Capital charge – Tool for economic screening purposes

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1. Background

A comprehensive economic analysis of a (bauxite and alumina) project requires developing yearly Discounted Cash Flows (DCF – refer section 4) for the lifetime of the project, accounting for operating and capital costs (opex and capex), construction period, production capacity build-up, alumina price, plant depreciation period, tax rate, discount rate for the calculation of the Net Present Value (NPV), etc. However, when an assessment of the economics of a potential project in its early phase or a preliminary comparison of several project options is required, the necessary time to execute such an exercise is often not available and / or its accuracy not needed.

This article describes a useful tool to screen a (list of) potential project(s), e.g. test it against a target IRR (Internal Rate of Return) hurdle rate, when (indicative) capex and opex values are known, without generating a full DCF analysis.

2. Net Present Value (NPV) and capital charge

The NPV is the sum of a project's annual cash flows at a selected discount rate which depends on the industry and includes the cost of capital and a risk element (refer section 4).

As illustration Table 1 shows at three discount rates the NPV of the sum of discounted cash flows of USD100/yr based on the following assumptions:

- Project construction time: three years, starting next year.
- Full production from operating year 1 onward.
- Capital depreciation period: 20 years.
- Project evaluation period: 30 operating years after construction.
- Corporate income tax rate: 30%, no tax holiday.

Discount rate[1] (%)	NPV of USD100/yr cash flows over 30 year period[2] ($)
8	626
10	496
12	401

[1] Representing project hurdle rate (e.g. minimum IRR),
[2] After three years of construction, and after 30% tax

Table 1: Net present value of USD100/yr cash flows over a 30-year period

In other words, annual cash flows of USD 100/yr starting after three years of construction during an operating period of 30 years represents the same value as USD496 today, when applying a discount rate of 10%. Stated differently: at a discount rate of 10% an expense of USD496 today is compensated by annual cash flows of USD100/yr during an operating period of 30 years starting after three years of construction. It would be tempting to assume that the same applies to a capital expenditure of USD496 today. However this is not the case because a capital depreciation period is included (applicable to most projects). During this period the capital investment is generally equally spread and tax deductible (refer section 4). In the current analysis a depreciation period of 20 years has been assumed (typical for many bauxite and alumina projects), meaning that 5% of the capital investment per year is tax deductible for this period of time. The consequence is that a capital expenditure of USD676 may be made (instead of USD496), and still achieve an IRR of 10%. Along the same line capital expenditures of USD843 (instead of USD626) and USD557 (instead of USD401) may be made, and still achieve IRR's of 8% respectively 12% (compare numbers in Table 1).

Or putting it differently, and expressing everything per tonne of product: if opex USD/t plus USD100/t 'capital charge' = 'full cost USD/t' of a project were exactly equal to the (assumed) unit price of the product sold, for instance USD676/t, the IRR of the project would be 10% based on the above. And if the full cost were less than the price for the project's lifetime, the IRR of the project would be more than 10%, equal to saying that the NPV (10%) would be positive.

In other words by adding a 'capital charge' in this example of ~15% of the capex (= 100/676*100%), expressed in USD/t product to its average annual opex, a full cost is obtained providing a practical method to check if the project meets (in this example) a hurdle rate of 10% IRR based on the above mentioned assumptions.

The capital charge (expressed as percentage of project capex to be added to the opex – both expressed as USD/t_A) required to test a project against a target IRR (project hurdle rate) is shown in Table 2, which also includes an approximate range of the capital charge, reflecting the following variables:

- Project evaluation period (25-30 yr)
- Investment capital phasing (1st yr / 2nd yr / 3rd yr – 20% / 70% / 10% and 33% / 33% / 33%)
- Capital depreciation period (15-20 yr)
- Tax rate (25-35%)

Target IRR (%)	Capital charge to be added to opex for screening purposes (% of project capex)	Approx. capital charge range[1] (% of project capex)
6	9.2	8.9-9.9
7	10.5	10.1-11.2
8	11.9	11.4-12.5
9	13.3	12.7-14.0
10	14.8	14.1-15.6
11	16.3	15.6-17.2
12	18.0	17.1-19.0

[1] Reflecting different evaluation periods, tax rates, depreciation periods, capital phasing, etc.

Table 2: Capital charge as function of targeted IRR

The full cost (in USD/t_A) arrived at by adding the opex (in USD/t_A) of a project to the relevant capital charge (expressed as USD/t_A) may also be used for screening purposes to compare with full costs of other project options obtained on the same basis.

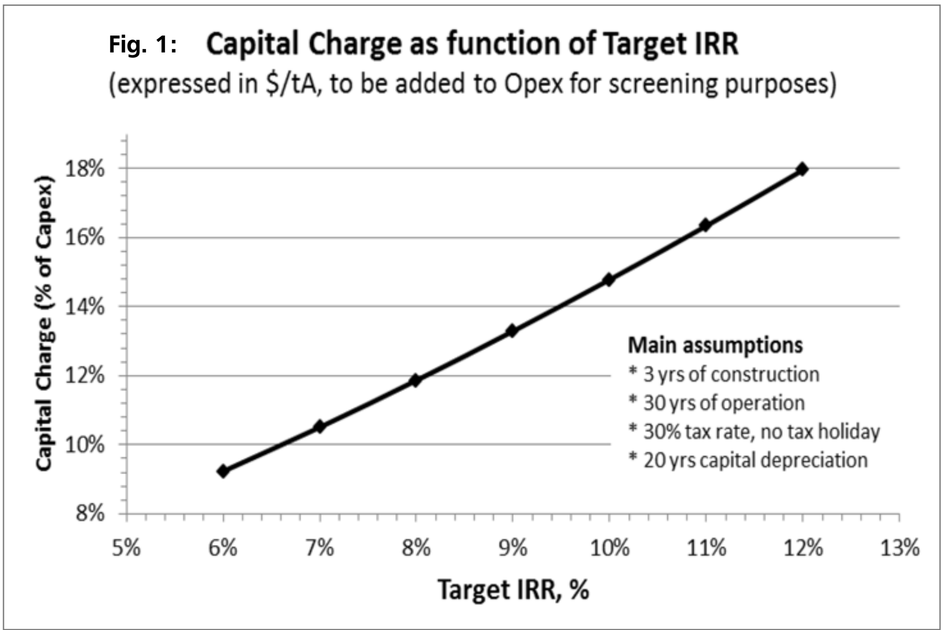
Fig. 1 graphically shows the capital charge as function of target IRR.

3. Example

Assume a screening hurdle rate of 8% IRR and a long-term alumina price of USD360/t_A, with other assumptions as above. Will the

Project	Average annual opex ($/$t_A$)	Capex ($/annual t_A)
A	180	1,400
B	200	1.350
C	220	1,150

Table 3: Project examples (numbers per tonne alumina)



following bauxite and alumina projects of 1 million tpy of alumina production (see Table 3) meet this hurdle rate and which one is the most attractive?

Applying the above approach a 'full cost' can be calculated as shown in Table 4.

Project	Average annual opex ($\$/t_A$)	Capital charge at 11.9% of capex[1] ($\$/t_A$)	Full cost ($\$/t_A$)
A	180	167	347
B	200	161	361
C	220	137	357

Table 4: Full cost comparison

[1] To meet the 8% IRR hurdle rate – refer Table 2

Table 4 shows that only projects A and C meet the hurdle rate of 8% IRR minimum (full cost of both is less than the assumed alumina price of USD360/t_A). And project A ranks higher than C because its full cost is less than that of project C.

4. Glossary

Discounted Cash Flow (DCF) analysis is a method to evaluate the attractiveness of an investment opportunity by estimating future cash flows and taking into consideration the time value of money (also called capitalisation of income). The DCF analysis estimates future cash flows and discounts them to arrive at a present value which is used to evaluate the potential for investment – the sum of all future cash flows, both incoming and outgoing, is the net present value (NPV), which is taken as the value or price of the cash flows in question (see below). If the value arrived at through DCF analysis is higher than the current cost of the investment, the opportunity may be attractive.

Net Present Value (NPV, M$) is the sum of a project's annual cash flows at a selected interest/discount rate, e.g. NPV(8%). The discount rate depends on the industry sector and ordinarily includes the cost of capital and a risk element. Risks in this context include technical risks (e.g. geological, operational), economic risks (e.g. deteriorating fiscal climate), and political risks (e.g. political stability of a country). In the bauxite and alumina industry the discount rate typically ranges from about 5-12%. The NPV measures how much value is added or lost and is often used as prime criterion to assess the attractiveness of an investment. It is a central tool in the DCF analysis and is a standard method for using the time value of money to appraise long-term projects.

Internal Rate of Return (IRR, %) is the discount percentage at which NPV equals zero. The IRR may be considered a measure of the 'quality' of an investment.

Capital depreciation: the gradual reduction of an asset's value. It is an expense, but because it is non-cash, it is often effectively a tax write-off; that is, a company usually may reduce its taxable income by the amount of the depreciation on the asset, thus providing a source of free cash flow.

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