# SME'S ENVIRONMENTAL CSR INVESTMENT: EVALUATION, DECISION AND IMPLICATION[1]

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## Abstract

Corporate social responsibility (CSR) is a voluntary yet competitive activity which affects business value. Together with growing concern towards CSR related to environmental issues such as climate change, environmental CSR has attracted many to involve especially small- and medium-sized enterprises (SMEs) as they are seen as the best entity to perform it compare to large corporations. As a primary contributor to green house gas (GHG) emission, SMEs have bigger responsibility to participate for cleaner environment. However, with limited capacity, it is difficult for SMEs to decide between social responsibility and profitability. Limited investment valuation methods add to the complexity. To overcome such barrier, this paper builds up a proposal based on real option valuation (ROV) as a solution that improves small businesses decision making processes in choosing investments that deal with both issues: profitability and CSR, with focus on climate change, a branch of environmental CSR. By incorporating uncertainties and providing flexibility, ROV is able to balance up SMEs' profitability and CSR activities through the creation of strategic options. Based on a case study, it is hope that findings of this paper lighten up these dilemmas and none of SMEs' objectives is sacrificed.

Keywords: Corporate social responsibility, real options, SMEs

JEL: G11, G31, M14

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## 1. INTRODUCTION

Corporate social responsibility (CSR) is also known in many various terms such as corporate conscience, corporate citizenship, corporate social performance and sustainable responsible business (Wood, 1991). It is a form of corporate self regulated mechanism which is integrated into business model to ensure active compliance with law, ethical standards and international norms. Managers are aware that realization towards CSR activities can mitigate corporate crises and build reputations as the perceived value of CSR upon creation of business value has increased. Upon realization on the goodwill and reputation of CSR, small- and medium- sized enterprises (SMEs) are looking forward to search for definitive, value for money based formulae to gain managerial reputation. There is also awareness that in some cases "*SMEs are better placed to take advantage of CSR programs"* (Sarbutts, 2003).

On the other hand, Lord Sieff, the former chairman of Marks and Spenser plc has stated that, *"business only contributes fully to a society if it is efficient, profitable and socially responsible"* (Cannon, 1992, p 33). The statement is parallel with Wood (1991) who has stated that the basic idea of CSR is when business and society are interwoven rather than distinct entities.

CSR has a wide area of coverage. CSR Europe[2] for instance has issued a guideline which segregate CSR according to focus activities in its reporting requirement. CSR activities should belong to one of these categories:

- Workplace (employees);
- Marketplace (customers, suppliers);
- Environment;
- Ethics; and
- Human rights.

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[2] CSR Europe is a membership organisation that consists of 70 multinationals corporations and 31 national partner organisations which initially established to address European problems of structural unemployment, restructuration and social exclusion in 1995. Today, the organisation is committed to develop innovative business practices and work together to provide solutions to emerging societal needs.

Results of McKinsey survey[3] conducted in 2008 have similar segregation. The survey also found that most managers regardless of size and industry have expected that CSR relating to environmental programs create more value in the next five years.

However, the positive developments in integrating CSR among businesses have led to a problem in realizing the value stemming from such activities. The problems are faced by all firm sized, not only restricted to SMEs. CSR professionals and consultants interviewed in the McKinsey survey appeared to be unsure of what number to be put as value added resulting from the integration. Not only that, they also reported that they do not have any idea of what are the effects that such programs have on value creation. The lack of certainty in this matter has diverted CSR professionals to focus on the social benefits rather than financial value.

In order to see how CSR may affect business value, it is suggested that a new methodology to value the activity is explored. World Business Council for Sustainable Development (WBCSD, 1999), for example, has sought to develop a clear understanding of CSR besides to produce materials and resources on how to measure CSR and report their impact on society. For that purposes, a matrix of CSR indicators is suggested. This concern is again emphasized in the recommendations suggested by McKinsey survey which has lined that, "*A clear first step would be to develop metrics that focus on integrating the financial effects on environmental, social and governance programs with the rest of the company's finances*" (McKinsey Global Survey Result, 2009, p 9). Yet, how to measure the value or benchmark it against other is still a question mark.

To deal with the above dilemma, it is important to firstly identify how uncertainties related to CSR should be treated. Any solution to the question would allow a figure to be recognized as value added by CSR activities and, hence, increase the value of the business. In order to explore into this issue, a specific CSR activity of dealing with

[3] McKinsey Survey was conducted in conjunction with Boston College's Center for Corporate Citizenship. It collects responses from 238 CFOs, investment professionals and finance executives from various ranges of industry and region in United States, simultaneously with 127 CSR professionals and institutional investors.

climate change undertaken by small businesses in steel industry has been put into focus. As mentioned earlier, environmental CSR is predicted to create more value in the future. Therefore, with many growing concerns supported with the increasing number in climate change activities, such as scientific research, regulations, social awareness and education, it is worth looking into the issue. For that matter, this research intends to answer these following questions:

- How real options assist small businesses to incorporate uncertainty arisen from climate change in capital budgeting process?
- How SMEs managers are able to plan for strategic considerations arising from environmental CSR activities, especially in the issue of climate change?

In order to solve the above issues, it is suggested that real option valuation (ROV) is applied. Real option theory allows for a strategic view of CSR and suggests that CSR should be negatively related to the firm´s ex-ante downside business risk (Husted, 2005). Instead of looking at CSR issue as a whole, this research considers only a branch of CSRs – i.e. SMEs compliance to international environmental norms towards climate change. It is hope that this research is able to provide strategic intuition for SMEs managers in deciding about CSR activities. Taking investment in preventive technology towards global warming in the first step towards CSR integration as an example, ROV is applied as valuation method to provide quantitative intuition in decision making. Eventually, the valuation method is able not only to quantify CSR value added, but also to close the gap that exist between financial theory and strategic approaches (Myers, 1984), which have being admitted by many CSR professionals (McKinsey Survey).

Such approach is done by providing the element of flexibility in business activity. In order to do so, the research demonstrates how real option theory is used to obtain better understanding of environmental CSR, the related uncertainties and its impact on firm’s value. It also explores the potential of real option versus discounted cash flow (DCF) valuation method in finding better ways to mitigate environmental uncertainties.

The paper is organized as follows. The next section (Section 2) highlights literature review on real option valuation related to integration of CSR investment to deal with environmental issues of climate change. Section 3 illustrates the research design and the case. Section 4 presents the analysis of the option to switch and discusses the result. Finally, section 5 concludes the research.

## 2. LITERATURE REVIEW: REAL OPTION AND ENVIRONMENTAL CSR OF CLIMATE CHANGE

### *2.1. Climate change*

Global climate change has received a critical evaluation together with energy security issue as it widely affects human health, community infrastructure, eco-system, agricultural and economic activity. Mainly caused by fossil fuels combustion, the emission of greenhouse gasses (GHG) has increased atmospheric carbon dioxide levels which contribute to additional absorption and emission of thermal infra-red. The Intergovernmental Panel on Climate Change (IPPC) 2007 report states that "*most of the observed increase in globally averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations*[4]".

Besides the physical impacts described above, the indirect impact of climate change affects businesses' reputation and investment risk profile. The impacts are material yet unpredictable (Gars & Volk, 2003; Stern, 2006), hence they cause significant result on business environment (Cogan, 2004). Impact varies depending on business activities, location, sources of competitive advantage, existing assets portfolios and management capabilities (Austin & Sauer, 2003). Therefore, managers' strategic responses to climate change are important and act as additional determinant of firm's value in the future (Gars & Volk, 2003; Innovest, 2005). This is very true when it comes to growing small businesses looking for opportunities and striving to survive.

[4] Anthropogenic is a term denoting something caused or resulted by human activities. In this case, anthropogenic greenhouse gas concentrations is a term that indicates the portion of carbon dioxide in the atmosphere produced directly by human activities such as the burning of fossils fuels rather than by such processes of respiration and decay.

Nevertheless, the impact of climate change on business is highly uncertain (Austin & Sauer, 2003; Gars & Volk, 2003; Stern, 2006). Scientific and economic reports have identified that climate change has increased the global temperature ranging from 1.8 to 4.0 degree Celsius (IPPC, 2007). The consequences, according to Stern (2006), are that, if no prevention measure is exercised, the increase in temperature will cost, on overall, the equivalent of losing at least 5% of global gross domestic product (GDP) each year. Even worse, the risks and impacts could lead to higher reduction in GDP with minimum 20% in near future.

On the other hand, the availability of policies and regulation taken by governments to handle climate change issues remain unclear. With specific reference to private sectors, strategic response to climate change is difficult when it comes to financial decisions relevant to investment planning and risk mitigation. The conditions are even more complicated when private firms have no motivation because they operate in countries outside the list of Annex 1 of Kyoto Protocol[5].

Since the degree of uncertainty characterized by the impact of climate change is very high, strategic responses to value investment and risk mitigation become more complicated especially in predicting future cash flows and profiling investment risk. A specific financial valuation technique able to incorporate particular dimensions and challenges of climate change becomes therefore essential. Capital budgeting techniques bear the responsibility not only to capture future cash flow patterns of proposed investment but also to highlight risk associated with the investment, hence assisting management in making *sound* judgments on investment strategies.

### *2.2. Real Option in Climate Change*

In the early years, climate change valuation has been tackled with DCF valuation techniques (Austin & Repetto, 2000; Austin & Sauer, 2003: Gars & Volk, 2003). But DCF is unable to incorporate managerial flexibility to respond to the arrival of new

[5] Please refer to Appendix I for list of countries under Kyoto Protocol.

information and to changes in business environment over time (Mun, 2002). Consequently, DCF has proven to be short in dealing with uncertainties, and fails to connect to strategic importance and flexibility (Ross, 1995). Since these limitations were stated, practitioners and academicians started to look for alternatives.

Real option valuation (ROV) arises as a more comprehensive valuation methodology, capable of pricing rights using option theory and, therefore, valuing flexibility. This valuation technique is an extension of financial options theory, developed at its beginning by Black & Scholes (1973) for European options, Merton (1973) for American options and Cox & Ross (1976) for options on real assets. Seen as alternative to DCF, ROV started to gain attention already in the early 1980s. Since then, real option literature counts with many contributions, both theoretical as well practical applications to various cases in several economic fields. Brennan & Schwartz (1985), McDonald & Siegel (1985), Kemna & Vorst (1990), Myers & Majd (1990), Dixit & Pindyck (1994), Grenadier & Weiss (1997), and Cortazar, Schwartz & Salinas (1998) are among the contributions directly related to the evaluation of natural resource investments. Unlike DCF based valuation techniques, ROV accommodates changes and uncertainties, pricing flexibility in processes of strategic planning and investments which are being constantly re-evaluated (Mun, 2002).

ROV solutions are theoretically very complex, thus the theoretical explanation is beyond the scope of this paper. Sticking to the aim of tending to practical and managerial purposes, this paper deals with the analysis in a discrete time framework where standard binomial lattices and risk neutral probabilities are applied to price real options (Mun 2002, Schwartz & Trigeorgis, 2004, among many other authors).

When looking at the value of real options, several principles may be taken into account. These principles stem from basic relationships affecting variables that determine the price of financial options. When translated to the analysis of real investments using option theory, some particularly relevant are: (i) A real option is more valuable when the expiry date is longer. Holding the option for a longer period allows firms to wait for latest information and development before making any potential investment. (ii) A real option is at its higher value when the risk is greater. Owning certain options means the business risks are hedged against downside outcomes. (iii) Exclusive ownership increases the value of a real option, for example in the case of holding an option to patent a new design, product or process. (iv) Greater importance of uncertain future cash flows of the project also increases the option value. With these perspectives, real option methodology is used to conceptualize and value existing option(s), help future creation of further options with the objectives to hedge risks, reduce business hazard and leverage investments over time (Mun, 2002).

When dealing with climate change, real option carries various potential of applications. Firms may apply an *option to delay* investment in clean technology until market forces have proven its value, price of carbon credits (CER)[6] is justified, or new policy is further regulated. *Option to contract* is available in order to reduce carbon emissions when CER is expensive and unfeasible if operation reaches optimal level. An *option to abandon* is exercised when investment is no longer profitable due to continuously high emission and expensive penalty. When abandoning is not practical because current investment has the possibility for other usage that is related but more responsive to climate change policy, then firms may apply for an *option to `scope up´*. Above all, when investment is already employed, and there are chances that firm may choose greener and cleaner technology, the first option that should come into consideration is an *option to switch*.

The application of the above options can be found in many studies related to environmental evaluation such as valuation of investments towards green technology, renewable energy and carbon pricing. For example, Bastian-Pinto, Brandão & de Lemos Alves (2010) use switching option to alternate usage of fuel and ethanol as source of power. Van der Maaten (2010) uses real options to evaluate investment in a solar hot water system and Kumbaroglu, Madlener, & Demirel (2008) study the deferral option in investments of renewable power generation technologies.

[6] CER is a **carbon credit** generic term for any tradable certificate or permit representing the right to emit one tonne of carbon dioxide or the mass of another greenhouse gas with a carbon dioxide ($tCO_2e$) equivalent to one tonne of carbon dioxide (Collins English Dictionary, 2009).

In a more specific case related to climate change, Fuss, Obersteiner & Szolgayova (2008) found that a moderate increase in CER uncertainty permits a dramatic increase in investment to reduce emissions while deterministic permit pricing leads to less investment. They found that with the ability of ROV to incorporate volatility of the CER pricing in the trade system, the approach is more effective in reducing carbon emission because carbon emitters prefer to reduce emission to have stable and predictable cost structure. This is the "in the money" position due to high volatility of CER. The study is furthered by Anda, Golub & Strukova (2009), where they formulate rules for the selection of an emission target for a climate policy.

## 3. RESEARCH DESIGN

This research employs an exploratory case study (Cooper & Slagmulder, 2004) based on stylized facts as applied by various scholars in real option valuation (for example Brennan & Schwartz, 1985; Dixit and Pindyck, 1994; Trigeorgis, 1996). This approach is the most suitable one to be applied due to the emerging nature of climate change and scarcity of prior research, difficulty to construct principles and gathering of concrete information for the purpose of achieving deduction (Perry, 1998).

### *3.1. Research Setting*

The case refers to an operation mix of steel making process carried out by small business. According to Figure A, there are two types of steel making process[7] possible to be carried out by SMEs, Blast Oxygen Furnace (BOF) and Electrical Arc Furnace (EAF). Firms have the alternative to operate solely in BOF or combine the production process with EAF, but not to produce solely on EAF.

<Insert Figure A here>

[7] Steel making process refers to the small box indicated in Figure A.

Generally, BOF allows bigger profit margin compared to EAF. However, with the aim to reduce carbon emission and spending on CER, EAF proves to be cleaner and greener. EAF bears the disadvantage that it depends 100% on supply of scrap, which is more limited compared to iron ores and coal that are needed in BOF process. Due to this, a firm may not depend solely on EAF but has to mix its steel making production process. The average efficient production mix ratio between BOF and EAF in percentage is 60-40[8]. Yet with growing concern to deal with climate change and positive increment in the supply of scrap metals (Terörde, 2006), it is worth to evaluate the technology in the firm´s strategic investment.

In order to decide whether it is beneficial to add EAF into the production system, a feasibility study is conducted. This study compares two production states based on BOF alone (**method A**) or BOF combined with EAF (the combination between two processes with ratio of 60-40 ratio is **method B**). For illustrative purpose, method B is rigid in the sense that once EAF is employed, the plant production has to be continuously based on 60-40 ratio. However, if scrap is not available, the plant could not reverse back to produce 100% on method A, but would have to rely on producing at only 60% of the full capacity. If this is happening, the firm will lose sales.

For a plant with capacity of producing 3933 tonnes, Method A generates €1774000 gross profit but the cost of CER is €94392. For the same production quantity, method B generates only €1605000 of gross profit but is able to lower cost of CER by 35.5% to €60880. The lower profit margin is due to increase in the production cost, especially related to raw material, because currently the price of scrap is higher than the price of iron ores (Steelonthenet.com, London Metal Exchange). In addition the cost of clean energy per Btu[9] is still expensive. The detailed production accounting for both methods are summarized in Figure B.

[8] Obtained from Energy Efficiency Guide for Industry in Asia.

[9] BTU or Btu is British thermal unit, a traditional unit of energy equal to about 1055 joules. It is approximately the amount of energy needed to heat 1 pound (0.454 kg) of water, which is exactly one tenth of a UK gallon or about 0.1198 US gallons, from 39°F to 40°F (3.8°C to 4.4°C).

Figure B also has underlined the cost of CER for each method of production. The CER from BOF production is nearly 2 tonnes for every tonne of crude steel produced compared to only 0.357 tonne by EAF. Combination of both EAF and BOF in method B is able to reduce the cost of CER by 35.5%, which is nearly €34000 (€33512 in exact). On the other hand, the uncertain future of CER prices affects the amount of future CER saving or spending; and net profits too. With the current CER price of 12€ per tonne (Reuters) the saving of carbon credit from method B is still insufficient to compensate for the reduction of gross profit of €169000.

<Insert Figure B here>

The manufacturer has to choose whether to continue with production method A - emitting €94392 worth of CER, or save €34000 but losing 10% of the production profit in the initial year. The parameters of the case are as follows:

***Time steps***

A time step of 1 year for each node, thus $\delta t = 1$.

***Option time frame***

Bearing the assumption that $t_0$ is 2011; the time period for the analysis is 5 years. In principle CER market will expire in 2012. However, due to current policy and regulations development on climate change and increase participation from countries all over the world, together with human realization towards climate change impact, it is assumed that the policy will continue into practice and become more stringent. Therefore, the CER market is expect to resume in existence. Most recent agreements reached at the 17$^{th}$ UNO Conference on Climate Change, held in Durban and closed on December 11$^{th}$ 2011, will have to confirm the scope of this policy.

***Uncertainty***

Only uncertainty and volatility of CER prices are considered in the analysis. Other sources of uncertainty, such as cost and availability of iron ores, coal and scrap are ignored. Uncertainty and volatility of CER prices affect firm's decision towards investment in green technology. The relationship between uncertainty and volatility of CER prices is applied to derive towards a more transparent and understandable valuation method which later assists understanding on how CER price is incorporated into the valuation.

***Volatility Estimate of CER***

The volatility of CER prices has been calculated based on historical data and represented by $\sigma$ = 56.5%. Data are obtained from EU ETS price from 11 February 2005 to 6 September 2006 from Reuters. EU ETS is used as proxy of CER price because CER price is seldom disclosed. Furthermore, Emission Reduction Purchase Agreements links CER prices to EU Emission Trading Scheme, suggesting that the volatility of these two units (EU ETS and CER) is comparable. Once CER has been issued, it has to fulfil the technical requirements of International Transaction Log of Kyoto Protocol, 1997, which is theoretically fully fungible with an EU ETS unit.

***Up and Down Factors***

The up and down steps in the lattice present neutral probabilities and are determined by volatility. As usual in option theory, the up and down factors affect assets value. These values are required in order to calculate the lattice of projected CER, according to the following equations:

$$\text{Up step, } u = e^{\sigma\sqrt{\delta t}} \qquad [1a]$$

$$\text{Down step, } d = \frac{1}{e^{\sigma\sqrt{\delta t}}} \qquad [1b]$$

***Risk-free Rate***

Risk-free rate, $r_f$, is 5%.

***Probability Factor***

Probability factors for good and bad condition are represented by *p* and *q[=(1-p)]* respectively. *p* is calculated as:

$$p = \frac{e^{\delta t\, r_f} - e^{-\sigma\sqrt{\delta t}}}{e^{\sigma\sqrt{\delta t}} - e^{-\sigma\sqrt{\delta t}}} \qquad [2]$$

Using this equation, the probability factors are:

$p = 0.4054$ ($\approx 0.4$), and

$1 - p = q = 0.5945$ ($\approx 0.6$).

From the above data and information, the projection of production of gross profit for both method A and B for the next 5 years is illustrated in Figure C.

<Insert Figure C here>

### *3.2. Decision Rule of DCF*

According to DCF rule, the decision is made based on the highest total present value (PV) of net revenue (in round up figures) between the two proposed production states, Method A and B. Since the projection is forecasted till 5th year using risk-free rates, the PV of the cash flows available in Figure C is solved by totalling the present value obtained from binomial algebraic expansion as follows.

$t_0$: $(a + b)^{0} = 1$ [3a]

$t_1$: $(a + b)^{1} / 1+r_f = a + b / 1+r_f$ [3b]

$t_2$: $(a + b)^{2} / (1+r_f)^{2} = a^2 + 2ab + b^2 / (1+r_f)^{2}$ [3c]

$t_3$: $(a + b)^{3} / (1+r_f)^{3} = a^3 + 3a^2b + 3ab^2 + b^3 / (1+r_f)^{3}$ [3d]

$t_4$: $(a + b)^{4} / (1+r_f)^{4} = a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + b^4 / (1+r_f)^{4}$ [3e]

$t_5$: $(a + b)^{5} / (1+r_f)^{5} = a^5 + 5a^4b + 10a^3b^2 + 10a^2b^3 + 5ab^4 + b^5 / (1+r_f)^{5}$ [3f]

In this case, the results are:

PV method A = PV (A)

= € 9 328 882 [10] (≈ €9.329 million)

PV method B = PV (B)

= € 7 570 897 [11] (≈ €7.571 million)

Therefore, method A: producing on single production process of BOF is profitable compared to the proposal of employing production process with reduced emission. Production process mix of method B shall be ignored.

## 4. ANALYSIS AND RESULT: OPTION TO SWITCH

Following the DCF result in previous section, method A is more profitable compared to method B. However, by employing this method the firm will have to spend €94392 for carbon emission. At current state, the price of CER of 12€ is not a liability but the realization that environmental laws are getting stringent; an early approach to reduce emission seems beneficial. The firm is interested in reducing CER spending. At the same time, the firm is aware that scrap supply is limited and managers are not ready to forgo the potential sales in PV of € 1757985 (or nearly 19% reduction in PV) if method B is chosen. Therefore, a switch between production processes from method A to method B is evaluated, by applying ROV through binomial lattice approach.

The cost of switching from method A to B, and vice versa, is calculated as the difference between the amounts of CER spending on each method. From method A to B, the firm will have CER saving of 34000€, while to switch back to method A the firm has to incur additional 34 000€ again.

[10] Refer to Appendix III.

[11] Refer to Appendix IV.

In short, the switching costs are:

S(A→B) = + 34 000€ (CER saving)

S(B→A) = - 34 000€ (CER loss)

Switching cost not only affects the current payoff and optimal operating decision but also alters exercise cost. It also will cause a "chain effect" on the future decision. As future outcomes are depending on prior decision (i.e. which option has been exercised earlier), the flow creates a series of *nested options* which is analogous to a *compound option*. Different to options without switching cost - which resemble European options with additive value -, there are some interaction occurring in compound options.

Therefore, let I (A→B) be switching cost from Method A to B. Incremental cash flow of switching from A to B is calculated by:

$$C_t^s(A \to B) \equiv [\max C_t^s(B) - C_t^s(A) - I(A \to B), 0] \qquad [4]$$

The value of the flexibility to switch operation from A to B is denoted by F (A→B) while the reverse operation is denoted by F (B→A). The sum of switching value is obtained by performing the following operation.

$$F(A \to B) = S_0(A \to B) + S_1(A \to B) + S_2(A \to B) + \text{..........} + S_n(A \to B). \qquad [5]$$

Where switching cost does not exist, the calculation of $S_n$ (A→B) is calculated by:

$S_n$ (A→B)

$$C_n^+(A \to B) = \max(\text{cash flow}_{b,+,n} - \text{cash flow}_{a,+,n}, 0)$$

$$C_n^-(A \to B) = \max(\text{cash flow}_{b,-,n} - \text{cash flow}_{a,-,n}, 0)$$

Taking the same direct approach, maximum cash flow between Method A and B is obtained by deducting switching cost from the initial operation. So instead of:

$$C_n^+(A \to B) = \max(\text{cash flow}_{b,+,n} - \text{cash flow}_{a,+,n}, 0), \qquad [6a]$$

the inclusion of switching cost would alter the equation to:

$$C_n^+ \text{ (A}\rightarrow\text{B) = max (cash flow }_{b, +, n} \text{ - cash flow }_{a, +, n}\text{, 0) - I (A}\rightarrow\text{B).} \qquad [6b]$$

By applying equation [5] the switching costs are:

$$F(A\rightarrow B) = S_0(A\rightarrow B) + S_1(A\rightarrow B) + S_2(A\rightarrow B) + S_3(A\rightarrow B) + S_4(A\rightarrow B) + S_5(A\rightarrow B)$$

= 0 + 0 + 22808 + 19798 + 32677 + 11723[12]

= € 86 996.

$$F(B\rightarrow A) = S_0(B\rightarrow A) + S_1(B\rightarrow A) + S_2(B\rightarrow A) + S_3(B\rightarrow A) + S_4(B\rightarrow A) + S_5(B\rightarrow A)$$

= 135000 + 138830 + 164509 + 163514 + 177646 + 174495[13]

= € 953 993.

When a project bears no switching cost, the value of flexible option will be additive as for example PV (A) + F (A→B) = PV (B) + F (B→A) to resemble European options. However, with the existence of switching cost the condition does not hold[14]. In Kulatilaka & Trigeorgis (1994), switching cost resulted in options interactions since the cost to switch from a technology is difference from the cost of switching back. In this case, a similar effect is noted. Since current decision to switch or not affects future technology employment (i.e. method A or B), it also would affect future switching cost. In such cases, flexible value, *V*, must be determined simultaneously with the schedule of optimal operating modes.

To count for optimal operating modes, management has two choices, either to continue in current mode or to switch immediately. By opting for continuing with current mode

[12] Refer to Appendix V
[13] Refer to Appendix IV

[14] Proof: with switching cost,
PV (A) + F (A→B) ≠ PV (B) + F (B→A)
9328882 + 86996 ≠ 7570897 + 953993
9415878 ≠ 8524890

for the next period, the project will receive current payoffs $C_t^s$(A), plus any expected future benefits with the assumption of having optimal future operation. Yet, if operation switches immediately, the project has to incur into switching cost to allow receiving an alternative current cash flow and expected future benefits. The switching mode would be optimal only if the value of switching exceeds the value of delaying potential switching.

For that, the following conditions must hold.

$$V_t^s(\mathrm{A}) = \mathrm{Max}\ (C_t^s(\mathrm{A}) + \hat{\mathrm{E}}\ [V_{t+1}^s(\mathrm{A})]/(1+\mathrm{r}),\ C_t^s(\mathrm{B}) + \hat{\mathrm{E}}\ [V_{t+1}^s(\mathrm{B})]/(1+\mathrm{r}) - \mathrm{I}(\mathrm{A}\rightarrow\mathrm{B}) \qquad [7a]$$

where:

$$\hat{\mathrm{E}}\ [V_{t+1}^s(i) \equiv pV_{t+1}^+(i) + (1\text{-p})\ V_{t+1}^-(i),\ i = \mathrm{A\ or\ B};$$

$C_t^s(m)$: cash flow at time *t* and state *s* when operating in mode *m*

$V_t^s(m)$: flexible project value as of time *t* given that state *s* is entered while operating in mode *m*, assuming optimal future switching decisions

$m_t^s(i)$: optimal operating mode at time *t* given that state *s* is entered while operating mode *i*

Ê [.] : risk-neutral expectations operator

The backward iterative process begins from the terminal time, T (in this case T=5) by simplifying equation [7a] to:

$$V_t^s(\mathrm{A}) = \mathrm{Max}\ (C_t^s(\mathrm{A}),\ C_t^s(\mathrm{B}) - \mathrm{I}(\mathrm{A}\rightarrow\mathrm{B})$$

$$V_t^s(\mathrm{A}) = C_t^s(\mathrm{A}) + \max\ ([C_t^s(\mathrm{B}) - C_t^s(\mathrm{A})] - \mathrm{I}(\mathrm{A}\rightarrow\mathrm{B}),0) \qquad [7b]$$

By performing the backward iterative process, the terminal values for each state then become:

<u>If Method A is entered</u>

$V_5^{+++++}$(A) = Max (10209, 6509 + 34) = 10209 (stay in A)

$V_5^{++++-}$(A) = Max (5069, 3718 + 34) = 5069 (stay in A)

$V_5^{+++--}$(A) = Max (2517, 2124 + 34) = 2517 (stay in A)

$V_5^{++---}$(A) = Max (1250, 1213 + 34) = 1250 (stay in A)

$V_5^{+----}$(A) = Max (621, 693+34) = 727 (switch to B)

$V_5^{-----}$(A) = Max (308, 398 +34) = 432 (switch to B)

*(Note: Figures are in €'000)*

The results of the iterative process  is as shown in Figure D.

<Insert Figure D here>

Referring to the figure, comparing switching mode from A→B is entered using method A versus method B at t0,

$$V_0 \text{ (A)} = \max [m_0 \text{ (A)}, m_0 \text{ (B)}]$$

$$= [9348247, 9213247]$$

$$= € \; 9348247 \text{ i.e. } m_0 \text{ (A)}.$$

Thus, if entered using Method A, the operation should stay at method A.

The process is later repeated for Method B.

If Method B is entered

$V_5^{+++++}$(B) = Max (6509, 10209-34) = 10175 (switch to A)

$V_5^{++++-}$(B) = Max (3718, 5069-34) = 5035 (switch to A)

$V_5^{+++--}$(B) = Max (2124, 5069-34) = 2483 (switch to A)

$V_5^{++---}$(B) = Max (1213,1250-34) = 1216 (switch to A)

$V_5^{+----}$(B) = Max (693, 621-34) = 693 (stay in B)

$V_5^{-----}$(B) = Max (396, 308-34) = 396 (stay in B)

*(Note: Figures are in €'000)*

Figure E shows the results of the iterative process which compares switching mode from B→A entered using method B versus method A at t0. The results are:

$$V_0\ (B) = \max\ [m_0\ (B), m_0\ (A)]$$

$$= [9009115, 9144115]$$

$$= €\ 9144115 \text{ i.e. } m_0\ (A).$$

<Insert Figure E here>

Thus, if the production is entered using Method B, the operation should switch to method A. Yet, if immediate switching is not possible, then $V_0$ (B) is € 9009115.

From the whole process, the compound effect introduced by switching option A/B can be identified by comparing the direct approach and the backward iterative process, i.e. by comparing results obtain from equation 6b and 7b. The results are shown in Figure F.

<Insert Figure F here>

As a whole, operation with flexibility to switch from Method A to B with optimal production schedule increases the project value by €19365. Even though the increment over PV (A) is small, counted only for 0.2%, it gives the ability to the business to be flexible and able to have the opportunity to reduce CER cost up to 35.5%. If the firm stays at Method A, any uncertainty related to the increment of future CER price will cause the firm to pay higher CER credit. However, the optimal production schedule (Figure G) allows the firm to enjoy maximum cash flow at a particular time while at the same time cushions the business if such CER increment occurs.

<Insert Figure G here>

## 5. DISCUSSION AND CONCLUSION

CSR activities regardless of nature and size of the practitioners are able to create goodwill and reputation, which at the same time affects business value. Attaching financial value to CSR activities is difficult thus most CSR professionals focus more on social benefits to emphasize the importance of CSR.

With various types of CSR available to be integrated into business practices, environmental CSR - like activities related to climate change - has captured attention of many. A lot of studies available are successful in highlighting the significant impact among climate change, business value and reputation (among them, Austin & Sauer, 2003; Gars & Volk, 2003; Innovest, 2005). The participation is increasing with the realization that in most cases SMEs is the best candidate to fulfil it (Sarbutts, 2003). However, environmental issue bears a very high uncertainty, thus requires a valuation method which is able to incorporate the related factors and development into capital budgeting, strategic planning and risk mitigation.

Real option is able to integrate flexible production methods through switching option of European option to analogue switching process without cost, and compound option to analogue switching option with cost. Through the case study presented, it is proven that regardless of size, real option is able to deal with complex activities with high uncertainties. Therefore drawing conclusion from this case, SMEs are able to evaluate their CSR activities by applying ROV and realize it.

As the post effect of Kyoto Protocol 1997 is getting significant, any activities related to the environment should be taken seriously. With target to reduce GHG emission starting with countries listed in Annex 1, public and privates parties are committed to reach the target. The introduction of carbon credit also contributes to such motivation. Industries and firms who emit more GHG than allowable are required to fund development of green technology that aims to reduce carbon emission and increase energy saving projects.

Since such participation is voluntary plus the fact that in some cases SMEs are better off to fulfil the responsibility (Sarbutts, 2003), businesses are further encouraged with the existence of CER and EU ETS markets where carbon credits are tradable. As the target of GHG reduction is set, steel industry together with the SMEs component in the network being major contributor of GHG (Gelen & Moriguchi, 2001) are motivated to innovate and invest on new technology so that the target is achievable.

Improvement from BOF to EAF is able to reduce carbon emission. However, with the scarcity of scrap as the main input in the EAF production of crude steel, manufacturers are still relying on BOF to cope with world demand. On the other hand, the scarcity of scrap should not form a barrier for steel manufacturers to perform their social responsibility to reduce carbon emission. Through the approach of real option, SMEs, being part of steel producers are able to evaluate the advantages of switching from rigid mode of BOF to combine mode of BOF and EAF.

The analysis shown in this paper has also proved that by incorporating the uncertainties of climate change using as proxy the carbon credit in CER units, SMEs are able to have an initial quantitative intuition of how the switching option has positive impact on profitability. In our case analysis, the flexibility to switch from one state to another and the capability of switching back, namely from method A (rigid production of BOF) to B (combine production of BOF and EAF) and to A again, increases additional return value of €19365 (compared to rigid production of Method A).

The research approach is conducted in a simplistic way to enhance transparency and easy understanding, following Kulatilaka & Trigeorgis (1994) and Mun (2002). Relying only on uncertainty and volatility of CER prices, climate change proxy variables are able to be incorporated into the valuation process. Further thorough analysis is required to identify the accurate interaction between the two methods of production.

Taking uncertainty and volatility of CER prices as representative of climate change in the valuation technique as a whole is insufficient. In reality, holding the same focus and objective laid in this research, there are other variables that worth considering to be included in the model. As prices and availability of iron ores, coal and scrap embed uncertainty and volatility, a more comprehensive model that iterate these variables would bring deeper and more meaningful quantitative intuition. Nevertheless, the analysis conducted in this study is capable of triggering managers´ realization that ROV is able to incorporate variables relevant to strategic concern when it comes to climate change. Uncertainty is transferred to flexibility of switching between production processes.

The application of real option analysis and the way it responses to the many uncertainties surrounding climate change have contribute to economic and policy perspective towards the issue (Toman, 1998; Heal & Kristom, 2002; IEA, 2006). Many analysts have started to incorporate the real option analysis in the valuation of climate change impact, for example, in energy sector analysis (IEA, 2006). Supported with findings from this research, together with the statement above, real option bears the potential to address climate change issue and connects to environmental strategic responses. Overall, with such alignment, SMEs are able to fulfil their CSR to the society and environment.

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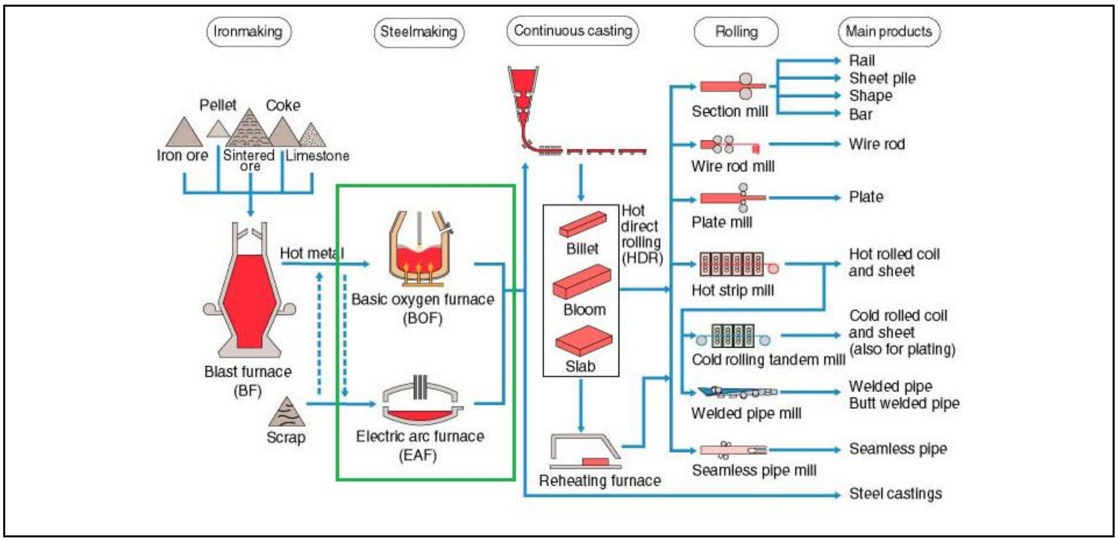
**Figure A. Steel Making Process**




Source: Kawasaki Steel

**Figure B. Production Accounting for Method A and Method B**

| | Method A | Method B | | |
|---|---|---|---|---|
| | BOF (100%) | BOF (60%) | EAF (40%) | Total |
| Revenue | 3067740 | | | 3067740 |
| *less:* | | | | |
| Primary Production Cost | | | | |
| Raw Material & Related Var. Cost | 916793 | 541810 | 503428 | 1045238 |
| Direct Energy Consumption | 376947 | 224180 | 193322 | 417502 |
| Production Gross Profit | 1774000 | | | 1605000 |
| CER Cost | 94392 | 52480 | 6700 | 60880 |

Calculations are based on historical data obtained from MEPS, Steelonthenet.com and London Metal Exchange, where the average steel price is €780 per tonne.

The direct production cost structure is obtained from several cases at Energyefficiencyasia.com and the basic principles are provided as in Appendix II.

Some figures have been rounded up to ease calculations and understanding.

**Figure C. Five-Year Production Gross Profit Projection for Method A and Method B in Good and Bad Condition (round-up figures in ´000 €)**

**Method A**

| t0 | t1 | t2 | t3 | t4 | t5 |
|---|---|---|---|---|---|
| | | | | | 10209 |
| | | | | 7194 | |
| | | | 5069 | | 5069 |
| | | 3572 | | 3572 | |
| | 2517 | | 2517 | | 2517 |
| 1774 | | 1774 | | 1774 | |
| | 1250 | | 1250 | | 1250 |
| | | 881 | | 881 | |
| | | | 621 | | 621 |
| | | | | 437 | |
| | | | | | 308 |

**Method B**

| t0 | t1 | t2 | t3 | t4 | t5 |
|---|---|---|---|---|---|
| | | | | | 6509 |
| | | | | 4919 | |
| | | | 3718 | | 3718 |
| | | 2810 | | 2810 | |
| | 2124 | | 2124 | | 2124 |
| 1605 | | 1605 | | 1605 | |
| | 1213 | | 1213 | | 1213 |
| | | 917 | | 917 | |
| | | | 693 | | 693 |
| | | | | 524 | |
| | | | | | 396 |

**Figure D. Value of Project with Flexible Method A/B if Method A versus B is Entered at $t_0$**

If method A is entered at ($t_0$)

| | | | | | |
|---|---|---|---|---|---|
| | | | | | 10209 |
| | | | | 13979,64 | |
| | | | 14361,75 | | 5069 |
| | | 13118,79 | | 6941,731 | |
| | 11262,03 | | 7131,691 | | 2517 |
| 9348,247 | | 6557,188 | | 3447,143 | |
| | 5746,914 | | 3597,616 | | 1250 |
| | | 3497,937 | | 1810,029 | |
| | | | 2015,267 | | 727 |
| | | | | 1047,965 | |
| | | | | | 432 |

If method B is entered at (t0)

| | | | | | |
|---|---|---|---|---|---|
| | | | | | 10209 |
| | | | | 13979,64 | |
| | | | 14361,75 | | 5069 |
| | | 13118,79 | | 6941,731 | |
| | 11262,03 | | 7131,691 | | 2517 |
| 9213,247 | | 6557,188 | | 3447,143 | |
| | 5746,914 | | 3597,616 | | 1250 |
| | | 3497,937 | | 1810,029 | |
| | | | 2015,267 | | 727 |
| | | | | 1047,965 | |
| | | | | | 432 |

**Figure E. Value of Project with Flexible Method B/A if Method B versus A is Entered at $t_0$**

If method B is entered at ($t_0$)

| | | | | | |
|---|---|---|---|---|---|
| | | | | | 10175 |
| | | | | 13913,26 | |
| | | | 14264,53 | | 5035 |
| | | 12992,2 | | 6875,35 | |
| | 11107,46 | | 7034,471 | | 2483 |
| 9009,115 | | 6430,598 | | 3380,762 | |
| | 5552,225 | | 3518,899 | | 1216 |
| | | 3301,125 | | 1776,029 | |
| | | | 1948,886 | | 693 |
| | | | | 1013,965 | |
| | | | | | 396 |

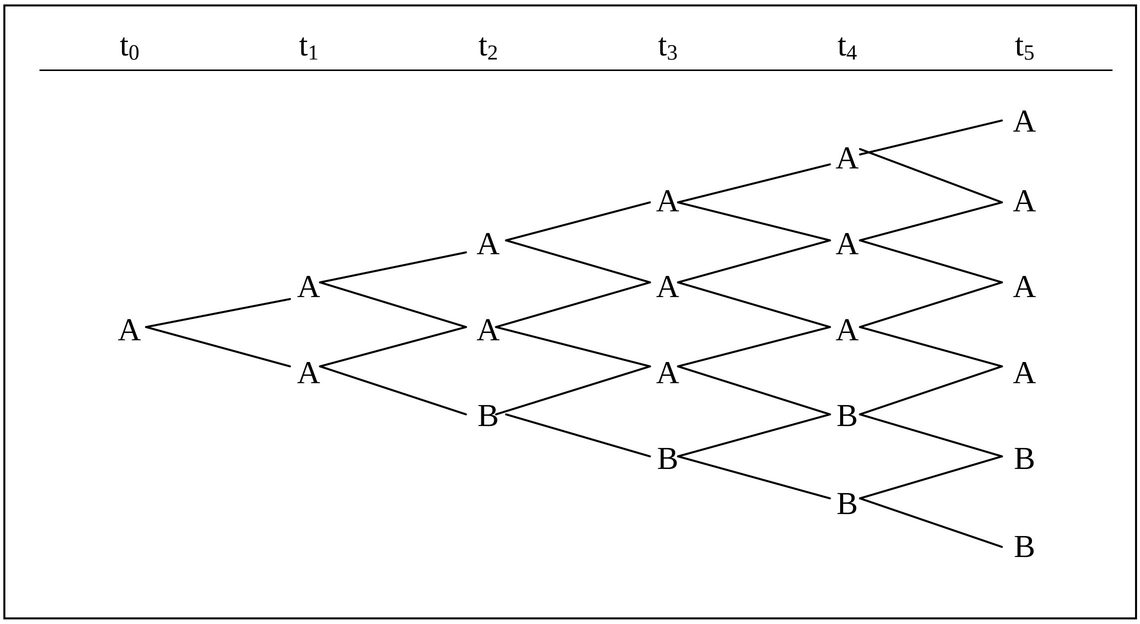
If method A is entered at ($t_0$)

| | | | | | |
|---|---|---|---|---|---|
| | | | | | 10175 |
| | | | | 13913,26 | |
| | | | 14264,53 | | 5035 |
| | | 12992,2 | | 6875,35 | |
| | 11107,46 | | 7034,471 | | 2483 |
| 9144,115 | | 6430,598 | | 3380,762 | |
| | 5552,225 | | 3518,899 | | 1216 |
| | | 3301,125 | | 1776,029 | |
| | | | 1948,886 | | 693 |
| | | | | 1013,965 | |
| | | | | | 396 |

**Figure F. Compund Effect in Flexibility Option with Optimal Operation**

| | **Direct Approach** | **Backward Iterative Approach with Optimal Operation** |
|---|---|---|
| F(A→B) | 86996 | = V(F) – PV(A)<br>= 19365 |
| F(B→A) | 953993 | = V(F) - PV(B)<br>= 1573218 |
| F(B→A) excluding immediate switching | $\sum S_{t=5}^{t=0}$ - $S_0$<br>= 779449 | = 9009115 – PV(B)<br>= 1438219 |

**Figure G. Optimal Production Schedule with Flexible Production Method A/B Option**



**APPENDIX I: List of Countries under Annex 1 of Kyoto Protocol (1997).**

| | |
|---|---|
| Australia | Lithuania |
| Austria | Luxembourg |
| Belarus | Malta |
| Belgium | Monaco |
| Bulgaria | Netherlands |
| Canada | New Zealand |
| Croatia | Norway |
| Czech Republic Denmark | Poland |
| Estonia | Portugal |
| European Union | Romania |
| Finland | Russian Federation |
| France | Slovakia |
| Germany | Spain |
| Greece | Sweden |
| Hungary | Switzerland |
| Iceland | Turkey |
| Ireland | Ukraine |
| Italy | United Kingdom of Great Britain and Northern Ireland |
| Japan | United States of America |
| Latvia | |
| Liechtenstein | |

**APPENDIX II: Integrated Steel Making – Crude Steel Cost Model**

| Item $/unit | Factor | Unit | Unit cost | Fixed | Variable |
|---|---|---|---|---|---|
| Iron ore | 1.435 | t | 124 | | 177.94 |
| Iron ore transport | 1.435 | t | 20 | | 28.7 |
| Coking coal | 0.519 | t | 200 | | 103.80 |
| Coking coal transport | 0.519 | t | 19.5 | | 10.12 |
| Steel scrap | 0.162 | t | 330 | | 53.46 |
| Scrap delivery | 0.162 | t | 5 | | 0.81 |
| Oxygen | 83 | m 3 | 0.085 | | 7.06 |
| Ferroalloys | 0.014 | t | 1650 | | 23.10 |
| Fluxes | 0.59 | t | 45 | | 26.55 |
| Refractories | 0.011 | t | 650 | | 7.15 |
| Other costs | 1 | | 14.25 | 3.56 | 10.69 |
| By-product credits | | | | | -21.6 |
| Thermal energy, net | -2.67 | GJ | 12.50 | | -33.38 |
| Electricity | 0.122 | MWh | 100 | 1.83 | 10.37 |
| Labour | 0.48 | Man hr | 37 | 4.44 | 13.32 |
| Depreciation | | | | 48.00 | |

Source: http://www.energyeficiencyasia.org

## APPENDIX III: Calculation of Method A's Present Value, PV (A).

| | t0 | t1 | t2 | t3 | t4 | t5 |
|---|---|---|---|---|---|---|
| Cash Flow | | | | | | 10208,67 |
| | | | | | 7193,92 | |
| | | | | 5069,47 | | 5069,47 |
| | | | 3572,40 | | 3572,40 | |
| | | 2517,43 | | 2517,43 | | 2517,43 |
| | 1774,00 | | 1774,00 | | 1774,00 | |
| | | 1250,12 | | 1250,12 | | 1250,12 |
| | | | 880,94 | | 880,94 | |
| | | | | 620,79 | | 620,79 |
| | | | | | 437,46 | |
| | | | | | | 308,275 |
| PV(Cash Flow) | | | | | | 111,837 |
| | | | | | 194,3834 | |
| | | | | 337,8569 | | 407,2153 |
| | | | 587,2276 | | 566,2232 | |
| | | 1020,657 | | 738,1124 | | 593,0926 |
| | 1774,000 | | 855,2732 | | 618,5109 | |
| | | 743,2732 | | 537,5155 | | 431,9077 |
| | | | 311,4177 | | 300,2787 | |
| | | | | 130,4783 | | 157,264 |
| | | | | | 54,66797 | |
| | | | | | | 22,90487 |
| | 1774,000 | 1679,934 | 1590,856 | 1506,501 | 1426,619 | 1350,973 |
| **Total PV(A)** | | | **€9328,882** | | | |

## APPENDIX IV: Calculation of Method B's Present Value, PV (B).

| t0 | t1 | t2 | t3 | t4 | t5 |
|---|---|---|---|---|---|
| Cash Flow | | | | | 6508,60 |
| | | | | 4919,09 | |
| | | | 3717,77 | | 3717,77 |
| | | 2809,83 | | 2809,83 | |
| | 2123,62 | | 2123,62 | | 2123,62 |
| 1605,000 | | 1605,00 | | 1605,00 | |
| | 1213,03 | | 1213,03 | | 1213,03 |
| | | 916,79 | | 916,79 | |
| | | | 692,90 | | 692,90 |
| | | | | 523,68 | |
| | | | | | 395,7881 |
| | | | | | |
| PV(Cash Flow) | | | | | 71,30237 |
| | | | | 132,9163 | |
| | | | 247,7721 | | 298,637 |
| | | 461,8773 | | 445,3566 | |
| | 860,9954 | | 622,649 | | 500,3148 |
| 1605,000 | | 0 | | 559,5885 | |
| | 721,2245 | | 521,5705 | | 419,0955 |
| | | 324,0902 | | 312,498 | |
| | | | 145,6335 | | 175,5305 |
| | | | | 65,44204 | |
| | | | | | 29,40711 |
| 1605,000 | 1506,876 | 712,8957 | 1328,258 | 1247,054 | 1170,813 |
| **Total PV(B)** | | **€7570,897** | | | |

**APPENDIX V: Switching Cost from Method A to B (in'000)**

F (A→B) = $S_0$ (A→B) + $S_1$ (A→B) + $S_2$ (A→B) + $S_3$ (A→B) + $S_4$ (A→B) + $S_5$ (A→B)
where;

***$S_0$ (A→B) = 0***

-135,00 Max (1605-1774+34,0)

***$S_1$ (A→B) = 0***

-359,80 [Max (2124 -2517+34, 0)]
0
-3,08 [Max ( 1213-1250+34, 0)]

***$S_2$ (A→B) = 22808***

-728,57 [Max ( 2810-3572+34,0)]
0
22,808 -135,00 [Max (1605-1774+34,0)]
39,913
69,85 [Max (917-881+34,0)]

***$S_3$ (A→B) = 19798***

-1317,70 [Max ( 3718-5069+34,0)]
0
0 -359,80 [Max ( 2124-2517+34,0)]
19,798 0
34,646 -3,08 [Max (1213-1250+34,0)]
60,631
106,11 [Max(693-621+34,0)]

***$S_4$ (A→B) =32677***

| | | | | |
|---|---|---|---|---|
| | | | | -2240,83 |
| | | | | [Max (4919-7194+34,0)] |
| | | | 0 | |
| | | | | -728,57 |
| | | 0 | | [Max (2810-3572+34,0)] |
| | 13,032 | | 0 | |
| | | | | -135,00 |
| 32,677 | | 22,807 | | [Max (1605-1774+34,0)] |
| | 48,496 | | 39,913 | |
| | | | | 69,85 |
| | | 69,664 | | [Max (917-881+34,0)] |
| | | | 95,303 | |
| | | | | 120,22 |
| | | | | [Max (524-437+34,0)] |

***$S_5$ (A→B) = 11713***

| | | | | | |
|---|---|---|---|---|---|
| | | | | | -3666,07 |
| | | | | | [Max(6509-10209+34,0)] |
| | | | | 0 | |
| | | | | | -1317,70 |
| | | | 0 | | [Max (3718-5069+34,0)] |
| | | 0 | | 0 | |
| | | | | | -359,80 |
| | 0 | | 0 | | [Max (2124-2517+34,0)] |
| 11,713 | | 0 | | 0 | |
| | | | | | -3,08 |
| | 20,498 | | 0 | | [Max (1213-1250+34,0)] |
| | | 35,871 | | 0 | |
| | | | | | 106,11 |
| | | | 62,775 | | [Max (693-621+34,0)] |
| | | | | 109,857 | |
| | | | | | 121,5132 |
| | | | | | [Max (396-308+34,0)] |

**APPENDIX VI: Switching Cost from Method B to A (in '000)**

F (B→A) = $S_0$ (B→A) + $S_1$ (B→A) + $S_2$ (B→A) + $S_3$ (B→A) + $S_4$ (B→A) + $S_5$ (B→A)
where;

***$S_0$ (B→A) = 135000***

135,00 [Max (10209-6509-34,0)]

***$S_1$ (B→A) = 138830***

| | | |
|---|---|---|
| | 359,80 | [Max (2517-2124-34,0)] |
| 138,830 | | |
| | 3,08 | [Max (1250-1213-34,0)] |

***$S_2$ (B→A) = 164509***

| | | | |
|---|---|---|---|
| | | 728,57 | [Max (3572-2810-34,0)] |
| | 354,692 | | |
| 164,508 | | 135,00 | [Max (1774-1605-34,0)] |
| | 51,428 | | |
| | | -69,85 | [ Max (881-917-34,0)] |

***$S_3$ (B→A) = 163514***

| | | | | |
|---|---|---|---|---|
| | | | 1317,70 | [Max (5069-3718-34,0)] |
| | | 707,583 | | |
| | 348,887 | | 359,80 | [Max (2517-2124-34,0)] |
| 163,514 | | 138,829 | | |
| | 53,5588 | | 3,08 | [Max(1250-1213-34,0)] |
| | | 1,174 | | |
| | | | -106,11 | [Max (621-693-34,0)] |

***$S_4$ (B→A) = 177645***

| | | | | |
|---|---|---|---|---|
| | | | | 2240,83 [Max ( 7194-4919-34,0)] |
| | | | 1269,975 | |
| | | 686,481 | | 728,57 [Max (3572-2810-34,0)] |
| | 355,521 | | 354,692 | |
| 177,645 | | 164,508 | | 135,00 [Max (1774-1605-34,0)] |
| | 73,865 | | 51,428 | |
| | | 19,5918 | | -69,85 [Max (881-917-34,0)] |
| | | | 0 | |
| | | | | -120,22 [Max (437-524-34,0)] |

***$S_5$ (B→A) = 174495***

| | | | | | |
|---|---|---|---|---|---|
| | | | | | 3666,07 |
| | | | | | [Max(10209-6509-34,0)] |
| | | | | 2149,572 | |
| | | | | | 1317,70 |
| | | | 1223,218 | | [Max (5069-3718-34,0)] |
| | | 665,351 | | 707,583 | |
| | | | | | 359,80 |
| | 346,904 | | 348,887 | | [Max (2517-2124-34,0)] |
| 174,495 | | 163,514 | | 138,829 | |
| | | | | | 3,08 |
| | 74,096 | | 53,558 | | [Max (1250-1213-34,0)] |
| | | 20,659 | | 1,174 | |
| | | | | | -106,11 |
| | | | 447 | | [Max (621-693-34,0)] |
| | | | | 0 | |
| | | | | | -121,513 |
| | | | | | [Max (308-396-34,0)] |