



Upstream Economics

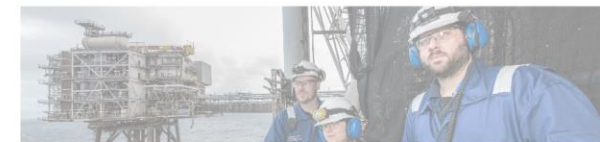
Seminar: Introduction to Upstream Oil and Gas for the Net Zero World



Natan Battisti

Planning and Economics Adviser -Harbour Energy

30 November 2023



Agenda

- Introduction
- Key Petroleum Economics Concepts
- E&P project inputs:
 - Technical
 - Contract specific
 - Macroeconomics
- E&P project outputs:
 - Key economic metrics
 - Sensitivity analysis
- Decision making
- Q&A

Introduction: Who am I

- Born in Brazil, grew up in a farm, Italian citizenship by heritage, proud gaucho!
- A Petroleum Engineer passionate about energy, economy, and politics
- Since 2018 with Harbour Energy
- Lived in 3 countries, worked with 7 countries
- Planning and Economics Adviser since 2022
- STEM Ambassador London Chapter Chair at Harbour
- 10-year member of SPE Intl.
- London SPE Sponsorship Chair 2023/2024
- 2024 – 2026 nominated SPE Intl. Young Professional Committee
- Até o Último Barril co-founder
- Experience



ORIGEM

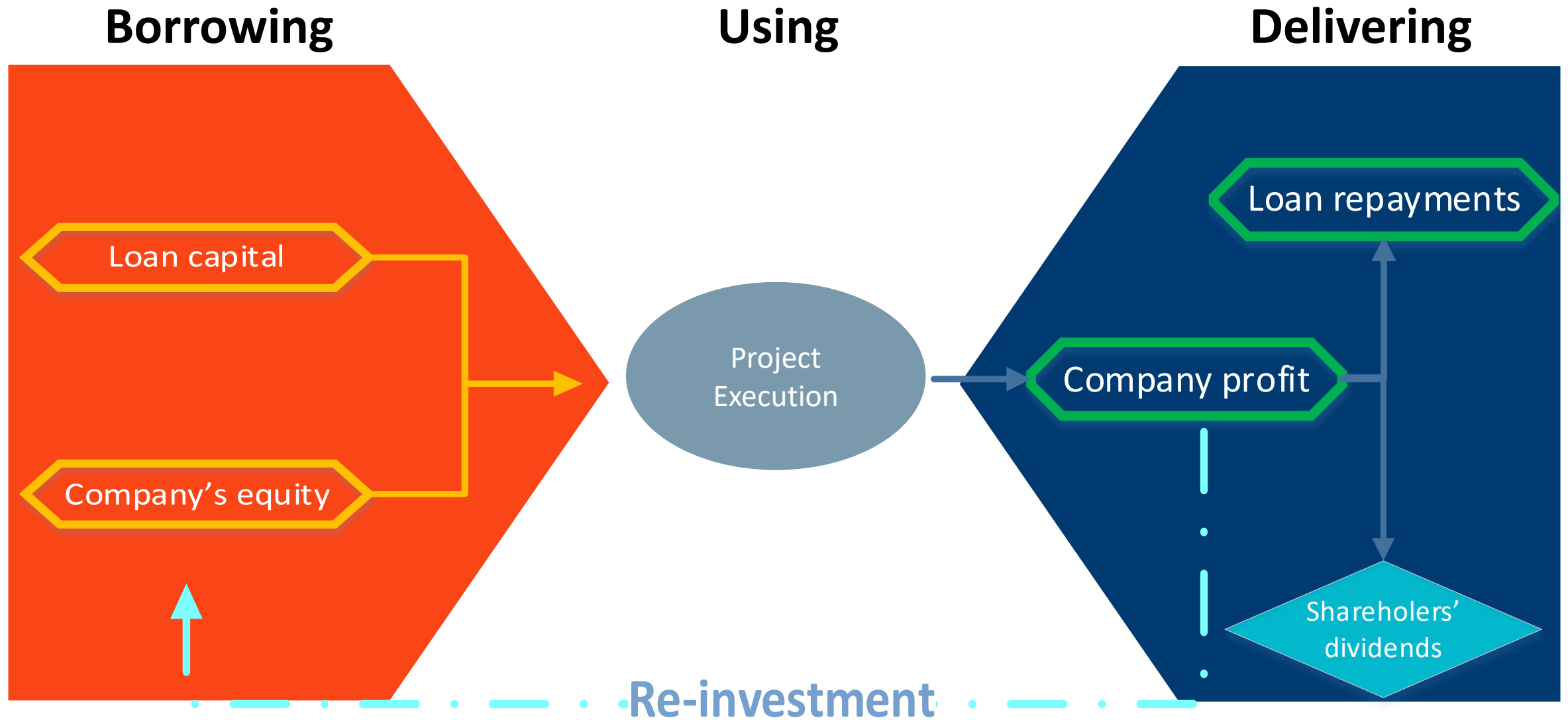
PremierOil

Harbour Energy

■ Countries I lived and worked

■ Countries I have worked with

Introduction: Capital flow



Key concepts: Why do we run economics

Premises

- You are a C-level executive at an Exploration and Production (E&P) company
- You must choose one project to go ahead
- What an E&P need to produce/generate?



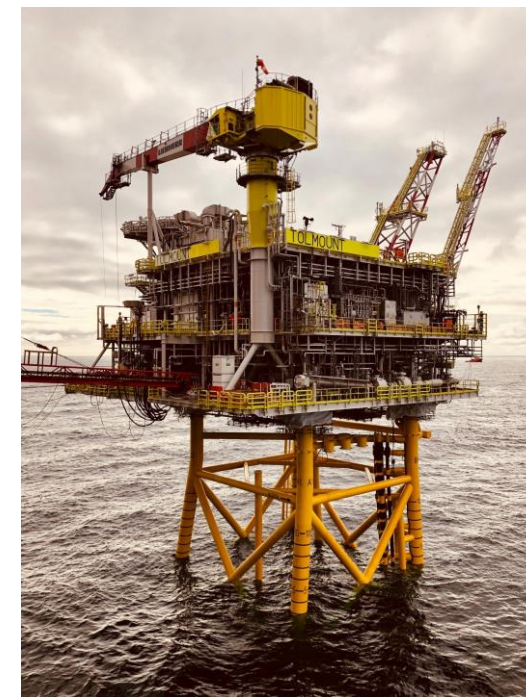
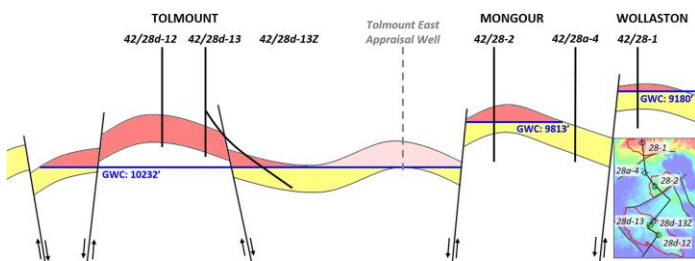
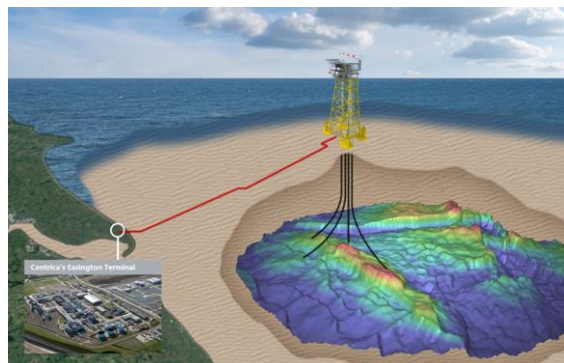
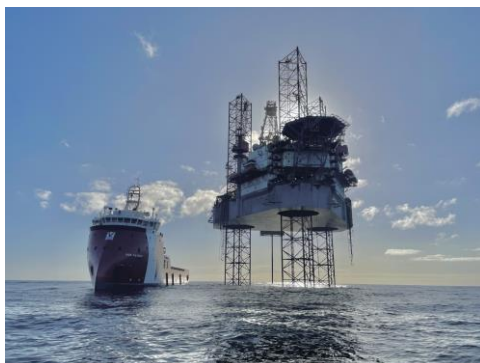
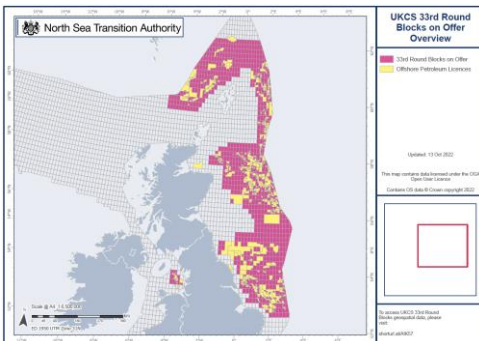
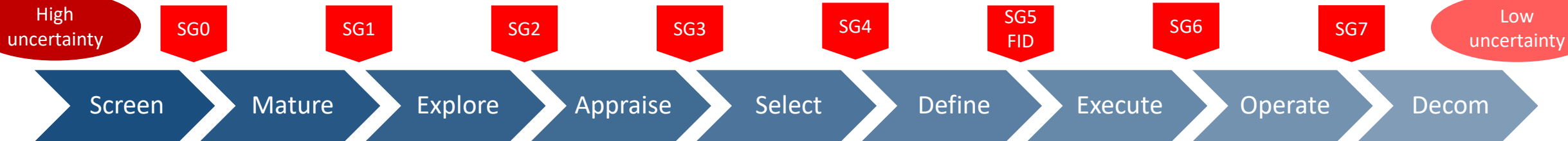
Key concepts: Why do we run economics

	1st HC (year)	Sunk costs (\$m)	Resource in place (mmboe)	Recovery factor (%)	Devex (\$m)	Fiscal regime
Project A (Onshore)	2026	\$15m	250	20%	100	Royalty
Project B (Offshore)	2024	\$50m	200	30%	250	PSC 20y



Key concepts: E&P project life-cycle

Critical decision making all along the project life-cycle

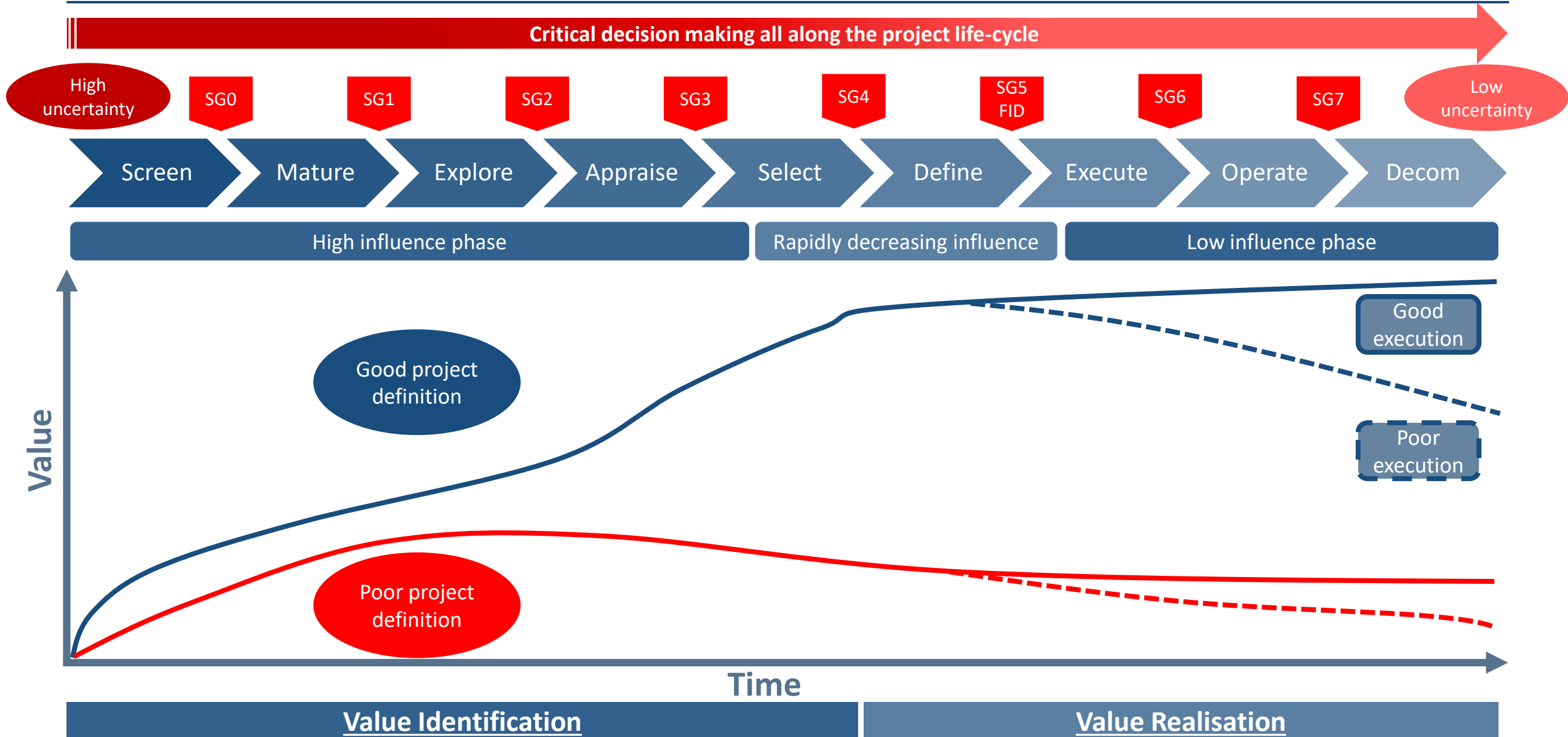


Value Identification

Value Realisation

Key concepts: E&P project life-cycle

Critical decision making all along the project life-cycle



Key concepts: Business risks

Technical - underground

Reservoir heterogeneity	Gas oil ratio
Reservoir connectivity	Water-oil contact
Well integrity	Multiphase well flow
Acquifer	Oil quality

Technical – above ground

Process safety	Spills
Environment	Occupational health/safety
Multiphase flow	EPCI
Simultaneous operations	Operations



Non-technical

Oil & Gas industry + Add to myFT

California accuses Big Oil of covering up climate change risks in lawsuit

Civil action seeks damages to help mitigate costs of global warming caused by fossil fuels

Carbon Taxes in Europe

Carbon Tax Rates per Metric Ton of CO₂e, as of April 1, 2021

Country	Carbon Tax Rate (€/t CO ₂ e)
IS	€29.72 #9
NO	€30.59 #5
SE	€11.00 #1
FI	€62.00 #4
EE	€2.00
LV	€12.00 #16
GR	€21.23 #12
DK	€23.78 #11
NL	€30.00 #3
IE	€35.50 #7
LU	€20.00 #13
PT	€24.00 #10
ES	€15.00 #15
FR	€45.00 #6
PL	€0.07 #19
UA	€0.25 #18
CH	€85.76 #2
LI	€85.76 #2
SI	€17.30 #14

World Bank, "Carbon Pricing Dashboard"

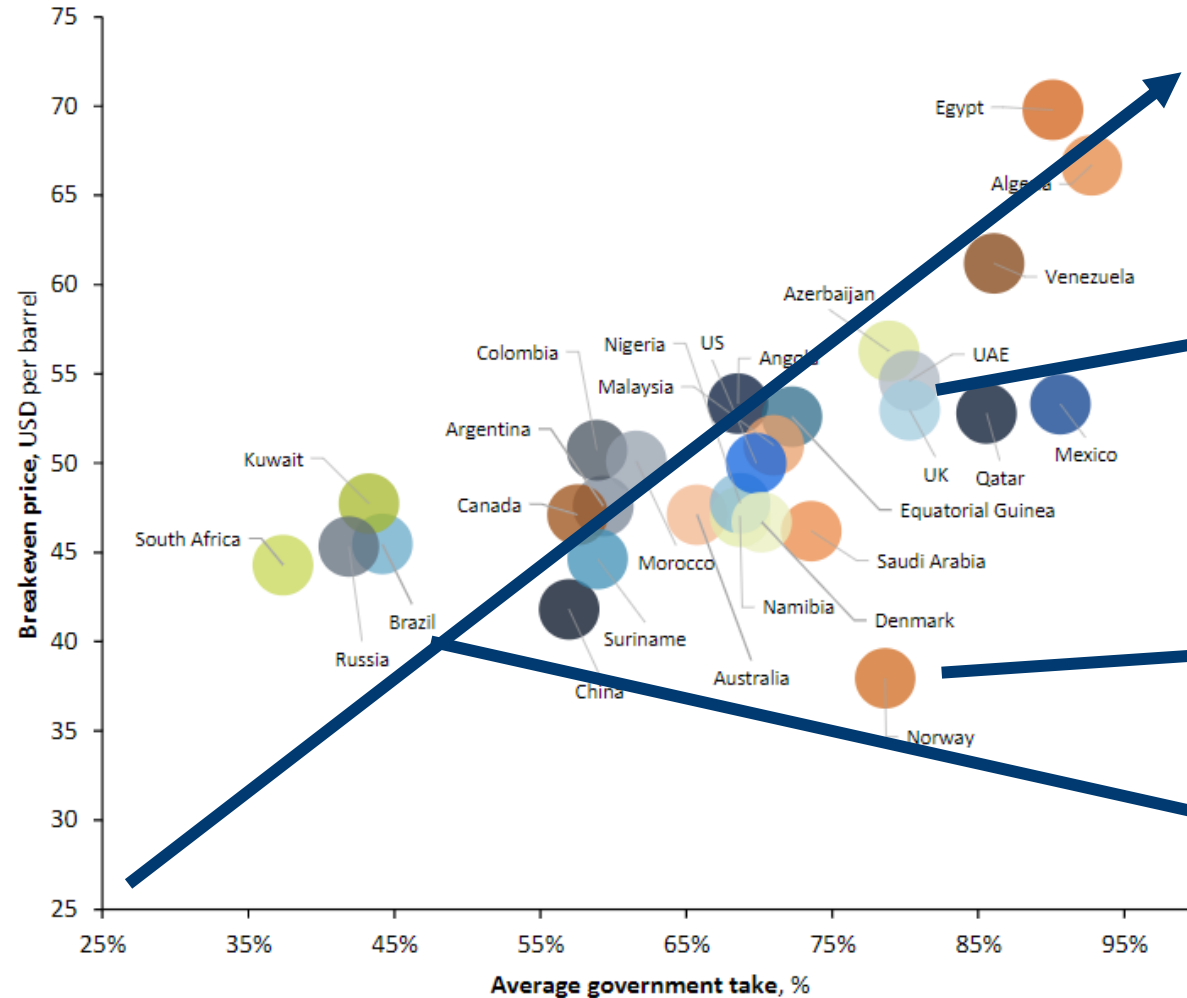
Key concepts: Types of E&P contracts

- E&P contracts have changed and grown in complexity.
- There are three main family types of contracts globally.
- Each contract has its pros and cons

	Royalty / Concession Regime	Production Sharing Agreements/Contracts (PSA/PSC)	Service Agreements Risk Contracts
Risks	Contractor	Shared	State
Ownership	Contractor	State	State
Countries	UK, NO, US, CA, BR	BR, AO, MX	VN, IR, IQ, EC, MX
From a Contractor point of view			
Royalties	Likely (UK/NO exceptions)	Unlikely	-
Tax	Yes	Yes	Yes
Bonus	No (BR as one exception)	Yes	No
Firm commitment	Yes	Yes	
Share of production	All production	Part of production	No

Key concepts: Government Take by country/regime

Average government take and implied breakeven price for the case example under different fiscal regimes



More cost/boe
Less contractor take

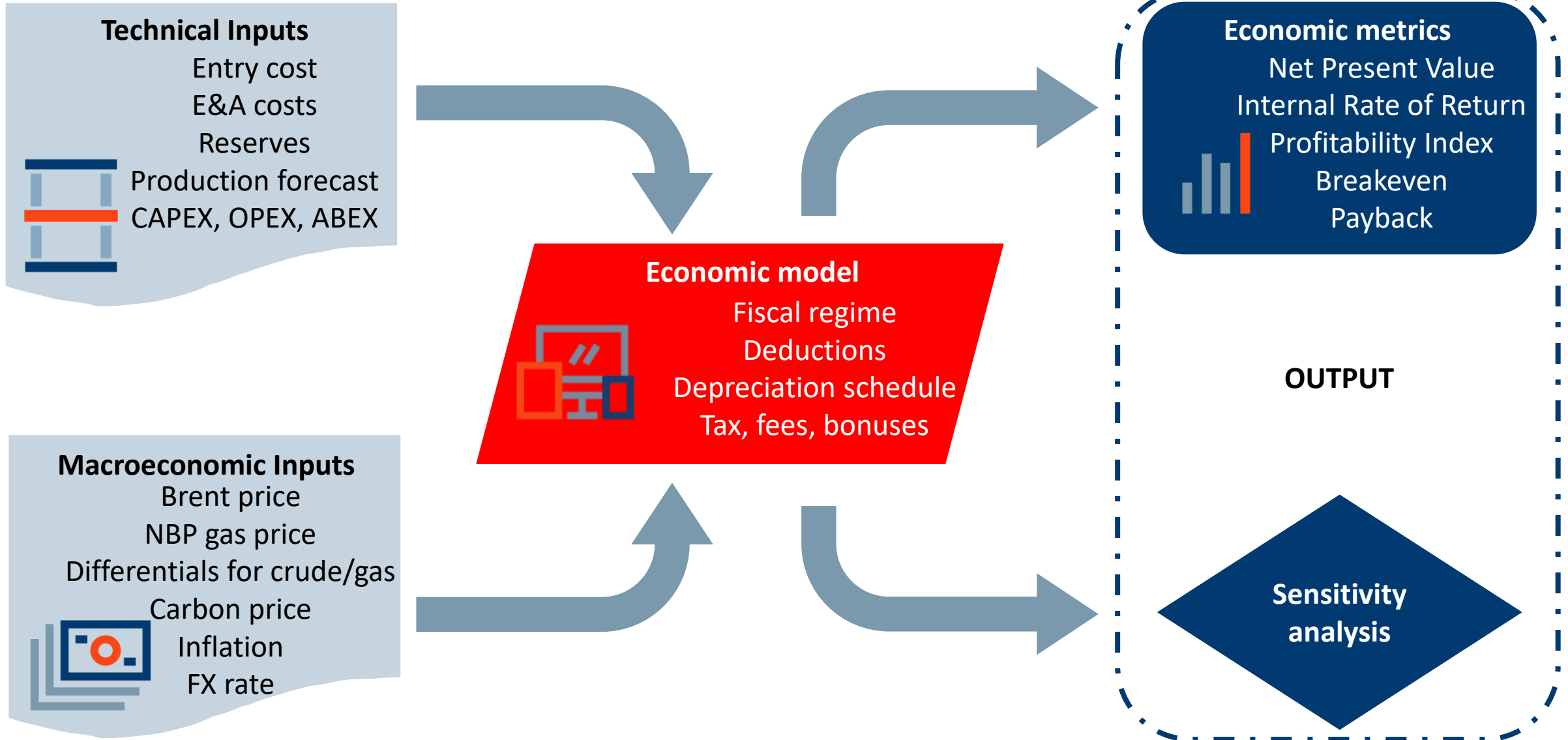
EPL 1 and 2 resulted in UK being the less friendly OECD country for O&G

Mature basin, stable fiscal policy, Europe source of energy

Pre-Salt giant fields make PSCs work. But smaller fields need incentives

Chart source: Rystad Fiscal Regime Report 2023

E&P project: Economic modelling



E&P project: Technical Inputs

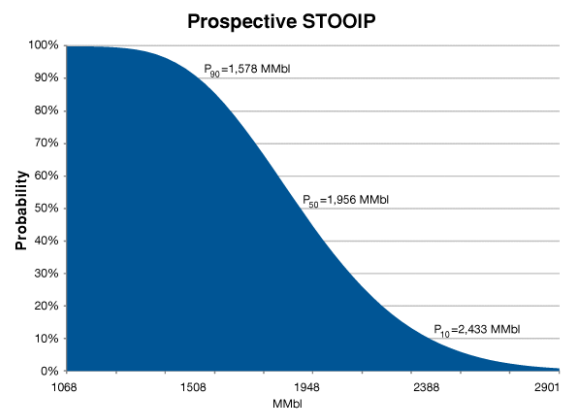
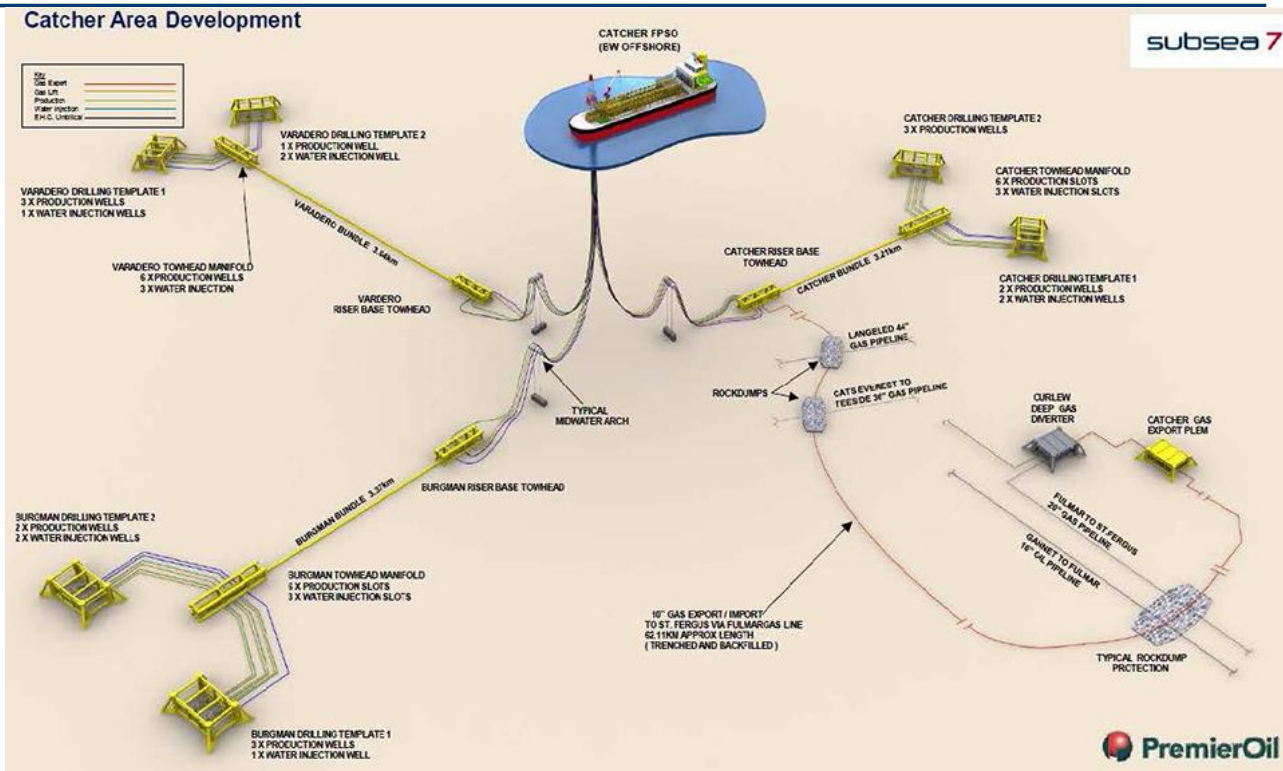
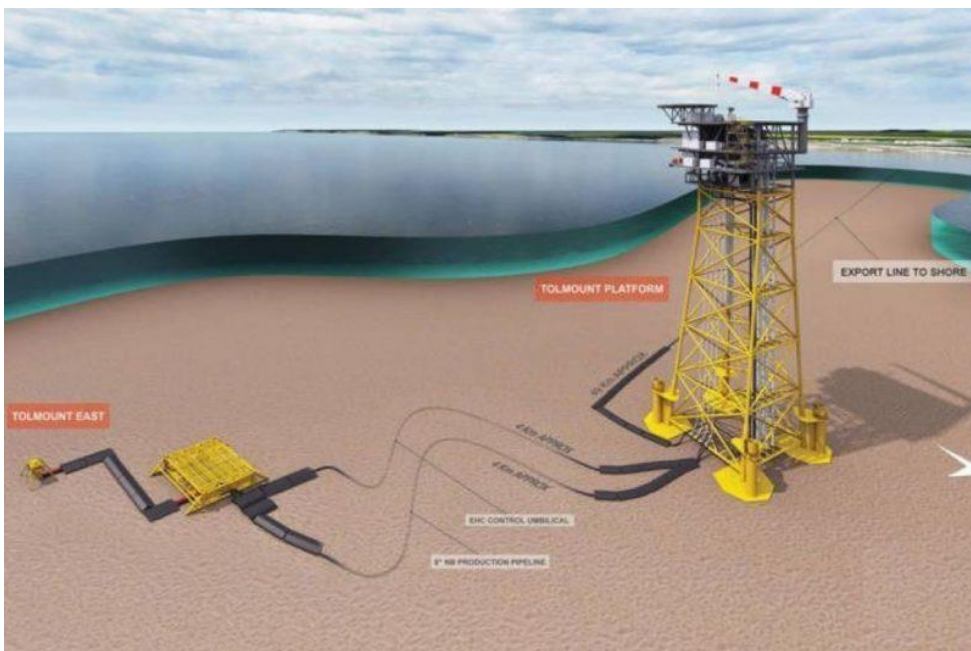
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Technical Inputs

- Entry cost
- E&A costs
- Reserves



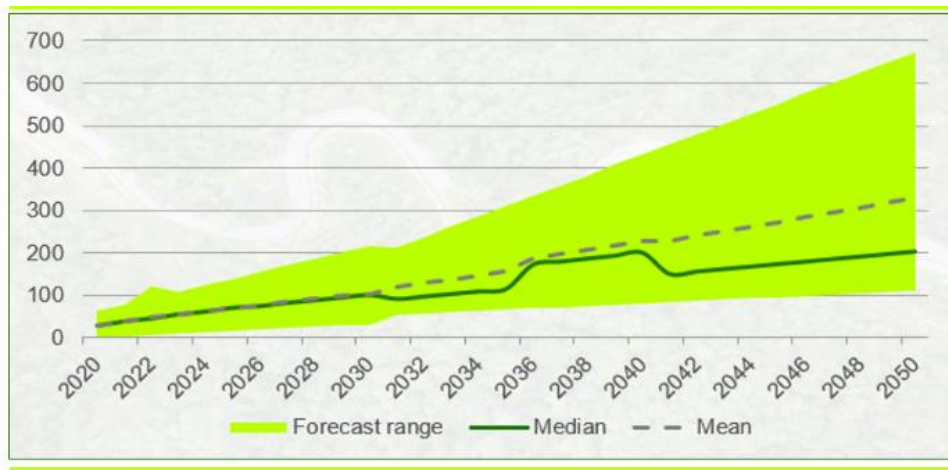
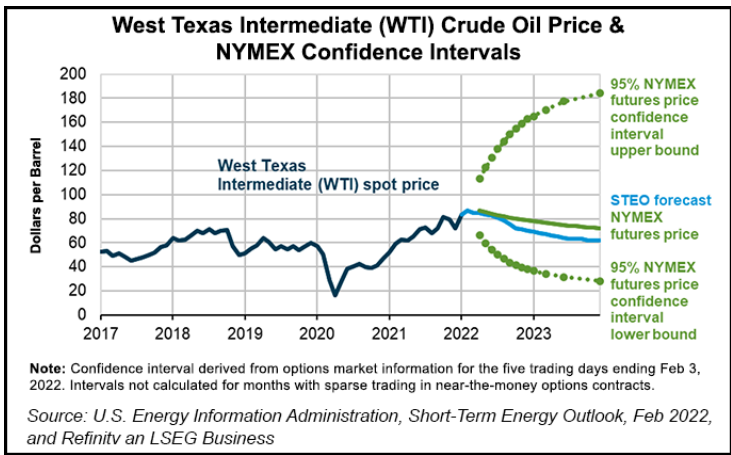
Production forecast
CAPEX, OPEX, ABEX



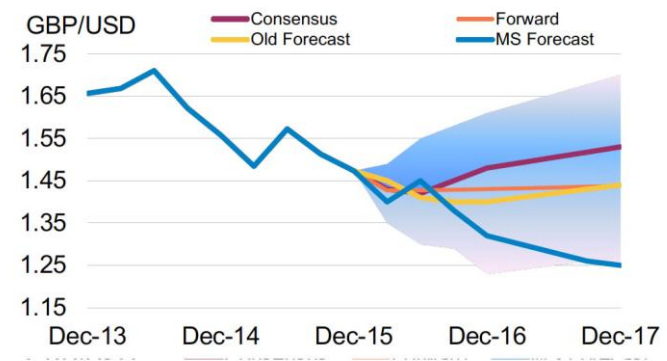
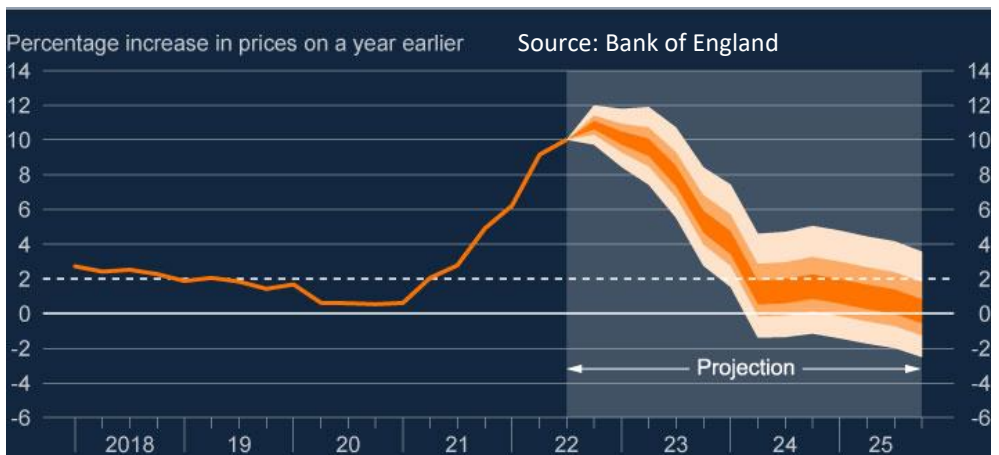
E&P project: Macroeconomic Inputs

2 Macroeconomic Inputs

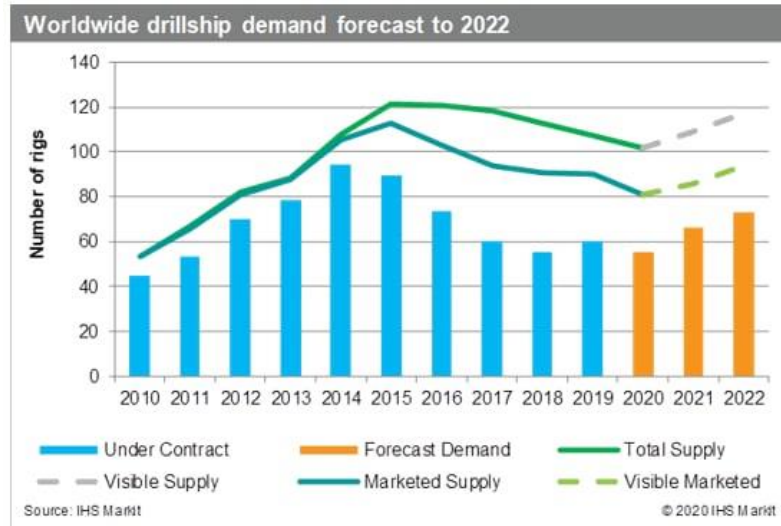
- Brent price
- NBP gas price
- Differentials for crude/gas
- Carbon price
- Inflation
- FX rate



DATA: CRU



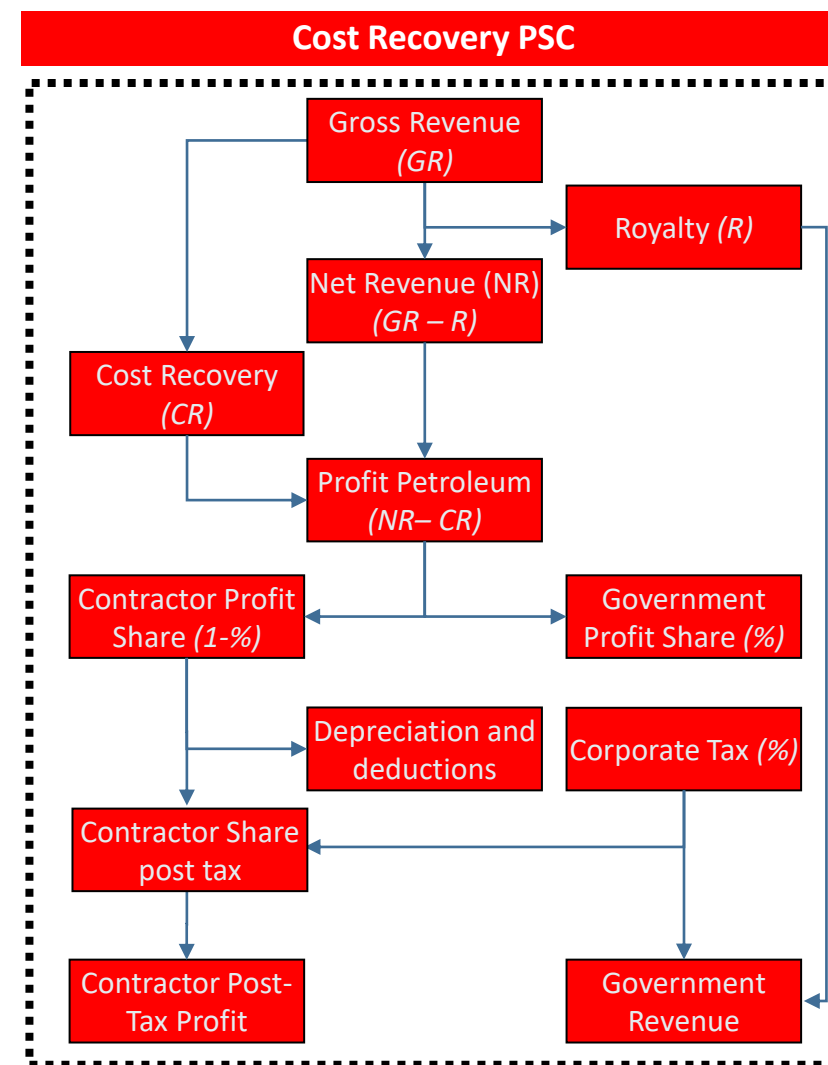
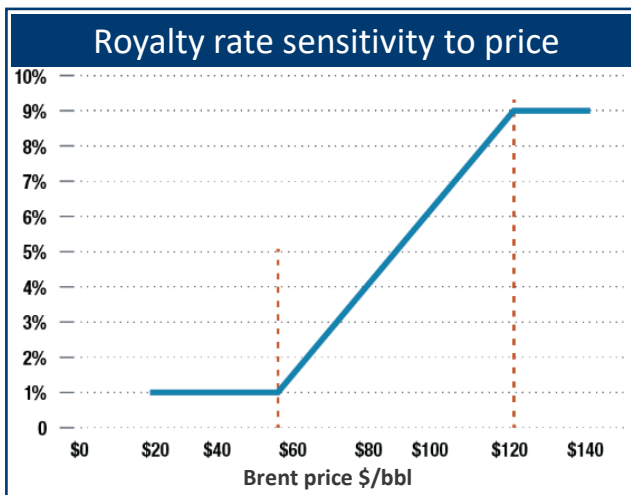
Source: Morgan Stanley Research forecasts



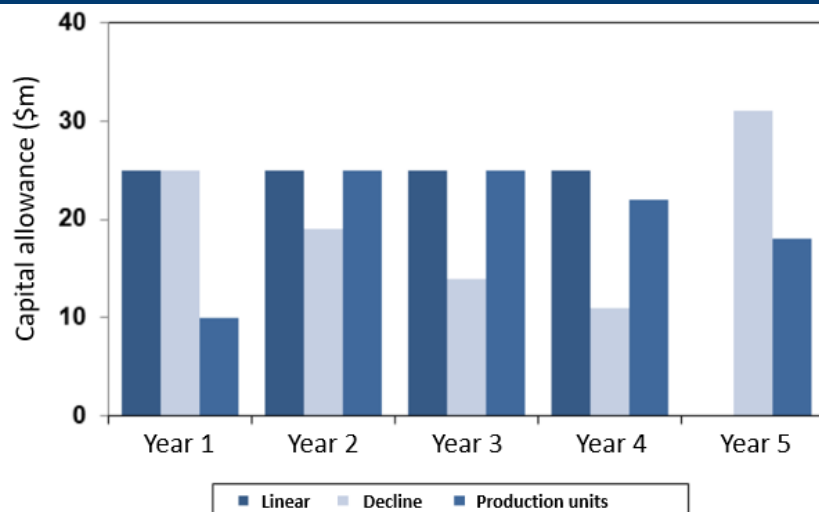
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Economic model

- Fiscal regime
- Deductions
- Depreciation schedule
- Tax, fees, bonuses



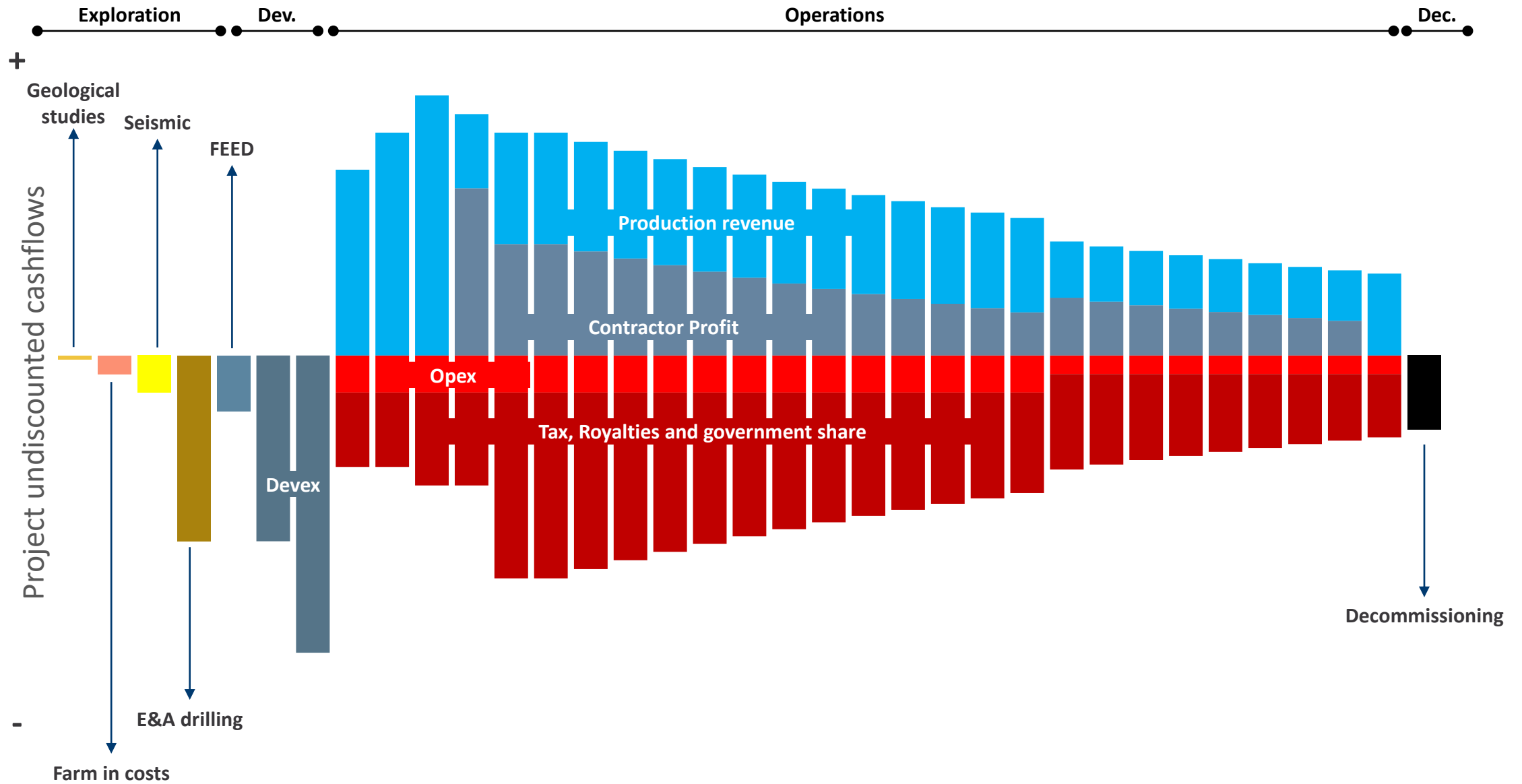
Depreciation methods



Other key contract terms

- Cost recovery:
 - All or part of expenditures?
 - How much % recoverable per period?
- Government take:
 - Fix vs variable.
 - If variable, based on realised prices, production or revenue?
- Corporate tax:
 - Field based or ring fence?
 - Windfall? Carbon tax?

E&P project: Outputs



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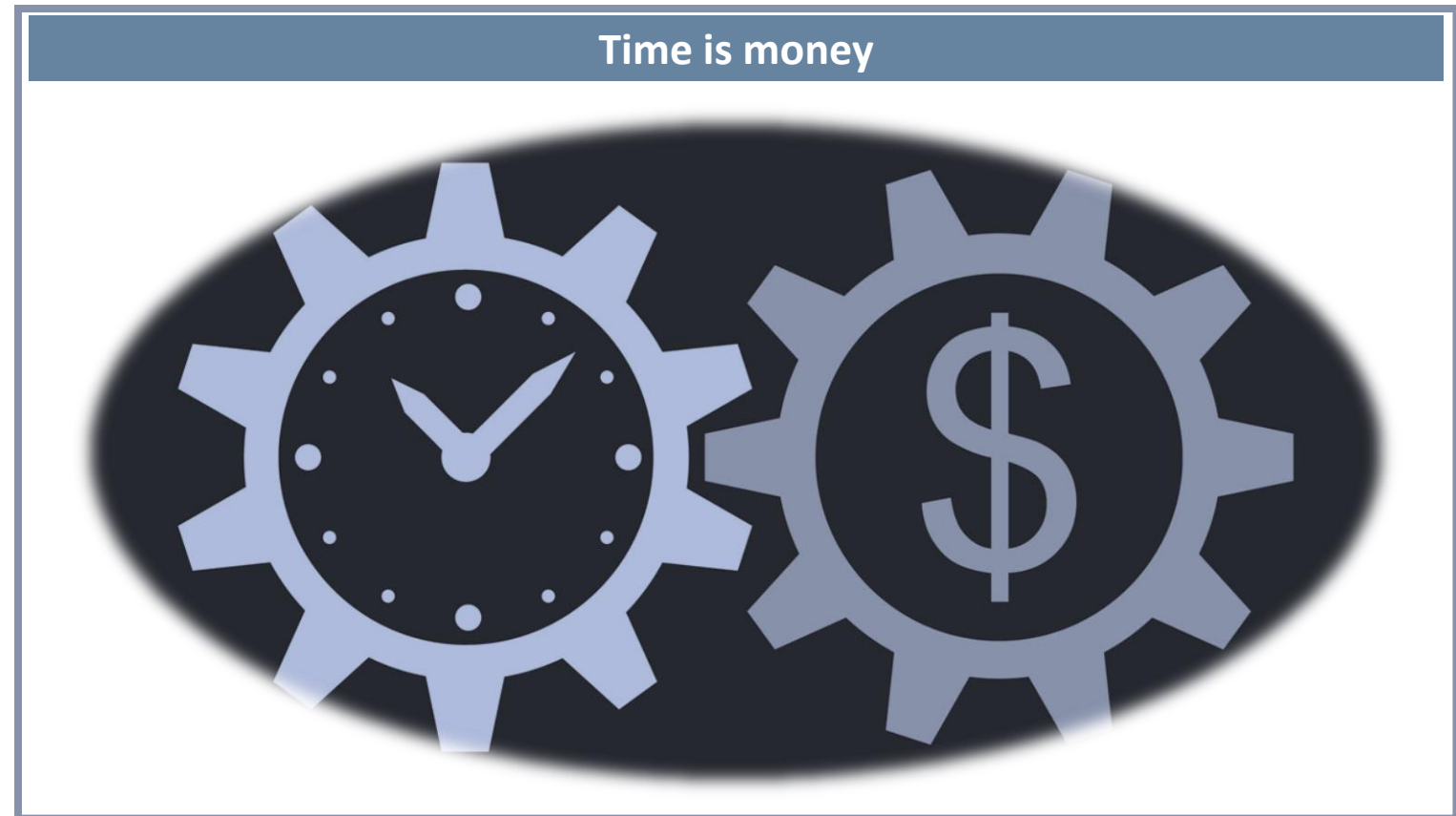
Economic metrics



Time
Value
of
Money

That is why fixed rate savings offer you interest in your money when you invest

- A Dollar or any unit of currency is worth more today than it is tomorrow. This is known as the **Time Value of Money**.
- Value of money is depreciated by inflation.



4 Economic metrics



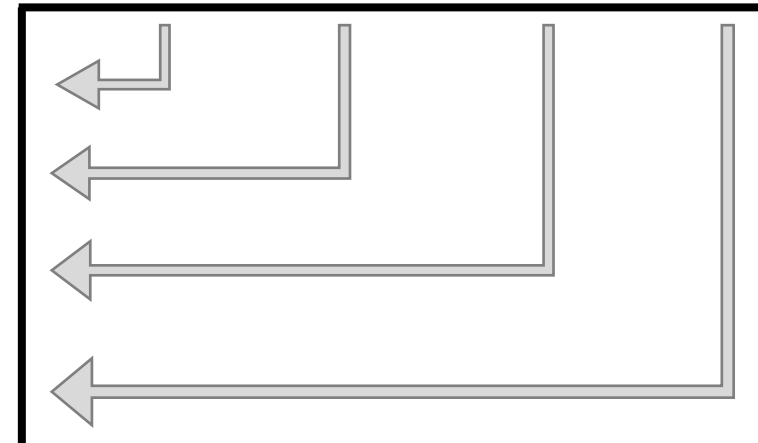
Discount rate (*i*)

- Weighted Average Cost of Capital (WACC) = **$(\text{Cost of Equity} * \% \text{ Equity}) + (\text{Cost of Debt} * \% \text{ Debt})$**
- Vary from company to company.
- Represents the risk of a business.
- Midstream & renewables: lower cost of capital
- Generally
 - the bigger the company, the lower the WACC
 - the better the financials of a company, the lower the WACC
- Often assumed as 10%, but commonly vary from 8% - 15%
- Cost of equity is higher than cost of debt

Net Present Value (NPV)

- NPV also known as Discounted Cash Flow (DCF) is a scenario!
- Inside the discount factor formula there is a ***discount rate***
- Discount rate*** adjusts time value of money and systematic risk
- Net Present Value = Future Value (FV) / **Discount Factor**
- NPV depends on the schedule (more to follow)

Year 0 Year 1 Year 2 Year 3 Year 4



Net Present Value explained

Discount rate@10%

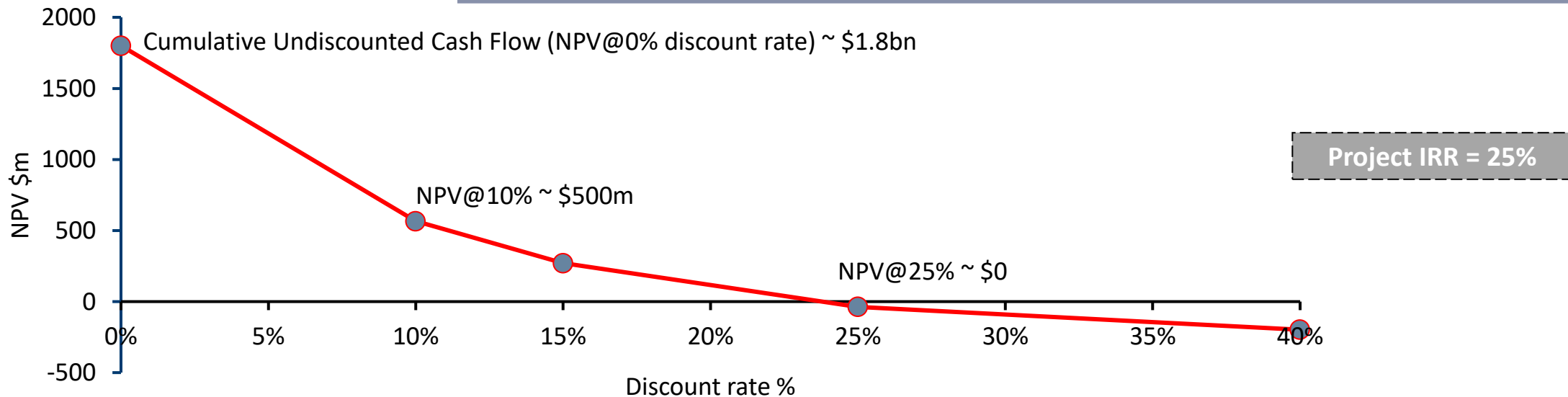
Year (t)	2021	2022	2023	2024	2025	2026	2027	Total
Cashflow	-250	50	100	100	70	60	50	180
Discount Factor	1.000	1.100	1.210	1.331	1.464	1.611	1.772	
PV NCF t=0	-250							
PV NCF t=1	45.5							
PV NCF t=2	82.6							
PV NCF t=3	75.1							
PV NCF t=4	47.8							
PV NCF t=5	37.3							
PV NCF t=6	28.2							
Total NPV	66.5							

4 Economic metrics

Internal Rate of Return (IRR)

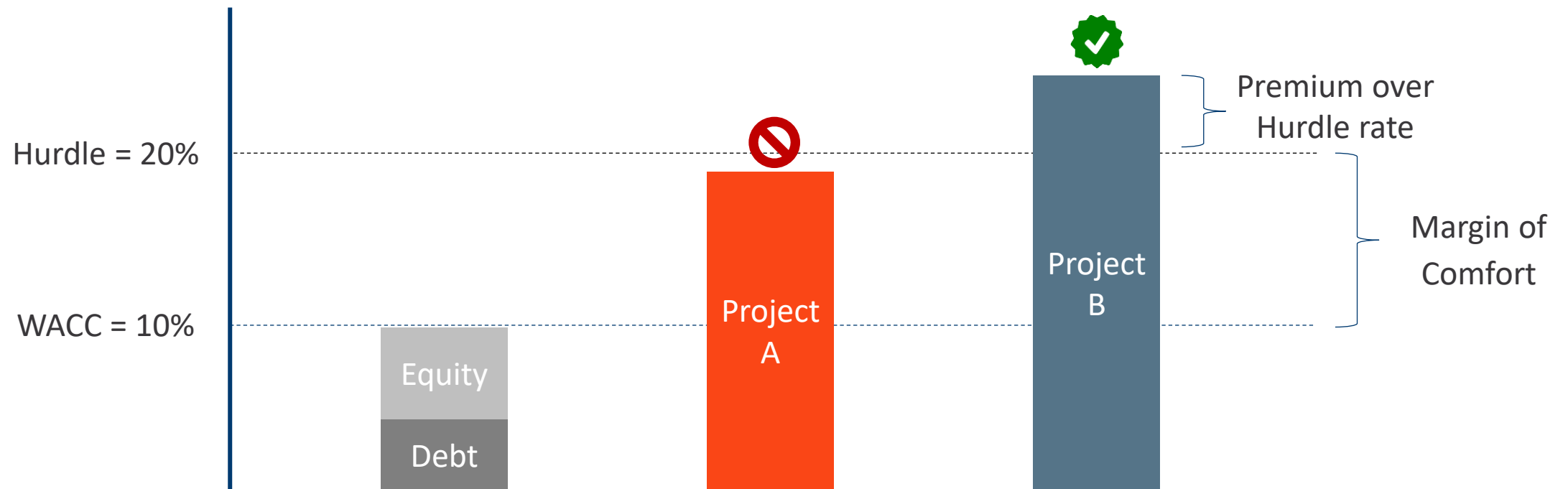
Internal Rate of Return (IRR)

- The **discount rate** at which the NPV is equal to zero.
- Test what is the maximum discount rate the project absorbs before returning negative value.
- Test how quickly an investment pays itself and return value.
- Private equity investors loves that. Shows the resilience of a project.



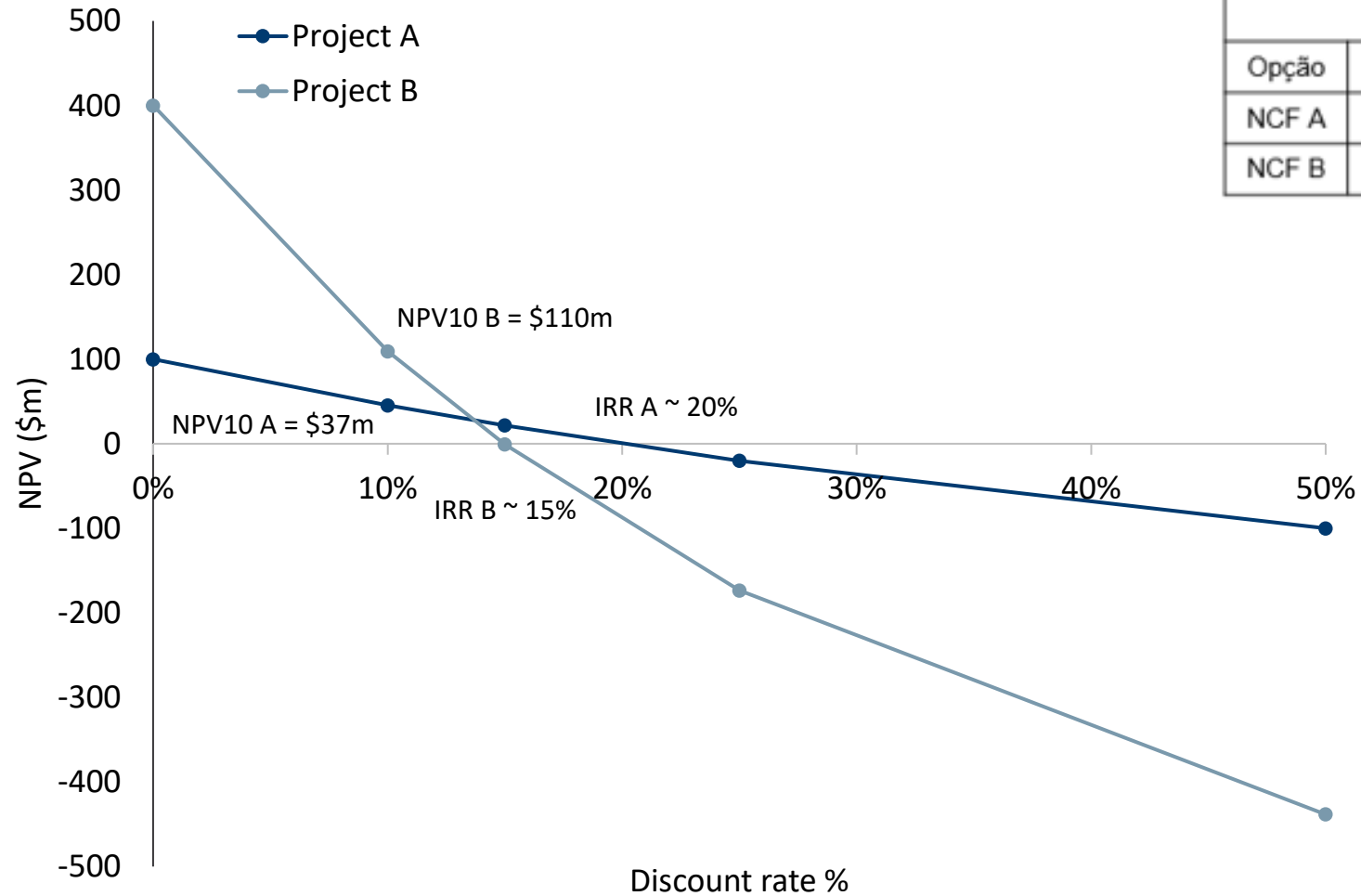
Project IRR vs Corporate Hurdle Rate

- Each company, depending on the strategy, will have a different target IRR,
- It is called Corporate Hurdle Rate.
- Sometimes, depending on other project characteristics such as location, financing, etc a project might require a different IRR than the established Hurdle Rate to progress through Final Investment Decision.



NPV and IRR analysed together

Which project would you choose at discount rate of 10%?



Opção	Ano 1	Ano 2	Ano 3	Ano 4	Ano 5
NCF A	-100	-	-	-	200
NCF B	-1000	350	350	350	350

IRR : Project A > Project B

BUT

NPV@10% : Project A < Project B

4

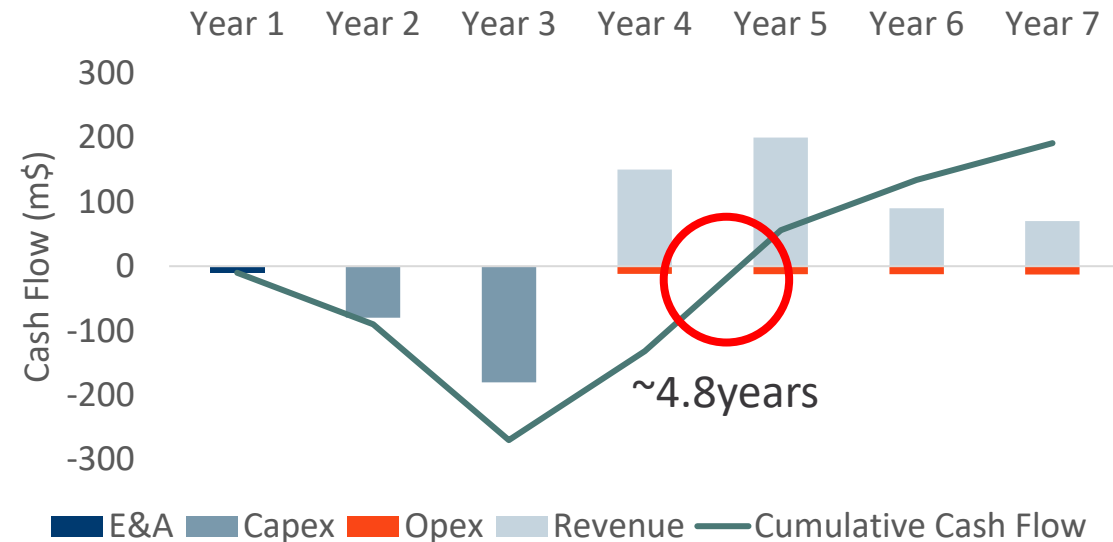
Economic metrics

Payback



Payback

- Amount of time it takes for a project to pay itself.
- Simple Investment Recovery Metric.
- Liquidity and Risk Assessment.
- Decision-Making Simplicity.
- Can be calculated on a discounted or undiscounted basis.



4 Economic metrics

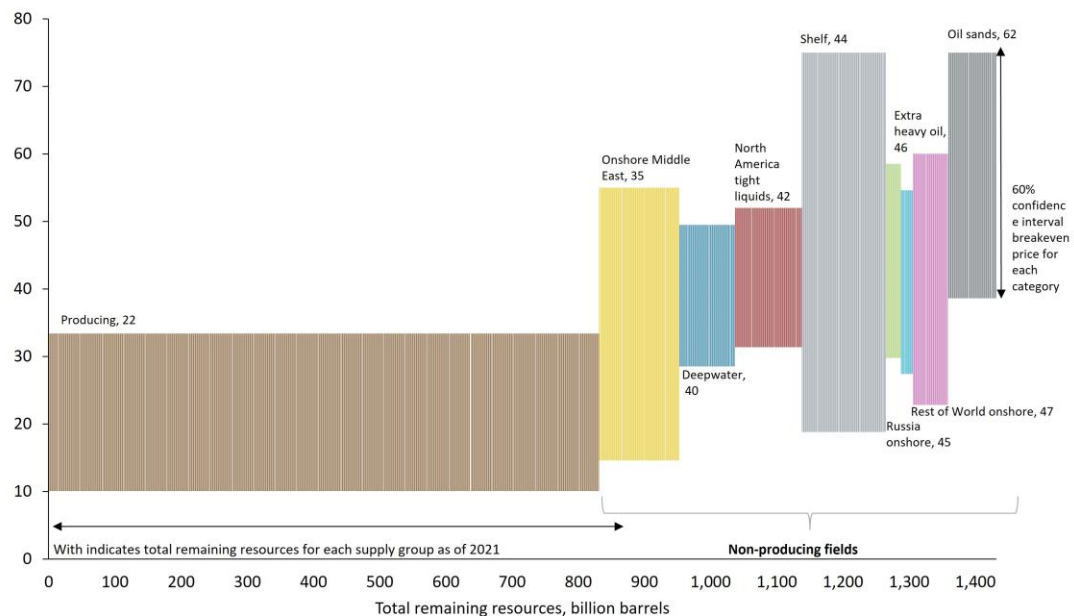
Breakeven



- What commodity price returns NPV = \$0m
- Can be analysed for oil, gas or both together. Depends the project.
- Important to understand whether a project is resilient to low price scenarios.

Figure 3: Cost of supply curve for remaining global resources

Brent breakeven price, USD per barrel



*Breakeven price is the real Brent oil price that gives a net present value of zero given a real discount rate of 7.5%. Breakeven price only includes future costs. Boxes are an average of all fields within each category.
Source: Rystad Energy UCube October 2022

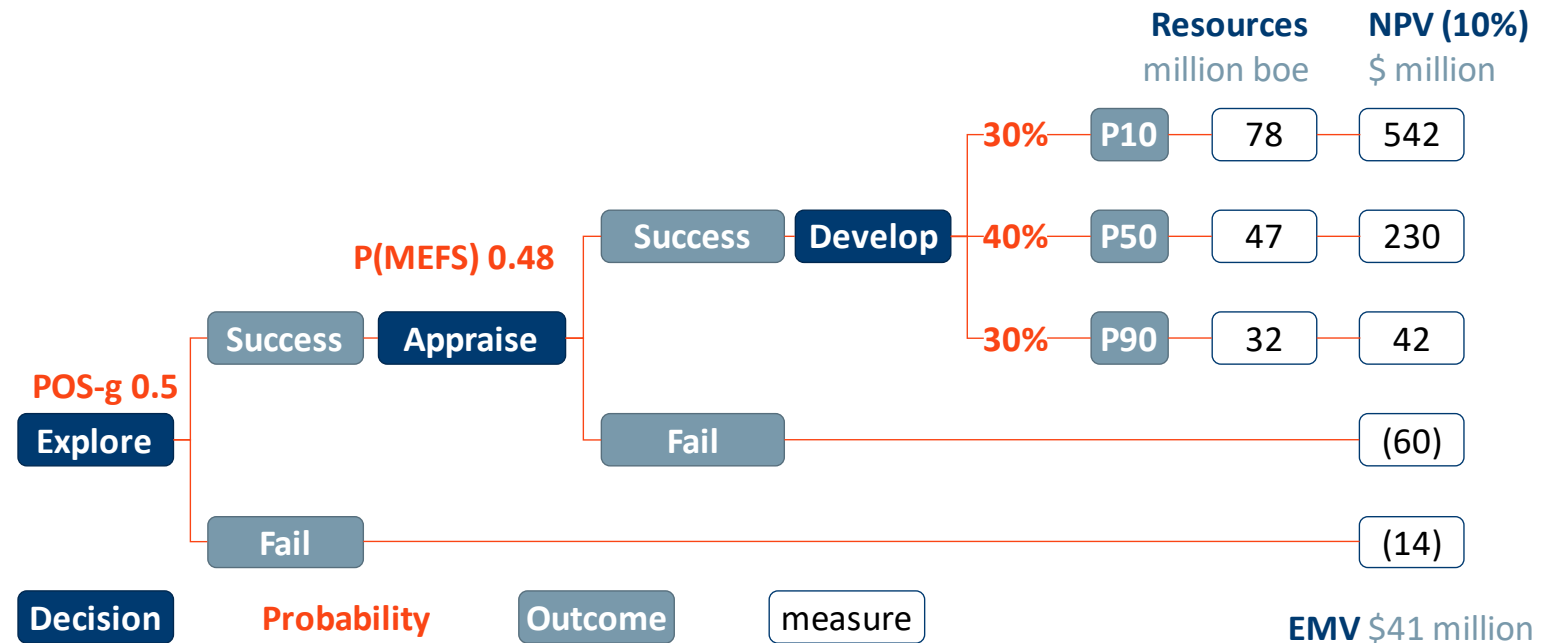
4 Economic metrics

EMV



Expected Monetary Value (EMV)

- EMV is a risk-weighted present value considering the present cost of failure associated with the project.
- Use NPVs from different scenarios (failure, and successes).
- Typical for Exploration and Appraisal projects where the uncertainty is high.



4 Economic metrics



Profitability Index Ratio (PIR)

- The PIR represents the relationship between the costs and value return of a proposed project.
- The PIR can be calculated on a discounted or undiscounted.
- $PIR = NPV / \text{Net Present Costs (NPC)}$
- Very critical for capital allocation.
- The higher the better.

	NPV (\$m)	NPC (\$m)	NPV/NPC
Project A	250	200	1,25
Project B	200	100	2

E&P project: Outputs

4 Economic metrics

Other

Unit Finding Cost (UFC)

$$= \text{E\&A} / \text{Reserves} = 10\$m / 50\text{mboe}$$

$$= \$0.20/\text{boe}$$

Unit Development Cost (UDC)

$$= \text{Devex} / \text{Reserves} = 260\$m / 50\text{mboe}$$

$$= \$5.2/\text{boe}$$

Unit Operating Cost (UOC)

$$= \text{Opex} / \text{Reserves} = 50\$m / 50\text{mboe}$$

$$= \$1/\text{boe}$$

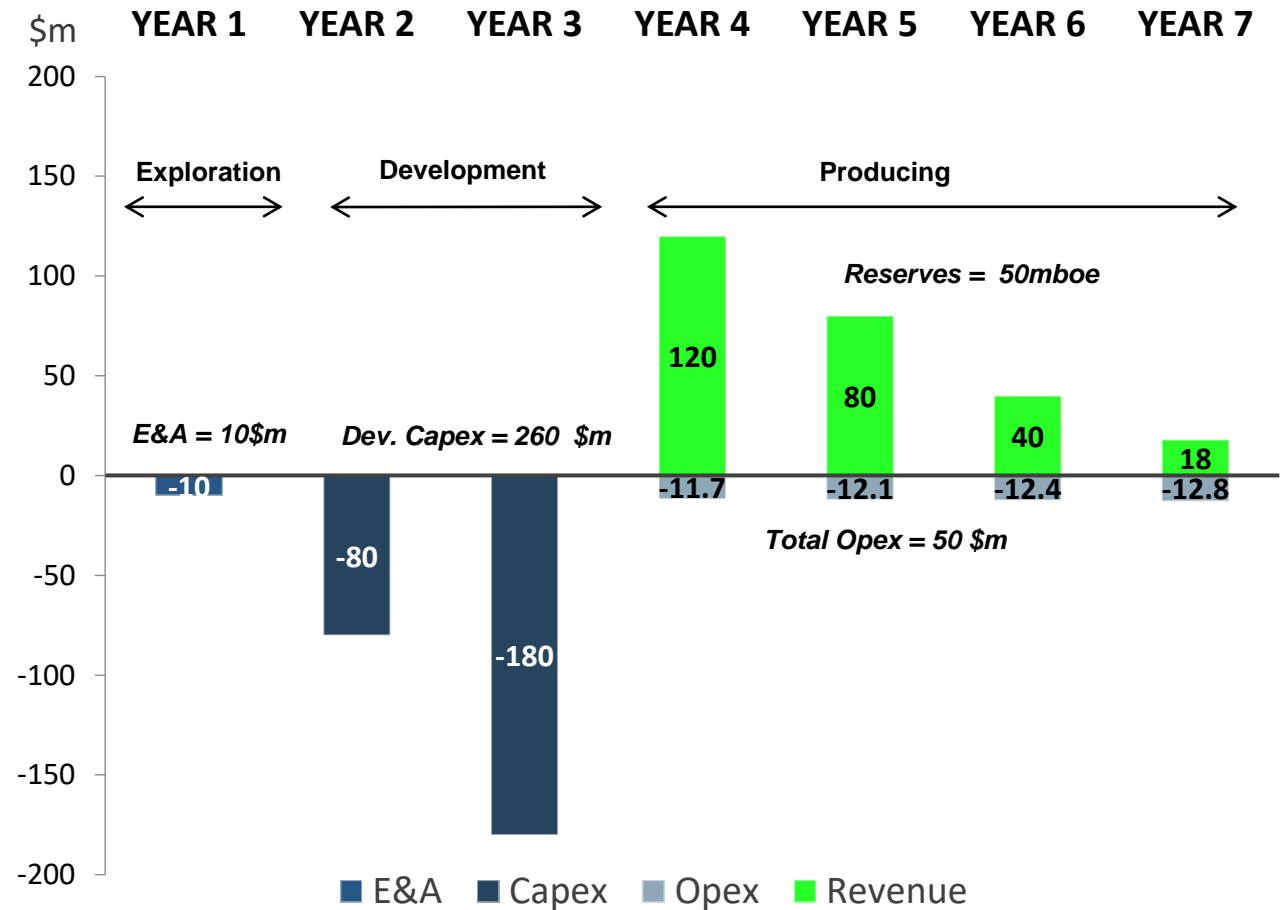
Unit Technical Cost (UTC)

$$= (\text{Devex} + \text{Opex}) / \text{Reserves} = 310\$m / 50\text{mboe}$$

$$= \$6.4/\text{boe}$$

Maximum Exposure

$$= \text{Cumulative Capex expenditure before revenue come in stream} = -270\$m$$

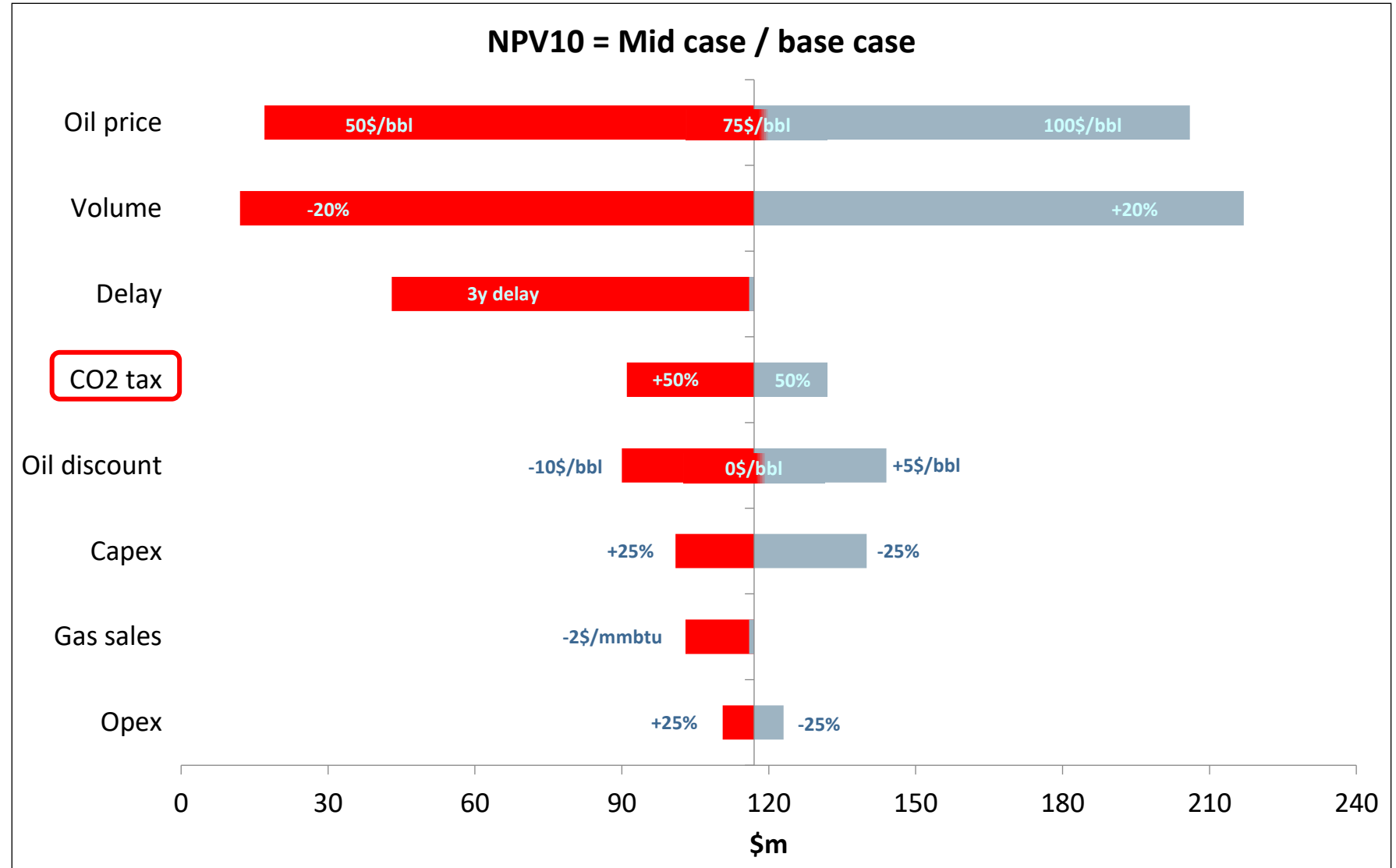


Sensitivity analysis

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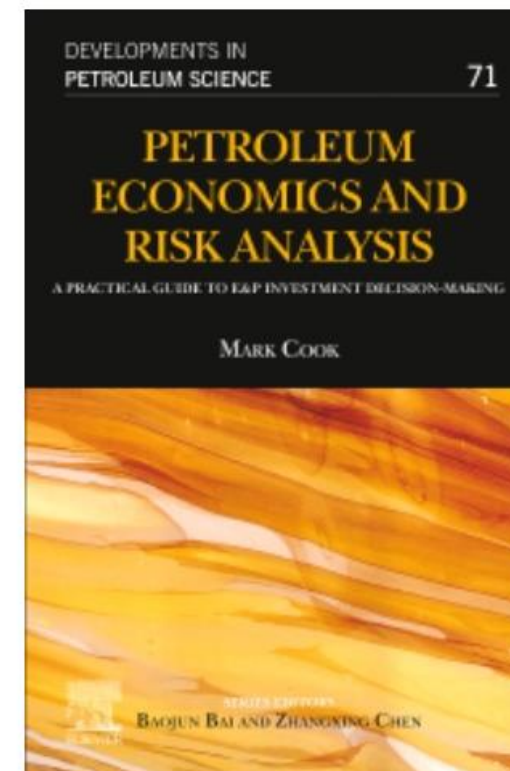
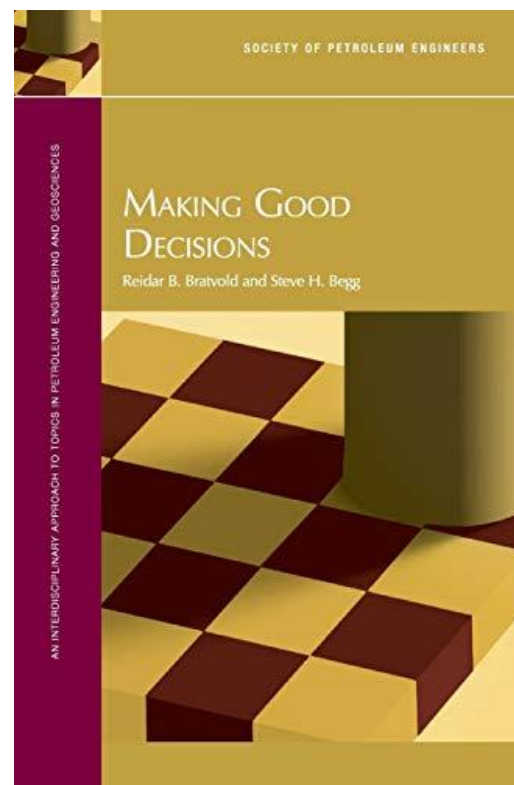
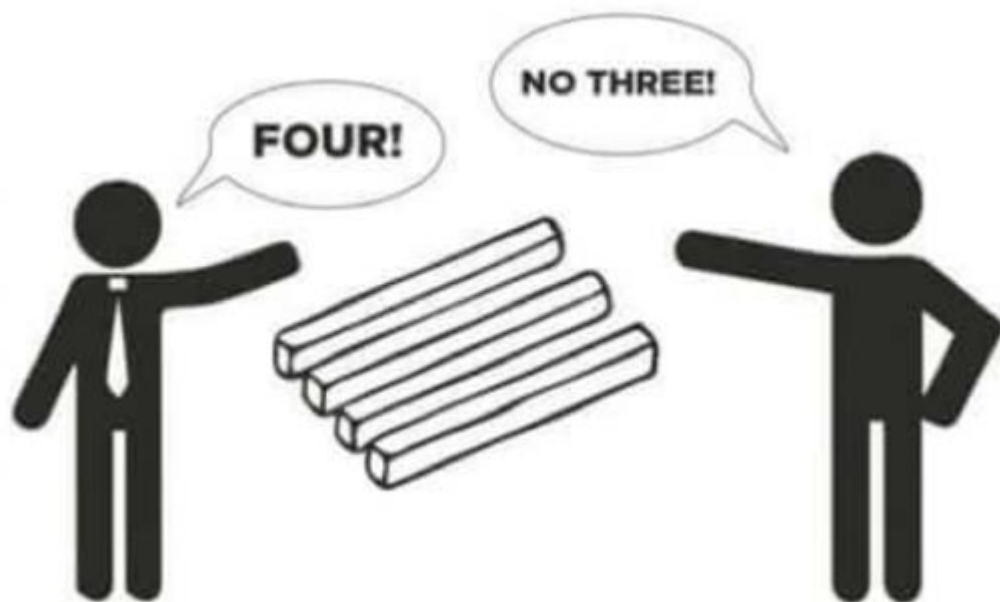
Sensitivity analysis

- Usually, sensitivities are run for the NPV, but it can be done for other metrics as well.
- Variables used for sensitivity change based on project specifics and fiscal regimes.
- Stress test the parameters.



Decision making under uncertainty

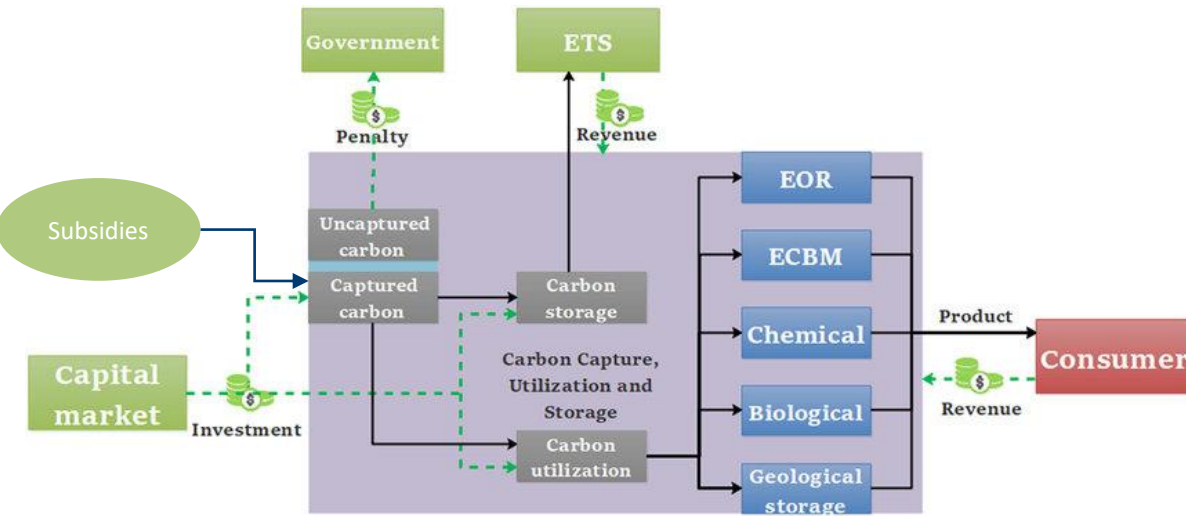
Different perspectives



Energy transition: different business model and economics

CCUS

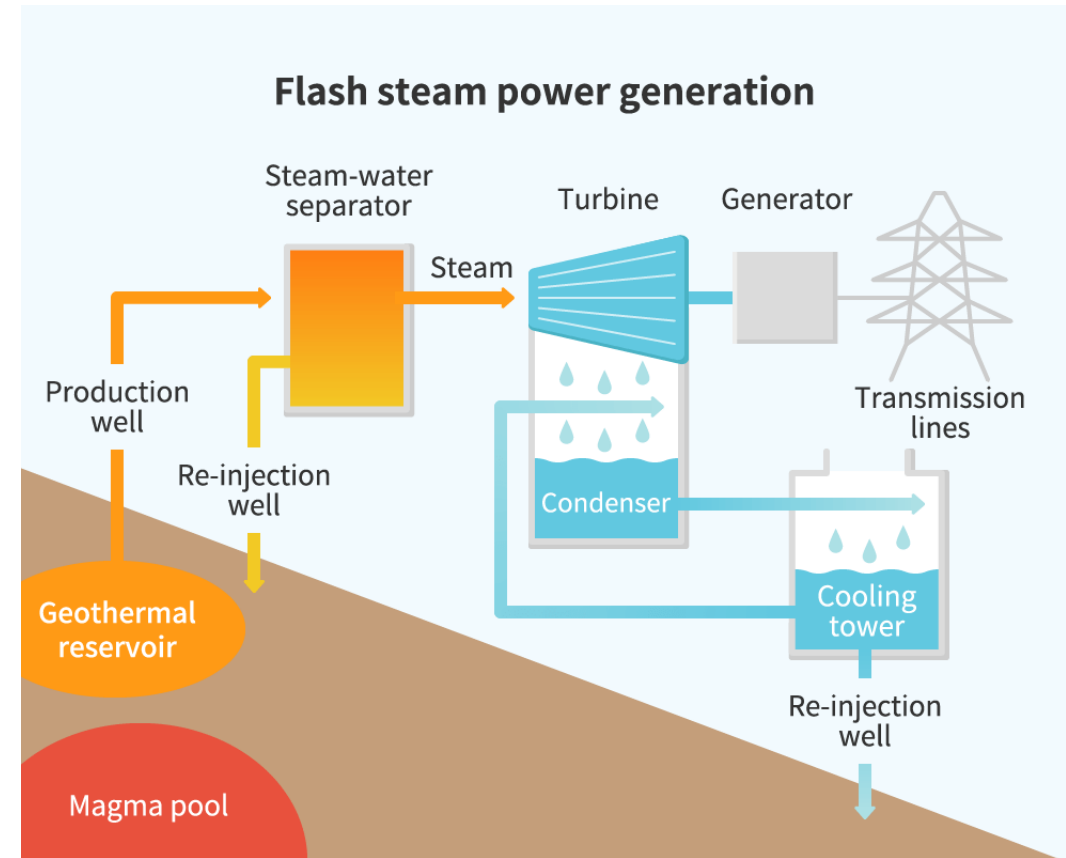
Power Gen



ETS: Emission Trading System
 EOR: Enhanced Oil Recovery
 ECBM: Enhanced Coal Bed Methane Recovery

→ CO₂ flow
 - - - - - Monetary flow

Source: Processes 2020, 8(5), 576; <https://doi.org/10.3390/pr8050576>



Source: <https://www.renovainc.com/en/business/geothermal/>

Recap

Economic Metrics

- NPV / EMV
- IRR
- PIR
- Payback
- Breakeven

Financial Metrics

- Earnings Before Interest and Taxes (EBIT)
- Earnings per share (\$/share)
- Return On Capital Employed (%)
- Weighted Average Cost of Capital (%)
- Revenue/Profit/Cashflow per boe (\$/boe)

Technical Metrics

- Reserve Life (years)
- Reserves Replacement Ratio (%)
- Unit Finding Cost (\$/boe)
- Unit Development Cost (\$/boe)
- Lifting Cost (\$/boe)
- Unit Technical Cost (\$/boe)
- Commercial Success Ratio (%)
- Technical Success Ratio (%)

Each metric tells a different story and serves for different purpose. Evaluate a set of them together. Know their pros and cons. Different investors weight them differently.

For alternative energy sources and CCUS, economics are modelled very differently

Thank you!



Contact details

Natan Battisti

Natan.battisti@harbourenergy.com

(0) 7395 286 264

Head Office | 23 Lower Belgrave Street | London | SW1W 0NR

