

Seminar on
“CDM business Opportunities for Cogeneration Projects”

Introduction of PDDs of
Wind + Diesel Hybrid Electricity
and
Dak Pone Hydropower Projects

Dr. Nguyen Duc Minh
Eng. Tran Minh Tuyen
Email: minh.nguyenduc@fpt.vn / minh_tuyen@fpt.vn



Research Center for Energy and Environment

Lane 62, Nguyen Chi Thanh str., Hanoi, Vietnam – Tel: (84-4) 7733686; Fax: (84-4) 7734022
Email: ngrcee@hn.vnn.vn; Web: www.rcee.net

I. Wind + Diesel Hybrid Electricity Project

Contents

1. Generation description
2. Baseline description
3. Emission reduction calculation
4. Monitoring methodology
5. Environmental impacts



Research Center for Energy and Environment

Lane 62, Nguyen Chi Thanh str., Hanoi, Vietnam – Tel: (84-4) 7733686; Fax: (84-4) 7734022
Email: ngrcee@hn.vnn.vn; Web: www.rcee.net

General Description

- 1. Objective:** Construct a wind+diesel hybrid electricity system to sell the generated output to Phu Quy island
- 2. Capacity:** 6,6 MW - 6 wind units with 1.1 MW each and existing and expanded diesel plant (also 6.6MW capacity)
- 3. Location:** Phu Quy Island, Binh Thuan province, 120 km far from Phan Thiet city.
- 4. Project sponsor:** EVN and **Electricity Company No 2.**
- 5. Project development:** Research Center for Energy Environment; Department of Technology, Science & Telecommunication (EVN)
- 6. Planning:** Starting: QII, 2004
 - First wind power unit: 1/1/2006
 - Completion: 2009
 - Contract for CO₂ sale : during 10 year (from 1/1/2006)
- 7. CO₂ emission reduction amount:** 106,372tCO₂ during 10 years



Research Center for Energy and Environment

Lane 62, Nguyen Chi Thanh str., Hanoi, Vietnam – Tel: (84-4) 7733686; Fax: (84-4) 7734022
Email: ngrcee@hn.vnn.vn; Web: www.rcee.net

Baseline

1. Project category

- + Renewable Energy Project category is applicable
- + Small Scale project (<15 MW), Renewable electricity generation for a grid (Isolated grid)
- Application: SS CDM Appendix B, Item I.D. 28
- Use the IPCC default value: 0,8 kgCO₂/kWh (diesel plant efficiency of 33,5%).

2. Project boundary:

- + Geographical : Phu Quy Island
- + Physical: Island grid and generation activity only

The emission from fuel transportation from mainland is not taken into account. So it is expected that the Baseline emission estimated will be lower than the real reduction achieved. So emission calculation will be more conservative

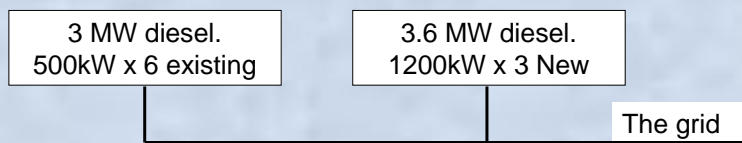


Research Center for Energy and Environment

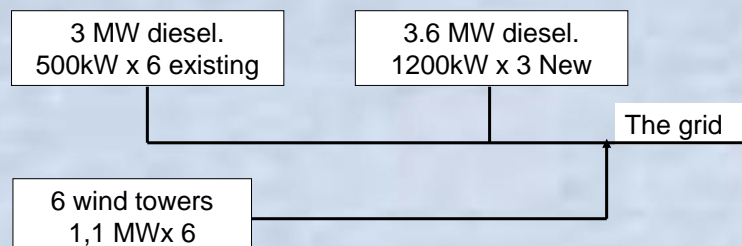
Lane 62, Nguyen Chi Thanh str., Hanoi, Vietnam – Tel: (84-4) 7733686; Fax: (84-4) 7734022
Email: ngrcee@hn.vnn.vn; Web: www.rcee.net

Baseline (cont.)

Baseline scenario



CDM scenario



Research Center for Energy and Environment

Lane 62, Nguyen Chi Thanh str., Hanoi, Vietnam – Tel: (84-4) 7733686; Fax: (84-4) 7734022

Email: ngrcee@hn.vnn.vn; Web: www.rcee.net

Baseline (cont.)

3. Potential Baseline Option (FBO):

If in case of absence of the proposed project, there are some alternatives replacing diesel for electricity generation:

- + Gas, LPG: but they are excluded due to the transportation problem (gas) and price (LPG).
- + Solar: This is a renewable energy type but its capacity can not meet demand of the island. Moreover, generation cost per kWh is so high. So it is excluded.
- + Wave: Recently, the technology using wave energy for electricity generation is so expensive and is not commercialized in the world.



Research Center for Energy and Environment

Lane 62, Nguyen Chi Thanh str., Hanoi, Vietnam – Tel: (84-4) 7733686; Fax: (84-4) 7734022

Email: ngrcee@hn.vnn.vn; Web: www.rcee.net

Baseline (cont.)

4. Finance analysis (Additionality)

- + Investment: 1370 USD/kW (870 USD/kW-wind and 500 USD/kW-diesel)
- + All other finance input data are in accordance with the Vietnam current situation
- + The results are (discount rate 12% and lifetime : 20 years, with 3USD/T.CO₂)

Results	Unit	Baseline	CDM
NPV	MUSD	6.04	7.10
Levelized gen. cost	UScent/kWh	7.98	7.63
Dis. Pay-back period	year	4.52	7.39
IRR	%	32.00	21.94



Research Center for Energy and Environment

Lane 62, Nguyen Chi Thanh str., Hanoi, Vietnam – Tel: (84-4) 7733686; Fax: (84-4) 7734022
Email: ngrcee@hn.vnn.vn; Web: www.rcee.net

Emission reduction calculation

1. Emission calculation of the project activity

The formula used to calculate annual CO₂ emission:

$$E1 = (\text{Cap1} * \text{CEF1} + \text{Cap2} * \text{CEF2}) * \text{LF} * \text{Hours}$$

Where:

E1: Emission amounts of the project activity

Cap1,Cap2: Existing and new diesel machines capacity, kW

CEF: Carbon emission factor , kgCO₂/kWh

Existing machines (30% efficiency): CEF1=0.895 kgCO₂/kWh

New machines (33.5% efficiency): CEF2 = 0.8 kgCO₂/kWh

Hours = 8760 hours per year

LF: Load factor of the diesel-fired plant

$$\text{LF} = (\text{Electricity} - \text{Wind electricity}) / ((\text{Cap1} + \text{Cap2}) * 8760)$$



Research Center for Energy and Environment

Lane 62, Nguyen Chi Thanh str., Hanoi, Vietnam – Tel: (84-4) 7733686; Fax: (84-4) 7734022
Email: ngrcee@hn.vnn.vn; Web: www.rcee.net

Emission reduction calculation

2. Emission calculation of the Baseline project

The formula used to calculate annual CO2 emission:

$$E2 = \text{Cap} * \text{LF} * \text{Hours} * \text{CEF}_{\text{baseline}}$$

Where:

E2: Emission amounts of the baseline activity

Cap = Cap1 + Cap2 - The capacity of the baseline plant, kW

CEF: Default carbon emission factor [kgCO₂/kWh]

$$\text{CEF} = 0.8 \text{ kgCO}_2/\text{kWh}$$

Hours = 8760 hours per year

LF=75% - Load factor of the baseline plant



Research Center for Energy and Environment

Lane 62, Nguyen Chi Thanh str., Hanoi, Vietnam – Tel: (84-4) 7733686; Fax: (84-4) 7734022

Email: ngrcee@hn.vnn.vn; Web: www.rcee.net

Emission reduction calculation

3. Project schedule and emission reduction amount

Emission calculation of Phu Quy

year	Diesel			Wind		Project emission E1 = E3	Baseline emission E4	Annual CO2 reduction
	Cap1 kW	Cap2- kW	Diesel LF	wind- kW	Wind-kWh	TCO2	TCO2	TCO2
2006	2400	1200	0.6583	1100	2890800	17923.84	18921.6	997.76
2007	3000	1200	0.5143	3300	8672400	16421.25	22075.2	5653.95
2008	3000	2400	0.4444	5500	14454000	17928.80	28382.4	10453.60
2009	3000	3600	0.4500	6600	17344800	21937.23	34689.6	12752.37
2010-2015	3000	3600	0.4500	6600	17344800	21937.23	34689.6	12752.37
2016-2025	3000	3600	0.4500	6600	17344800	21937.23	34689.6	12752.37
2026	3000	3600	0.5000	5500	14454000	24374.70	34689.6	10314.90
2027	3000	3600	0.6000	3300	8672400	29249.64	34689.6	5439.96
2028	3000	3600	0.7000	1100	2890800	34124.58	34689.6	565.02
2029	3000	3600	0.7500	0	0	36562.05	34689.6	-1872.45



Research Center for Energy and Environment

Lane 62, Nguyen Chi Thanh str., Hanoi, Vietnam – Tel: (84-4) 7733686; Fax: (84-4) 7734022

Email: ngrcee@hn.vnn.vn; Web: www.rcee.net

Monitoring methodology

1. Data are used to monitor emissions from the project activity:

- + Electricity generated by the wind + diesel system (*is to estimate load factor of the system*)
- + Electricity generated by diesel units, DO fuel consumption for electricity generation (*is to re-estimate emission factor*)
- + Electricity generated by wind units (*is to cross check electricity metering*)

2. Data are used to determine the baseline of emissions within the project boundaries

- + Electricity generated by the wind + diesel system (*is to estimate load factor of the system*).



Research Center for Energy and Environment

Lane 62, Nguyen Chi Thanh str., Hanoi, Vietnam – Tel: (84-4) 7733686; Fax: (84-4) 7734022
Email: ngrcee@hn.vnn.vn; Web: www.rcee.net

Environmental impacts

Environmental impacts from the proposed project are limited to possible noise and visual pollution and change in land use.

- + **Noise pollution:** For modern wind turbines, at the distance of 4÷6 turbine diameter, it will be only 44÷40dB(A). Furthermore, wind plant location is selected on sand hills where is far away from inhabitant areas. Therefore, this issue is not reason for concern.
- + **Visual pollution, Land use:** As the Project site is located on sand hills where is far away from inhabitant areas, so there is no concern regarding these problems.



Research Center for Energy and Environment

Lane 62, Nguyen Chi Thanh str., Hanoi, Vietnam – Tel: (84-4) 7733686; Fax: (84-4) 7734022
Email: ngrcee@hn.vnn.vn; Web: www.rcee.net

II. Dak Pone Hydropwer Project

Contents

1. Generation description
2. Baseline description
3. Emission reduction calculation
4. Monitoring methodology



Research Center for Energy and Environment

Lane 62, Nguyen Chi Thanh str., Hanoi, Vietnam – Tel: (84-4) 7733686; Fax: (84-4) 7734022
Email: ngrcee@hn.vnn.vn; Web: www.rcee.net

General Description

1. **Objective:** is to generate renewable electricity utilizing hydroelectric resources in the Dak Pone river and to sell the connected to the grid generated output to (EVN)
2. **Capacity:** 14 MW power plant consisting of 2 units of 7 MW each
3. **Location:** Mang Canh commune, Kon Plong district, Kon Tum province, 50 km far from Kon Tum province.
4. **Project sponsor:** Power Company No 3.
5. **Project development:** Research Center for Energy Environment
6. **Planning:**
 - Completion: 2006
 - Contract for CO₂ sale : during 10 year (from 1/1/2007)
7. **CO₂ emission reduction amount:** annually 39,731 T.CO₂



Research Center for Energy and Environment

Lane 62, Nguyen Chi Thanh str., Hanoi, Vietnam – Tel: (84-4) 7733686; Fax: (84-4) 7734022
Email: ngrcee@hn.vnn.vn; Web: www.rcee.net

Baseline

1. Project category

- + Renewable Energy Project category is applicable
- + Small Scale project (<15 MW), Renewable electricity generation for a grid (National electricity grid)
- Application: SS CDM Appendix B, Item I.D. 29
- + Emission factor is calculated to be 0.6245 kgCO₂/kWh (by RCEE)

2. Project boundary:

- + Geographical : The area where the the Dak Pone Hydropower Plant is installed
- + Physical: The nation electricity grid, which the plant is connected to



Research Center for Energy and Environment

Lane 62, Nguyen Chi Thanh str., Hanoi, Vietnam – Tel: (84-4) 7733686; Fax: (84-4) 7734022
Email: ngrcee@hn.vnn.vn; Web: www.rcee.net

Baseline (cont.)

3. Baseline scenario: is the Vietnam national electricity grid

4. Potential Baseline Option (FBO):

If in case of absence of the proposed project, there are some alternatives replacing diesel for electricity generation:

- + Diesel, Gas, LPG: but they are excluded due to the transportation problem (diesel, gas) and price (LPG).
- + Solar, wind: These are renewable energy types but they also are excluded because their potential is poor so generation cost per kWh is so high.



Research Center for Energy and Environment

Lane 62, Nguyen Chi Thanh str., Hanoi, Vietnam – Tel: (84-4) 7733686; Fax: (84-4) 7734022
Email: ngrcee@hn.vnn.vn; Web: www.rcee.net

Baseline (cont.)

5. Finance analysis (Additionality)

- + Investment: 1037 USD/kW
- + All other finance input data are based on Feasibility Study Document and the Vietnam current situation
- + The results are (discount rate 10% and lifetime: 30 years, with 4USD/T.CO₂)

Results	Unit	Without CDM	With CDM
NPV	MUSD	4.49	5.99
Levelized gen. Cost	Cent/kWh	3.25	3.00
Dis. Pay-back period	year	14.28	12.45
IRR	%	13.12	14.13



Research Center for Energy and Environment

Lane 62, Nguyen Chi Thanh str., Hanoi, Vietnam – Tel: (84-4) 7733686; Fax: (84-4) 7734022
Email: ngrcee@hn.vnn.vn; Web: www.rcee.net

Emission reduction calculation

1. Emission calculation of the project activity

$$E1 = 0 \text{ T.CO}_2$$

2. Emission calculation of the Baseline project

The formula used to calculate annual CO₂ emissions of the baseline are below shown:

$$E2 = E_0 * CEF_{\text{Baseline}}$$

Where:

E2: Emission amounts of the baseline activity [kgCO₂/year]

E₀ = 63.62*10⁶ kWh/year - Total amount of national grid electricity which is replaced by electricity generated from the plant.

$$CEF_{\text{Baseline}} = 0.6245 \text{ kgCO}_2/\text{kWh}$$

So, total amount of baseline CO₂ emission will be:

$$E2 = 63.62*10^6*0.6245 = 39,731,000 \text{ kgCO}_2/\text{year} = 39,731 \text{ TCO}_2/\text{year}$$



Research Center for Energy and Environment

Lane 62, Nguyen Chi Thanh str., Hanoi, Vietnam – Tel: (84-4) 7733686; Fax: (84-4) 7734022
Email: ngrcee@hn.vnn.vn; Web: www.rcee.net

Monitoring methodology

- 1. Data are used to monitor emissions from the project activity:**
 - + Electric generation of the project delivered to grid
 - + Total outputs and self-use (is to cross check electricity metering)
- 2. Data are used to determine the baseline of emissions within the project boundaries**
 - + Official data of the national grid will be only supplied, so it is can be not monitored



Research Center for Energy and Environment

Lane 62, Nguyen Chi Thanh str., Hanoi, Vietnam – Tel: (84-4) 7733686; Fax: (84-4) 7734022
Email: ngrcee@hn.vnn.vn; Web: www.rcee.net

Thank you!



Research Center for Energy and Environment

Lane 62, Nguyen Chi Thanh str., Hanoi, Vietnam – Tel: (84-4) 7733686; Fax: (84-4) 7734022
Email: ngrcee@hn.vnn.vn; Web: www.rcee.net