# ITU Expert-Level Training on Network Cost Modeling for Asia and Pacific Countries Level II

# Valuation
# Mobile networks

**Bangkok, Thailand, 15-19 November 2010**

*Note: The views expressed in this paper are those of the author and do not necessarily represent the opinions of ITU or its membership. The terms and definitions used are the author's own and can on no account be regarded as replacing the official ITU definitions.*

# The level of cost of capital is important for all mobile costing models.

## Weighted average cost of capital (WACC)

- Background
  - WACC introduction
  - WACC formulas
  - WACC components
    - WACC cost of equity
      - CAPM illustrated
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  - Parameters
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    - Beta - formula
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# Valuation introduction.

## Valuation introduction

- The cost of an operator's asset base can be divided into two elements – the opportunity cost of the investment ("the cost of capital") and the depreciation of the asset base. In order to determine the level of these costs, a valuation or depreciation methodology is used in a model.

*Source: GSMA*

# Valuation introduction.

## Economic depreciation

- Economic depreciation can be defined as the depreciation methodology that will result in the written-down value of an asset10 at any point in time being equal to the net present value of the cash flows it will generate in the future. This outcome would be expected in the event that there is perfect competition in the equipment market as well as the market in which the output of the asset is consumed.

- An alternative proxy for economic depreciation is annuity-based depreciation. A flat annuity-based depreciation methodology will result in the cost recovery for an asset, i.e. the depreciation plus the return on capital, being equal in every period of the asset's life. This is a sensible outcome when output, operating costs and equipment prices are stable.
- In the event that equipment prices are expected to change over the life of the asset, a tilt can be applied to the formula to ensure that the cost recovery in any period is equal to the cost recovery that a new entrant would seek having purchased a new asset.

*Source: GSMA*

# Valuation introduction.

## Straight line depreciation

- Straight-line depreciation divides the asset's price by the asset's life to produce an annual depreciation charge. To calculate the annualization charge, a capital charge is added. The straight-line depreciation charge will typically be higher than the economic depreciation charge in the early years of an asset's lifetime except where operating costs are rising very rapidly or output levels produced by an asset decrease rapidly as the asset becomes older. A further related limitation with this approach is that the annualization charge depends on the vintage of the assets being considered.

*Source: PTS*

# Valuation introduction.

## Tilted annuity depreciation

- The annuity approach calculates a single charge that replaces the depreciation charge and the capital charge.
- A standard annuity calculates the charge that, after discounting, recovers the asset's purchase price and financing costs in equal annual sums.
- If the price of the asset is expected to change over time, a tilted annuity would be more appropriate. A tilted annuity calculates an annuity charge that changes between years at the same rate as the price of the asset is expected to change. This results in declining annualization charges if prices are expected to fall over time.
- The tilted annuity charge is estimated according to the following formula:

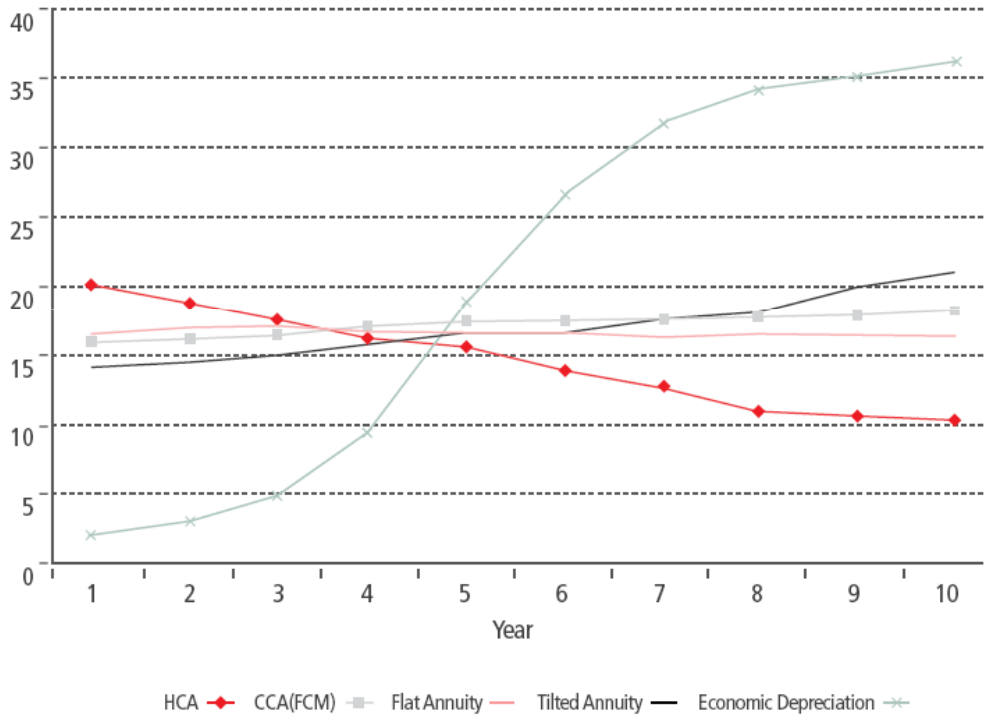
Where:
- r = cost of capital
- p = rate of price change ("tilt")
- t = asset lifetime
- I = investment.

$$\frac{r-p}{1-\left(\frac{1+p}{1+r}\right)^{t}} \times I$$

*Source: PTS*

# Cost recovery.

## Cost recovery under different depreciation profiles.



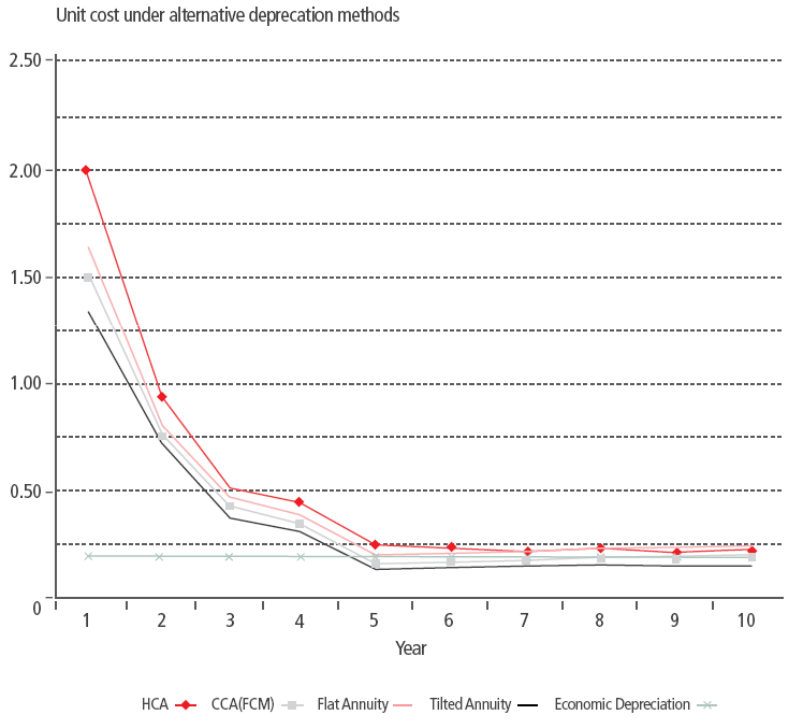

We have used a simple example to show the different cost recovery profiles that are observed for a single asset that has a useful life of ten years and whose price increases by 5% per annum and where outputs increase as set out in the figure.

The graphs below show the cost recovery profiles under HCA, FCM, Flat Annuity, Tilted Annuity and Economic depreciation as well as the unit cost. It should be noted that for simplicity, we show an economic depreciation profile that only takes into account the demand for the asset over its life. This is to show the impact economic depreciation has on unit costs. In practice, we would expect to an economic depreciation methodology to also reflect the extent to which the asset's replacement cost changes over its life.

*Source: GSMA*

# Cost recovery.

## Cost recovery under different depreciation profiles.




*Source: GSMA*

# Cost recovery.

## Cost recovery under different depreciation profiles.

| | |
|---|---|
| UEL (years) | 10 |
| WACC | 10% |
| Price trend | 5% |
| Investment | £100 |

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Demand (million minutes) | 10 | 20 | 40 | 80 | 160 | 240 | 280 | 300 | 310 | 320 |

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| HCA depn | £10 | £10 | £10 | £10 | £10 | £10 | £10 | £10 | £10 | £10 |
| Capital cost | £10 | £9 | £8 | £7 | £6 | £5 | £4 | £3 | £2 | £1 |
| Total cost | £20 | £19 | £18 | £17 | £16 | £15 | £14 | £13 | £12 | £11 |
| Unit cost | £2.00 | £0.95 | £0.45 | £0.21 | £0.10 | £0.06 | £0.05 | £0.04 | £0.04 | £0.03 |
| NVP | £100 | | | | | | | | | |

*Source: GSMA*

# Cost recovery.

## Cost recovery under different depreciation profiles.

| | |
|---|---|
| UEL (years) | 10 |
| WACC | 10% |
| Price trend | 5% |
| Investment | £100 |

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| FCM depreciation charge | £11 | £12 | £13 | £14 | £15 | £17 | £18 | £20 | £21 | £23 |
| Holding Gain/Loss | -£5 | -£5 | -£6 | -£6 | -£6 | -£6 | -£7 | -£7 | -£7 | -£8 |
| Cost capital | £10 | £9 | £9 | £8 | £7 | £6 | £5 | £4 | £3 | £2 |
| Total cost | £16 | £16 | £16 | £16 | £16 | £17 | £17 | £17 | £17 | £17 |
| Unit cost | £1.55 | £0.79 | £0.40 | £0.20 | £0.10 | £0.07 | £0.06 | £0.06 | £0.05 | £0.05 |
| NPV | £100 | | | | | | | | | |

*Source: GSMA*

# Cost recovery.

## Cost recovery under different depreciation profiles.

| | |
|---|---|
| UEL (years) | 10 |
| WACC | 10% |
| Price trend | 5% |
| Investment | £100 |

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Flat Annuity | £16 | £16 | £16 | £16 | £16 | £16 | £16 | £16 | £16 | £16 |
| Unit cost | £1.63 | £0.81 | £0.41 | £0.20 | £0.10 | £0.07 | £0.06 | £0.05 | £0.05 | £0.05 |
| NPV | £100 | | | | | | | | | |

*Source: GSMA*

# Cost recovery.

## Cost recovery under different depreciation profiles.

| | |
|---|---|
| UEL (years) | 10 |
| WACC | 10% |
| Price trend | 5% |
| Investment | £100 |

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Economic depreciation | £13 | £14 | £15 | £16 | £16 | £17 | £18 | £19 | £20 | £21 |
| Unit cost | £1.34 | £0.71 | £0.37 | £0.19 | £0.10 | £0.07 | £0.06 | £0.06 | £0.06 | £0.07 |
| NVP | £100 | | | | | | | | | |

*Source: GSMA*

# Cost recovery.

## Cost recovery under different depreciation profiles.

| | |
|---|---|
| UEL (years) | 10 |
| WACC | 10% |
| Price trend | 5% |
| Investment | £100 |

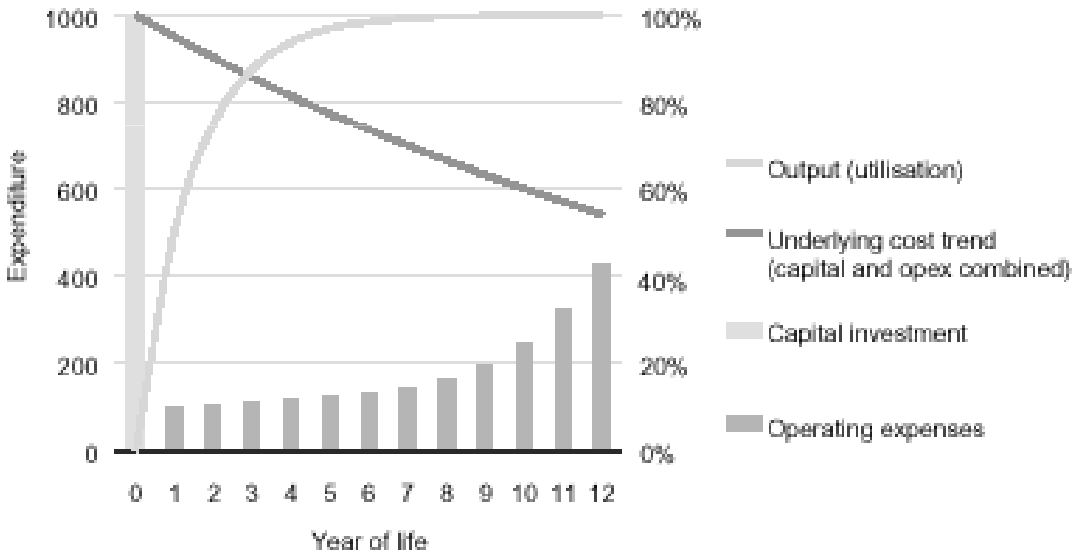
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Economic depreciation | £1 | £2 | £5 | £9 | £18 | £27 | £32 | £34 | £35 | £36 |
| Unit cost | £0.11 | £0.11 | £0.11 | £0.11 | £0.11 | £0.11 | £0.11 | £0.11 | £0.11 | £0.11 |
| NVP | £100 | | | | | | | | | |

*Source: GSMA*

# Economic depreciation.

## Economic depreciation

- The question to be addressed is:
- What time-series of prices, consistent with trends in the underlying costs of production, yield an expected NPV (net present value) of zero over the period of interest?

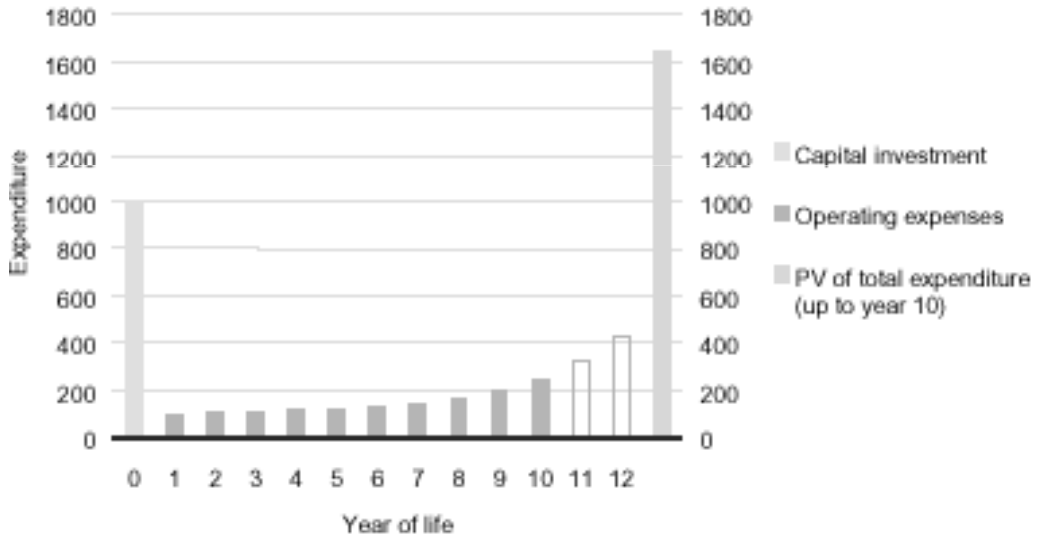



*Source: Analysys*

# Economic depreciation.

## Economic depreciation

- First calculate the total expenditure
- (we will initially assume a lifetime of 10 years)

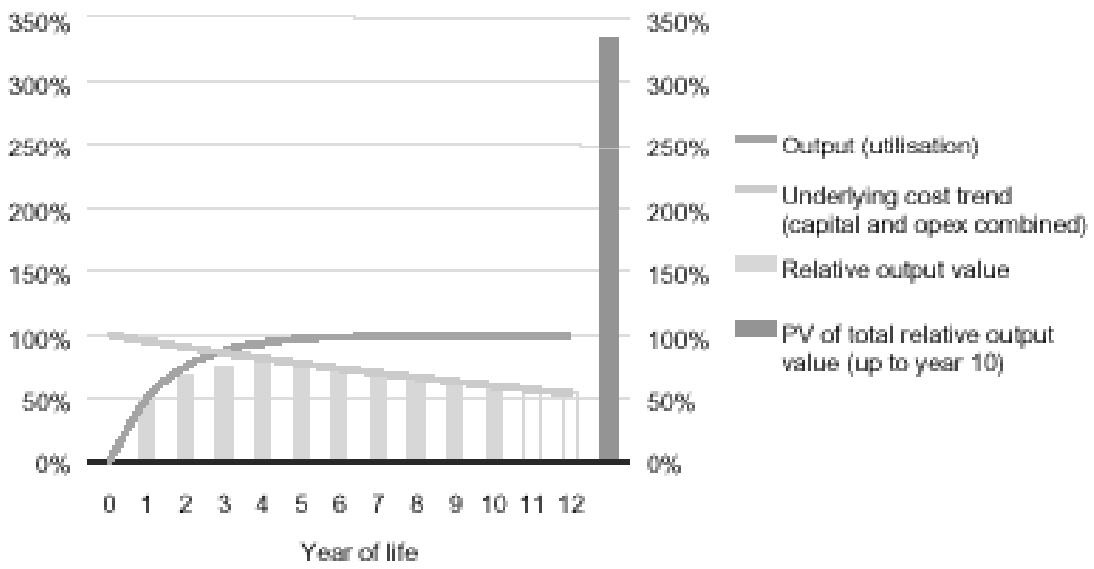



*Source: Analysys*

# Economic depreciation.

## Economic depreciation

- ...then calculate the total relative output value
- (assuming the same lifetime of 10 years)

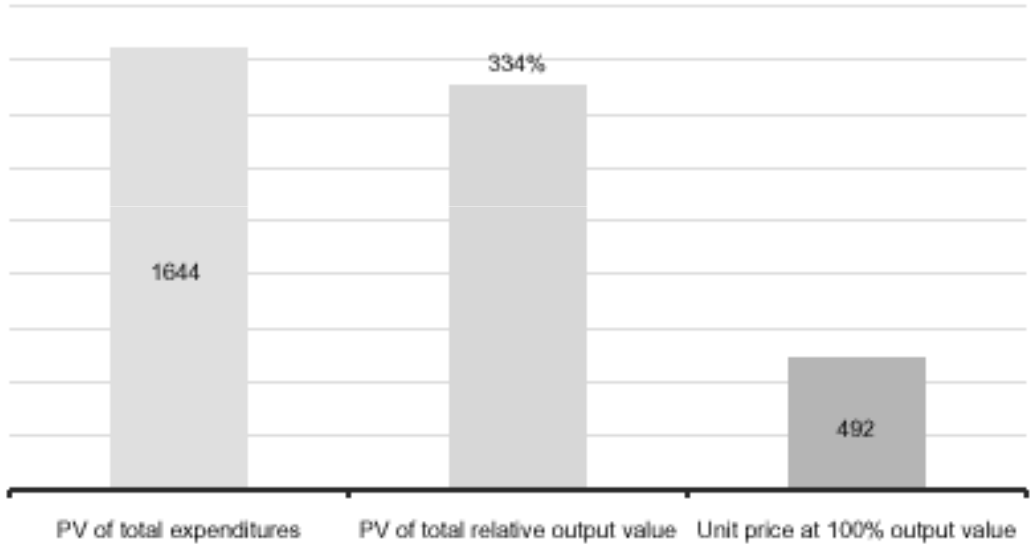



*Source: Analysys*

# Economic depreciation.

## Economic depreciation

- Divide one by the other to yield the unit price for a relative output value of 100%

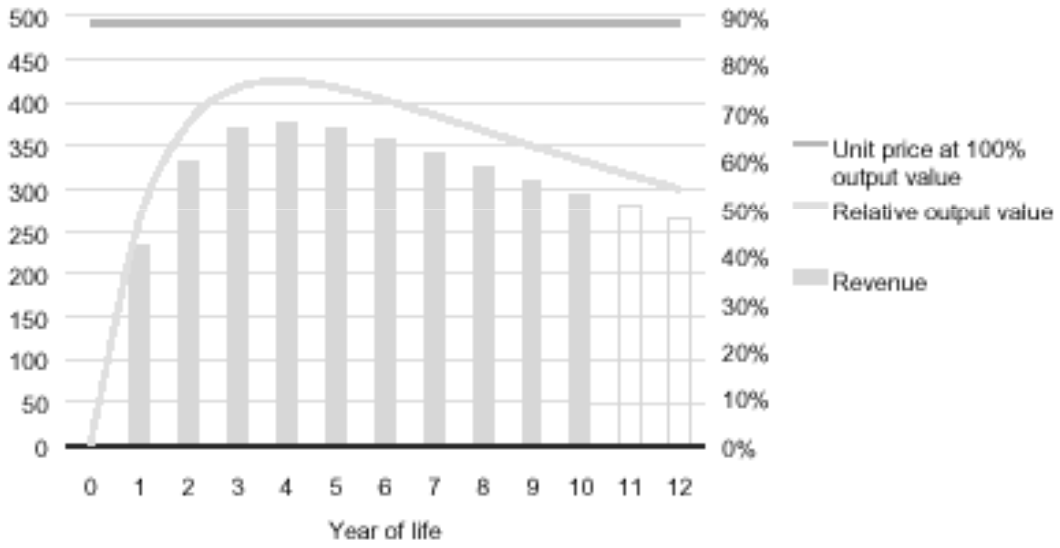



*Source: Analysys*

# Economic depreciation.

## Economic depreciation

- Multiply this by the relative output value in each year to yield annual revenues

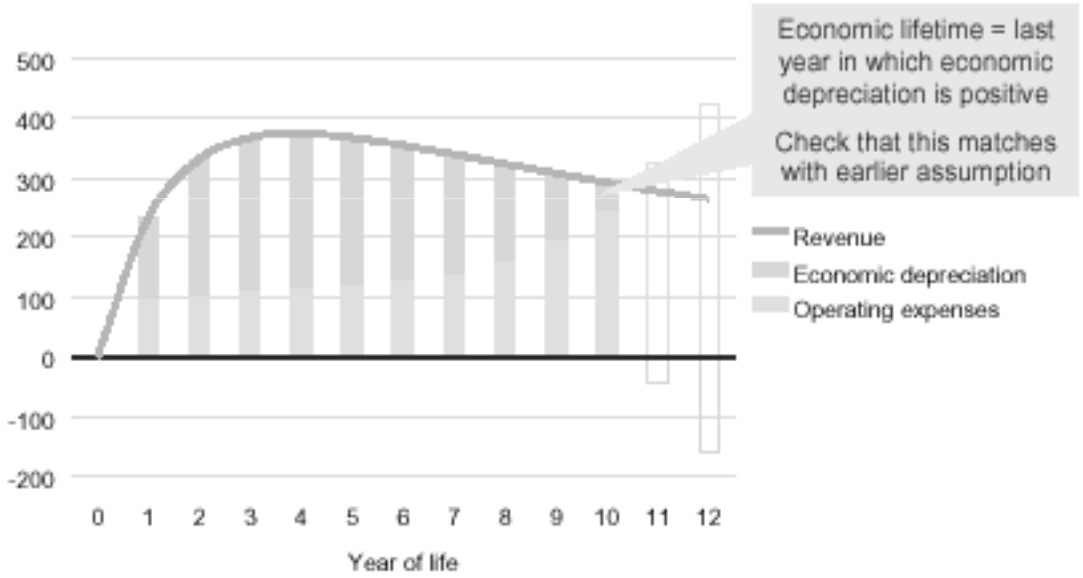



*Source: Analysys*

# Economic depreciation.

## Economic depreciation

- Economic depreciation is then the difference between revenues and operating expenses

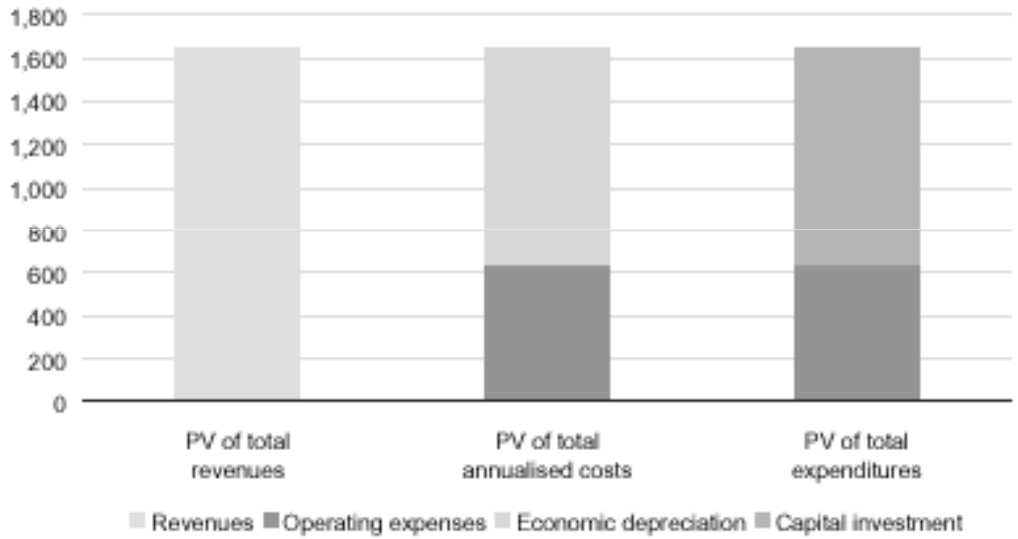



*Source: Analysys*

# Economic depreciation.

## Economic depreciation

- Check that everything is consistent!




*Source: Analysys*

# Mobile valuation references.

## Mobile valuation – references

- Analysys, Calls to mobile: economic depreciation, 2001
- GSMA, The setting of mobile termination rates: Best practice in cost modelling, 2008

*Source: Belfin*