THE OXFORD INSTITUTE FOR ENERGY STUDIES

A RECOGNIZED INDEPENDENT CENTRE OF THE UNIVERSITY OF OXFORD

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# Cashflow Modelling for the Energy Industry (2)

James Henderson

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*Energy in a Globalising World (2)*

# Outline of the course

**Overall objective – understand how senior management use economic models to make investment decisions**

1. Introduction to key themes in the global energy market
2. **Introduction to financial modelling as a management tool**
    1. **Understanding some key concepts**
3. Starting a model for a shale oil and gas field – revenues and prices
4. Inputting the costs – capital expenditure, operating costs and taxes
5. Calculating a discounted cashflow
    1. Why is it important
    2. How is it used to make decisions
6. Power plants – a gas-fired CCGT and a wind farm
7. Testing the investment decisions: running some numbers under different assumptions
8. Answering your questions

## The Question

- Value an energy asset given specific assumptions
  - Examples of a shale gas field and two power stations
- Test the sensitivity of the model
- Provide an investment conclusion for senior management

- Detailed breakdown of company operating and financial performance
- Investment analysts are responsible for asking fundamental questions of senior management
- There is pressure to perform across a broad range of metrics
- A “Sell” recommendation can have big implications

## Petroleo Brasileiro S.A. (PBR)

Bad news! →

| Income statement (BRLmn) | 2016A | 2017E | 2018E | 2019E | CAGR |
|---|---|---|---|---|---|
| EBITDA (adj) | 69,076 | 96,614 | 119,885 | 120,155 | 20.3% |
| EBIDA (adj) | 62,095 | 79,251 | 95,530 | 96,630 | 15.9% |
| Net income (op basis) | -3 | 21,257 | 35,640 | 35,257 | N/A |
| EPS (adj) ($) | 0.00 | 1.10 | 2.00 | 1.95 | N/A |
| Diluted shares (mn) | 6,522.2 | 6,522.2 | 6,522.2 | 6,522.2 | 0.0% |
| DPS (BRL) | 0.00 | 0.00 | 0.00 | 1.09 | N/A |

| Return data | | | | | Average |
|---|---|---|---|---|---|
| ROACE (%) | 2.3 | 5.8 | 8.2 | 8.0 | 6.1 |
| ROAE (%) | -0.0 | 8.7 | 13.8 | 12.1 | 8.6 |
| ROMC (%) | 3.3 | 8.4 | 12.3 | 13.2 | 9.3 |

| Balance sheet and cash flow (BRLmn) | | | | | CAGR |
|---|---|---|---|---|---|
| Shareholders' equity | 250,230 | 241,248 | 276,649 | 304,539 | 6.8% |
| Net debt/(funds) | 316,676 | 266,058 | 195,632 | 142,220 | -23.4% |
| Total debt | 385,784.0 | 357,003.1 | 333,978.2 | 279,878.1 | -10.1% |
| Market capital employed | 585,629 | 521,402 | 481,548 | 432,681 | -9.6% |
| Cash flow from operations | 89,709 | 123,001 | 128,252 | 127,617 | 12.5% |
| Capital expenditure | -49,744 | -59,698 | -44,656 | -47,641 | N/A |
| Dividends paid | 0 | 0 | 0 | -7,128 | N/A |
| Free cash flow | 39,965 | 63,303 | 83,596 | 79,976 | 26.0% |
| Net cash surplus/(deficit) | -28,737 | 21,837 | 47,401 | -688 | N/A |

| Valuation and leverage metrics | | | | | Average |
|---|---|---|---|---|---|
| P/E (adj) (x) | N/A | 8.3 | 4.6 | 4.7 | 5.9 |
| EV/EBITDA (adj) (x) | 7.2 | 4.7 | 3.2 | 2.7 | 4.4 |
| EV/EBIDA (adj) (x) | 8.1 | 5.7 | 4.0 | 3.4 | 5.3 |
| Equity FCF yield (%) | 67.3 | 106.5 | 140.7 | 134.6 | 112.3 |
| Dividend yield (%) | 0.0 | 0.0 | 0.0 | 3.9 | 1.0 |
| Total debt/capital (%) | 60.7 | 59.7 | 54.7 | 47.9 | 55.7 |
| Total debt/equity (%) | 154.2 | 148.0 | 120.7 | 91.9 | 128.7 |
| NAV per share | N/A | N/A | N/A | N/A | N/A |
| EV/boe | N/A | N/A | N/A | N/A | N/A |

| Selected operating metrics | | | | |
|---|---|---|---|---|
| **Upstream** | | | | |
| Oil production (000 b/d) | 2,224.3 | 2,185.0 | 2,362.2 | 2,531.8 |
| Gas production (000 cf/d) | 3,396.0 | 3,025.1 | 3,015.4 | 3,026.4 |
| Total production (000 boe/d) | 2,790.3 | 2,689.2 | 2,864.7 | 3,036.2 |
| Realisations ($/boe) | 37.5 | 61.3 | 74.9 | 71.4 |
| **Downstream** | | | | |
| Refining capacity (000 b/d) | N/A | N/A | N/A | N/A |
| Refining throughput (000 b/d) | 1,945.0 | 1,977.0 | N/A | N/A |

| | |
|---|---|
| Price (22-Mar-2017) | USD 9.11 |
| Price Target | USD 11.00 |

**Why Underweight?** Despite an attractive NAV valuation, we believe shares will be held captive with limited upside, as the market continues to focus on the unsustainable debt levels and cash flow outlook as well as headlines surrounding the ongoing corruption investigation. Between the two share classes, we believe the preferred offer much better value and upside potential.

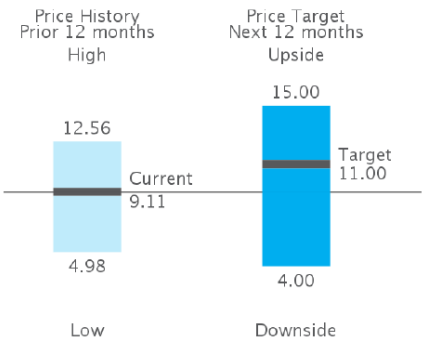
**Upside case** USD 15.00

Our upside case assumes a long-term Brent price deck of $90/bl in our NAV analysis plus a potential premium/discount.

**Downside case** USD 4.00

Our downside case assumes a long-term Brent price deck of $50/bl in our NAV analysis plus a potential premium/discount.

**Upside/Downside scenarios**




Source: Company data, Barclays Research
Note: FY End Dec

# Share price determines market valuation

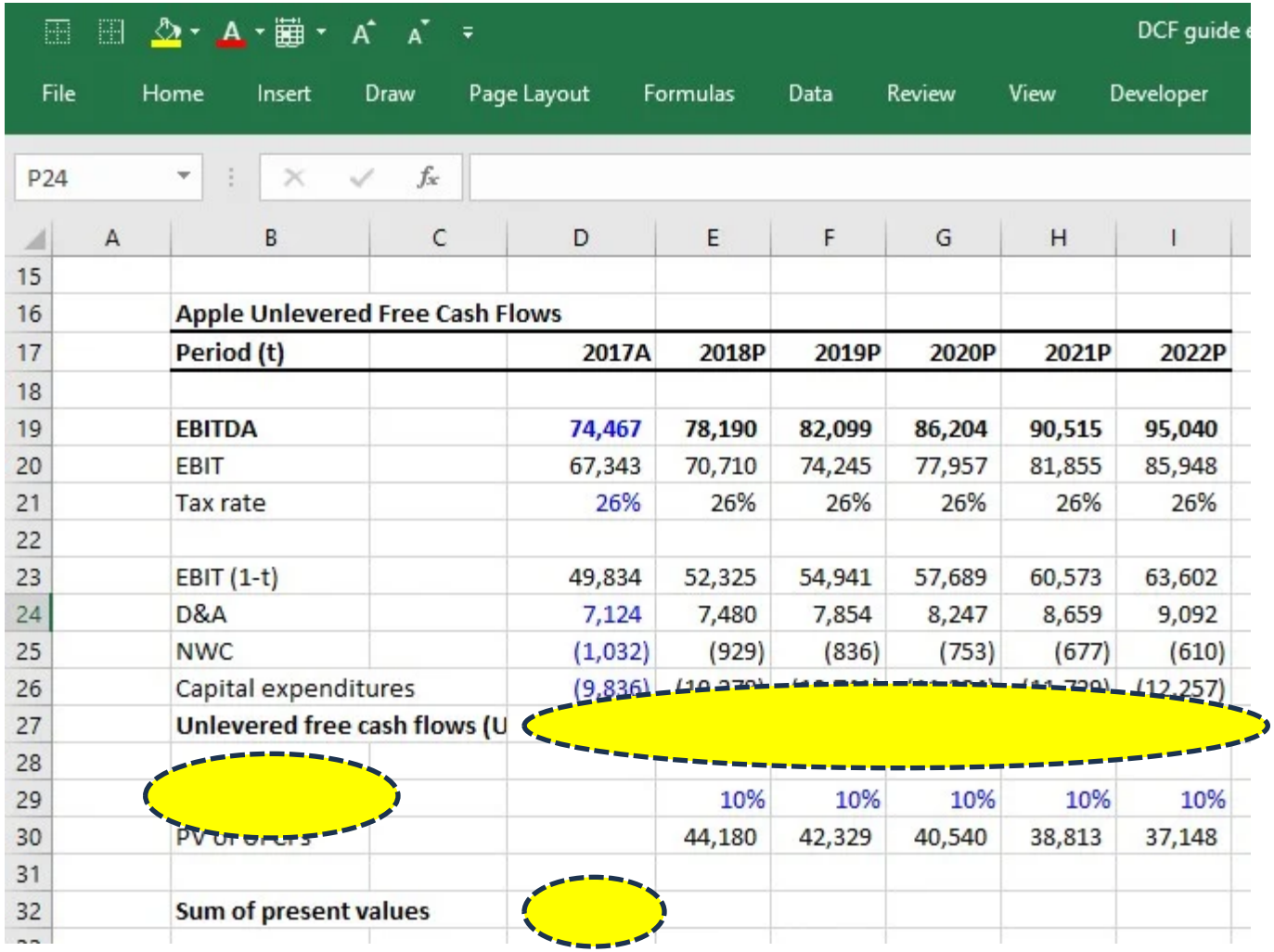

- Share price multiplied by number of shares in issue = market value
- Market value divided by profits gives “price to earnings ratio”
- Potential value can be derived by using multiples and future profit forecasts

# Comparison with Peer Groups

## Global peer valuation multiples

| | MCap | EV | EV/EBITDA | | | P/E | | |
|---|---|---|---|---|---|---|---|---|
| | $ bln | $ bln | '20E | '21E | '22E | '20E | '21E | '22E |
| **Global majors** | | | | | | | | |
| ExxonMobil | 239 | 315 | 15.9 | 7.9 | 6.9 | neg | 19.5 | 14.7 |
| Chevron | 199 | 243 | 14.0 | 7.2 | 6.6 | neg | 20.6 | 17.2 |
| Royal Dutch Shell | 158 | 238 | 8.0 | 5.0 | 4.6 | 32.7 | 11.9 | 9.5 |
| BP | 87 | 151 | 12.5 | 5.3 | 4.8 | neg | 13.6 | 9.7 |
| **Average** | | | **12.6** | **6.4** | **5.7** | **neg** | **16.4** | **12.8** |
| **EU majors** | | | | | | | | |
| Total | 126 | 170 | 10.2 | 5.8 | 5.2 | 31.0 | 13.1 | 10.6 |
| ENI | 44 | 64 | 6.1 | 3.9 | 3.4 | neg | 17.8 | 12.0 |
| Equinor | 64 | 80 | 5.9 | 3.4 | 3.2 | >50 | 12.9 | 12.4 |
| **Average** | | | **7.4** | **4.4** | **3.9** | **31.0** | **14.6** | **11.7** |
| **EM majors** | | | | | | | | |
| Petrochina | 115 | 209 | 4.6 | 4.2 | 4.2 | 42.9 | 29.0 | 17.4 |
| Petrobras | 57 | 120 | 4.3 | 4.0 | 3.8 | 8.8 | 7.9 | 7.3 |
| Sinopec | 76 | 124 | 5.3 | 4.1 | 3.8 | 16.1 | 9.5 | 9.2 |
| Ecopetrol | 27 | 41 | 8.9 | 5.5 | 5.1 | 45.5 | 11.5 | 9.6 |
| ONGC | 19 | 35 | 6.9 | 4.2 | 3.6 | 17.6 | 7.1 | 5.9 |
| PTT E&P | 15 | 15 | 4.1 | 3.8 | 3.4 | 20.4 | 14.9 | 12.3 |
| CNOOC | 3 | 3 | 10.1 | 9.0 | 8.4 | 35.0 | 22.2 | 15.0 |
| Saudi Aramco | 1,885 | 1,990 | 16.6 | 10.5 | 9.4 | 40.3 | 22.7 | 19.5 |
| **Average** | | | **7.6** | **5.7** | **5.2** | **28.3** | **15.6** | **12.0** |
| **US majors** | | | | | | | | |
| Pioneer NR | 35 | 38 | 16.3 | 7.6 | 6.2 | >50 | 18.8 | 13.4 |
| ConocoPhillips | 71 | 81 | 14.7 | 6.1 | 5.6 | neg | 23.6 | 18.7 |
| Apache | 7 | 18 | 8.3 | 5.4 | 5.7 | 18.1 | 14.4 | 14.1 |
| EOG | 41 | 44 | 8.9 | 5.6 | 5.3 | 48.1 | 14.9 | 13.6 |
| **Average** | | | **16.2** | **6.5** | **6.1** | **neg** | **neg** | **14.9** |
| **Russia majors** | | | | | | | | |
| Lukoil | 56 | 61 | 6.4 | 4.3 | 3.6 | 23.1 | 8.0 | 6.2 |
| Rosneft | 71 | 143 | 9.0 | 4.4 | 4.1 | 9.3 | 4.2 | 3.8 |
| Gazprom Neft | 24 | 32 | 6.3 | 3.8 | 3.2 | 12.1 | 4.4 | 3.7 |
| Tatneft | 18 | 18 | 7.0 | 4.5 | 4.1 | 11.5 | 6.7 | 6.1 |
| Gazprom | 72 | 113 | 5.7 | 3.7 | 3.2 | 9.7 | 4.1 | 3.6 |
| Novatek | 58 | 49 | 8.7 | 6.3 | 6.4 | 27.0 | 12.6 | 13.0 |
| **Average** | | | **7.2** | **4.5** | **4.1** | **15.4** | **6.7** | **6.1** |
| **Peer average** | | | **10.4** | **5.6** | **5.1** | **28.7** | **15.7** | **12.4** |
| **Peer median** | | | **8.9** | **5.4** | **5.1** | **31.0** | **14.6** | **12.4** |

# A typical spreadsheet summary of a cashflow model



| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 15 | | | | | | | | | |
| 16 | | **Apple Unlevered Free Cash Flows** | | | | | | | |
| 17 | | **Period (t)** | | **2017A** | **2018P** | **2019P** | **2020P** | **2021P** | **2022P** |
| 18 | | | | | | | | | |
| 19 | | **EBITDA** | | **74,467** | **78,190** | **82,099** | **86,204** | **90,515** | **95,040** |
| 20 | | EBIT | | 67,343 | 70,710 | 74,245 | 77,957 | 81,855 | 85,948 |
| 21 | | Tax rate | | 26% | 26% | 26% | 26% | 26% | 26% |
| 22 | | | | | | | | | |
| 23 | | EBIT (1-t) | | 49,834 | 52,325 | 54,941 | 57,689 | 60,573 | 63,602 |
| 24 | | D&A | | 7,124 | 7,480 | 7,854 | 8,247 | 8,659 | 9,092 |
| 25 | | NWC | | (1,032) | (929) | (836) | (753) | (677) | (610) |
| 26 | | Capital expenditures | | (9,836) | | | | | (12,257) |
| 27 | | **Unlevered free cash flows (U** | | | | | | | |
| 28 | | | | | | | | | |
| 29 | | | | | 10% | 10% | 10% | 10% | 10% |
| 30 | | PV of UFCFs | | | 44,180 | 42,329 | 40,540 | 38,813 | 37,148 |
| 31 | | | | | | | | | |
| 32 | | **Sum of present values** | | | | | | | |

***Discount rate based on principle of time value of money***

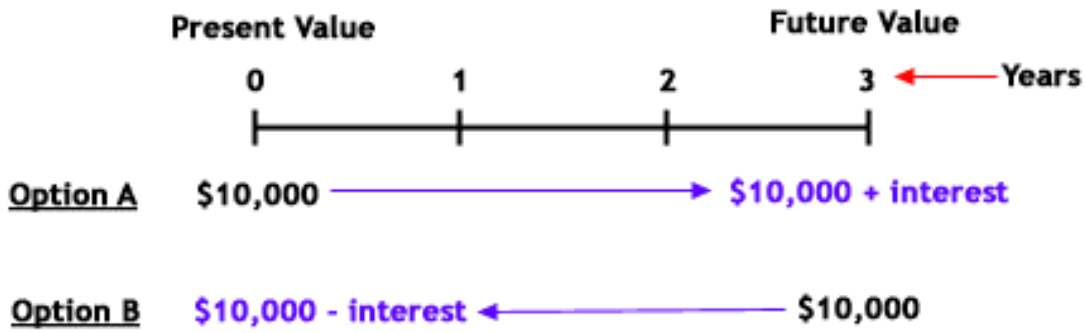
# Time Value of Money

- Money available at the present time is **worth** more than the **same** amount in the **future** due to its potential earning capacity.

- This **core** principle of finance holds that, provided money can earn interest, any amount of money is **worth** more the sooner it is received

- Equally, money available now can buy more than a similar amount of money available in the future because **inflation** erodes the value of money over time

# Time Value of Money Example




- If you had $10,000 today, you could earn interest on it
- Its future value is $10,000 x (1 + interest rate)$^{\text{No. of years}}$
- If interest rate is 5%, then $10,000 in 3 years is worth
  - $\$10{,}000 \times (1+.05)^3 = \$11{,}576$
- As a result, $10,000 in 3 years is not worth $10,000 now
  - $\$10{,}000 / (1+.05)^3 = \$8{,}638$
- Let's look at an example

# Impact of inflation

- I have $100
- A bar of chocolate costs $1
- Inflation is 5%
- In Year 1 I can buy 95 bars of chocolate
- By Year 6 the cost of a bar of chocolate has risen to $1.34

| | Money in wallet | Cost of chocolate | Chocolate bars |
|---|---|---|---|
| Year 1 | 100 | 1.05 | 95 |
| Year 2 | 100 | 1.10 | 91 |
| Year3 | 100 | 1.16 | 86 |
| Year 4 | 100 | 1.22 | 82 |
| Year 5 | 100 | 1.28 | 78 |
| Year 6 | 100 | 1.34 | 75 |

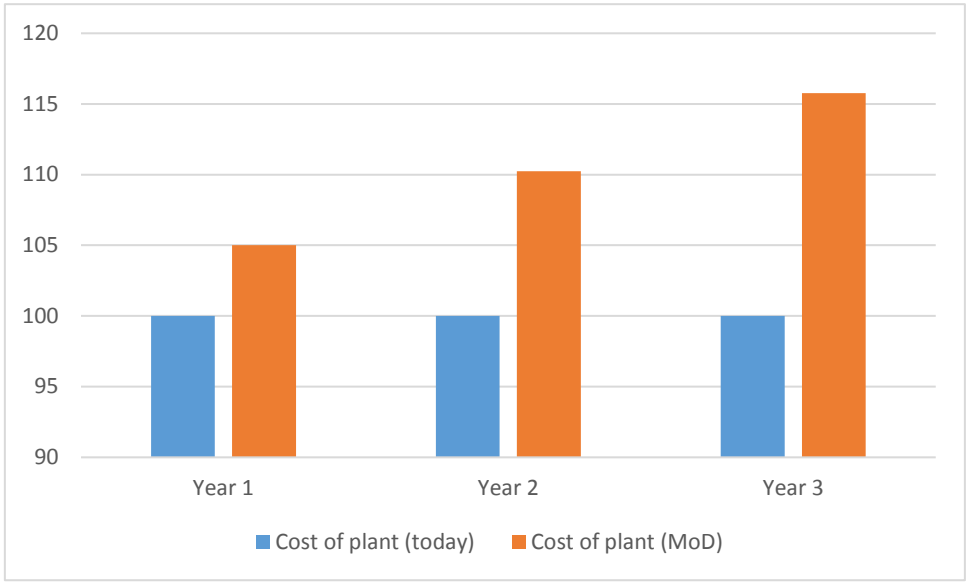
# Inflation and interest rates

- I have $500
- Inflation is running at 4% per annum, and the interest rate is 5%
- I want to purchase printer ink, which costs $5 per cartridge
- How many fewer cartridges can I buy in 7 years time than now if I just keep my $500 in my wallet?
- If I put my $500 in an interest bearing account, how many cartridges could I buy in 4 years time?

# Real and Nominal Figures

- Nominal cashflows include the impact of inflation
- They are called Money of the Day (MoD) because they reflect the actual worth in a certain year
- If we were forecasting the cost of a project, for example, we would need to add inflation to each year as we moved across the time horizon
- This is relevant for multi-year developments when parts are being purchased over time

# Nominal Costs Example




| | Year 1 | Year 2 | Year 3 | Total |
|---|---|---|---|---|
| Cost of plant (today) | 100 | 100 | 100 | 300 |
| Cost of plant (MoD) | 105 | 110 | 116 | 331 |

- Costs will rise over time because of inflation (in this example 5% per annum)

# Using “Real” figures makes life easier

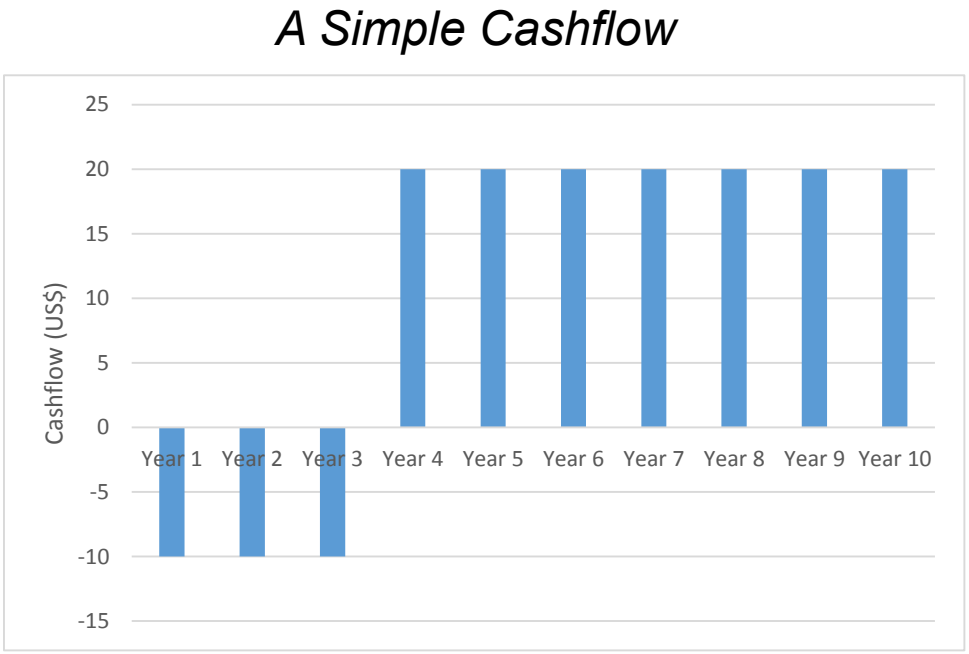
- When making assumptions in nominal, every figure needs to take an inflation assumption into account
- This can make things very complex
- To make life easier, we can just assume that our model is in “today’s money” – otherwise known as “in real terms”
- Generally, we would define all the figures as being in (e.g.) US$2023
- All figures in the cashflow will be lower as a result, and so it is important to define how the model is considering inflation

# Real and Nominal Figures

- Question 1
  - The cost of a plant is $500mm spent equally over 5 years in real (2023) terms
  - Inflation throughout the period is forecast to be 2.5% per annum
  - What is the expenditure on the plant in nominal terms in Year 5 and what is the total nominal cost?

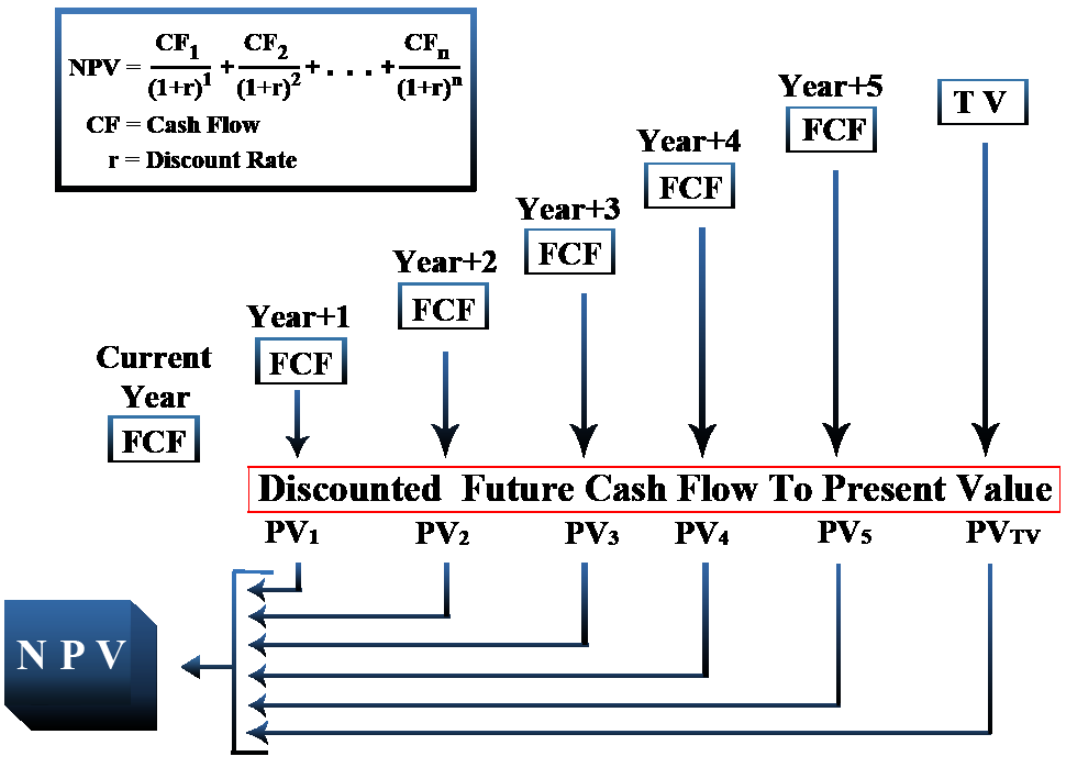
- Question 2
  - We are assuming that the oil price is $90 in real (2023) terms
  - Inflation is assumed to be 2% per annum
  - What is the real oil price in Year 5?
  - What is the nominal price in Year 5?

# Discounted Cashflow



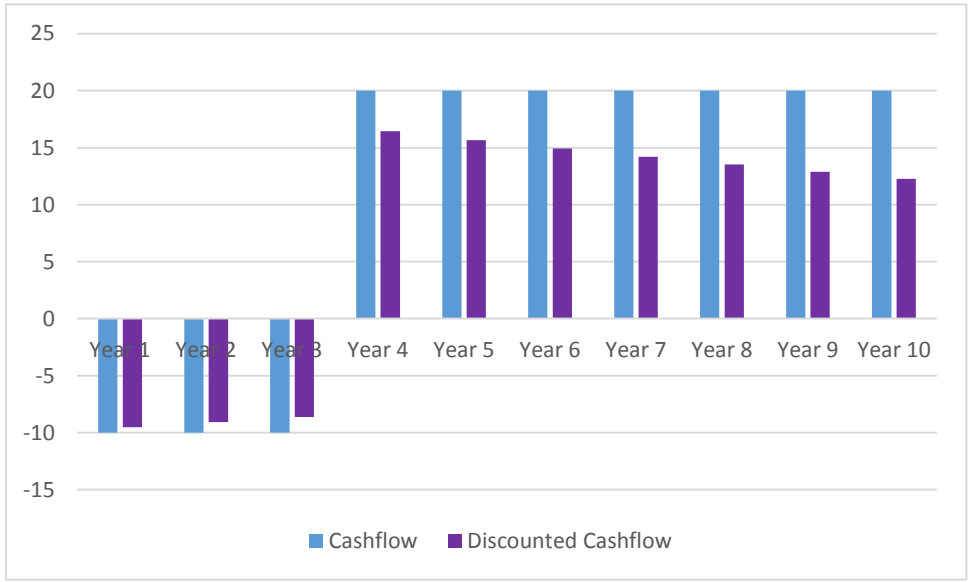

- In Year 0 (today), I decide to invest $30mm over 3 years in a plant that will run for 7 years, generating $20mm per year
- The plant will then be dumped
- What is the value (worth) of this investment in today's terms (assuming 5% interest rate)?

# The DCF Calculation as a foundation




- Management thought process is encapsulated in the DCF model
  - Key assumptions include price, cost, tax, long-term outlook, short-term cashflow and the value of money
- Management must ensure at all times that the combined value of their assets remains NPV positive, and should aim to maximise the return on their assets

# Discounted Cashflow Example



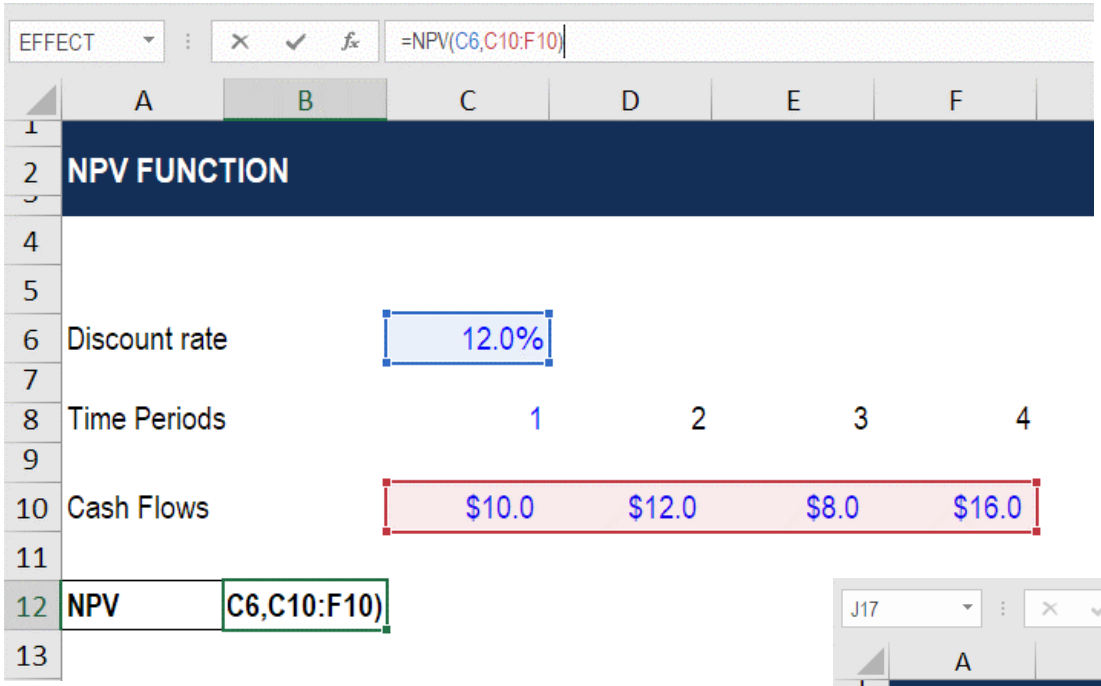

| | Today | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cashflow | 0 | -10 | -10 | -10 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Discount factor | 1 | 1.05 | 1.10 | 1.16 | 1.22 | 1.28 | 1.34 | 1.41 | 1.48 | 1.55 | 1.63 |
| Discounted Cashflow | 0 | -9.52 | -9.07 | -8.64 | 16.45 | 15.67 | 14.92 | 14.21 | 13.54 | 12.89 | 12.28 |
| Total Value | 72.74 | | | | | | | | | | |

- The further away that money is earned (or spent) the less worth (value) it has today
- We discount future cashflow by a factor reflecting the other options we had for using the initial funds
- If the total sum of negative and positive cashflow is positive then the investment is worth making

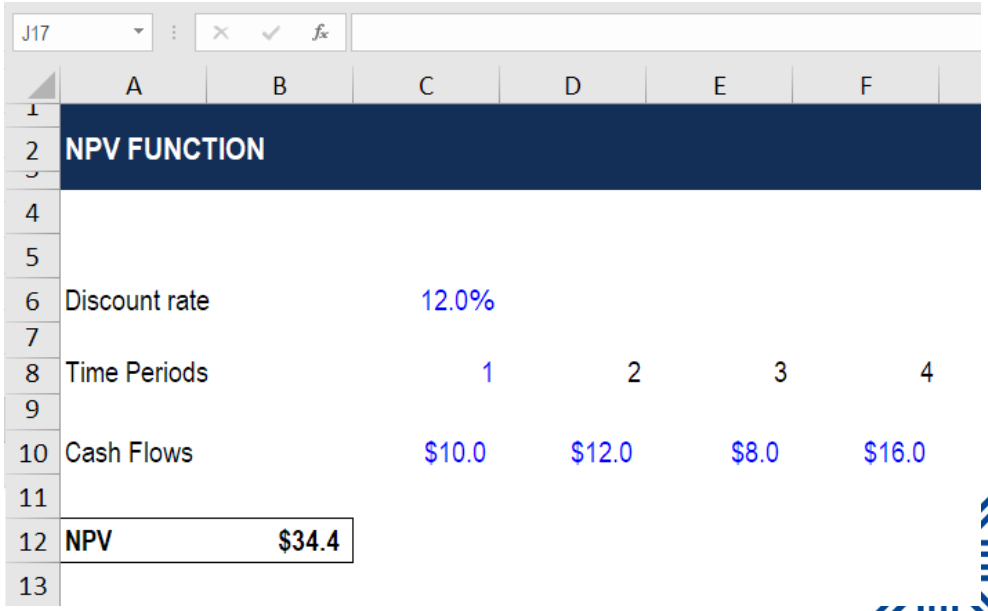
# A Good Explanation from Harvard

- https://hbr.org/2014/11/a-refresher-on-net-present-value

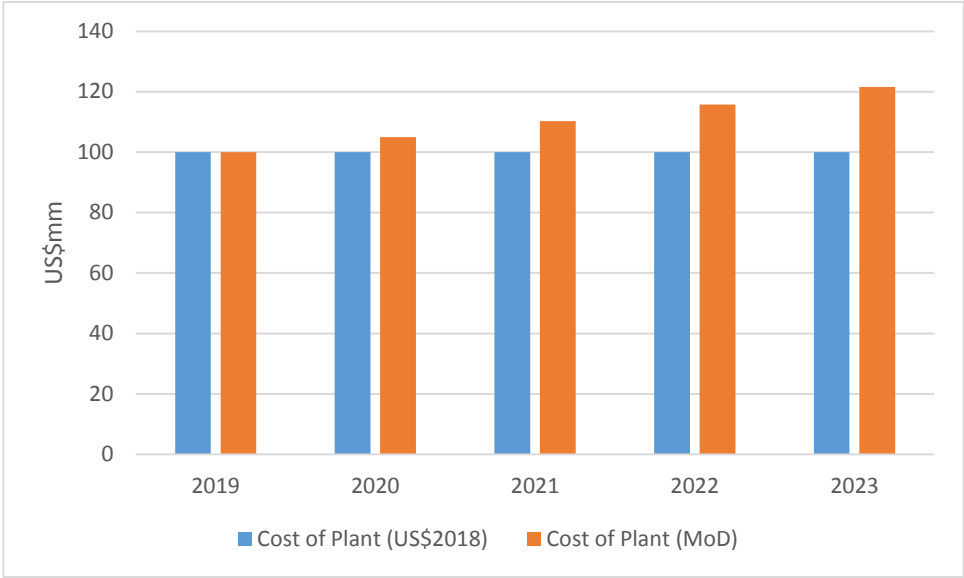
# Functionality in Excel




- The NPV function in Excel makes life very easy
- =NPV(discount rate, range of net cashflow)



# Real vs Nominal Cashflow and NPV




| | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|
| Cost of Plant (US$2018) | 100 | 100 | 100 | 100 | 100 |
| Cost of Plant (MoD) | 100 | 105 | 110 | 116 | 122 |
| NPV (Real) | 433 | | | | |
| NPV (MoD) | 476 | | | | |

- To make our lives easier, all our modelling will be carried out in real terms
- Our expectations of return should therefore be lower

# Construct a simple cashflow model

- All figures in US$2022 (Real)
- Capital costs - $600 over 3 years
- Revenues – start in year 4, $100 per year from year 4 to year 20
- Operating costs - $20 per year starting in year 4 until end of operations
- Discount rate 10%