Introduction to Petroleum Economics
Economics Overview

- Economics and Economic Analysis are Vital to the success of the oil & gas industry
  - Expense projects - Maintain reserves or production
  - Capital projects - Attain reserves or production

- Incremental Analysis and the ‘Do-nothing’ case are key to evaluating economic viability
Why Economics?

- Integrate all the technical analysis into a recommendation(s)
- Evaluate the recommendation(s) for profit potential with an economic analysis
- Make a final recommendation(s) to management based on technical and economic evaluations

Economics is typically the focal point of all the technical work - The Bottom Line.
Overall Flow of Funds

Absorbing Funds

- Loan capital
- Shareholders’ funds

The Project

- Loan repayments
- Shareholders’ profit

Generating Money

- Re-investment
- Shareholders’ dividend
Calculating Project Cash Flow

Cash Flow = Revenues - Expenditures

Revenue Items (Payments received)
- Gross revenues from sales of hydrocarbons
- Payments for farming out project or part of project

Expenditure Items (Payments made)
- **Capex**
  Capital expenditure on assets with lifetime >1 yr (platforms, facilities, wells)
- **Opex**
  Operating expenditure for assets with lifetime < 1 yr (maintenance, insurance)
- **Government take**
  (royalties, taxes)
Cash Flow

Cash Flow (CF) = Cash Inflows - Cash Outflows

Cash Flows are classified as:

- Revenues = (+) R
- Investments = (-) I
- Expenses = (-) E
- Federal Income Tax = (-) FIT
- Sale of Oil, Gas, NGLs, CO2, sulphur, etcera
- Sale of Surplus Equipment
- Processing fees and royalties
- Sale of Producing Properties
- Expense reduction
Investments

- Bonuses (Purchase Leases)
- Exploration (Seismic, Drilling)
- Tangible investment (Pipe, Equipment, Platform)
- Intangible drilling costs
- Intangible other investment
Expenses

Direct operating costs
- Differ from investments, may be discontinued at any time to shut in production
- Should include expenses caused by the proposed investment
- Are expressed as a fixed amount per well, fixed amount per field, or variable amount per unit of production

Other Direct costs - Non routine or anticipated periodic costs
- Periodic expense workovers
- Plug and abandonment costs
Expenses

Other Expenses (E)
- Production taxes
- Tariffs
- Transportation fees
Expenses

Indirect Expenses (E), Overhead
- Money required to run the business above the field level
- Costs for salaries, offices, supplies, and equipment
- Investment and expense overhead are included in economic analysis
- For example in the U.S., overhead rates are:
  - 10% on Investments
  - 24% on Direct Operating costs
Net Cash Flow

\[ \text{Net Cash Flow} = R - I - E - FIT = NCF \]

[The term Net refers to some reductions may have been made to reflect only the owners perspective.]

- Economic yardsticks are then developed from the NCF
  - \[ \sum \text{NCF by year} = \text{Actual Value Profit (AVP)} \]
  - Discounting is used to determine PVP, PVP/I, DCFR
NCF Summary

\[ \text{NCF} = \text{R} - \text{I} - \text{E} - \text{FIT} \]
Net Cash Flow Indicators

Cumulative Cash Flow, $M

First oil date

Payout time

Time (years)

Economic Lifetime

Maximum losses?
Cumulative Cash Flow

Cumulative Cash Surplus

Payout Time

Field life net cash flow

Maximum Exposure

Cash Surplus ($M)

Time (years)

Accrues to investor at end of economic lifetime of project.
Economic Yardsticks

**Profit or Actual Value Profit (AVP)**

Profit (AVP) = All Cash In - All Cash out
Actual Value Profit (AVP) = \( \sum \) NCF by year

**Profit to Investment Ratio (P/I)**

\[
P/I = \frac{Profit}{Investment}
\]

\[
P/I = \frac{AVP}{I}
\]
Economic Yardsticks

**Payout / Payback**

How long does it take to break even?
How long is the investment at risk?

Payout = Length of time required for the total cash outlay to be recovered through the profit generated by the project.

- Measured from the time of first investment
- Indicates the riskiness of the opportunity
- Not a good yardstick to compare large and small opportunities
# NCF Example

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<th>Year</th>
<th>Revenue</th>
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- \(\text{AVP} = \sum \text{NCF} = \)
- \(\text{P/I} = \frac{\text{AVP}}{\text{I}} = \)
- \(\text{Payout} = \)
Discounting / Time Value of Money

- In order to evaluate future profit, we need to ‘discount’ future $ to ‘today’ $.
- By discounting NCF, we develop discounted cash flow, DCF, and various discounted cash flow yardsticks.

DCF: Discounted cash flow is the concept which recognizes the time value of money by discounting future outlays and inflows to a present value reference (usually time zero).

**End of Year Discounting**

\[ F = P (1 + i)^n \]
\[ P = F (1 + i)^{-n} \]

**Mid Year Discounting**

\[ P = \frac{F}{(1 + i)^{n - 0.5}} \]

**Discount Factors**

- \[ \frac{1}{(1 + i)^n} \] end of year
- \[ \frac{1}{(1 + i)^{n - 0.5}} \] mid year

where:

- F = Future value
- P = Present value
- i = Annual interest rate (frac.)
- n = Number of years
Guidelines for Economic Analysis

- Use Tax Rate = 38% (35% federal, 3% effective state) for U.S. based projects
- Use guideline discount rate of 12%
- Use mid-year (or mid-period) discounting
- Include appropriate overhead rates in economic analysis
- PVP(12%) > 0 indicates the project is attractive to the company  =>  DCFR > 12%
- Maximize PVP of projects through prioritisation
Economic Yardsticks

Present Value Profit (PVP)

\[ PVP = \sum \text{annual DCF values} \]

(PVP also known as: NPV)

PVP to Investment Ratio (PVP/I) or PVP/PVI

\[ \frac{PVP}{I} = \frac{PVP}{\text{Investment}} \]

(PVP/PVI, PVI = present value of the investment stream)
DCF Example

Note: No discounting in year zero

- PVP(12%) = $\sum$ annual DCF values = 9.1
- PVP(12%)/I = 9.1/10 = 0.91

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Discounted Cash Flow Rate of Return (DCFR)

DCFR = Discount rate at which PVP=0.0

- DCFR is the bank rate of interest made on an investment in a project, or the interest rate that discounts the sum of net cash flows of the project to zero.

- DCFR is also known as, IRR, IIR, ROR, DCFROR, or simply Return.

- To determine the DCFR:
  - NCF is discounted at various discount rates => various PVP’s
  - Find the discount rate at which PVP=0
  - Iterative process to solve for DCFR
  - Graphical presentation is a Present Value Profile
### DCF Example

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PVP’s calculated at various discount rates => Present Value Profile