CDM PROJECT FOR PULP AND PAPER INDUSTRY OF VIETNAM
DỰ ÁN CDM CHO NGÀNH BỘT GIẤY VÀ GIẤY VIỆT NAM

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ABSTRACT

The Pulp and Paper industry of Vietnam is a significant emitter of green house gases caused by consumpting much energy in many stage of its operation. Therefore, this industry has many opportunities CDM implementation by the way of saving energy. CDM projects will mitigate emissions and provide significant financial resources contributing to the modernization of the paper industry. The goal for this paper is constructed the processes, methods and identifies opportunities for implementation of CDM projects in Vietnam's paper industry. Proposed method be applied at the factory Tan Mai Paper. The results show that the CDM project for the paper industry has high economic feasibility and open opportunities to reduce emissions to other industries in Vietnam.

Keywords: *Clean Deverlopment Mechanism (CDM); Pulp and paper; Saving energy; Green house emission (GHE); Vietnam.*

TÓM TẮT

Công nghiệp bột gấy và giấy phát thải đáng kể khí nhà kính gây ra bởi việc tiêu thụ rất nhiều năng lượng trong các công đoạn vận hành của nó Do đó, ngành công nghiệp này có rất nhiều cơ hội thực hiện cơ chế phát triển sách (CDM) thông qua tiết kiệm năng lượng. Dự án CDM sẽ giúp giảm khí thải và cung cấp nguồn lực tài chính để hiện đại hóa ngành giấy. Mục tiêu của bài báo này là xây dựng quy trình, phương pháp, và xác định những cơ hội cho việc thực hiện dự án CDM cho ngành giấy Việt Nam. Phương pháp đề xuất được áp dụng cho nhà máy giấy Tân Mai. Kết quả cho thấy, dự án CDM cho ngành giấy có tính khả thi về kinh tế cao và mở ra những cơ hội cho việc giảm khí thải cho các ngành công nghiệp khác tại Việt Nam.

Từ khóa: *Cơ chế phát triển sạch (CDM); Bột giấy và giấy; Tiết kiệm năng lượng; Khí thải nhà kính (GHE), Việt Nam.*

1. INTRODUCTION

Vietnam is a developing country that still pushing the process of industrialization. The rapid industrial growth, coupled with rising energy demand causing enormous environmental implications[1]. To ensure the stable economic growth, two major issues that Vietnam need to be addressed: energy security and environmental pollution reduction plan that draw towards sustainability and sustainable development. To help ensure the energy security stabilisation, energy saving and minimizing is the easiest ways to approach the issues as well as in the most feasible sense. In facing a devastation of energy lost as a results of industrial movement, preservation is necessary and urgent.

Considered to be the large energy consumption and production, energy saving and emission reduction is essential for the Paper industry in Vietnam[2]. During the implementation process, it is necessary to utilise every methods and solutions in order achieve the destination goals, thus, making full uses of CDM recourses is required. Therefore, the main objective of the study is to develop a process, methodology and identify opportunities in using CDM

implementation within the Paper industry in Vietnam. Research has shown that CDM brings many beneficial factors in the process of producing paper including[3]: successfully saves energy, emission reductions and AR-CDM (Afforestation and Reforestation CDM) in raw materials (references). The CDM implementation project concentrates on both methodologies in saving energy and reduce emission. To demonstrate economic viability, the study conducted a typical CDM project at Tan Mai Paper Mill and the results were very feasible. The result of this study have provided the basis of research for other disciplines in the same field.

2. THE RECENTLY ISSUES OF PULP AND PAPER INDUSTRY IN VIETNAM

Paper production is a complex process involving a separate production technology in pulp and paper production (CTMP, DIP, OCC ...). However, looking at it closely the production process consists of two main stages, pulp production and paper production (Figure 1).

2.1 High consumption and waste of energy

Considering the current production technology, the Paper production technology in Vietnam is too fossilise and unreliable in comparison with other neighbouring countries. With Tan Mai and Bai Bang company, which are the two most developed and modernise companies in the field, the machineries and technologies are date back to 30-40 years old[2]. This is one of the major causes of energy wastage and unreliable energy consumption found in most current mass paper production in Vietnam. Table 1 compares the energy consumption of Vietnam with other countries.

2.2 High emission and pollution

According to data collected and converted from BTN & MTPA, the emission produced by the paper industry up to 0.65 tCO_2/ton. Whether, the number of emission be large or small, it also depends on the technologies uses in each companies. Based on the 2010 total production, the Paper industry has released approximately 1,287 million tCO_2 into the environment[2].

In addition, waste water extracted from the production itself contained a high level pH with an average of 9-11, along with biochemical oxygen (BOD) demand, high chemical oxygen (COD) demand, can rapidly rise up to 700mg/l and 2,500mg/l. Suspended solids such as metals and pulp are many times higher than permitted limits (Table 2)[2].

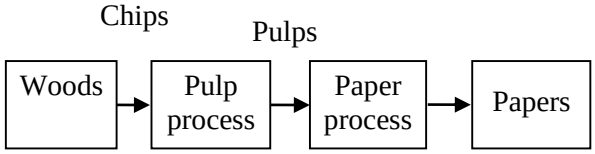

***Fig 1**. Pulp and paper production process*

***Table 1**. Comparision of energy consumptions[2]*

Energy	VietNam	India	North of America
Efficiency (%)	44 - 55	40 - 44	55
Chemicals (kg/tone)	80 - 50	71 - 35	75
Thermal energy (kCal/tone)	3.10^6 - 8.10^6	3.10^6 - 5.10^6	1.10^6 - $4,6.10^6$
Electricity (kWh/tone)	900 -1900	855 - 980	700 - 850
Water(m^3/tone)	175 - 350	180 - 280	20 - 40

***Table 2**. Pollution performance of wastewater in paper factories[2]*

Factors	Modern and large factory	Medium scale factory	Small scale factory
Water(m^3/tone)	40 - 70	80 - 100	150 - 300
BOD_5(kg/tone)	10 - 20	30 - 60	90 - 330
COD(kg/tone)	30 - 50	80 - 200	-
SS(kg/tone)	10	15 - 30	30 - 50

***Table 3**. Conversion rate of NIRI[10]*

Source	Factors				
	B/A	C/B	D/C	E/D	F/E
NIRI	0.5	1.33	1.2	0.5	3.67

3. OPPORTUNITIES FOR CER IN PAPER INDUSTRY

3.1 Saving energy

With the current production technology, Vietnam's pulp and paper industry is wasting a lot of energy in the production process. The main energy consumed in paper industry is electricity and thermal energy. Overall, waste energy due to the dated technologies, low automotive productive system, saving energy is forgotten, low efficiency of the production. Drawing from the issues mentioned, the proposed solution need to be taken into account: (1) sustainable energy savings include: upgraded technologies, improve lightsystem efficiency[4], air conditioner[5], install inverter for electric motors[6]; (2) saved thermal: transfer to biomass boiler, cycled thermal, apply new material and cogeneration [7]; upgraded paper technology production. The study will apply BIVIS[8] and OCM technology[3].

3.2 Establish the Raw forest framework approach to the requirement of AR-CDM[2][15]

With the large of forest area and many pecieces of trees with: gumtrees and pines is the main peciece which has high potentiality for CDM[9]. The absorbed CO_2 of tree depend on type of tree, age and density of tree. Therefore, the study will apply NIRI index[10] to calculate the amount of absorbed CO_2 (table 3).

$$F = 1.46A \quad (1)$$

with:

F: Amount of CO_2 absorbed (tCO_2/hecta)

A: wood reserves (m^3/hecta)

3.3 Reduced emission to get CERs

Reducing emission in paper industry is implemented in reducing emission of waste air, waste water and solid wastes. Annually, the sewage system of paper industry gave the large of amount of waste water into the environment which impacted significantly to the ecology of whole area. The emission factor of wastewater treatment process is 0,7 $kgCO_2/m^3$[11]. Reducing emission in paper industry is not only lowed the green house gas emission, its also decreased the sewage treatment cost.

Establishing CDM for paper industry will implement into 3 main solutions (fig 2): 1: saving energy; 2: Low emission; 3: establish AR-CDM in raw forests[12].

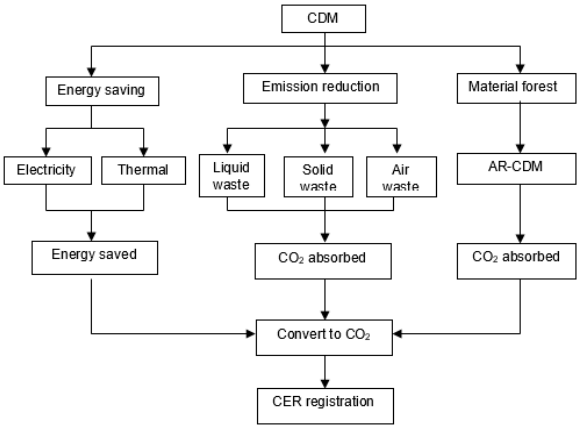

***Fig 2**. Pulp and paper CDM process*

4. IMPLEMENTATION METHOD AND INVESTIGATE CDM PROJECT

The implementation of CDM project in practical company depend on technology, scale and the finance of company. To get high feasibility of project, this method is investigating, detected and collected data at company directly to find-out and suggest the suited solutions.

To estimate the profit of CDM project, the study based on the economic indexs such as: payback period and IRR(internal rate on return). The project has the income and outcome in yearly which these are 2 basic elements to estimate the feasibility of finance. The contributed of CDM will be proved by the compararision of economic indexs with CDM and without CDM.

4.1 Finance analysis for saving energy solution

Figure 3 is cash flow diagram yearly of project, blocks in figure 3 has a formulations perspectively in table 4.

***Table 4**. Formulations for blocks in fig 3*

Blocks	Formulations
(1)	$C_0=S_0.G_s$
(2)	$C_{O\&M} = 5\%.C_0$
(3)	$G_S=G.F_E.(1+i)^n$
(4)	$R_E = P_E.G_s$
(5)	$SL_1 = E_{fac} \times G_s \times 10^6$
(6)	$M_{coal}=40\%.M$
(7)	$SL_2 = C_{fac} \times M_{coal}$
(8)	$SL_{CER} =(SL_1+SL_2)$
(9)	$R_{coal}=(M_{coal}.2{,}056-M_{bio}.0.85).10^{-3}$
(10)	$C_{CER} = 1{,}2\%.P_{CER}.SL_{CER}$
(11)	$R_{CER} = P_{CER}.SL_{CER} - C_{CER}$
(12)	$-C_0 - C_{O\&M} + R_E + R_{CER} + R_{coal}$

(1): investment budget; (2): maintain and operation cost; (3): Amount of saved electricity is calculated by total amount of electricity of paper industry G and saving factor of project F_E, I is paper industry growth factor, n is applied year; (4): profit of amount of saved electricity with EVN's Prize P_E; (5): the amount of CO_2 (SL_1) converted from electricity with E_{fac}= *524g-CO_2/kWh* (exchange factor); (6): Amount of coal which reduced (M_{coal}) (used biomass replacetion), F_c =40% is reduced factor in project; (7): Amount of CO_2 is coverted from coal (SL_2): calculated by emission factor of coal C_{fac}=*2.339 kgCO_2/kg*[13]; (9): Profit when converted from coal to biomass material (R_{coal}). The exchange factor is established on the amount of material which products a tone of steam with coal M_{coal} and biomass M_{bio} (used by the practical operation of boiler at Tan Mai factory); (10): CER trade cost (C_{CER}): cost of CER trade market is 1,2% of value of CER; (11): income of CER (R_{CER}): net income from CER.

4.2 Analysis and estimate the feasibility of technology transfer solution

Figure 4 showed cash flow of upgrade technology project. The corresponding formulations for blocks in figure 4 is showed in table 5. Similar the diagram in figure 3, (1): investment budget (S_{0pulp}, S_{0paper}); (2): maintain and operation cost (estimated 10% investment budget); (3): amount of saved electricity power (G_s) of electricity in new technology process E_{Rpulp}, E_{Rpaper}. G_w is amount of electricity power which reduced in saving water process. Q_T: yearly productivity; (6): the amount of CO_2 was reduced when transfer to new techonology (SL_2). P_{fac} : emission factor of paper industry. K: reduced emission factor; (10): profit of product trade is the net income when the products was traded in market. LR_{pulp}, LR_{paper}: net interest; (11): the amount of water which saved in new technology. C_{pulp}, C_{paper}: the factor of used water in production; (12) based on the real datas in factory operation with F_w =*0.2 kWh/m^3*: calculated on real datas of Tan Mai company.

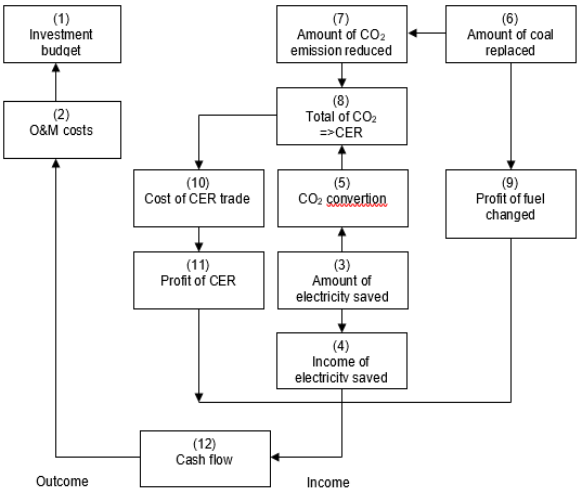

***Fig 3**. Cash flow of saving energy project*

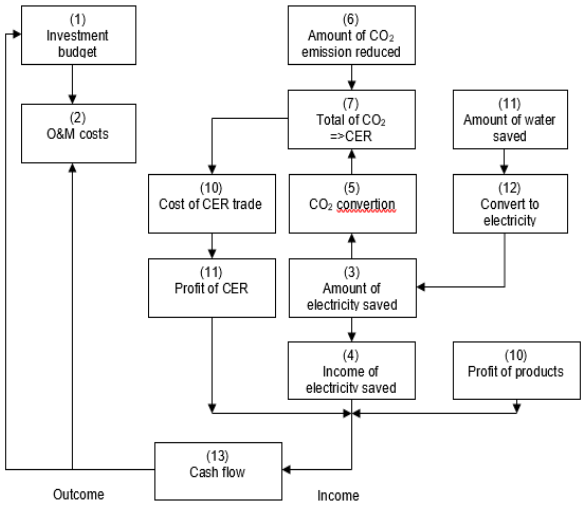

***Fig 4**. Cash flow of upgrade technology project*

***Table 5**. Formulations for blocks in fig 4*

Blocks	Formulations
(1)	$C_0 = S_{0pulp}.Q_{pulp} + S_{0paper}.Q_{paper}$
(2)	$C_{O\&M} = 10\%C_0$
(3)	$G_s = E_{Rpulp}.Q_{Tpulp} + E_{Rpaper}.Q_{Tpaper\ n} + G_w$
(4)	$R_E = P_E.G_s$/Tỷ giá USD
(5)	$SL_1 = E_{fac}.G_s.10^3$
(6)	$SL_2 = k.P_{fac}.(Q_{pulp}+Q_{paper})$
(7)	$SL_{CER} = SL_1+SL_2$
(8)	$C_{CER} = 1{,}2\%.P_{CER}.SL_{CER}/10^6$
(9)	$R_{CER} = P_{CER}.SL_{CER} - C_{CER}$
(10)	$R_T = Q_{Tpulp}.LR_{pulp} + Q_{Tpaper}.LR_{paper}$
(11)	$W=(65-10).(Q_{pulp}+Q_{paper})$
(12)	$G_w = F_W.W$
(13)	$-C_0 - C_{O\&M} + R_E + R_{CER} + R_T$

5. IMPLEMENT CDM PROJECT IN TAN MAI PAPER COMPANY

Tan Mai Paper Mill production capacity has breach 120,000 tons of paper and 90,000 tons of pulp to become the largest production unit in Sothern Vietnam and second in the country in terms of production scale. Tan Mai manufacture consist of 3 paper production lines: MG1, MG2, MG3 and 2 pulp production lines: CTMP and DIP. According to the investigation in factory, the DIP and MG3 production lines are relatively modern and stable, so energy saving solution will be concentrated on the remaining lines. The article will analyse the following two scenarios: Scenario 1: Implementation of energy saving solutions such as renovation of lighting system, Air conditioner system, installation of inverter for electrical motors, invest the Biomass boiler system (20T/h). Scenario 2: Investing in new technology, specifically: applying BIVIS technology production (100,000 tons/year) to replace for CTMP process and OCM technology lines (100000 tons/year) to replace for both MG1 and MG2 process. All of input datas for each scenario is given in Tables 6, 7 and 8.

Economic analysis results for scenarios 1 are shown in table 9, table 10 and table 11.

Table 9 is an analytical results of the energy saving project, recognizing that this is a highly feasible option, with a payback period of less than two years. The contribution of CDM in this case is largely distinguish, specifically reducing the payback period to 0.83 years and increasing the internal rate of return from 27% to 87%, while reducing the emission rate by 32,000 tCO_2/year.

***Table 6**. Input datas of saving energy project*

Elements	Unit	Amount
Investment budget	10^9 vnd	C_0= 16.56
Amount of saving energy of project	gWh/year	G_s=2.348
Amount of CERs reduced in project.	tCO_2/year	SL_{CER}=32,378
Prize of 1 CER	Vnd	P_E=341.000
Income of project (without CDM)	10^9 vnd	R=8,8

***Table 7.** Input datas of BIVIS technology*

Elements	Unit	Amount
Investment budget	USD/tone	600
Profit	USD/tone	200
Exchange rate	Vnd/USD	21,000
Emission factor of paper industry	tCO_2/tone	0.65
Interest rate	%	12
Efficiency	%	80

***Table 8.** Input datas of OCM technology*

Elements	Unit	Amount
Investment budget	USD/tone	500
Profit	USD/tone	150
Exchange rate	Vnd/USD	21,000
Prize of 1 CER	Vnd	341.000
Interest rate	%	12
Efficiency	%	80

***Table 9**. Results of saving energy project*

Payback period (without CDM)	1.88 year
Payback period (with CDM)	0.83 year
IRR (without CDM)	27%
IRR (with CDM)	87%

***Table 10**. Results of BIVIS project*

IRR(without CDM)	20.61%
IRR(with CDM)	21.94%
Payback period (without CDM)	6.18 year
Payback period (with CDM)	5.78 year

***Table 11**. Results of OCM project*

IRR(without CDM)	16.60%
IRR(with CDM)	18.53%
Payback period (without CDM)	4.0 năm
Payback period (with CDM)	3.77 năm

The results in tables 10 and 11 are the result of a technology transfer project, which consist of low payback period that are less than seven years for BIVIS technology and maximum of four years for OCM technology. The result also shows the positive contribution of CDM to the project, particularly when the CDM implementation will reduce the payback period to 5.78 years with BIVIS technology and 3.77 years with OCM technology. In addition, IRR index also increased significantly with CDM. The total CO_2 reduction from the project is 100,000 tCO_2 per year. Thus, the implementation of CDM will help Tan Mai paper company significantly reduce emissions and save production costs.

6. CONCLUSION

In order to reduce emissions and save energy for the Pulp and Paper industries of Vietnam, the development of CDM framework in implementation and methodology is essentially crucial. Since the contribution of the CDM to the project is highly positive, the CDM helps shorten the payback period and increase the project's internal rate of return. Research conducted in Tan Mai manufacture shows that the proposed energy saving project has helped to shorten the payback period over a year and reduce emission by 32,000 tCO_2 per year into the environment. With the changes in term of technologies and programs. CDM implementation also has an active role in shorten the payback period and eliminating 100,000 tCO_2 to be release into the environment. If implemented throughout the paper industry, the CDM helps significantly reduce emissions and is a solution to accelerate the modernization of the paper industry to meet the goal of sustainable development.

The study only focuses on the Pulp and Paper Industry in Vietnam, the major energy consumption and emissions factors that the country faces, however, it also creates a pathway to prosecute other similar issues on rising for other industries. In the process of economic development, it is necessary to make the most of all support measures, and the CDM is an effective support solution for clean energy projects and for the improvement of existing production technologies. Taking advantage of the benefits of CDM to help the investment project will improve the feasibility of the project.

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