
- Project manager of multidisciplinary teams with reports quoted on AIM, TSX, OSX, ASX, NYMEX
- Experienced in a range of reservoirs including fractured carbonate reservoirs, tight gas, coal bed methane, and gas storage in depleted fields.
- Member of SPE, SPEE, GESGB
- Chair of SPE London section 2024-25
- Chair of Continuing Education for London section, 2016-2024
- SPE Regional Service Award, North Sea Region, 2019
- Qualified Reserves Auditor (PRMS) and Competent Person (AIM)

- Sources of funds for oil and gas projects
- What are Reserves?
- Basics of the PRMS reserves standards
- Reserves reporting
- How do reserves impact upstream project finance decisions?

Sources of funds for oil and gas projects



- In oil and gas project financing, risk assessment is vital to identify potential obstacles to the project's success.
 - Risks may include operational challenges, commodity prices, or regulatory changes.
 - Lenders typically require a detailed risk analysis that outlines mitigation strategies.
 - ESG reporting can also be requested: CO₂ intensity and carbon reduction initiatives for the field.

- The options available to a company to fund a project will depend on:
 - Company size: Diversified asset base? Equity (influence) in the project?

A range of sources including:

- Self financing
 - Balance sheet funded by other operations of the company.

- Corporate loans
 - When a company is large enough to borrow using a corporate credit facility.

- Public listing or Private equity
 - Selling equity in the company to raise capital.

- Farming down
 - Selling equity in a project/field/licence.

- Reserves-based lending (RBL)
 - Asset-based financing, with loans based on the value of a project's 1P or 2P reserves over a limited period. The oil or gas assets are collateral. The borrowing base is adjusted periodically to reflect changes in the value of reserves, linking finance terms to the asset's performance.

- Forward sales, pre-purchase agreements
 - Finance provided in exchange for sale of crude directly to a lender, often a commodity trader.

- In Europe and the UK, RBLs use 1P and/or 2P reserves
 - 1P only for a single asset company
 - 2P for a larger portfolio with diversified risk
 - Can be mixed, eg for a North Sea portfolio: 1P for near-term Undeveloped fields and those immediately after start-up; 2P for fields with established production

- North American RBLs are only based on PDP, PDNP and less often PUD

- In the US an operator can simply own the physical reserves in the ground. The bank's security for RBL includes a mortgage over this.
- In the UK (and most places outside USA) there is no change in ownership of subsurface assets
 - All subsurface assets are owned by 'The Crown', not Operators.
- In other jurisdictions, other licence regimes (eg Oil Mining Licenses, Production Sharing Contracts, Service Contracts) need different considerations by the Bank

What are Reserves?



What are reserves and why are they important?



- What are Reserves?
 - A company's share of remaining commercially recoverable oil and gas to be produced and sold
 - Reserves are the main Upstream asset of an E&P company
 - They contribute to a field's value, the company's value and therefore share price
- Reserves have many purposes:
 - Corporate reporting
 - Asset valuation for acquisitions and divestments
 - Investment decisions for financing
 - Government planning

- International – PRMS (Petroleum Resource Management System)*
- USA – SEC (Securities and Exchange Commission)
- Canada – COGE (Canadian Oil and Gas Evaluation)
- Other countries – eg Russian, Chinese standards
- UNFC (United Nations Framework Classification for Resources)

- The PRMS was adapted for CO₂ storage as the SRMS (CO₂ Storage Resources Management System) and the classifications changed to include “Capacity”, which is equivalent to reserves

* <https://www.spe.org/en/industry/reserves/>

Basics of the PRMS reserves standards



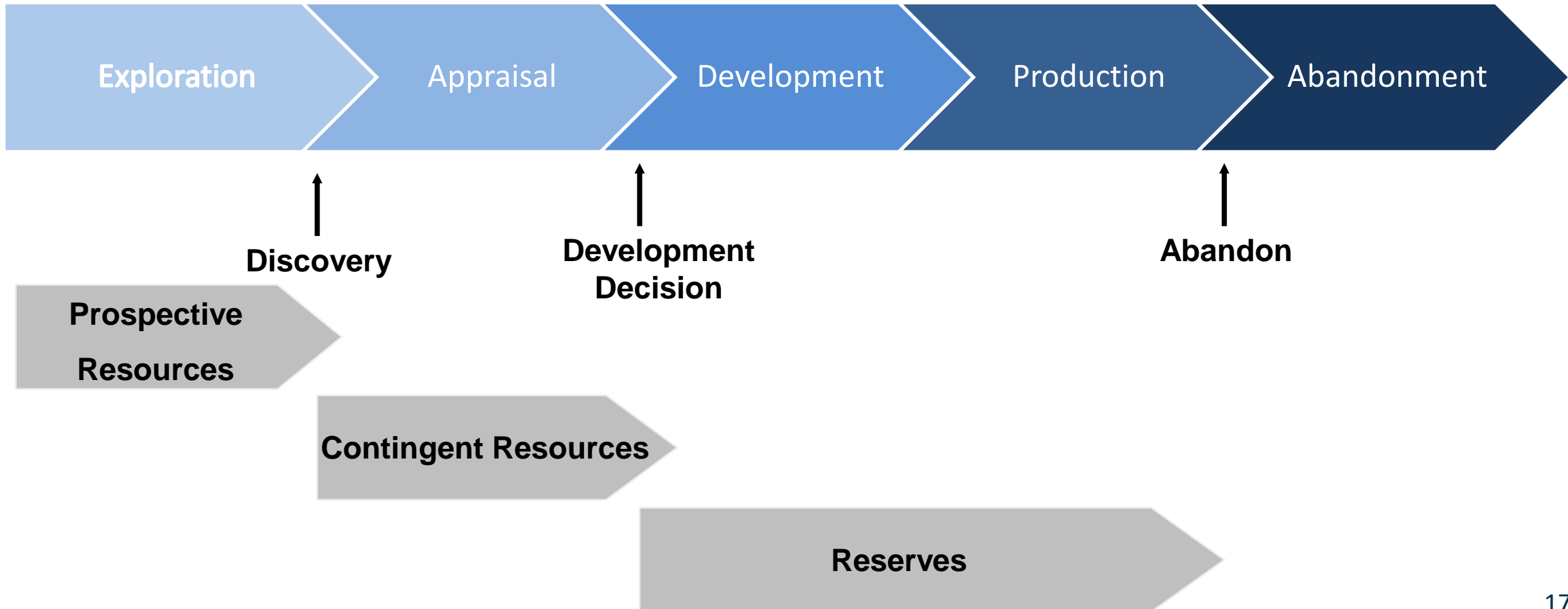
- Petroleum Resources Management System (PRMS)
 - A classification system for oil and gas reserves
 - Co-sponsored by several industry bodies: SPE, WPC, AAPG, SPEE, SEG, SPWLA and EAGE
 - Uncertainty in recovery of the defined project is evaluated separately from commercialisation risks
 - Based on net sales quantities: accounts for ownership/entitlement

PRMS is

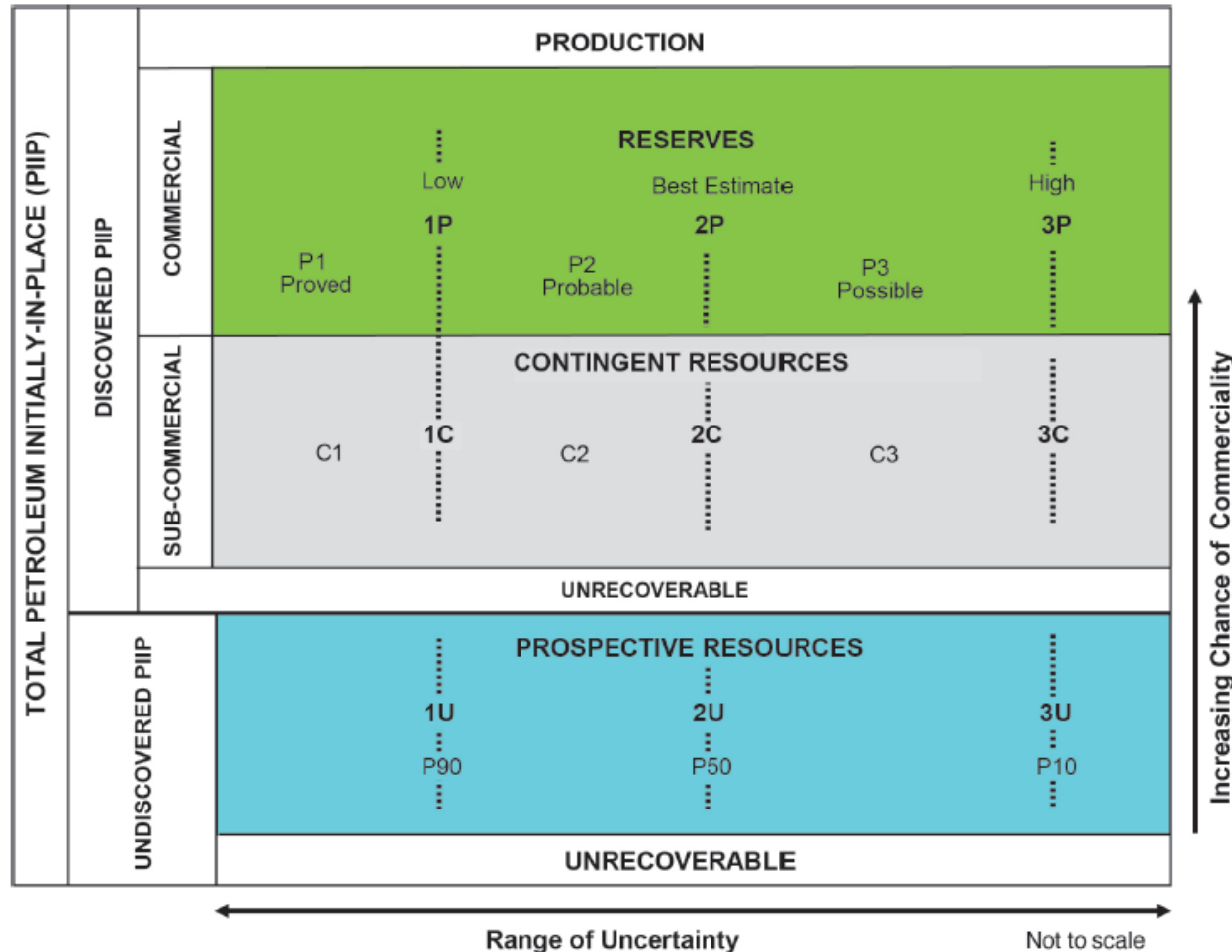
- NOT a 'rule-book' for evaluation:
 - It is a principles-based system that require judgement
 - Recognises that all situations encountered are different and require thought.

- NOT a set of regulations for reporting such as frequency or report formatting
 - These are provided by regulatory disclosure requirements
 - Such reports will be different in the UK, Denmark, Australia, etc.

- The PRMS reserves classification depends on maturity and is “project-based”



PRMS Resource Classification Framework



Classify by
Chance of
Commerciality of
project: risk

Categorise based on uncertainty of sales quantities

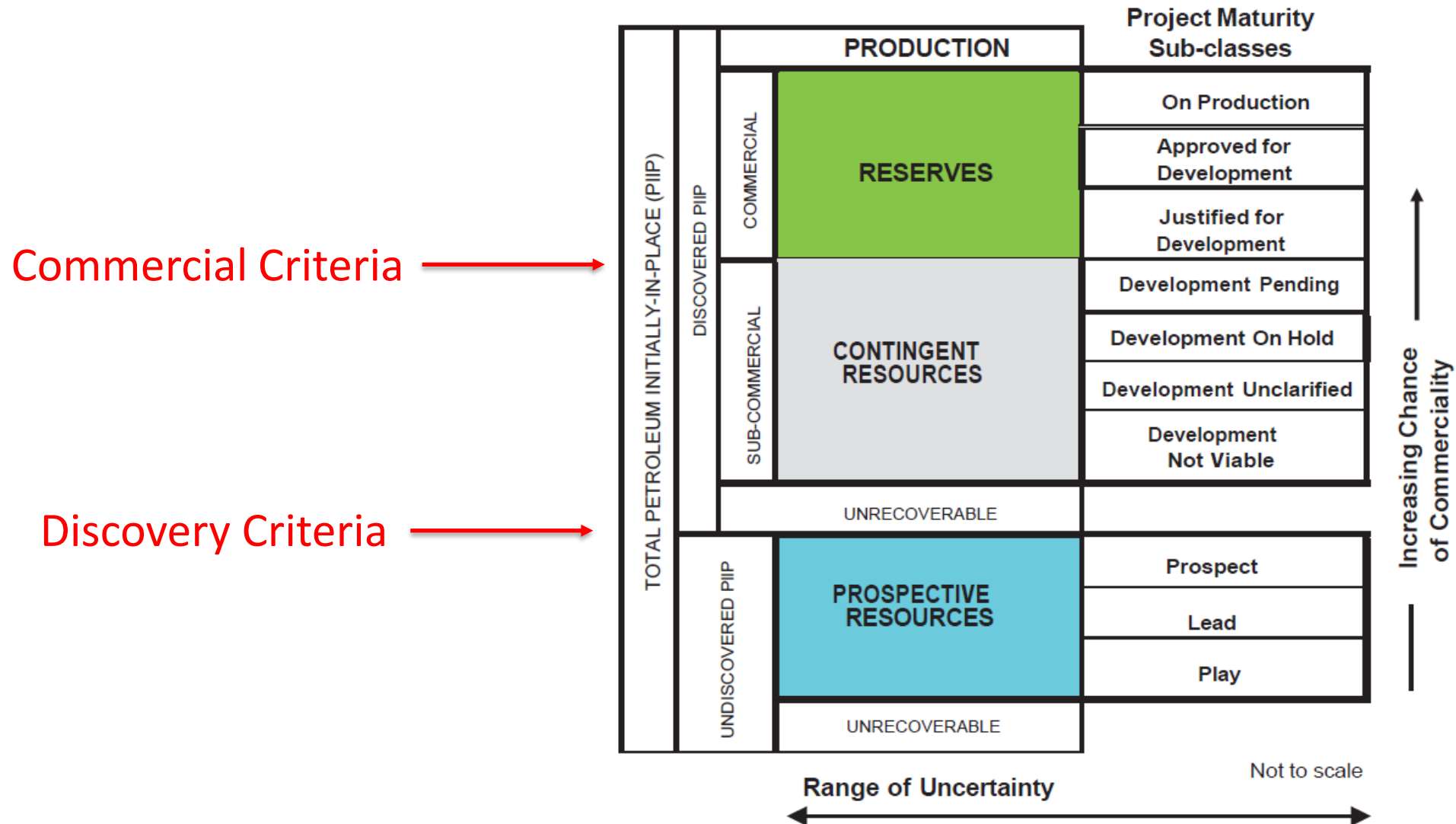
- Uncertainty will exist in all resources estimates
 - It cannot be avoided. However, it can be managed if it is recognised and understood.

- Reserves: 1P, 2P, 3P
 - Proved, Proved plus Probable, and Proved plus Probable plus Possible

- Uncertainty relates to probability
 - 1P/Low: 90% probability (P90) that the quantities recovered will exceed this.
 - 2P/Best: 50% probability (P50) that the quantities recovered will exceed this.
 - 3P/High: 10% probability (P10) that the quantities recovered will exceed this.

- Contingent Resources: 1C, 2C, 3C; Prospective Resources: 1U, 2U, 3U

PRMS Sub-Classes, based on project maturity



- Reserves Status
 - May be subdivided based on operational status :
 - Developed (Producing or Non-Producing)
 - Undeveloped
 - Reserves status is applied consistently to 1P, 2P, 3P

- Economic Status
 - Contingent Resources may be subdivided by economic status:
 - Economically Viable
 - Economically Not Viable

- Discovery Criteria
 - A well is needed to make a discovery!
 - Established through testing or sampling, the existence of a significant quantity of potentially recoverable hydrocarbons.
 - Where there are no samples, logging and a suitable producing analogue can be used.

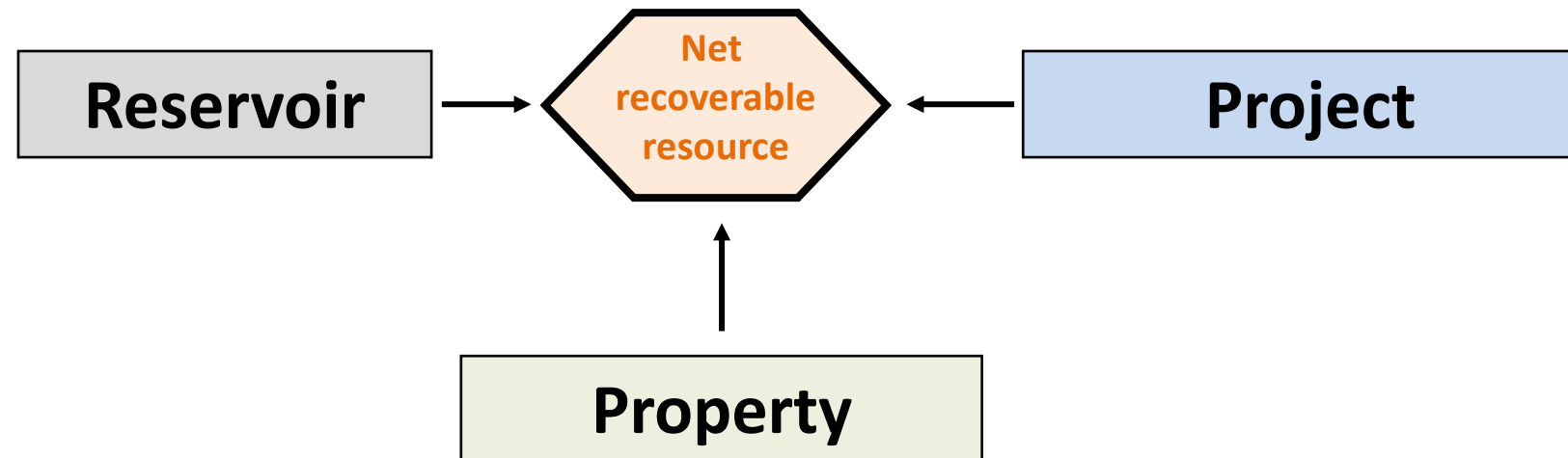
- Commerciality requires evidence of:
 - A technically mature Field Development Plan
 - Finance in place, or expected
 - Intent to initiate development within a reasonable time frame
 - Meets economic criteria
 - A reasonable expectation of a market for sales products and acceptable treatment/disposal for other product streams (eg water, CO₂)
 - Production and transportation facilities will be available
 - Evidence that all internal/external approvals will be forthcoming

- Positive project economics are only one part of Commerciality
 - A project can be economically attractive but not commercial.

- Economic viability is based on cash-flow estimates of NPV:
 - 1P, 2P, 3P reserves are estimated at the same economic parameters ie future prices, costs, operating methods, environmental conditions and regulations.
 - Typically best estimate or normal planning assumptions use.
 - Sensitivity analysis usually carried out.

- The Economic Limit is the time when the maximum cumulative net cash flow occurs for a project
 - It is required as technical production forecasts (eg decline curve forecasts, simulation outputs) can extend far beyond the expected field life.
 - Reserves are the earliest of the economic limit, technical limits, licence period, etc.

- Key elements of the PRMS:
 - Reservoir
 - Property
 - Project



FORBES > BUSINESS > ENERGY

Turkey Finds Enormous Gas Field In The Black Sea — But Tricky Process Ahead

Ariel Cohen Contributor

I cover energy, security, Europe, Russia/Eurasia & the Middle East

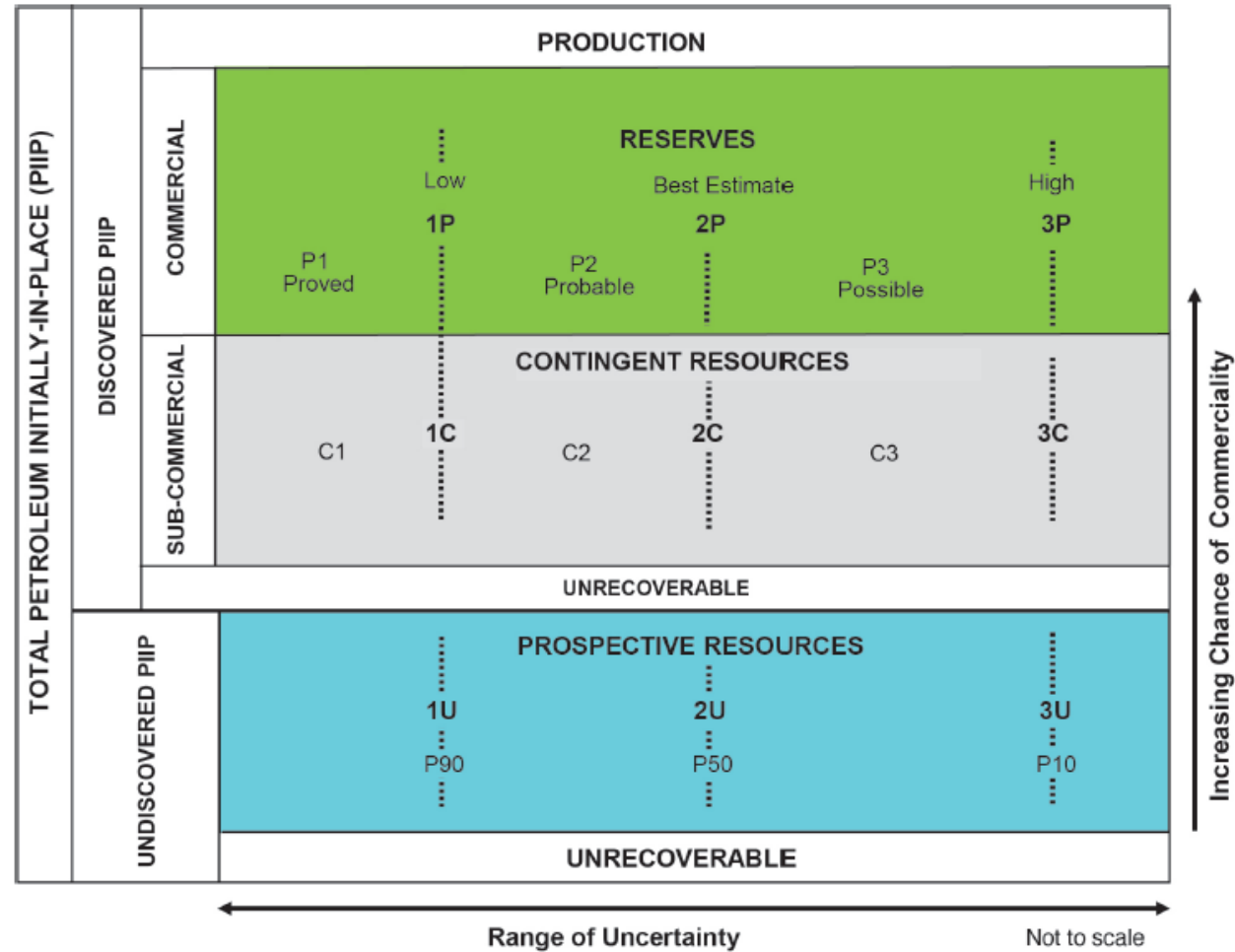
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Sep 18, 2020, 08:52am EDT

In late August, Turkey's president Recep Tayyip Erdogan announced that the Turkish Petroleum Corporation (TPAO)'s FATIH drilling ship discovered a 320 billion cubic meters (bcm) i.e. 11 trillion cubic feet (tcf) of natural gas **reserves** in the Black Sea, within the western part of Turkey's Exclusive Economic Zone (EEZ). The reserve — identified to be within the Tuna-1 exploration zone — was discovered some 4,525 meters below the sea bottom, at near 2 km depth. News of the discovery has been welcomed in Turkey as a game-changer with regards to the country's expensive natural gas import bill.

While certainly a promising development for Turkey's energy security, important unknowns remain surrounding the economic viability of Tuna-1 (aka 'Sakarya'). According to investment banks, **the main issue is the economic extractable reserve value of the well and whether this value would justify costly deep-water upstreaming operations.**

PRMS Resource Classification Framework



What are PROSPECTIVE RESOURCES ?

- They are a company's idea of where they should explore for hydrocarbons
 - Categorised as: 1U, 2U, 3U. Also as Low, Best Estimate and High.

- A successful exploration well will confirm the presence of oil or gas
 - Volumes become Contingent Resources and possibly Reserves in future.

- BUT there is a risk there may not be a discovery at all
 - Prospects each have a Chance of Success. A geologist might say this is 10% or 60%.

- A Chance of Development is also applied.

What are CONTINGENT RESOURCES ?

- A discovery with a development project not yet Commercial, due to one or more contingencies
 - Eg a gas field without a market for gas; or a field with high CAPEX making development uneconomic.
 - Categorized as: 1C, 2C, 3C.
- These can progress to become reserves in future, once they pass the Commerciality criteria.
- The Chance of Development applies to these projects.

- What are RESERVES?
- **Quantities** to be **commercially** recoverable by application of **development projects** to **known accumulations** from a **given date forward** under **defined conditions**.
- Reserves must further satisfy four criteria: discovered, recoverable, commercial, and remaining based on the project.
- The uncertainty range in Reserves estimates: 1P, 2P, 3P categories.

Reserves Reporting



- The PRMS does not indicate the content of a report. Each jurisdiction will have separate disclosure requirements.

- Reserves experts write reports for many reasons, including:
 - Stock exchange requirements (LSE, AIM, SEC, TSX, ASX, OSE, SGX, etc...)
 - Annual reserves and resource reports
 - Competent Person's Report for take-overs, defence work, etc.
 - Others
 - For financiers (banks and other lenders)
 - e.g. Reserves Based Lending
 - For investors/buyers of upstream assets

- Why not report reserves only once? Why annually?

- Oil and gas reserves volumes change annually due to:
 - Price and cost changes
 - Updated understanding of the reservoir (geoscience, reservoir engineering)
 - Infill drilling, sidetracking old wells, recompletions
 - Appraisal of discoveries leading to Final Investment Decisions (FID)
 - Reductions in reserves due to production/sales
 - New and improved techniques and technologies
 - Acquisitions and divestments of a company's interests in fields

- Why not report reserves only once? Why annually?
- Oil and gas reserves volumes change annually:

PART 4. RECONCILIATION OF CHANGES IN RESERVES

Item 4.1 Reserves Reconciliation

The following table provides a reconciliation between gross Reserves disclosed on the 27 February 2023 (effective date 31 December, 2022) and this disclosure (effective date 31 December, 2023).

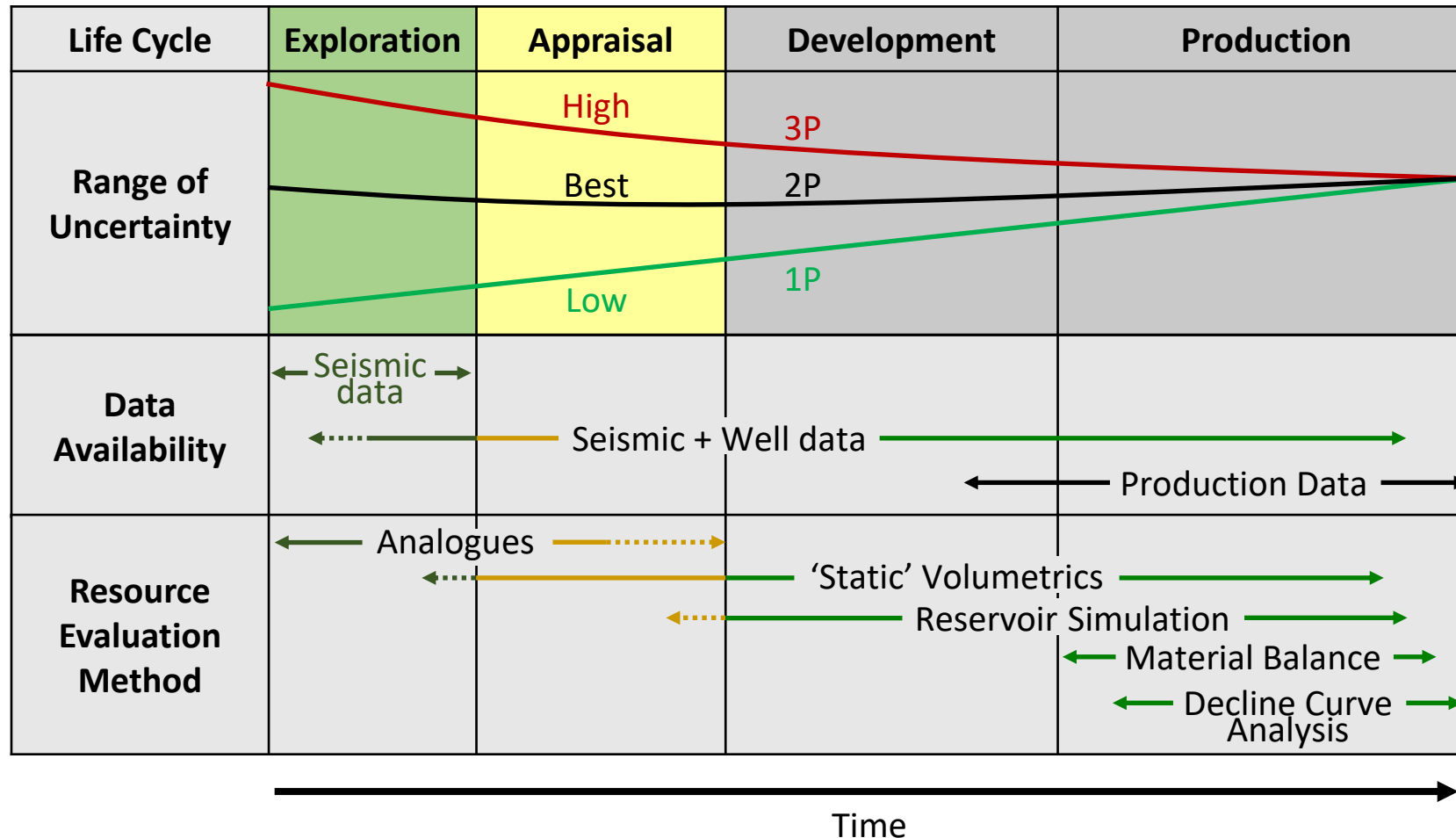
Gross	Light and Medium Oil (MMstb)			Conventional Natural Gas (Bscf)		
	Proved	Probable	Proved + Probable	Proved	Probable	Proved + Probable
Effective date 31 December 2022	29.1	18.3	47.4	32.9	16.5	49.4
Extensions and Improved Recovery	0.0	0.0	0.0	0.0	0.0	0.0
Resource Transfers	0.0	0.0	0.0	0.0	0.0	0.0
Technical Revisions	1.9	-0.2	1.8	1.4	10.1	11.5
Discoveries	0.0	0.0	0.0	0.0	0.0	0.0
Acquisitions	0.0	0.0	0.0	0.0	0.0	0.0
Dispositions	0.2	0.0	0.0	0.0	0.0	0.0
Economic Factors	5.6	-0.2	0.1	0.1	-0.1	0.0
Production	5.6	0.0	5.6	9.5	0.0	9.5
Effective date 31 December 2023	25.7	18.0	43.6	24.9	26.4	51.3

Notes:

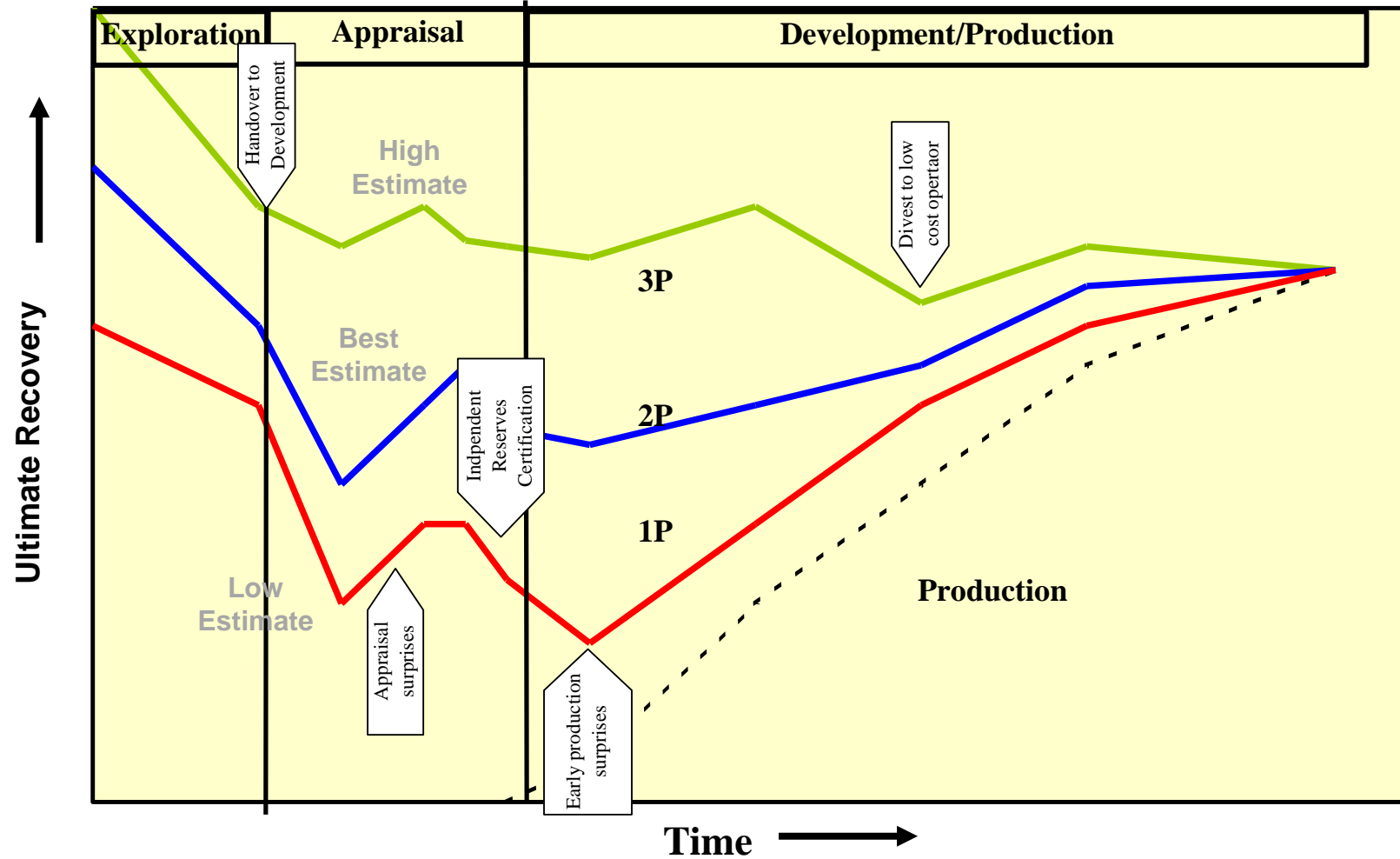
1. Figures in table may not add precisely due to rounding.
2. Gross Company Reserves are the total project sales volumes multiplied by AOC's share of Prime's working interest.
3. RISC notes that the Proved + Probable Reserves reconciliation for oil and gas is lower than the Proved in some categories. This results in

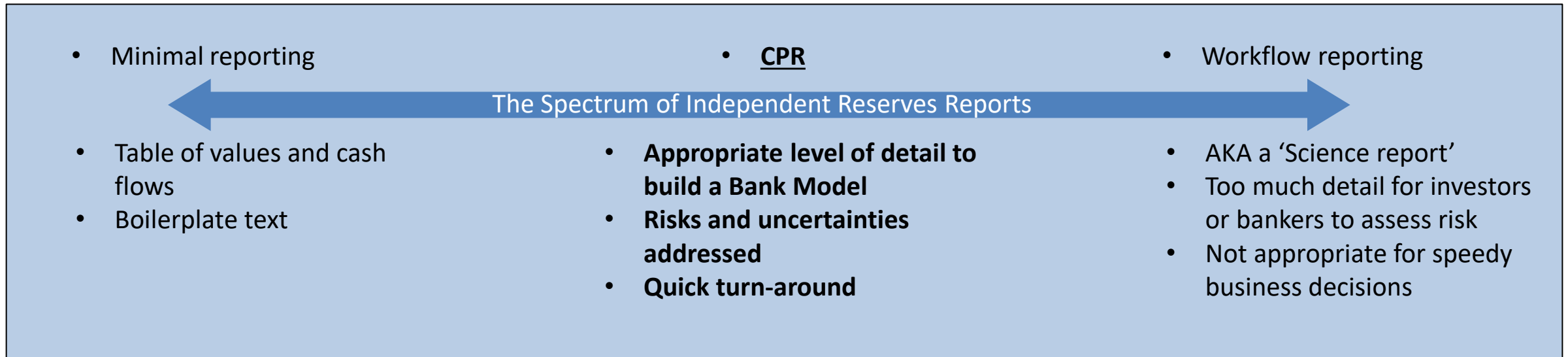
Evaluation Techniques – Depends on lifecycle stage

- Technical forecasts will mature with time, but there is no single rule to suit all fields/reservoirs



An example resource uncertainty history

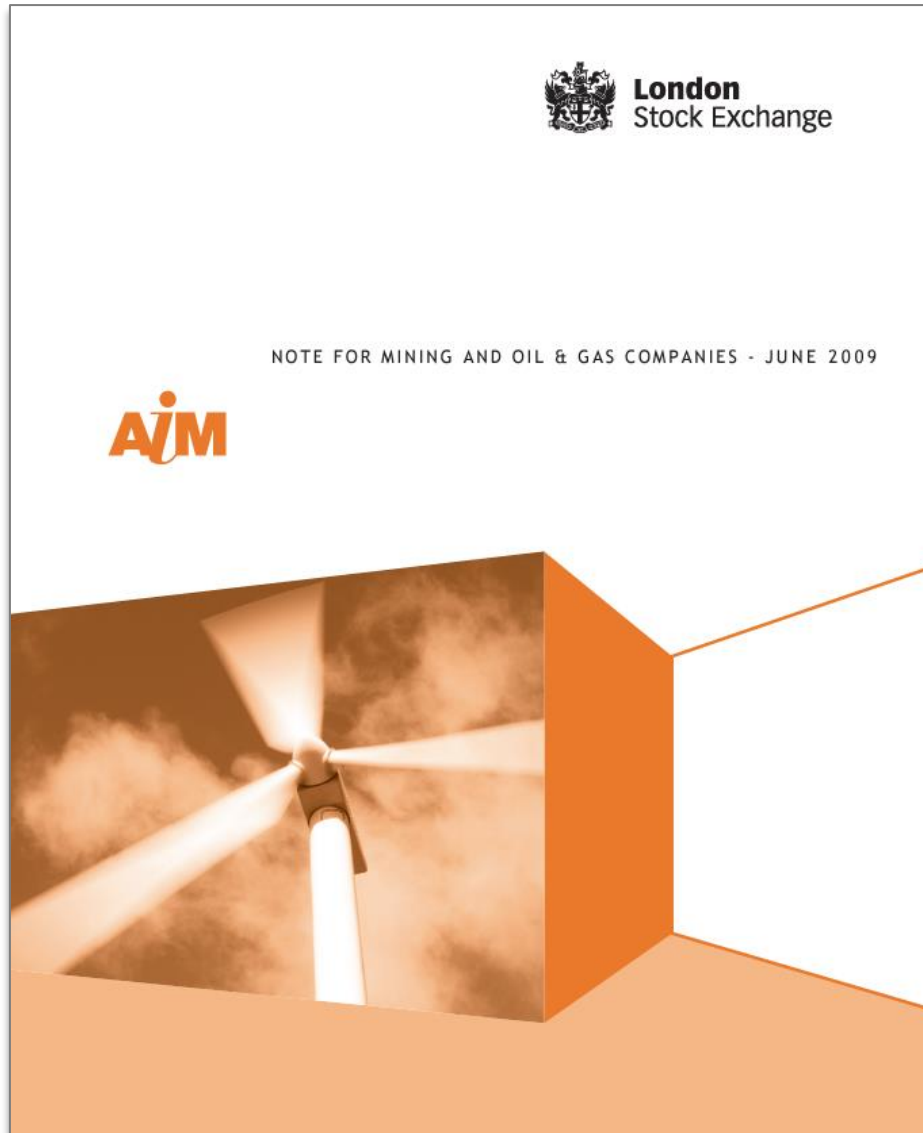




Small oil and gas producers are concerned by banks' use of documents with 'minimal reporting':

- Multiple layers of conservatism
 - Conservative production forecasts AND Conservative oil prices AND Conservative bank cover ratios
- Leaves only a small perceived ability for a significant loan to enable growth

The answer to satisfy the borrower and the bank is a **COMPREHENSIVE INDEPENDENT REPORT.**



Appendix 2 CONTENT OF CPR

The CPR should cover (as a minimum) the following:

Executive summary

Table of contents

Introduction

explanation of the sources of all information on which the CPR is based (for example any site visits (including details of who undertook such visit and when), drilling results, seismic data, reservoir or well data, sample analysis, interviews with directors, details of desktop research)

visits (including details of who undertook such visit and when), drilling results, seismic data, reservoir or well data, sample analysis, interviews with directors, details of desktop research)

- description of **reserves** and/or **resources**, where applicable detailing characteristics, type, dimensions and grade distribution, and the methods to be employed for their exploration and extraction (including **Appendix 1** disclosure)

Overview of the region, location and assets

- description of the **applicant's assets** and **liabilities**, the rights in relation to them and a description of the economic conditions for the working of those licences, concessions or similar including a

appropriate maps, some background on the country and location plans demonstrating the major properties comprising the **assets**, their workings and geographical characteristics and wells, platforms, pipelines, bore holes, sample pits, trenches and similar, to the extent they exist

- details of a
- appropriate properties comprising the **assets**, their workings and geographical characteristics and wells, platforms, pipelines, bore holes, sample pits, trenches and similar, to the extent they exist

Reserves & resources

statement of volume, tonnage and grades, (in accordance with a **Standard**, which should be consistently applied and disclosed in line with the tables in **Appendix 3**), method of estimation, expected recovery and dilution factor, expected extraction and processing tonnage or volume, as appropriate, depending on whether the **reserves** and/or **resources** are of minerals or oil and/or gas. Where there are resources that have not been sufficiently appraised in order to provide the previous information, a separate statement of such resources together with any other quantified information which has been appraised in accordance with a **Standard**

statement of **reserves** (if any), and where applicable **resources** including an estimate of volume, tonnage and grades, (in accordance with a **Standard**, which should be consistently applied and disclosed in line with the tables in **Appendix 3**), method of estimation, expected recovery and dilution factor, expected extraction and processing tonnage or volume, as appropriate, depending on whether the **reserves** and/or **resources** are of minerals or oil and/or gas. Where there are resources that have not been sufficiently appraised in order to provide the previous information, a separate statement of such resources together with any other quantified information which has been appraised in accordance with a **Standard**

estimate of net present value (post tax) at a discount rate of 10% of **reserves** (or equivalent depending on **Standard** used) analysed separately and the principal assumptions (including cost assumptions, effective date, constant and or forecast prices, forex rates) on which valuation is based together with a sensitivities analysis. Additional valuations may be included within the CPR and should include an explanation of the basis of such a valuation and the method used

estimate of net present value (post tax) at a discount rate of 10% of **reserves** (or equivalent depending on **Standard** used) analysed separately and the principal assumptions (including cost assumptions, effective date, constant and or forecast prices, forex rates) on which valuation is based together with a sensitivities analysis. Additional valuations may be included within the CPR and should include an explanation of the basis of such a valuation and the method used

Other assets

- any other a
- commentary on operations, document

estimate of net present value (post tax) at a discount rate of 10% of **reserves** (or equivalent depending on **Standard** used) analysed separately and the principal assumptions (including cost assumptions, effective date, constant and or forecast prices, forex rates) on which valuation is based together with a sensitivities analysis. Additional valuations may be included within the CPR and should include an explanation of the basis of such a valuation and the method used

Conclusions

Qualifications and basis of opinion

- full details and qualifications of the CP (company and individual(s)) and a statement of the CP's independence

Appendices – Glossary and definitions of any terms used



How do reserves impact upstream project finance decisions?

-
- Banks take a CPR, the FDP and other inputs to build a Banking Case and write a Technical Note.
 - This may be different to the volumes/rates/schedule/costs in the other documents.
 - Borrowing Base for Financing in RBLs
 - Reserves are the collateral.
 - Lenders use the 1P and/or 2P reserves as security for loans to mitigate their risk.
 - Higher reserves, with more confidence, mean larger loans can be secured. More wells drilled (higher CAPEX), faster access to the capital (schedule).

- A lender's view of reserves volumes and uncertainty will influence the structure of loan facilities and the terms offered to borrowers.
- Projects with high 1P may qualify for larger loan amounts and better financing terms such as lower interest rates, longer repayment periods, and less stringent conditions
 - Eg may require hedging of say 40% of oil volumes, to lock in a value and reduce price uncertainty.
- May also include 'Green RBLs' and offer better interest rates if the borrower reduces its CO₂ intensity or CO₂ volumes.

- One indicator of confidence in reserves is the range of 1P, 2P, 3P.
 - A tight range indicates less uncertainty (eg 1P/2P ratio of 0.9)
 - A wide range indicates more uncertainty (eg 1P/2P ratio of 0.5)

- The economics of 1P, 2P and 3P profiles could be very different

- If a company's internal decisions are based on 2P hurdles AND a positive 1P NPV, then a very wide range of uncertainty may lead to the project being denied funding.
 - Engineers will need to spend time gathering data, analogues and reducing CAPEX to meet the internal 1P hurdles.
 - This happens even if a project is self-funded

- In North Sea licences, companies have a responsibility for decommissioning any installations and infrastructure once production has ceased.

- The UK checks that parties are financially capable of meeting their decommissioning obligations, so infrastructure is removed without the taxpayer picking up the bill.
 - Not all countries require this

- Annual decommissioning security calculations are performed to determine whether security needs to be posted, and if so, how much is needed to ensure abandonment will be fully funded.

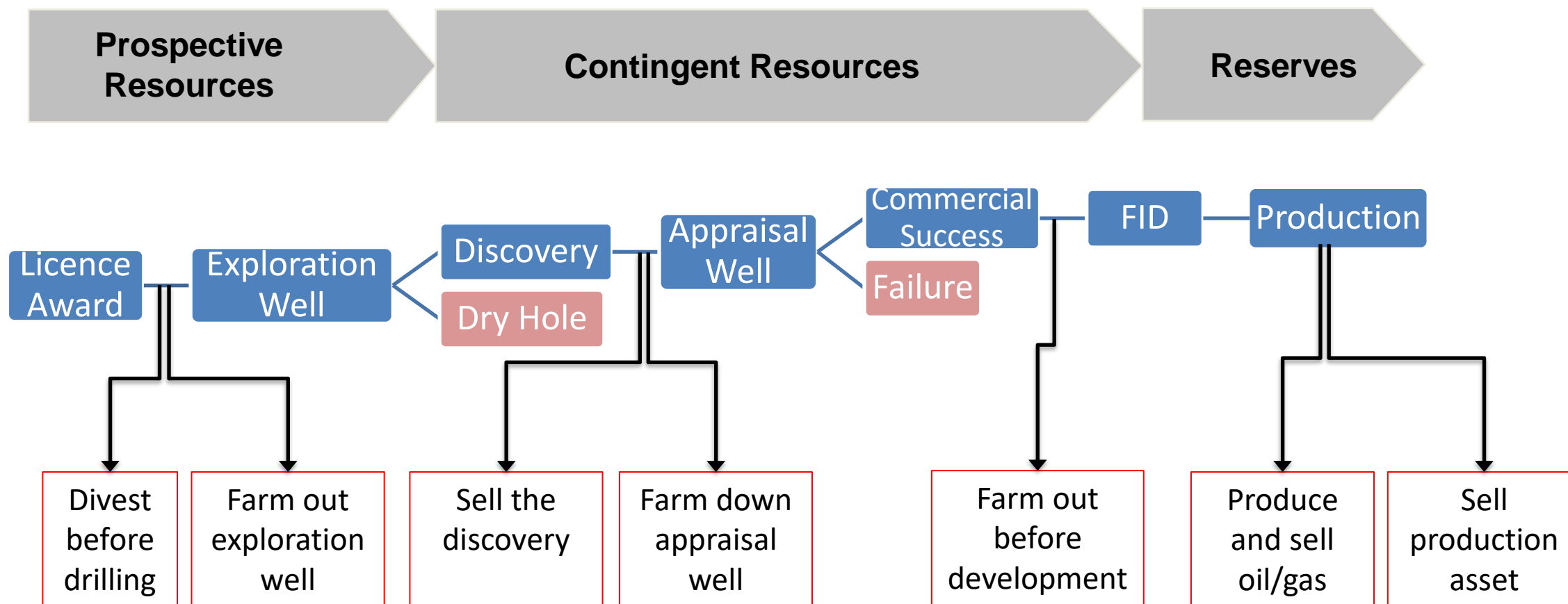
- Larger reserves and a later economic limit will reduce the capital exposure for companies – increasing the capital available for operations and expansion.

- A company's value is constrained by the economic limit date.
 - Would you invest in a single-asset company with a limiting date of 2026?
 - Lenders/investors want to see an asset life far longer than the loan life, partly to stay away from abandonment liabilities.

- Lender confidence, investor confidence, and share prices will be higher if there is a track record of extending reserves life with more 'projects'.

- A Reserves Replacement Ratio is the ratio of newly booked reserves, to production for the period
 - Resource transfers from Contingent Resources, improved production, acquisitions, etc.
 - Eg Serica reported in March 2024 *"2P reserves additions of 24 million boe during 2023 representing a reserves replacement ratio of 179%"*.

Reserves and resources have value at each stage



- PRMS document
 - <https://www.spe.org/en/industry/petroleum-resources-management-system-2018/>

- Guidelines for Application of the Petroleum Resources Management System
 - <https://onepetro.org/books/book/70/Guidelines-for-Application-of-the-Petroleum>

- Frequently Asked Questions about the PRMS
 - <https://www.spe.org/en/industry/reserves/prms-faqs/>

- Aim Note 16
 - <https://docs.londonstockexchange.com/sites/default/files/documents/guidance-note.pdf>



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