付属資料-D

環　境

カンボジア国
再生可能エネルギー利用地方電化マスタープラン調査

ファイナルレポート
第 5 巻　付属資料

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Appendix-D Environment

1. APPENDICES TO CHAPTER 2 OF PART 3 IN VOL. 2

Table AP-D.1.1 Illustrative List of Sensitive Sectors, Characteristics, and Areas

Note: The projects that belong to sensitive sectors, have sensitive characteristics, and/or are located in sensitive areas, shown below may have potential significant negative impacts on the environment and society. Each of such projects will be categorized as "Category A".

1. Illustrative list of large-scale projects in sensitive sectors

(1) Mining development
(2) Industrial development
(3) Thermal power (including geothermal power)
(4) Hydropower, dams and reservoirs
(5) River/erosion control
(6) Power transmission and distribution lines
(7) Roads, railways and bridges
(8) Airport
(9) Ports and harbors
(10) Water supply, sewage and wastewater treatment
(11) Waste management and disposal
(12) Agriculture involving large-scale land clearing or irrigation
(13) Forestry
(14) Fisheries
(15) Tourism

2. Illustrative list of sensitive characteristics

(1) Large-scale involuntary resettlement
(2) Large scale groundwater pumping
(3) Large-scale land reclamation, land development and land clearing
(4) Large-scale logging

3. Illustrative list of sensitive areas, including their vicinity

(1) National parks, nationally designated protected areas (coaster areas, areas for ethnic minorities or indigenous people and cultural heritage, etc. designated by national government), wildlife sanctuary and natural protected areas
(2) Areas where the national or local government believe to require careful considerations
a. Natural environment
- Primary forests or natural forests in tropical areas
- Habitats with important ecological value (coral reefs, mangrove wetlands, tidal flats, etc.)
- Habitats of rare species requiring protection under domestic legislation, international treaties, etc.)
- Areas in danger of large scale salt accumulation or soil erosion
- Areas with a remarkable tendency towards desertification

b. Social environment
- Areas with unique archeological, historical or cultural value
- Areas inhabited by ethnic minorities, indigenous people or nomadic people with traditional ways of life and other areas with special social value

Source: JICA Guidelines for Environmental and Social Considerations, April 2004

Table AP-D.1.2 Environmental Screening Format

(A check list for proposed rural electrification projects)

1. General Information

1.1 Name of the proposed project:
1.2 Name of Project owner/proponent
Project Execution Organization :
Name of the responsible office:
Name of contact persons:
Address:
E-mail:
Tel/Fax No.:
Cell phone no.:
Name of authorized person(s) responsible for the project
Name:
Position:
Address:
E-mail:
Tel/Fax:
Cell phone:
Signature:
1.3 Information regarding the project site
Name of the village, commune, district and province
Address:
Other information regarding the village(s) the project site area belongs

2. Outline of the Proposed Project

2.1 Information on project characteristics

(1) Needs involuntary resettlement		
	Yes	Scale: households, persons
	No	
(2) Groundwater pumping		
	Yes	Scale: m^3/year
	No	
(3) Land reclamation, land development and land cleaning		
	Yes	Scale: hectors
	No	
(4) Logging		
	Yes	Scale: hectors
	No	

2.2 Description of the project
Main design specifications:
……
……
……
……
……
……
……
……
……

2.3 Is the project consistent with the higher program/policy ?

	Yes	(outline of the higher program/policy)
	No	

2.4 Any alternatives considered before the project ?

	Yes	(outline of the alternatives)
	No	

2.5 Did the project proponent have meetings with related stakeholders during the project planning ?

	Yes	(mark the corresponding stakeholders)	
			Administrative body/local government
			Local residents/villagers
			NGOs
			Others (to specify)
	No		

2.6 Are any of the following areas located inside or around the project site ?

	Yes	(mark related items listed below)	
			National park, wildlife sanctuary, protected area designated by the government
			Virgin forests, tropical forests
			Ecological important habitat areas
			Habitat of valuable species protected by domestic laws or international treaties
			Likely salt cumulus or soil erosion areas on a massive scale
			Remarkable desertification trend areas
			Archaeological, historical or cultural valuable areas
			Living areas of ethnic, indigenous people or nomads who have a traditional lifestyle or specifically valuable areas
	No		

2.7 My the project have potential negative impacts to the environment and local communities ?

	Yes	(brief description of the potential negative impacts)
	No	
	Not identified	

2.8 Mark the related potential environmental and social impacts and describe briefly the contents of the impacts, if any.

Items of potential impacts		Items of potential impacts	
	Air pollution		Local economy, employment, livelihood, etc.
	Water pollution		Land use and utilization of local resources
	Soil pollution		Existing social infrastructures and services
	Waste (liquid and/or solid)		Poverty issue
	Causing noise and vibration		Ethnic and /or indigenous people
	Ground subsidence		Misdistribution of benefits
	Offensive odors		Local conflict of interests among villagers
	Geographical features		Gender issue
	Bottom sediment		Children's rights
	Biota and ecosystem		Natural and/or cultural heritages
	Potential conflict on water use rights		Infectious diseases such as HIV/AIDS, etc.
	Public health and hygiene		Others if any
	Global warming		
	Involuntary resettlement		

Outline of related impacts marked as above:

(1) (2)

(3) (4)

2.9 Key Results of the Environmental Screening

Source: JICA Study Team

Table AP-D.1.3 A Generic "Scope of Work Items for Conducting an IEIA and/or EIA"

Scope of Work Items	Remarks
I. Study on contents and rationale of proposed project	
1. Project site location	
2. Project rationale	
3. General layout of project facilities	
4. Principal design features	
5. Description by project phases	
a. Pre-construction activities	
b. Construction activities	
c. Project operation activities	
II. Study on natural environmental conditions	
1. Physical environment	
a. Geology	
b. Topography	
c. Soil characteristics	Composition, heavy metals, etc. For Category II or Category C projects, this item will not be required.
d. Meteorology	
e. Hydrology	
f. Air quality	
g. Water quality	Parameters are temperature, pH, turbidity, DO, BOD, COD, Ca, Mg, Zn, total P, total N, Cyanides, heavy metals, phenol, etc. For Category II or Category C projects, this item will not be needed.
i) concerned river	
ii) groundwater	
h. Sediments of concerned river	Sediment transport, particle size distribution, seasonal variation,, etc. For Category II or Category C projects, this item will not be required.
2. Biological environment	
a. Terrestrial flora and fauna	
b. Aquatic flora and fauna	
c. Rare, endangered or protected species in the project area and its vicinity	
III. Study on socio-economic and cultural environment	
1. Demographics and population characteristics	
2. Community structures	
3. Employment and labor market, economic activities, main income sources and income levels	
4. Agriculture, forestry, livestock breeding and fisheries	
5. Industries	
6. Public health and hygiene	
7. Education	
8. Recreation	
9. Cultural properties and heritages	
10. Indigenous people and their communities	
IV. Study on future environmental conditions without project	
V. Environmental impact assessment	During construction and operation phases
1. Potential impacts on physical environment	
a. Study on each item of II.1 above	
b. Study on noise conditions	
2. Potential impacts on biological environment	
a. Study on each item of II.2 above	
3. Potential impacts on socio-economic environment	
a. Impacts on livelihood of concerned villagers and communities	
b. Impacts on agricultural/industrial activities	
c. Impacts on employment and labor market	
d. Impacts on land use	Land acquisition and others
e. Impacts on water uses	
f. Impacts on public health and hygiene	
g. Impacts on recreation, cultural properties and heritages	
VI. Resettlement Issues	If resettlement is required.
1. Number of households and people to be resettled	
2. New locations (host area) for resettlement	
3. Resettlement and compensation plan	
4. Livelihood improvement plan for resettled people	
VII. Environmental Management Plan	This item may not be required for the projects of Category II or Category C.
1. Impact avoidance and mitigation measures	
a. Measures for physical environmental impacts	
b. Measures for biological env. impacts	
c. Measures for socio-economic impacts	
d. Programs for implementing measures	
2. Environmental Monitoring Plan	
a. During construction phase	
b. During operation phase	
3. Institutional responsibilities and agreements for implementation of the Environmental Management Plan	
VIII. Comparison between with and without project	

Source: JICA Study Team

Table AP-D.1.4 Environmental Screening for "*Bay Srok*" MHP Project

(A check list for proposed MHP project)

1. General Information

- Name of the proposed project: **Bay Srok MHP Project**
- Name of Project owner/proponent: not decided yet
  - ・ Project Execution Organization : not decided yet
  - ・ Name of authorized person(s) responsible for the project : not decided yet
- Information regarding the project site
  - ・ Name of the village, commune, district and province :
    Bay Srok Village, Bay Srok Commune, Lamphat District, Rattana Kiri Province
  - ・ Other information regarding the village(s) the project site area belongs :
    Refer to a separated document titled " The Results of Interview and Field Survey of Bay Srok MHP Project Site".

2. Outline of the Proposed Project

2.1 Information on project characteristics

(1) Needs involuntary resettlement		
	Yes	Scale: households, persons
●	No	
(2) Groundwater pumping		
	Yes	Scale: m^3/year
●	No	
(3) Land reclamation, land development and land cleaning		
	Yes	Scale: hectors
●	No	
(4) Logging		
●	Yes	Scale: about o.5 hectors for power house space
	No	

2.2 Description of the project

- Main design specifications:
  The MHP will utilize the water head difference of the O Sien Ler Waterfall. Gross head is 23.2 m. Potential Power is 170 kW.

2.3 Is the project consistent with the higher program/policy ?

●	Yes	(outline of the higher program/policy) Rural electrification plans in the Province
	No	

2.4 Any alternatives considered before the project ?

●	Yes	(outline of the alternatives) O Ka Tieng MHP and other few candidate MHPs are also under consideration.
	No	

2.5 Did the project proponent have meetings with related stakeholders during the project planning ?

●	Yes	(mark the corresponding stakeholders)	
		●	Administrative body/local government
		●	Local residents/villagers
			NGOs
			Others (to specify)
	No		

2.6 Are any of the following areas located inside or around the project site ?

	Yes	(mark related items listed below)	
			National park, wildlife sanctuary, protected area designated by the government
			Virgin forests, tropical forests
			Ecological important habitat areas
			Habitat of valuable species protected by domestic laws or international treaties
			Likely salt cumulus or soil erosion areas on a massive scale
			Remarkable desertification trend areas
			Archaeological, historical or cultural valuable areas
			Living areas of ethnic, indigenous people or nomads who have a traditional lifestyle or specifically valuable areas
●	No		

2.7 My the project have potential negative impacts to the environment and local communities ?

	Yes	(brief description of the potential negative impacts)
●	No	
	Not identified	

2.8 Mark the related potential environmental and social impacts and describe briefly the contents of the impacts, if any.

Items of potential impacts		Items of potential impacts	
	Air pollution		Local economy, employment, livelihood, etc.
	Water pollution		Land use and utilization of local resources
	Soil pollution		Existing social infrastructures and services
	Waste (liquid and/or solid)		Poverty issue
	Causing noise and vibration		Ethnic and /or indigenous people
	Ground subsidence		Misdistribution of benefits
	Offensive odors		Local conflict of interests among villagers
	Geographical features		Gender issue
	Bottom sediment		Children's rights
	Biota and ecosystem		Natural and/or cultural heritages
	Potential conflict on water use rights		Infectious diseases such as HIV/AIDS, etc.
	Public health and hygiene		Others if any
	Global warming		
	Involuntary resettlement		

Remarks: No any negative impacts would be caused to such items as listed above.

2.9 Key results of the environmental screening :

(1) The candidate project site is located outside of any "Protected Area".

(2) The MHP will utilize the head difference of the O Sien Ler Waterfall having seven (7) cascades existing along O Sien Ler River. The location is in the area of Bay Srok Village, Bay Srok Commune, Rattana Kiri Province.

(3) The 7 cascades waterfall is under the management of "Provincial Rural Development Committee (the Committee). The waterfall is a tourism spot.

(4) From the above, the following key factors should be considered:
   1) In spite that the project site will be outside of any Protected Area, carrying out IEIA is recommended. The IEIA must be approved by the MOE.
   2) Stakeholders meeting shall be held at various stage from the project planning to reflect opinions and comments concerned parties, especially those of the villagers and the Committee.
   3) During dry season, operations of the MHP will be limited during night time to mitigate impacts to the tourism. The operational scheme shall be accepted by the parties concerned.

(5) The area of Bay Srok village and its vicinity is a place having gem stone resource. Collection and processing of gem stones are trhe major income sources of the villagers. As of January 2005, average income amount per household here is about 150,000 Riel (US$38) which is much higher than that of other villages in the Province. Therefore, population of the village is increasing, which causes electricity demand also being increased.

(6) For details of the social-economic conditions of the village, refer to a separated document "The Results of Interview and Field Survey of Bay Srok MHP Project Candidate Site".

Source: JICA Study Team

Table AP-D.1.5 Environmental Screening for "*O Phlai*" MHP Project

(A check list for proposed MHP project)

1 General Information

- Name of the proposed project: **O Phlai MHP Project**
- Name of Project owner/proponent: Not defined yet

・ Project Execution Organization : not decided ne
・ Name of authorized person(s) responsible for the project: not decided yet

- Information regarding the project site

・ Name of the village, commune, district and province:
Sre Om Pum Commune, Pecher Chenda District, Mondul Kiri Province
・ Other information regarding the village(s) the project site area belongs:
There are three (3) villages in the Commune. No waterfalls exist in the Commune area.

2 Outline of the Proposed Project

2.1 Information on project characteristics

(1) Needs involuntary resettlement		
	Yes	Scale: households, persons
●	No	
(2) Groundwater pumping		
	Yes	Scale: m^3/year
●	No	
(3) Land reclamation, land development and land cleaning		
	Yes	Scale: hectors
●	No	
(4) Logging		
●	Yes	Scale: about 0.3 hectors
	No	

2.2 Description of the project

Main design specifications:
(1) Gross head : 20m (another 20 m available along the O Phlai River)
(2) Potential power : 45 kW

2.3 Is the project consistent with the higher program/policy ?

●	Yes	(outline of the higher program/policy)
	No	

2.4 Any alternatives considered before the project ?

●	Yes	(outline of the alternatives) Bu Sra MHP, which will use the head of Bu Sra Waterfall.
	No	

2.5 Did the project proponent have meetings with related stakeholders during the project planning ?

●	Yes	(mark the corresponding stakeholders)	
		●	Administrative body/local government
		●	Local residents/villagers
			NGOs
			Others (to specify)
	No		

2.6 Are any of the following areas located inside or around the project site ?

●	Yes	(mark related items listed below)	
		●	National park, wildlife sanctuary, protected area designated by the government
			Virgin forests, tropical forests
			Ecological important habitat areas
			Habitat of valuable species protected by domestic laws or international treaties
			Likely salt cumulus or soil erosion areas on a massive scale
			Remarkable desertification trend areas
			Archaeological, historical or cultural valuable areas
		●	Living areas of ethnic, indigenous people or nomads who have a traditional lifestyle or specifically valuable areas
	No		

2.7 My the project have potential negative impacts to the environment and local communities ?

	Yes	(brief description of the potential negative impacts)
●	No	
	Not identified	

2.8 Mark the related potential environmental and social impacts and describe briefly the contents of the impacts, if any.

Items of potential impacts		Items of potential impacts	
	Air pollution		Local economy, employment, livelihood, etc.
	Water pollution		Land use and utilization of local resources
	Soil pollution		Existing social infrastructures and services
	Waste (liquid and/or solid)		Poverty issue
	Causing noise and vibration		Ethnic and /or indigenous people
	Ground subsidence		Misdistribution of benefits
	Offensive odors		Local conflict of interests among villagers
	Geographical features		Gender issue
	Bottom sediment		Children's rights
	Biota and ecosystem		Natural and/or cultural heritages
	Potential conflict on water use rights		Infectious diseases such as HIV/AIDS, etc.
	Public health and hygiene		Others if any
	Global warming		
	Involuntary resettlement		

Remarks: No any negative environmental impacts would be caused to such items as listed above.

2.9 Key Results of the Environmental Screening:

(1) The project site is located on the boundary of a Wildlife Sanctuary called Pham Nam Lyr designated in the Mondul Kiri Province.
Therefore, Initial Environmental Impact Assessment will be required.
(2) Bu Sra Waterfall will not be touched. The waterfall exists along another river called Prek Por River.
(3) It is intended to supply the installed power only to Bu Sra Commune. This may cause problem with the villagers living in the Sre Om Pum Commune. The generated power should also be supplied the Sre Om Pum where the MHP will be located.
(4) For details of livelihood and others of the Sre Om Pum Commune, see Interviews/Field Survey records as attached.

Source: JICA Study Team

Table AP-D.1.6 Environmental Screening for "*Stung Sangke (D/S)*" MHP Project

(A check list for proposed MHP project)

1 General Information

- Name of the proposed project: **Sangke (D/S) MHP Project**
- Name of Project owner/proponent: not decided yet

・ Project Execution Organization : not decided yet
・ Name of authorized person(s) responsible for the project : not decided yet

- Information regarding the project site

・ Name of the village, commune, district and province :
Ratanak Mondul and Samlout Districts, Battambang Province
・ Other information regarding the village(s) the project site area belongs :

2 Outline of the Proposed Project

2.1 Information on project characteristics

(1) Needs involuntary resettlement		
	Yes	Scale: households, persons
●	No	
(2) Groundwater pumping		
	Yes	Scale: m^3/year
●	No	
(3) Land reclamation, land development and land cleaning		
	Yes	Scale: hectors
●	No	
(4) Logging		
●	Yes	Scale: about o.5 hectors for power house space
	No	

2.2 Description of the project

Main design specifications:
The MHP will utilize the water flow of Stung Sangke River. Gross head is 15 m. Potential Power is 118 kW.

2.3 Is the project consistent with the higher program/policy ?

●	Yes	(outline of the higher program/policy) Rural electrification plans in the Province
	No	

2.4 Any alternatives considered before the project ?

●	Yes	(outline of the alternatives) O Samrel MHP, Ta Taok MHP, Kampong Lpov MHP an dothers
	No	

2.5 Did the project proponent have meetings with related stakeholders during the project planning ?

	Yes	(mark the corresponding stakeholders)	
			Administrative body/local government
			Local residents/villagers
			NGOs
			Others (to specify)
●	No		

2.6 Are any of the following areas located inside or around the project site ?

	Yes	(mark related items listed below)	
			National park, wildlife sanctuary, protected area designated by the government
			Virgin forests, tropical forests
			Ecological important habitat areas
			Habitat of valuable species protected by domestic laws or international treaties
			Likely salt cumulus or soil erosion areas on a massive scale
			Remarkable desertification trend areas
			Archaeological, historical or cultural valuable areas
			Living areas of ethnic, indigenous people or nomads who have a traditional lifestyle or specifically valuable areas
●	No		

2.7 My the project have potential negative impacts to the environment and local communities ?

	Yes	(brief description of the potential negative impacts)
	No	
●	Not identified	

2.8 Mark the related potential environmental and social impacts and describe briefly the contents of the impacts, if any.

	Items of potential impacts		Items of potential impacts
	Air pollution		Local economy, employment, livelihood, etc.
	Water pollution		Land use and utilization of local resources
	Soil pollution		Existing social infrastructures and services
	Waste (liquid and/or solid)		Poverty issue
	Causing noise and vibration		Ethnic and /or indigenous people
	Ground subsidence		Misdistribution of benefits
	Offensive odors		Local conflict of interests among villagers
	Geographical features		Gender issue
	Bottom sediment		Children's rights
	Biota and ecosystem		Natural and/or cultural heritages
	Potential conflict on water use rights		Infectious diseases such as HIV/AIDS, etc.
	Public health and hygiene		Others if any
	Global warming		
	Involuntary resettlement		

Remarks: No any negative impacts would be caused to such items as listed above.

2.9 Key results of the environmental screening :

(1) The candidate project site is located outside of any "Protected Area".
(2) Therefore, only the Report of the Environmental Screening would be required to be submitted to the Provincial Authority (Battambang Province) for the project approval.
(3) Due to a lot of land mines are still remained in and around the area, detailed field surveys are still not possible. To complete a more certain report on the Environment Screening, land mine cleaning will be required in advance.

Source: JICA Study Team

Table AP-D.1.7 Environmental Screening for "*Stung Sangke (U/S)*" MHP Project

(A check list for proposed MHP project)

1 General Information

- Name of the proposed project: **Sangke (U/S) MHP Project**
- Name of Project owner/proponent: not decided yet

・ Project Execution Organization : not decided yet
・ Name of authorized person(s) responsible for the project : not decided yet

- Information regarding the project site

・ Name of the village, commune, district and province :
Ratanak Mondul and Samlout Districts, Battambang Province
・ Other information regarding the village(s) the project site area belongs :

2 Outline of the Proposed Project

2.1 Information on project characteristics

(1) Needs involuntary resettlement		
	Yes	Scale: households, persons
●	No	
(2) Groundwater pumping		
	Yes	Scale: m^3/year
●	No	
(3) Land reclamation, land development and land cleaning		
	Yes	Scale: hectors
●	No	
(4) Logging		
●	Yes	Scale: about o.5 hectors for power house space
	No	

2.2 Description of the project

- Main design specifications:

The MHP will utilize the water flow of Stung Sangke River. Gross head is 15 m. Potential Power is 118 kW.

2.3 Is the project consistent with the higher program/policy ?

●	Yes	(outline of the higher program/policy) Rural electrification plans in the Province
	No	

2.4 Any alternatives considered before the project ?

●	Yes	(outline of the alternatives) O Samrel MHP, Ta Taok MHP, Kampong Lpov MHP an dothers
	No	

2.5 Did the project proponent have meetings with related stakeholders during the project planning ?

	Yes	(mark the corresponding stakeholders)	
			Administrative body/local government
			Local residents/villagers
			NGOs
			Others (to specify)
●	No		

2.6 Are any of the following areas located inside or around the project site ?

	Yes	(mark related items listed below)	
			National park, wildlife sanctuary, protected area designated by the government
			Virgin forests, tropical forests
			Ecological important habitat areas
			Habitat of valuable species protected by domestic laws or international treaties
			Likely salt cumulus or soil erosion areas on a massive scale
			Remarkable desertification trend areas
			Archaeological, historical or cultural valuable areas
			Living areas of ethnic, indigenous people or nomads who have a traditional lifestyle or specifically valuable areas
●	No		

2.7 My the project have potential negative impacts to the environment and local communities ?

	Yes	(brief description of the potential negative impacts)
	No	
●	Not identified	

2.8 Mark the related potential environmental and social impacts and describe briefly the contents of the impacts, if any.

	Items of potential impacts		Items of potential impacts
	Air pollution		Local economy, employment, livelihood, etc.
	Water pollution		Land use and utilization of local resources
	Soil pollution		Existing social infrastructures and services
	Waste (liquid and/or solid)		Poverty issue
	Causing noise and vibration		Ethnic and /or indigenous people
	Ground subsidence		Misdistribution of benefits
	Offensive odors		Local conflict of interests among villagers
	Geographical features		Gender issue
	Bottom sediment		Children's rights
	Biota and ecosystem		Natural and/or cultural heritages
	Potential conflict on water use rights		Infectious diseases such as HIV/AIDS, etc.
	Public health and hygiene		Others if any
	Global warming		
	Involuntary resettlement		

Remarks: No any negative impacts would be caused to such items as listed above.

2.9 Key results of the environmental screening :

(1) The candidate project site will be located on the boundary of Samlot Protected Area (Protected Landscape).
(2) Therefore, carrying out IEIA will be required, and the report shall be submitted to the MOE for review and approval.
(3) Due to a lot of land mines are still remained in and around the area, detailed field surveys are still not possible. To carry out an IEIA, land mine cleaning will be required in advance.

Source: JICA Study Team

Table AP-D.1.8 Environmental Screening for "*Stung Tatai (D/S)*" MHP Project

(A check list for proposed MHP project)

1 General Information

- Name of the proposed project: **Tatai (D/S) MHP Project**
- Name of Project owner/proponent: Not defined yet

・ Project Execution Organization : not decided yet
・ Name of authorized person(s) responsible for the project: not decided yet

- Information regarding the project site

・ Name of the village, commune, district and province:
Kokir Chrum and Trapeang Chuetrav Villages, Thmabang District, Koh Kong Province
・ Other information regarding the village(s) the project site area belongs:
This project site is outside of any Protected Area. It is accessible by vehicle. There are about 140 households in the villages.

2 Outline of the Proposed Project

2.1 Information on project characteristics

(1) Needs involuntary resettlement		
	Yes	Scale: households, persons
●	No	
(2) Groundwater pumping		
	Yes	Scale: m^3/year
●	No	
(3) Land reclamation, land development and land cleaning		
	Yes	Scale: hectors
●	No	
(4) Logging		
●	Yes	Scale: about 0.3 hectors
	No	

2.2 Description of the project
Main design specifications:
(1) Gross head : 32 m (along Stung Tatai River)
(2) Potential power : 62 kW

2.3 Is the project consistent with the higher program/policy ?

●	Yes	(outline of the higher program/policy) National Rural Electrification Plan
	No	

2.4 Any alternatives considered before the project ?

●	Yes	(outline of the alternatives) Tatai (U/S) MHP, O Sla (D/S) MHP, Chhay Areng (D/S) MHP, etc.
	No	

2.5 Did the project proponent have meetings with related stakeholders during the project planning ?

●	Yes	(mark the corresponding stakeholders)	
		●	Administrative body/local government
			Local residents/villagers
			NGOs
			Others (to specify)
	No		

2.6 Are any of the following areas located inside or around the project site ?

	Yes	(mark related items listed below)	
			National park, wildlife sanctuary, protected area designated by the government
			Virgin forests, tropical forests
			Ecological important habitat areas
			Habitat of valuable species protected by domestic laws or international treaties
			Likely salt cumulus or soil erosion areas on a massive scale
			Remarkable desertification trend areas
			Archaeological, historical or cultural valuable areas
			Living areas of ethnic, indigenous people or nomads who have a traditional lifestyle or specifically valuable areas
●	No		

2.7 My the project have potential negative impacts to the environment and local communities ?

	Yes	(brief description of the potential negative impacts)
●	No	
	Not identified	

2.8 Mark the related potential environmental and social impacts and describe briefly the contents of the impacts, if any.

Items of potential impacts		Items of potential impacts	
	Air pollution		Local economy, employment, livelihood, etc.
	Water pollution		Land use and utilization of local resources
	Soil pollution		Existing social infrastructures and services
	Waste (liquid and/or solid)		Poverty issue
	Causing noise and vibration		Ethnic and /or indigenous people
	Ground subsidence		Misdistribution of benefits
	Offensive odors		Local conflict of interests among villagers
	Geographical features		Gender issue
	Bottom sediment		Children's rights
	Biota and ecosystem		Natural and/or cultural heritages
	Potential conflict on water use rights		Infectious diseases such as HIV/AIDS, etc.
	Public health and hygiene		Others if any
	Global warming		
	Involuntary resettlement		

Remarks: No any negative environmental impacts would be caused to such items as listed above.

2.9 Key Results of the Environmental Screening:

(1) The project site is located outside of any Protected Area. Therefore, only the Environmental Screening Report would be required. The Report shall be submitted to the Provincial Authority (Koh Kong Province) for its review and approval.

Stakeholders meetings will be required on every stage from the project planning to reflect opinions, comments and desires of the concerned parties, especially those of the villagers. Project information shall be made available to the concerned parties.

Source: JICA Study Team

付属資料-E

経済・財務分析

カンボジア国
再生可能エネルギー利用地方電化マスタープラン調査

ファイナルレポート
第 5 巻　付属資料

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付属資料-E　経済・財務分析

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Appendix-E Economic and Financial Analysis

1. FINANCIAL ANALYSIS

1.1 FINANCIAL ANALYSIS AT EDC

Summary

Electricity sales and power generation have increased along with the increase in the number of customers. However, the gross profits decreased from Riel 32.0 billion in 2002 to Riel 24.4 billion in 2003 due to high electricity production cost and insufficient electricity tariffs. The EdC's liquidity and financial operation remains unsatisfactory and would continue to remain so way as long as (i) electricity supplies are based almost entirely on costly imported fuel; (ii) EdC is unable to recover costs through tariff increase; and (iii) outstanding Government and Municipalities' arrears remain large. Consequently, EdC will not be able to earn sufficient profits to provide any significant investment for rehabilitation or expansion through self-finance. In order to obtain revenues to cover no less than their operating expenses and debt service requirements, EdC needs to improve their expense profit structure by (i) reduction of electricity production costs; (ii) rationalization of insufficient electricity tariffs; and (iii) reduction of overdue arrears.

1.1.1 Past Financial Performance and Present Financial Position

Electricity sales and power generation have increased along with the increase in number of customers (Fig. A2-1 and A2-2). However, gross profit and net operating income decreased in 2003 (Fig. A2-3) due to: 1) high electricity production cost, 2) insufficient electricity tariffs.

1) Sales growth rate were 14.0% in 2002, 14.8% in 2003 (Fig. A2-1).
2) Cost of Sales/Sales (%) went up to 92.7% in 2003 from 89.1% in 2002. Therefore, gross profit decreased from Riel 32.0 billion in 2002 to Riel 24.4 billion in 2003 (Fig. A2-3).
3) Net operating income decreased from Riel 3.4 billion in 2002 to Riel 0.9 billion in 2003 (Fig. A2-3), in spite of Operation expenses/Sales (%) decrease from 9.8% in 2002 to 7.0% in 2003.
4) The level of system losses in PHN's decreased from 25.4% in 1999 to 12.7% in 2003 (Fig. A2-5).

   EdC's liquidity and financial operation remains unsatisfactory and would continue to remain that way as long as:

5) Electricity supplies are based almost entirely on costly imported fuel or purchased power from IPPs, both payable in US dollars. Yearly average international crude oil prices rose in 2004 following 2003.
6) EdC is unable to recover costs through tariff increase.
7) Account receivable decreased from Riel 90.9 billion in 2002 to Riel 55.4 billion in 2003 (Fig. A2-7). Receivables for Government were improved, but outstanding Government arrears remain large. On the other hand, other assets increased from Riel 48.1 billion in 2002 to Riel 68.8 billion in 2003 (Fig. A2-7). The greater part of other assets are import VAT on power purchases, fuel and spare parts which EDC will be reimbursed by the

Government.

Consequently, EdC will not be able to earn sufficient profits (Fig. A2-3) to provide any significant investment for rehabilitation or expansion through self-finance.

1.1.2 Key Financial Issues and Remedial Measures

(1) High Electricity Production Cost

EdC's generation of electricity is exclusively based on imported fuel or IPP purchased power, and its cost are extremely sensitive to fuel price in the international market. The rise of the fuel price in 2003 had a strong effect on their electricity production cost, which similarly affected the purchase price from IPP. Such situation was continued to remain as it is in 2004 (Fig. A2-6).

(2) Energy purchase in future

EdC is planning to reduce their purchase cost in future. EdC expects cost reduction through GMS Transmission Project funded by ADB and WB etc. EdC also have plans to purchase energy from IPPs instead of their own un-efficient generators.

(3) Insufficient Electricity Tariffs

The poor financial performance of EdC is largely due to inadequate tariffs to recover their electricity production cost. Moreover, average tariff decreased from 595 Riel/kWh in 2000 to 579 Riel/kWh in 2003 (Fig. A2-4). In order to improve this situation, EDC applied to EAC for setting new tariffs in 2003, but they have not received permission yet, and new tariffs are not obtained.

(4) Outstanding Government and Municipalities' Arrears

Receivables for Government and Municipalities were improved, however outstanding Government arrears remain large. According to 'Aged Debtors Listing 2002 and 2003', Government's debt decreased from Riel 42.9 billion in 2002 to Riel 22.1 billion in 2003, Municipalities' debt decreased from Riel 10.0 billion in 2002 to Riel 2.7 billion in 2003.

(5) Distribution Losses in PHN's

There have been remarkable improvements in losses from 25.4% in 1999 to 12.7% in 2003 (Fig. A2-5), due to : a) continuing rehabilitation and refurbishment by foreign aid, b) investigation and improvement of big customers.

(6) Power Development Plan and Financing

Neither EdC nor the Government has access to local funding and neither is in a position to provide substantial amount of counterpart funds for significant power sector expansion.

(7) Financial Action Plan

EDC is continuing efforts to improve their financial structure along with the Financial Action Plan which was approved by the Government in August 2003. Some improvements could be made, but its progress is very slow.

i) Reduction of overdue Government and Municipalities' arrears

Receivables for Government and Municipalities were improved, but outstanding Government arrears remain large (2(4)).

ii) Reimbursement of VAT to EdC

EdC still have not received reimbursement of VAT. Other assets increased from Riel 48.1 billion in 2002 to Riel 68.8 billion in 2003 (Fig. A2-7). The greater part of other assets are import VAT on power purchases, fuel and spare parts which EDC will be reimbursed by the Government.

(8) Remedial Measures

EdC should improve their expense profit structure in order to obtain revenues to cover no less than the sum of operating expenses and debt service requirements.

i) Reduction of electricity production costs

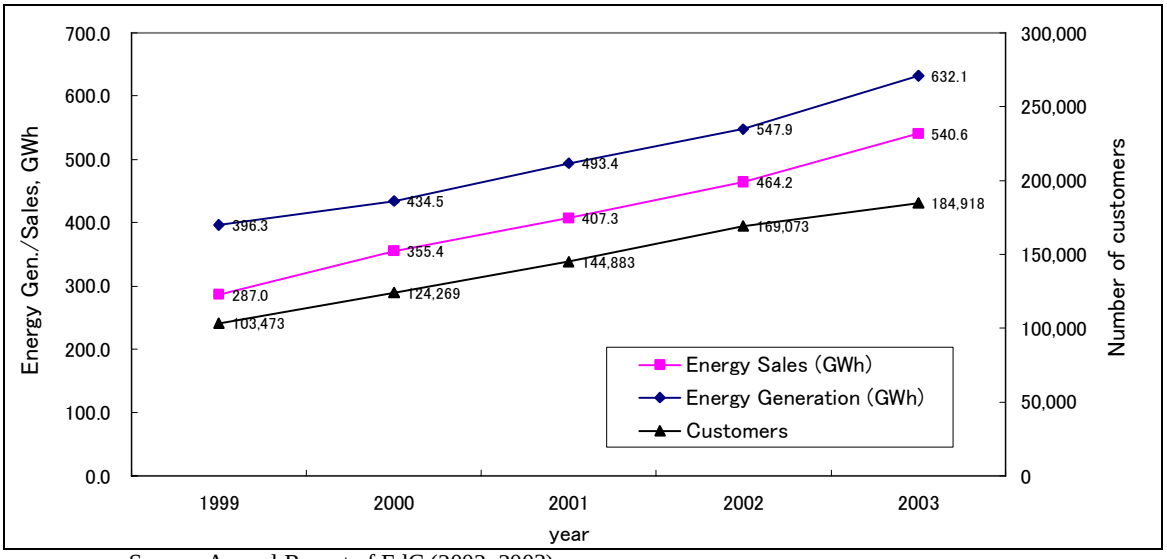
- Purchase cheaper energy from IPPs instead of their own un-efficient generators
- Purchase cheaper electricity from neighbor countries. In this respect, it would be desirable to realize the GMS Transmission Project by ADB and WB at an early stage.
- Reduction of distribution losses

ii) Rationalization of insufficient electricity tariffs

- In short-term, obtain a sufficient new tariff
- In long-term, construct annually tariff setting mechanism which recover their electricity production cost and profit

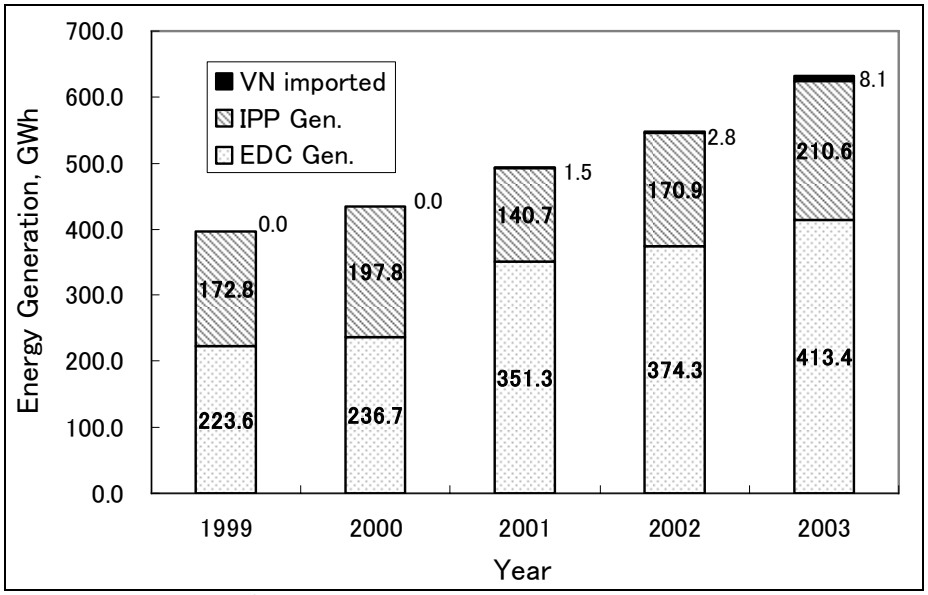
iii) Reduction of overdue arrears

- Receivables for Government and Municipalities
- Reimbursement of VAT from Government
- Receivables for domestic consumers



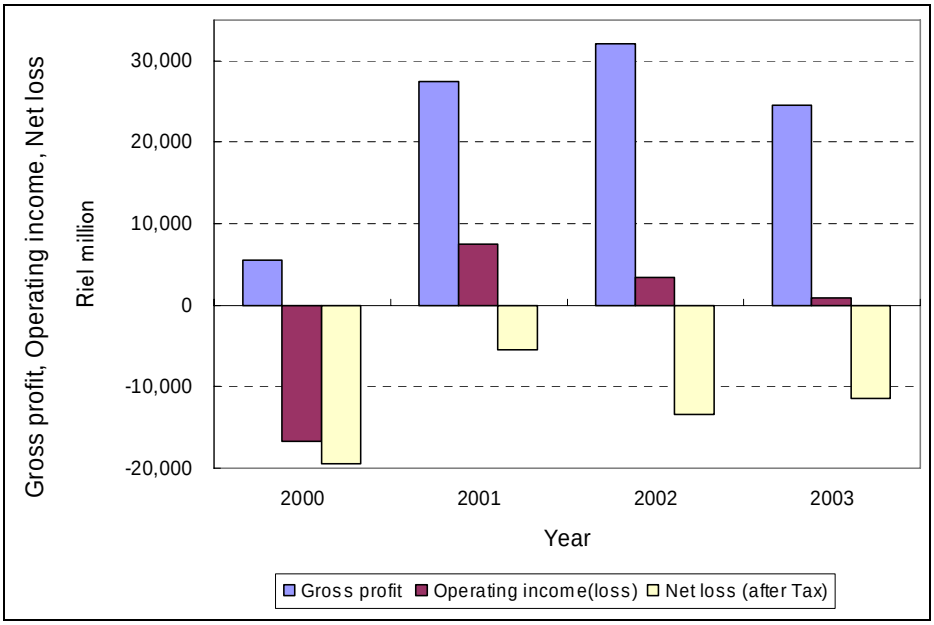
Source: Annual Report of EdC (2002, 2003)

Figure AP-E.1.1 Energy Generation, Energy Sales, Customers



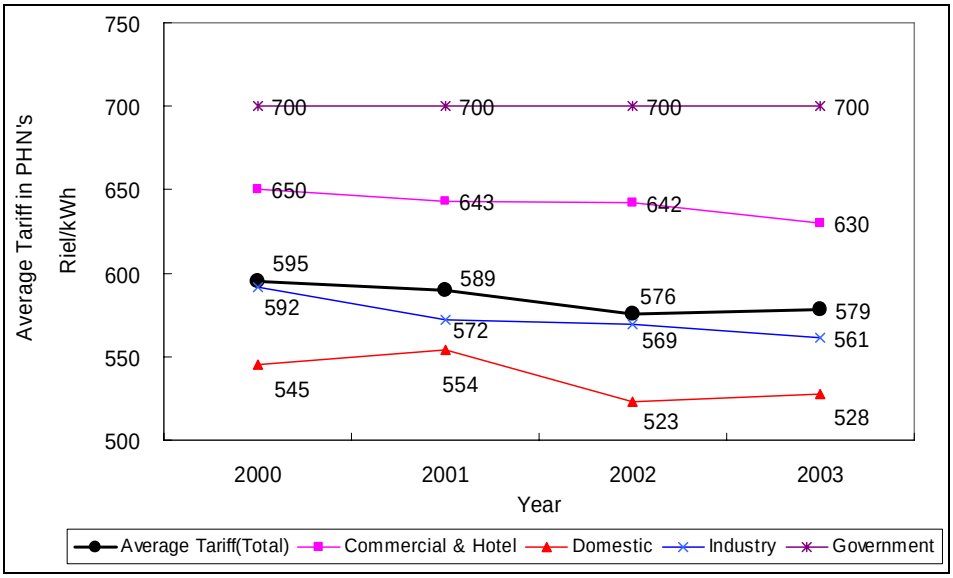
Source: Annual Report of EdC (2002, 2003)

Figure AP-E.1.2 Energy Generation



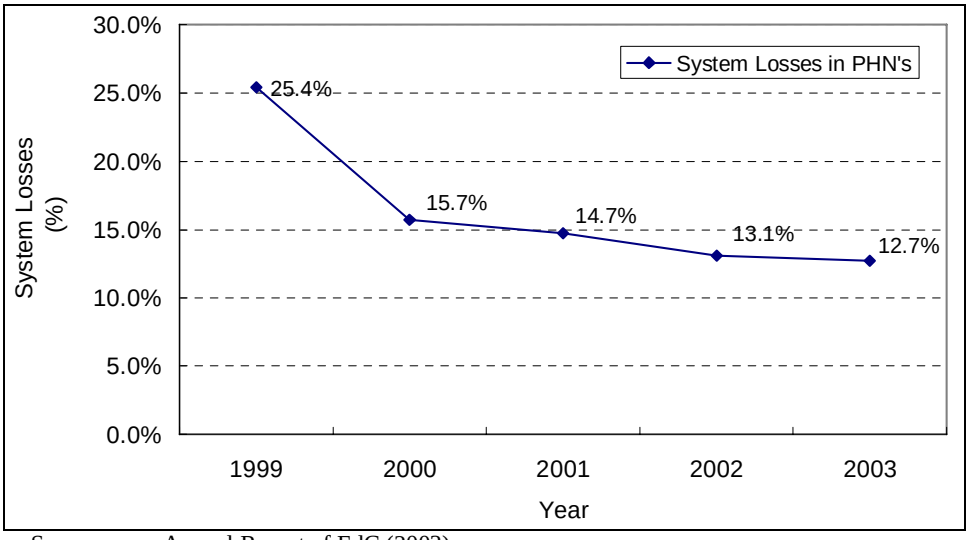
Source: Annual Report of EdC (2002, 2003)

Figure AP-E.1.3 Gross profit, Operation income, Net loss



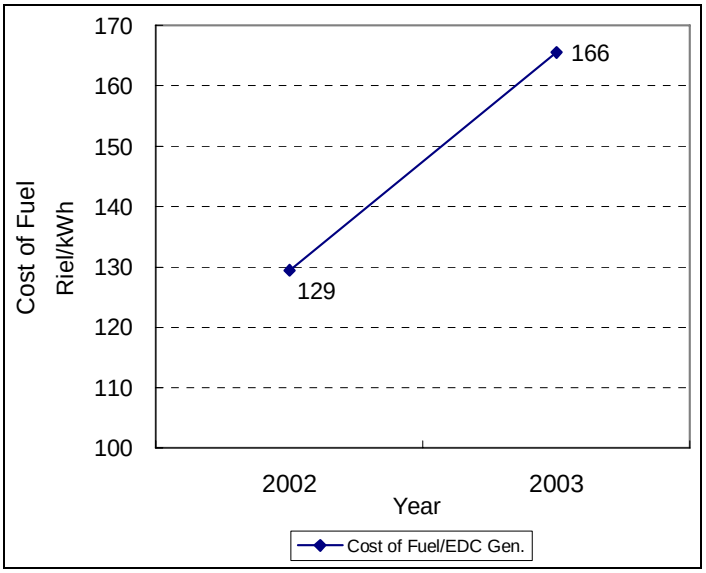
Source: EdC

Figure AP-E.1.4　　Average Tariff in PHN's



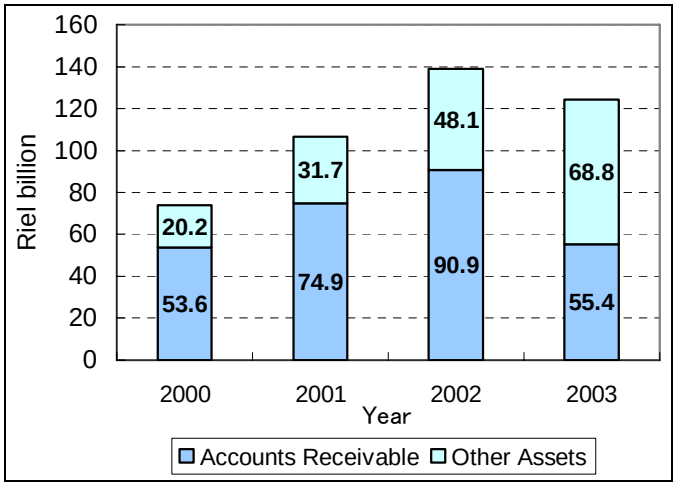
Source:　　Annual Report of EdC (2003)

Figure AP-E.1.5　　System Losses in PHN's



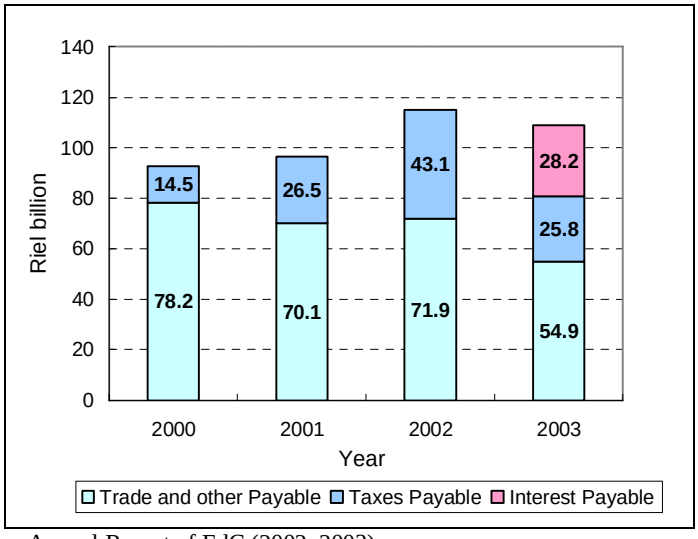
Source: Annual Report of EdC (2003), Consolidated Financial Statements for the Year ended 31 Dec. 2003

Figure AP-E.2.6 Cost of Fuel/EDC generation



Source: Annual Report of EdC (2002, 2003)

Figure AP-E.2.7 Accounts Receivable, Other Assets



Source: Annual Report of EdC (2002, 2003)

Figure AP-E.1.8 Trade and other payable, Taxes Payable, Interest Payable

2. ECONOMIC ANALYSIS

Table AP-E.2.1　Economic Analysis for Solar BCS and Diesel Generator BCS

					Battery	Charging
DG BCS			Cost Total	1,232,727,320	528,600,429	1,162,866,418
	DR=	4%	NPV=	770,984,938	332,314,733	714,839,444

Unit: US$

Year	REE (Solar)					Customer	
	Capital	O/M	Replacement	Total Cost	Remarks	Battery (70Ah)	Charging
2005	83,874,377			83,874,377	New installatio	58,733,381	44,725,631
2006		39,166,663		39,166,663		0	44,725,631
2007		39,166,663		39,166,663		0	44,725,631
2008		39,166,663	7,212,642	46,379,305	DG	58,733,381	44,725,631
2009		39,166,663		39,166,663		0	44,725,631
2010		39,166,663		39,166,663		0	44,725,631
2011		39,166,663	7,212,642	46,379,305	DG	58,733,381	44,725,631
2012		39,166,663	0	39,166,663		0	44,725,631
2013		39,166,663	0	39,166,663		0	44,725,631
2014		39,166,663	7,212,642	46,379,305	DG	58,733,381	44,725,631
2015		39,166,663	75,575,946	114,742,609	Charge controller	0	44,725,631
2016		39,166,663	0	39,166,663		0	44,725,631
2017		39,166,663	7,212,642	46,379,305	DG	58,733,381	44,725,631
2018		39,166,663	0	39,166,663		0	44,725,631
2019		39,166,663	0	39,166,663		0	44,725,631
2020		39,166,663	7,212,642	46,379,305	DG	58,733,381	44,725,631
2021		39,166,663	0	39,166,663		0	44,725,631
2022		39,166,663	0	39,166,663		0	44,725,631
2023		39,166,663	7,212,642	46,379,305	DG	58,733,381	44,725,631
2024		39,166,663	0	39,166,663		0	44,725,631
2025		39,166,663	75,575,946	114,742,609	Charge controller	0	44,725,631
2026		39,166,663	7,212,642	46,379,305	DG	58,733,381	44,725,631
2027		39,166,663	0	39,166,663		0	44,725,631
2028		39,166,663	0	39,166,663		0	44,725,631
2029		39,166,663	7,212,642	46,379,305	DG	58,733,381	44,725,631
2030		0	0	0	PV, Charge Con..	0	44,725,631

				REE(Cost)	Battery	Charging
SOLAR BCS			Cost Total	1,276,812,909	528,600,429	1,113,599,170
	DR=	4%	NPV=	770,938,699	332,314,733	684,553,788
	Subsidy	39.4%	204,899,118			

Unit: US$

Year	REE (Solar)					Customer	
	Capital	O/M	Replacement	Cost	Remarks	Battery (70Ah)	Charging
2005	315,413,523			315,413,523	New installation	58,733,381	42,830,737
2006		13,036,339		13,036,339		0	42,830,737
2007		13,036,339		13,036,339		0	42,830,737
2008		13,036,339		13,036,339		58,733,381	42,830,737
2009		13,036,339		13,036,339		0	42,830,737
2010		13,036,339		13,036,339		0	42,830,737
2011		13,036,339		13,036,339		58,733,381	42,830,737
2012		13,036,339		13,036,339		0	42,830,737
2013		13,036,339		13,036,339		0	42,830,737
2014		13,036,339		13,036,339		58,733,381	42,830,737
2015		13,036,339	116,119,058	129,155,397	Charge controlle	0	42,830,737
2016		13,036,339		13,036,339		0	42,830,737
2017		13,036,339		13,036,339		58,733,381	42,830,737
2018		13,036,339		13,036,339		0	42,830,737
2019		13,036,339		13,036,339		0	42,830,737
2020		13,036,339		13,036,339		58,733,381	42,830,737
2021		13,036,339		13,036,339		0	42,830,737
2022		13,036,339		13,036,339		0	42,830,737
2023		13,036,339		13,036,339		58,733,381	42,830,737
2024		13,036,339		13,036,339		0	42,830,737
2025		13,036,339	116,119,058	129,155,397	Charge controlle	0	42,830,737
2026		13,036,339		13,036,339		58,733,381	42,830,737
2027		13,036,339		13,036,339		0	42,830,737
2028		13,036,339		13,036,339		0	42,830,737
2029		13,036,339		13,036,339		58,733,381	42,830,737
2030		13,036,339	403,252,803	416,289,141	PV, Charge Con., fittings	0	42,830,737

Table AP-E.2.2 Economic Analysis for Biomass Gasification Mini-grid and Diesel Generator Mini-grid

Biomass Gasification Power Generation(mini-grid)

		REE(Cost)	Grid/ Connection	Annual Fee
	Cost Total	2,025,868,823	151,896,675	1,555,544,724
DR= 4%	NPV=	1,341,594,108	146,054,495	956,227,395
	cost/kWh	0.288		

Unit: US$

Year	REE (Solar)					Customer	
	Capital	O/M	Replacement	Cost	Remarks	Grid/ Conection	Annual Fee
2005	477,630,656			477,630,656	New installation	151,896,675	59,828,643
2006		44,377,022		44,377,022			59,828,643
2007		44,377,022		44,377,022			59,828,643
2008		44,377,022		44,377,022			59,828,643
2009		44,377,022		44,377,022			59,828,643
2010		44,377,022		44,377,022			59,828,643
2011		44,377,022		44,377,022			59,828,643
2012		44,377,022		44,377,022			59,828,643
2013		44,377,022	84,387,042	128,764,064	engine		59,828,643
2014		44,377,022		44,377,022			59,828,643
2015		44,377,022		44,377,022			59,828,643
2016		44,377,022		44,377,022			59,828,643
2017		44,377,022		44,377,022			59,828,643
2018		44,377,022		44,377,022			59,828,643
2019		44,377,022		44,377,022			59,828,643
2020		44,377,022		44,377,022			59,828,643
2021		44,377,022	84,387,042	128,764,064	engine		59,828,643
2022		44,377,022		44,377,022			59,828,643
2023		44,377,022		44,377,022			59,828,643
2024		44,377,022		44,377,022			59,828,643
2025		44,377,022	185,651,492	230,028,514	gasifier		59,828,643
2026		44,377,022		44,377,022			59,828,643
2027		44,377,022		44,377,022			59,828,643
2028		44,377,022		44,377,022			59,828,643
2029		44,377,022	84,387,042	128,764,064	engine		59,828,643
2030		44,377,022		44,377,022			59,828,643

DG mini-grid

		REE(cost)	Grid/ Connection	Annual Fee
	Cost Total	3,615,396,684	151,896,675	3,079,578,277
DR= 4%	NPV=	2,250,987,718	146,054,495	1,893,084,183
	cost/KWh	0.483		

Unit: US$

Year	REE (Solar)					Customer	
	Capital	O/M	Replacement	Total Cost	Remarks	Grid/ Conection	Annual Fee
2005	222,781,790			222,781,790	New installation	151,896,675	118,445,318
2006		130,843,902		130,843,902			118,445,318
2007		130,843,902		130,843,902			118,445,318
2008		130,843,902	15,189,668	146,033,570	DG		118,445,318
2009		130,843,902		130,843,902			118,445,318
2010		130,843,902		130,843,902			118,445,318
2011		130,843,902	15,189,668	146,033,570	DG		118,445,318
2012		130,843,902		130,843,902			118,445,318
2013		130,843,902		130,843,902			118,445,318
2014		130,843,902	15,189,668	146,033,570	DG		118,445,318
2015		130,843,902		130,843,902			118,445,318
2016		130,843,902		130,843,902			118,445,318
2017		130,843,902	15,189,668	146,033,570	DG		118,445,318
2018		130,843,902		130,843,902			118,445,318
2019		130,843,902		130,843,902			118,445,318
2020		130,843,902	15,189,668	146,033,570	DG		118,445,318
2021		130,843,902		130,843,902			118,445,318
2022		130,843,902		130,843,902			118,445,318
2023		130,843,902	15,189,668	146,033,570	DG		118,445,318
2024		130,843,902		130,843,902			118,445,318
2025		130,843,902		130,843,902			118,445,318
2026		130,843,902	15,189,668	146,033,570	DG		118,445,318
2027		130,843,902		130,843,902			118,445,318
2028		130,843,902		130,843,902			118,445,318
2029		130,843,902	15,189,668	146,033,570	DG		118,445,318
2030		130,843,902		130,843,902			118,445,318

	BGPG	DG	
GWh/YR	291.6	291.6	
Electricity	7,583	7,583	GWh
NPV	4,661	4,661	GWh
houses	2,025,289	2,025,289	
kWh/mos /house	12	12.0	

Table AP-E.2.3 Cost estimate of Micro Hydro power by village size, @ 10 kWh per household per month

No	Gross	Net	Continu-ous	FOB Cost of Gen. Equip.	Unit Price	Nos. of house-holds	Length of LV Lines @ L	Length of MV Lines @ Lm km/h.h	Cost of LV & MV Lines	Step-up Transformer	Distribution Transformer	Other costs	Total Cost	Per h.h. cost	Cost per Gross kW	% GE Cost to Total	Annual Energy Sold @ t-hr per day	Annual Capital Cost	Fuel Consumption	Cost for Fuel Purchase	O&M Costs	Annual Total Costs	Annual Gene-ration Costs	kWh Cost with Soft Loan	Gene. Cost with Soft Loan
	kWe	kWe	kWe	($)	$/Pe	h.h.	km	km	$	$	$	$	$	$/h.h.	$/Pg	%	MWh	$/yr	ton/yr	$/yr	$/yr	$/yr	$/yr	$/kWh	$/kWh
1	9	7	7	21,000	4,000	**54**	1.0	1.8	13,425	1,050	1,943	5,613	43,031	**797**	4,781	**49%**	6.6	4,060		0	1,480	5,540	3,760	0.844	0.573
2	11	10	10	30,000	4,000	**77**	1.0	2.6	17,025	1,500	2,775	7,695	58,995	**766**	5,363	**51%**	9.4	5,570		0	1,900	7,470	5,157	0.798	0.551
3	22	20	18	54,000	4,000	**138**	2.0	4.7	31,800	2,700	4,995	14,024	107,519	**779**	4,887	**50%**	16.8	10,150		0	2,520	12,670	8,382	0.755	0.500
4	**32**	**30**	**28**	**84,000**	**4,000**	**215**	**3.0**	**7.3**	**48,825**	**4,200**	**7,770**	**21,719**	**166,514**	**774**	**5,204**	**50%**	**26.1**	**15,720**		**0**	**3,220**	**18,940**	**12,339**	**0.725**	**0.472**
5	40	35	32	96,000	4,000	**246**	4.0	8.4	59,100	4,800	8,880	25,317	194,097	**789**	4,852	**49%**	29.9	18,320		0	3,680	22,000	14,102	**0.736**	**0.472**
6	70	64	60	180,000	4,000	**462**	7.0	15.7	107,925	9,000	16,650	47,036	360,611	**781**	5,152	**50%**	56.2	34,040		0	5,100	39,140	24,641	**0.697**	**0.439**
7	120	102	94	282,000	4,000	**723**	11.0	24.6	169,275	14,100	26,085	73,719	565,179	**782**	4,710	**50%**	87.9	53,350		0	6,760	60,110	37,374	**0.684**	**0.425**
8	160	140	130	390,000	4,000	**1,000**	15.0	34.0	232,875	19,500	36,075	101,768	780,218	**780**	4,876	**50%**	121.5	73,650		0	8,500	82,150	50,838	**0.676**	**0.418**
9	250	220	205	615,000	4,000	**1,577**	24.0	53.6	369,000	30,750	56,888	160,746	1,232,384	**781**	4,930	**50%**	191.7	116,340		0	11,800	128,140	78,564	**0.669**	**0.410**
														781		**50%**						Average of > 200 hh		**0.698**	**0.439**

Basic data

Unit consumption	Pd	100	W
Operation hour per day	t	3.33	= 10 kWh per hh
Unit length of LV lines	L	15	m/h.h.
Unit length of MV lines	Lm	34	m/h.h.
km cost of LV line	CostLV	7,100	$/km
km cost of MV line	CostMV	6,000	$/km
	Cost Step	200	$/kW
	Cost Dist	370	$/kW
% of IF and installation	IFI	15%	
Unit consumption of fue	F	0.00	kg/kWh
Unit fuel cost	FC	0.00	$/ton
Discount factor	i	0.07	
	n	20	
		3.8697	
	CRF	0.0944	D/L
	CRFP	0.0944	Plant(7%,20YRS)
Grant (Plant, LV,MV Lines)		25%	

Table AP-E.2.4 Cost estimate of Biomass power by village size, @ 10 kWh per household per month

No	Gross	Net	Continu-ous	FOB Cost of Gen. Equip.	Unit Price	Nos. of house-holds	Length of LV Lines @ L	Length of MV Lines @ Lm	Cost of LV & MV Lines	Step-up Transfor mer	Distribut ion Transfor mer	Other costs	Total Cost	Per h.h. cost	Cost per Gross kW	% GE Cost to Total	Annual Energy Sold @ t-hr per day	Annual Capital Cost	Fuel Wood Consum ption	Cost for Fuel Purchas e	O&M Costs	Annual Total Costs	Annual Gene-ration Costs	kWh Cost with Soft Loan	Gene. Cost with Soft Loan
	kWe	kWe	kWe	($)	$/Pe	h.h.	km	km/h.h	$	$	$	$	$	$/h.h.	$/Pg	%	MWh	$/yr	ton/yr	$/yr	$/yr	$/yr	$/yr	$/kWh	$/kWh
1	9	7	7	7,875	1,500	**54**	1.0	0.0	5,325	1,050	1,943	2,429	18,622	**345**	2,069	**42%**	6.6	2,190	4.4	88	1,305	3,583	2,850	0.546	0.434
2	11	10	10	11,250	1,500	**77**	1.0	0.0	5,325	1,500	2,775	3,128	23,978	**311**	2,180	**47%**	9.4	2,880	6.2	125	1,650	4,655	3,857	0.497	0.412
3	22	20	18	20,250	1,500	**138**	2.0	0.0	10,650	2,700	4,995	5,789	44,384	**322**	2,017	**46%**	16.8	5,310	11.2	224	2,070	7,604	6,042	0.453	0.360
4	**32**	**30**	**28**	**31,500**	**1,500**	**215**	**3.0**	**1.1**	**20,925**	**4,200**	**7,770**	**9,659**	**74,054**	**344**	**2,314**	**43%**	**26.1**	**8,730**	**17.4**	**348**	**2,520**	**11,598**	**8,700**	**0.444**	**0.333**
5	40	35	32	36,000	1,500	**246**	4.0	1.2	26,700	4,800	8,880	11,457	87,837	**357**	2,196	**41%**	29.9	10,280	19.9	399	2,880	13,559	9,943	**0.453**	**0.333**
6	70	64	60	67,500	1,500	**462**	7.0	2.3	47,625	9,000	16,650	21,116	161,891	**350**	2,313	**42%**	56.2	19,010	37.4	749	3,600	23,359	16,844	**0.416**	**0.300**
7	120	102	94	105,750	1,500	**723**	11.0	3.6	74,775	14,100	26,085	33,107	253,817	**351**	2,115	**42%**	87.9	29,800	58.6	1,172	4,410	35,382	25,158	**0.403**	**0.286**
8	160	140	130	146,250	1,500	**1,000**	15.0	5.0	102,375	19,500	36,075	45,630	349,830	**350**	2,186	**42%**	121.5	41,100	81.0	1,621	5,250	47,971	33,944	**0.395**	**0.279**
9	250	220	205	230,625	1,500	**1,577**	24.0	7.9	163,350	30,750	56,888	72,242	553,855	**351**	2,215	**42%**	191.7	65,010	127.8	2,556	6,675	74,241	51,924	**0.387**	**0.271**
														342		**43%**							Average of > 200 hh	**0.416**	**0.300**

Basic data

Unit consumption	Pd	100	W
Operation hour per day	t	3.33	= 10 kWh per hh
Unit length of LV lines	L	15	m/h.h.
Unit length of MV lines	Lm	5	m/h.h.
km cost of LV line	CostLV	7,100	$/km
km cost of MV line	CostMV	6,000	$/km
	Cost Step	200	$/kW
	Cost Dist	370	$/kW
% of IF and installation	IFI	15%	
Unit consumption of fue	F	1.50	kg/kWh
Unit fuel cost	FC	20.00	$/ton
Discount factor	i	0.07	
	n	20	
		3.8697	
	CRF	0.0944	D/L
	CRFP	0.1424	Plant(7%,10YRS)
Subsidy (Plant, LV,MV Lines)		25%	

Table AP-E.2.5 Cost estimate of Diesel power by village size, @ 10 kWh per household per month

No	Gross	Net	Continu-ous	FOB Cost of Gen. Equip.	Unit Price	Nos. of house-holds	Length of LV Lines @ L	Length of MV Lines @ Lm	Cost of LV & MV Lines	Step-up Transformer	Distribution Transformer	Other costs	Total Cost	Per h.h. cost	Cost per Gross kW	% GE Cost to Total	Annual Energy Sold @ t-hr per year	Annual Capital Cost	Diesel Oil Consumption	Cost for Fuel Purchase	O&M Costs	Annual Total Costs	Annual Gene-ration Costs	kWh Cost with Soft Loan	Gene. Cost with Soft Loan
	kWe	kWe	kWe	($)	$/Pe	h.h.	km	km	$	$	$	$	$	$/h.h.	$/Pg	%	MWh/yr	$/yr	KL/yr	$/yr	$/yr	$/yr	$/yr	$/kWh	$/kWh
1	9	7	7	2,625	500	**54**	1.0	0.0	5,325	1,050	1,943	1,641	12,584	**233**	1,398	**21%**	6.6	1,390	2.0	1,378	1,035	3,803	2,969	0.579	0.452
2	11	10	10	3,750	500	**77**	1.0	0.0	5,325	1,500	2,775	2,003	15,353	**199**	1,396	**24%**	9.4	1,740	2.8	1,965	1,250	4,955	4,009	0.529	0.428
3	22	20	18	6,750	500	**138**	2.0	0.0	10,650	2,700	4,995	3,764	28,859	**209**	1,312	**23%**	16.8	3,250	5.0	3,522	1,590	8,362	6,540	0.499	0.390
4	**32**	**30**	**28**	**10,500**	**500**	**215**	**3.0**	**1.1**	**20,925**	**4,200**	**7,770**	**6,509**	**49,904**	**232**	**1,560**	**21%**	**26.1**	**5,540**	**7.8**	**5,488**	**1,940**	**12,968**	**9,649**	**0.496**	**0.369**
5	40	35	32	12,000	500	**246**	4.0	1.2	26,700	4,800	8,880	7,857	60,237	**245**	1,506	**20%**	29.9	6,630	9.0	6,279	2,260	15,169	11,077	**0.507**	**0.370**
6	70	64	60	22,500	500	**462**	7.0	2.3	47,625	9,000	16,650	14,366	110,141	**238**	1,573	**20%**	56.2	12,160	16.8	11,792	2,700	26,652	19,251	**0.475**	**0.343**
7	120	102	94	35,250	500	**723**	11.0	3.6	74,775	14,100	26,085	22,532	172,742	**239**	1,440	**20%**	87.9	19,080	26.4	18,454	3,170	40,704	29,080	**0.463**	**0.331**
8	160	140	130	48,750	500	**1,000**	15.0	5.0	102,375	19,500	36,075	31,005	237,705	**238**	1,486	**21%**	121.5	26,270	36.5	25,524	3,650	55,444	39,486	**0.456**	**0.325**
9	250	220	205	76,875	500	**1,577**	24.0	7.9	163,350	30,750	56,888	49,179	377,042	**239**	1,508	**20%**	191.7	41,630	57.5	40,252	4,325	86,207	60,837	**0.450**	**0.317**
														230		**21%**							Average of > 200 hh	**0.475**	**0.343**

Basic data

Pd	100	W
t	3.33	= 10 kWh per hh
L	15	m/h.h.
Lm	5	m/h.h.
CostLV	7,100	$/km
CostMV	6,000	$/km
Cost Step	200	$/kW
Cost Dist	370	$/kW
IFI	15%	
F	0.30	L/kWh
FC	0.70	$/L
i	0.07	
n	20	
	3.8697	
CRF	0.0944	D/L(7%,20YRS)
CRFP	0.1627	Plant(10%,10YRS)
	25%	

付属資料-F

支援制度

カンボジア国
再生可能エネルギー利用地方電化マスタープラン調査

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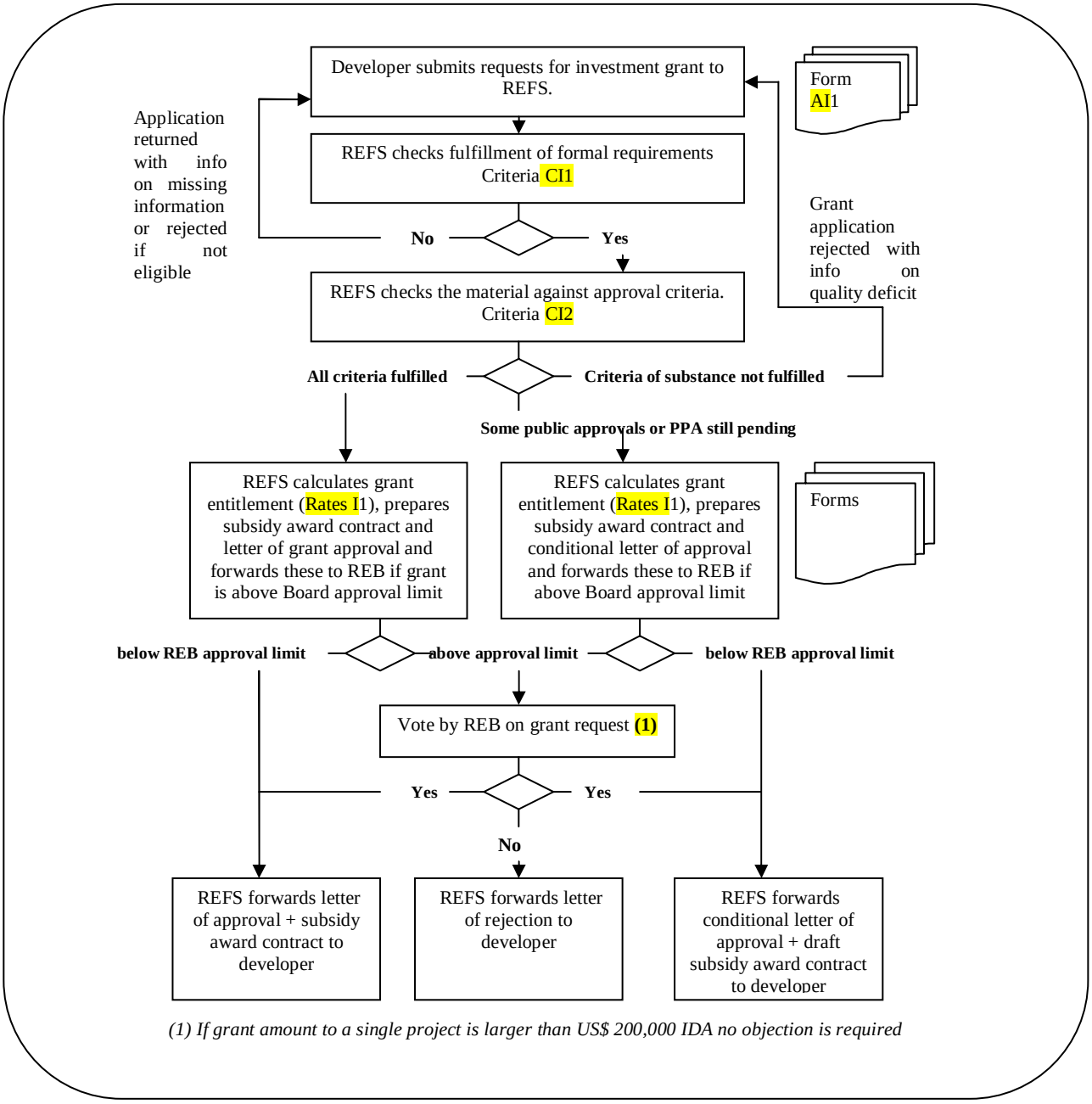
付属資料-F　支援制度

Appendix-F Supporting System

1. REF PROJECT CYCLE AND APPLICATION FORM FOR REF INVESTMENT GRANTS

1.1 PROJECT CYCLE

Approval of subsidy award contract: flow chart



(1) If grant amount to a single project is larger than US$ 200,000 IDA no objection is required

Criteria for Approval of Investment Grants

Criteria CI1: Criteria for Formal Check on Application for Investment Grant

1. Is the application form fully and correctly filled out or is any information missing
2. Is copy of the feasibility report attached
3. Is copy of the application to EAC for the generation/distribution license attached; and or copy of the license itself
4. Is copy of the letter of intent for project loan attached by the bank connection of developer
5. Are copies for all relevant approval documents attached; or if, not yet processed, of the applications for approval
6. Is the project eligible for REF-grant support, falling into one of the following categories:
   - Isolated grid project with diesel generator
   - Isolated grid project served by micro-hydro (possibly with diesel generator as back-up)
   - Isolated grid project served by biomass/biogas -fueled generator (possibly with diesel generator as back-up)
   - Micro- or mini-hydroplant connected to the national grid
   - Biomass/biogas fueled generator connected to the national grid
   - Solar Home System based project may include institutional systems like pagodas, schools etc.

Criteria CI2: Criteria for Approval of Investment Grant

As the license approval process by EAC covers issues 1-4, the review is performed in close consultation with the EAC-officer in charge of processing the license application. For maximum productivity, EAC and REFS formally decide on a division of labor and/or form for the mutual consultation process; including the evaluation criteria to be used.

(a) Criteria that apply to all categories of REF-supported projects

1. Compliance with regulatory conditions:
   - All needed local planning approvals have been obtained
   - An EIA, if required, has been performed and approved by the pertinent authorities
   - EAC has issued a license for the project, or, received a license application
   - No other party applied to EAC for a license for the same project in response to the publication by EAC of the license application, within the time limit established by the Electricity Act and EAC regulations

2. Compliance with technical conditions:
   - The technical norms and standards for rural electrification and for renewable energy are fulfilled; the least cost design is used (confirmed by consultant contracted by REFS to review the feasibility study)
   - The cost of individual major investment items is in line with the level of local costs according to the data bank on rural electrification costs established by REFS or EAC

3. Financial viability of the project
   - there is strong evidence of financial closure;
   - the commercial bank for providing the debt finance for the project has agreed to finance the project and finalized its due diligence assessment (copies of the draft loan agreement and the bank's project appraisal document are attached)
   - the evaluation confirms the bank's assessment of financial viability and ability of the project's cash flow in early years to service the debt payments.

4. Institutional viability of the project
   - is the project applicant a legal person; or actively engaged in becoming registered as a legal person (sponsors initiating RE projects need to establish a legally recognizable entity such as a co-operative or a company to qualify for grant awards)
   - projects are not to be managed or majority-owned by the public sector and must demonstrate local community support.

5. Compliance with World Bank standards for social and environmental safeguards

(b) Criteria specific for distribution projects

- The tariff calculation formula, used to established the tariff schedule submitted to EAC for approval, takes the REF-investment subsidy into account
- potential consumers have expressed their interest in the project by paying a deposit

(c) Criteria specific for grid-connected hydropower or biomass/biogas-fueled power plants

EdC has signed a PPA with the developer or a letter of intent.

Subsidy Rates for Investment Grants

Rates Schedule for Investment Grants, RI[1)]

	Subsidy per connection	Subsidy per kW
Isolated grid project with diesel generator	US$45	n.a.
Isolated grid project served by micro-hydro (possibly with diesel generator as back-up)	US$45	US$400
Isolated grid project served by biomass-fueled generator (possibly with diesel generator as back-up)	US$45	US$400
Micro-hydroplant connected to national grid	n.a.	US$400
Mini-hydroplant connected to national grid	n.a.	US$400
Biomass/biogas fueled generator connected to national grid	n.a.	US$400

1) Rates for 1rst year of operation. To be adjusted in the following years in response to the balance between the supply of funds and the demand for funds

1.2 APPLICATION FORM

I. Forms for Investment Grants

Application: Investment Grant to Renewable Energy Generation Project selling Power to the National Grid or Connected to Local Mini-Grids

PART 1 - APPLICATION
Name and address of Applicant: Bank account number for transfer of grant:
Name of Co-financing Bank:
Business Form for Investing Entity • Private joint stock company…….: • Community joint stock company … : • Community cooperative ……: Copy of legal person registration, or active application for forming the legal person attached as Annex 6
Location of Project: • Province : • District : • Commune :

Project finance

	USD
Equity from investor	:
Loan (amount, maturity, interest rate) *)	:
Requested Grant from REFS	:
Grants from other sources	: _____
TOTAL ……:	

*) Proof of commercial bank debt financing including copies of the draft loan agreement and the banks project appraisal document, attached as Annex 5

Name of equity investors / ownership percentage	Name	Ownership %

Project Description:

(provide brief summary of project)

Compliance with regulatory conditions

Application for Local Planning Approval submitted	Yes:	No:	Attached as Annex 2
Is an environmental assessment required …… If Yes attach approval from relevant authority	Yes:	No:	Attached as Annex 3
Application for generation license submitted……	Yes:	No:	Attached as Annex 4
PPA signed with the electricity company……	Yes:	No:	Attached as Annex 4

Compliance with technical conditions	
Technical norms and standards are in accordance with national rules and regulations REF least cost design principles have been applied If there are deviations from norms and design recommendations, please justify	Included in feasibility study and to be confirmed by consultant contracted by REFS to review the feasibility study

Key project data

	Capacity in kW	Expected annual GWh output
Mini/micro-hydro power plant	:	
Biomass fueled power plant	:	
Length of MV line connecting plant to national grid	:	km
Length of MV-lines connecting villages covered by distribution license		km
Length of LV distribution lines		km
Number of household connections		No.

Demand Profile (if distribution included)	year 1 kWh / year	year 10 (kWh / year)
Electricity sales to households		
Electricity sales to private productive / commercial uses		
Electricity sales to public institutions (kWh / year)		
Total electricity sales (kWh/year)		

Investment Cost Estimate:	USD
Cost of generation plant	
Cost of MV line connection to national grid	
Cost of MV/LV distribution	
Total investment cost	

Key Ranking Indicators	USD
Estimated Total investment cost per kW of installed capacity	
Estimated Production cost per kWh for 10 year period (12% discount rate)	

Financial viability of the project over a 10 year period	
Sales forecast Operational cost break-down Profitability calculations Cash-flow projection	Included in feasibility study and to be confirmed by consultant contracted by REFS to review the feasibility study
IRR	%

Calculation of subsidy grants	Investment grant USD
Renewable energy generation ……..kW of USD 400	

PART 2 – SUPPORTING ANNEXES	
Annex 1:	Copy of feasibility study
Annex 2:	Documentation that all required local planning approvals have been obtained
Annex 3	Environmental assessment report, if required
Annex 4	Generation license application to ECA
Annex 5	Proof that the commercial bank for providing the debt finance for the project has agreed to finance the project and finalized its due diligence assessment, including copies of the draft loan agreement and the banks project appraisal document
Annex 6	Copy of legal person registration or active application for forming the legal person

PART 3 – APPROVAL AND TRANSFER ORDER (APP2)
Conditions for receiving investment grant have been confirmed and found in order. A project investment grant of USD is approved to be allocated for the project in accordance with the guidelines for grant disbursement The grant will be transferred to the applicants account no: Date of approval: Name of approving officer:

付属資料-G

地方開発銀行のソフトローン

カンボジア国
再生可能エネルギー利用地方電化マスタープラン調査

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付属資料-G　地方開発銀行のソフトローン

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Appendix-G Rural Development Bank Proposal on Soft Loans

1. THE ELIGIBILITY CRITERIA FOR PARTICIPATING REES/CECS IN THE IMPLEMENTATION OF RURAL ELECTRIFICATION BY RENEWABLE ENERGY

Participating REEs/CECs will need to meet the following eligibility criteria to receive loans from RDB under the project: (i) technical certificate on rural electrification from REF/MIME; (ii) willingness to deliver rural electrification services to the Project target group; (iii) a good accounting record/system on their electrification activities; (iv) a good management structure, including a board of directors, a chief executive, all with experience of rural electrification; (v) licensed at EAC; and (vii) equity at least 15% of project cost.

The REEs/CECs will submit the following items in support of any applications for a loan: (i) Articles of Association; (ii) information on their debt situation; (iii) feasibility study for the proposed use of the loan funds showing the financial feasibility of the proposal; (iv) report on the rural electrification activities of the past years (if any); (v) copy of their electrification license; (vi) copy of the ID of the Managing Director; (vii) minutes of the resolution agreeing to approach RDB; and (viii) collateral, such as land, building, equipment …etc.

In case of REEs/CECs have not sufficient capacity to get loan from RDB, RDB will need guarantee funds from REF in term of 50% of total loans for those REEs/CECs.

2. FINANCIAL OPTIONS BY ELECTRIFICATION TYPES

Table 1: Financial Options by Electrification Types

Type of Electrification	Scope of Work	Ownership	Funding Modality of Capital Costs	
			REE	CEC
1. Extension of REE grid	Rehabilitation of Distribution lines and Extension of an existing mini grid systems	REE	Subsidy (25%), Equity (15%), Soft Loan (60%)*	-
2. Renewable Energy new mini grid (Hydro)	Generation and distribution	REE/CEC	Subsidy (25%), Equity (15%), Soft Loan (60%)	Subsidy (50%), Equity (10%), Soft Loan (40%)
3. Renewable Energy new mini grid (Biomass)	Generation and distribution	REE/CEC	Subsidy (25%), Equity (15%), Soft Loan (60%)	Subsidy (25%), Equity (15%), Soft Loan (60%)
4. Diesel new mini grid	Generation and distribution	REE/CEC	Subsidy (25%), Equity (25%), Soft Loan (50%)	Subsidy (25%), Equity (25%), Soft Loan (50%)
5. Solar system	SHS,BCS	REE/CEC	Subsidy (25%) Equity (15%), Soft Loan (60%)	Subsidy (95%), Equity (5%), Soft Loan (0%)
	Remote & Social electrification by solar power	Public (Owned by a Renewable Energy Center (REC)	Grant (95%), Equity (5%)	

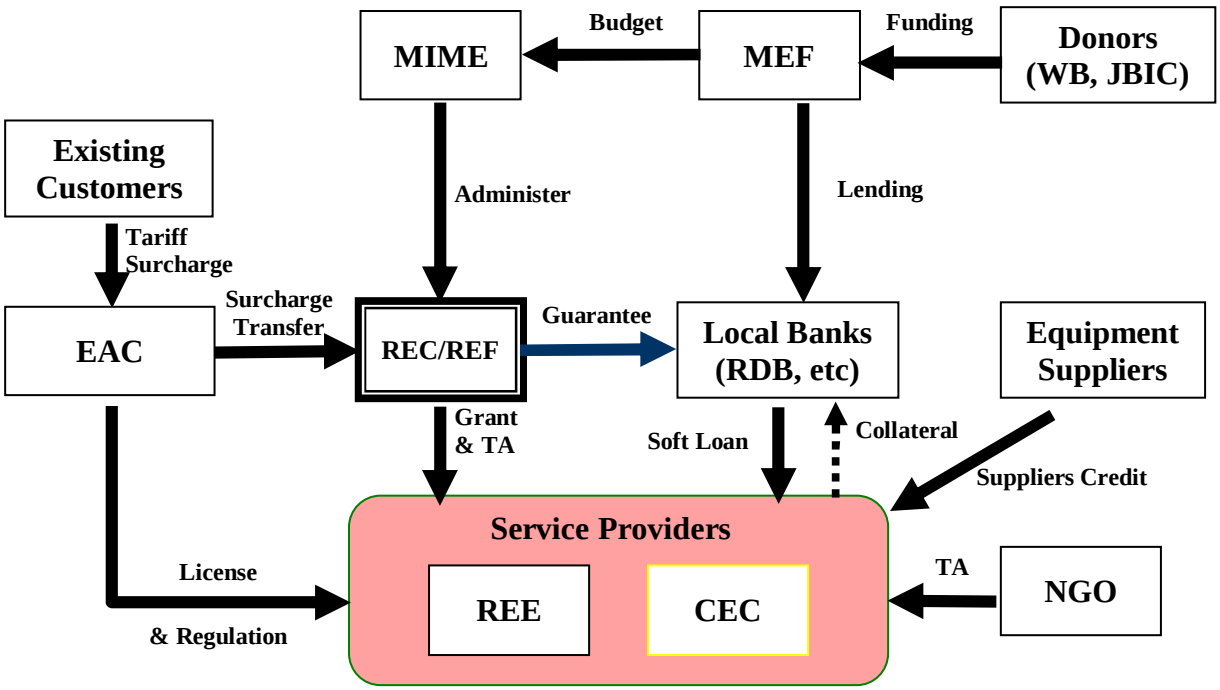
3. PROPOSED LENDING TERMS AND CONDITIONS

Lending Terms and Conditions shall be determined in the Subsidiary Loan Agreement between Ministry of Economy and Finance and Rural Development Bank, and in the Subsidiary Financing Agreement between RDB and REEs/CECs.

Table 2: Lending Terms and Conditions of Rural Electrification by Renewable Energy

Flow of Fund	USD	KHR
Donors (WB, JBIC) to Government	In SDR/USD 0.75% p.a. with 30 years repayment including a 10 years grace period	N.A.
The Government to RDB	2-3% p.a. with Government bearing the foreign exchange risk (SDR to USD) and with repayment 30 years with 10 years grace period.	6-7% p.a. with Government bearing the foreign exchange risk (SDR to USD and USD to Riel) and with repayment 30 years with 10 years grace period.
RDB to REEs/CECs	7-10% p.a. with repayment 10-15 years with 2-5 years grace period (period construction place). *The repayment will start from operation year.*	11-14% p.a. with repayment over 10 years with 2-5 years grace period (period construction place). *The repayment will start from operation year.*

4. PROPOSED SUPPORT STRUCTURE FOR SERVICE PROVIDERS (REE AND CEC)



Our Suggestion during the project implementation:

1- Two vehicles
2- Four computers (Two: Desktop, and Two: Laptop)
3- One photocopy machine
4- Camera/video camera.

付属資料-H

バイオマスパイロット事業の計画・評価シート

カンボジア国
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付属資料-H　バイオマスパイロット事業の計画・評価シート

Summary of Economic and Financial Analyses, Phase 1

No.	Project	Phase	Nos. of House-holds	Tariff Nighttim $/kWh	Tariff Daytime $/kWh	FIRR internal %	FIRR w/subsidy %	EIRR %	Short-term $	Saving Deposit at 10th million $	Saving Deposit at 30th million $	Total Costs $	Financial Resources Equity $	Tax $	Subsidy $	Soft $
1	Kampong Koi	1	886	**0.350**	0.300	**5.2%**	**9.3%**	**30.9%**	5,000	0.18	3.93	689,100	97,100	42,100	161,700	388,200
2	Samlout	1	774	**0.335**	0.275	**5.5%**	**9.8%**	**27.4%**	5,000	0.18	3.86	626,300	87,600	42,100	146,100	350,500
3	Pramaoy	1	145	0.400	0.340	5.0%	8.9%	33.3%	2,000	0.03	0.59	86,000	11,800	7,000	19,800	47,400
4	Samraong	1	470	0.270	0.250	4.9%	9.3%	37.3%	3,000	0.10	1.77	219,300	29,500	22,500	49,200	118,100
	Total		2,275							0.49	10.15	1,620,700				904,200

Note:

Loan conditions: @ 3%/yr with 3-yr grace followed by 12-yr repayment

FIRR including tax and excluding CER revenue.

Summary of Economic and Financial Analyses, Phases 1 and 2

No.	Project	Phase	Nos. of Households	Tariff Nighttim $/kWh	Tariff Daytime $/kWh	FIRR internal %	FIRR w/subsidy %	EIRR %	Short-term $	Saving Deposit at 10th million $	Saving Deposit at 30th million $	Total Costs $	Capital Costs Equity $	Capital Costs Tax $	Capital Costs Subsidy $	Capital Costs Soft Loan $
1	Kampong Kor	1+2	4882	**0.310**	0.270	**5.2%**	**9.4%**	**35.6%**	30,000	0.96	19.88	3,275,600	457,600	224,700	762,700	1,830,600
2	Samlout	1+2	4216	**0.305**	0.275	**5.6%**	**9.8%**	**26.0%**	30,000	0.86	19.45	3,397,100	480,600	193,100	801,000	1,922,400
3	Pramaoy	1+2	334	0.375	0.340	5.0%	8.8%	34.5%	4,000	0.07	1.34	193,200	26,600	15,800	44,400	106,400
4	Samraong	1+2	1230	0.380	0.320	5.9%	10.5%	32.8%	10,000	0.27	6.07	1,093,000	154,500	63,100	257,500	617,900
	Total		10,662							2.16	46.74	7,958,900				4,477,300

Note:

Loan conditions: @ 3%/yr with 3-yr grace followed by 12-yr repayment

FIRR including tax and excluding CER revenue.

Community Electrication Project, Kampong Kor, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A1 Principal Features of Electrification Plan

(1) Generating Equipment Planning

Items	Unit	Q'ty	Remarks
Nos. of households	h.h.	886	80% of the total 1,107 households
Unit nighttime domestic demand	W/hh	100	
Nighttime domestic demand	kW	88.6	
Street light demand	kW	4.0	1 light per 40 m of LV lir 200 street lights
Reserve capacity	kW	26.6	30% of nighttime domestic demand, allocated for station use + reserved power + distribution losses
Required capacity	kW	119.2	
Adopted capacity	kW	120.0	

(2) Energy Generation Planning for 8th Year Onward

Items	Monthly Unit Energy Sold	Monthly Energy Sold	Annual Energy Sold	Station Use, Losses, etc. (10%)	Annual Energy Generated	Annual Plant Factor	Annual Operation Hours	Remarks (refer to Table A2 for demand growth rates)
	kWh/hh	MWh	MWh	MWh	MWh	%	hr	
Nighttime domestic demand 1/, 2/	15.0	13.3	159.5	15.9	175.4	16.7%	1,462	100% from 8th year onward
Street light demand	0.7	0.6	7.2	0.7	7.9	0.8%	66	100% from the 1st year
Industrial demand 3/	7.5	6.6	79.7	8.0	87.7	8.3%	731	100% from 8th year onward
Irrigation pump demand 4/	1.2	3.2	12.9	1.3	14.2	1.4%	118	in 4 dry months, 100% from 8th year onward
Total energy	24.4	23.8	259.3	25.9	285.3	27.1%	2,377	100% from 8th year onward

Note:

1/ Typical consumption level of existing mini-grids in rural villages as of 2005 was 10 kWh (= 100W / 1,000 * 5hrs * 30 days * 67%) and assumed to be realized from 2nd year.

2/ Average consumption of existing REE mini-grids supplying to rural towns as of 2005 was 15 kWh（= 100 W / 1,000 * 7.5hrs * 30days * 67%）and was assumed to be realized in 7th year.

3/ Power demand of BCS, rice-mills, water supply stations, ice factory, workshop of boat engines, etc. Assumed to be 50% of the nighttime demand based on the actual demand of existing Anlong Ta Mey mini-grid (700 kWh at nighttime, 300 kWh for BCS at daytime) and potential daytime users in the villages shown in Table A3.

4/ see Table A3 for irrigation power demand.

Community Electrication Project, Kampong Kor, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A2 Energy and CER Sold

			1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Annual energy sold)																					
Demand growth	Growth rate																				
Domestic		1.10	50%	67%	73%	81%	89%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Street lights		0.00	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Industrial		1.10	0%	50%	67%	73%	81%	89%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Irrigation		1.10	0%	50%	67%	73%	81%	89%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Energy sold (MWh/yr)	Demand																				
Domestic		159.5	79.7	106.3	117.0	128.6	141.5	155.7	159.5	159.5	159.5	159.5	159.5	159.5	159.5	159.5	159.5	159.5	159.5	159.5	4,556
Street lights		7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	216
Industrial		79.7	0.0	39.9	53.2	58.5	64.3	70.8	77.8	79.7	79.7	79.7	79.7	79.7	79.7	79.7	79.7	79.7	79.7	79.7	2,198
Irrigation		12.9	0.0	6.5	8.6	9.5	10.4	11.5	12.6	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	356
Total		259.3	86.9	159.9	185.9	203.8	223.5	245.1	257.1	259.3	259.3	259.3	259.3	259.3	259.3	259.3	259.3	259.3	259.3	259.3	7,327
Unit energy sold (kWh per household per month)																					
Domestic		15.0	**7.5**	**10.0**	11.0	12.1	13.3	14.6	**15.0**	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
Street lights		0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	
Industrial		7.5	0.0	3.8	5.0	5.5	6.1	6.7	**7.3**	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	
Irrigation		1.2	0.0	0.6	0.8	0.9	1.0	1.1	**1.2**	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
Total		24.4	8.2	15.0	17.5	19.2	21.0	23.1	24.2	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	
(Operating revenue from electricity sales, $)																					
	Tariff																				
Domestic		$0.35	27,909	37,212	40,933	45,027	49,529	54,482	55,818	55,818	55,818	55,818	55,818	55,818	55,818	55,818	55,818	55,818	55,818	55,818	1,594,724
Street lights		$0.35	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	75,600
Industrial		$0.30	0	11,961	15,948	17,543	19,297	21,227	23,349	23,922	23,922	23,922	23,922	23,922	23,922	23,922	23,922	23,922	23,922	23,922	659,531
Irrigation		$0.30	0	1,938	2,584	2,843	3,127	3,440	3,783	3,876	3,876	3,876	3,876	3,876	3,876	3,876	3,876	3,876	3,876	3,876	106,868
Total			30,429	53,631	61,985	67,932	74,473	81,668	85,471	86,136	86,136	86,136	86,136	86,136	86,136	86,136	86,136	86,136	86,136	86,136	2,436,724
(Monthly tariff, $ per household)																					
Domestic			2.63	3.50	3.85	4.24	4.66	5.12	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	
Street lights			0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	
Industrial			0.00	1.13	1.50	1.65	1.82	2.00	2.20	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	
Irrigation			0.00	0.18	0.24	0.27	0.29	0.32	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	
Total			2.86	5.04	5.83	6.39	7.00	7.68	8.04	8.10	8.10	8.10	8.10	8.10	8.10	8.10	8.10	8.10	8.10	8.10	
(Tariff receivable, $/yr)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	kg-CO_2/kWh																				
(CER saleable)	(to-CO_2)	1.3	113	208	242	265	290	319	334	337	337	337	337	337	337	337	337	337	337	337	9,525
	($/yr) 1/	**$7**	791	1,455	1,692	1,855	2,033	2,230	2,340	2,360	2,360	2,360	2,360	2,360	2,360	2,360	2,360	2,360	2,360	2,360	66,676
Fuel tree consumed (ton per month)			10.9	20.0	23.2	25.5	27.9	30.6	32.1	32.4	32.4	32.4	32.4	32.4	32.4	32.4	32.4	32.4	32.4	32.4	916
Land required to supply fuel trees (ha)			13.0	24.0	27.9	30.6	33.5	36.8	38.6	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	
Nos. of fuel tree farmers (0.2 ha per farmer)			65	120	139	153	168	184	193	195	195	195	195	195	195	195	195	195	195	195	
Payment to fuel tree farmers ($/farmer/month			3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	
Total payment to fuel tree farmers ($/yr)			2,608	4,796	5,578	6,114	6,704	7,353	7,714	7,780	7,780	7,780	7,780	7,780	7,780	7,780	7,780	7,780	7,780	7,780	219,811

Ratio of tariff collected and billed= 100%

Note: 1/ Assumed at %4/ton-CO_2/yr deducting costs required for prepration of PDD, application and monitoring.

Community Electrication Project, Kampong Kor, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A3 Potential Daytime Users and Demand

No.	Demand	Diesel Consumption	Electricity Demand	Operation Hour	Unit Power Demand	Nos. of Customers	Total Demand		
		liter/month	kWh/month	hr/month	kW		kW	kWh/month	Load Factor
1	BCS	200	600	50	12.00	5	60.00	3,000	6.9%
2	Water supply	60	180	15	12.00	10	120.00	1,800	2.1%
3	Rice-mill	30	90	30	3.00	30	90.00	2,700	4.2%
4	Ice factory	30	90	30	3.00	1	3.00	90	4.2%
5	Workshop	25	75	60	1.25	1	1.25	75	8.3%
6	Café	115	345	296	1.17	1	1.17	345	41.1%
Monthly total		460	1,380	481	-	48	120.00	8,010	9.3%
Annual total		5520	16,560	5,772	-	-	120.00	**96,120**	9.3%

Source: The potential daytime users above are candidates in Kampong Kor for reference purpose.

Potential irrigation demand in the dry season

Unit land to irrigate	0.1	ha/hh
Ratio of irrigation hh	50.0%	
Total land area to irrigate	44.3	ha
Depth of irrigation	500	mm
Total irrigation water	0.222	mcm/yr
Irrigation period	4	month
Daily operation hour	8	hr/day
Total pump discharge	0.064	m^3/s
Pumping head	15.0	m
Combined efficiency	0.70	
Total power required	13	kW
Total energy required	13	MWh

Community Electrication Project, Kampong Kor, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A4 Cost Estimate

(1)	**Construction Costs**	Unit Price ($)	Q'ty	Unit	Amount($)	Total ($)	%シェア
	Power Station						
	Biomass gasification power generating equipment (FOB)	1,300	120	kW	156,000		
	Ocean freight & insurance (FOBx8%)	104	120	kW	12,480		
	Inland transportation & installation (FOB x (2%+5%))	91	120	kW	10,920		
	Switching equipment, main transformer		150	kVA	**61,000**		
						240,400	40.4%
	Civil and substation works						
	Road improvement works for dry season use to be further improved to all weather road in Phase 2	**24**	**2.50**	km	60,000		
	Land, powerhouse, water tank, etc. (10%FOB)	130	120	kW	15,600		
						75,600	
	Fuel tree preparation for 2nd year demand						
	Scarified seeds of Leucaena of 0.4-0.5 kg/ha and $15/kg	8	24	ha	180		
	Nursery	1	240	m^2	240		
	Watering of nursery for the first 3 months	**100**	3	month	300		
	Bush clearing	80	24	ha	1,918		
	Land preparation	**80**	24	ha	1,918		
	Transplanting	**80**	24	ha	1,918		
	Maintenance for initital 6 months @ $60/ha/mon	**360**	24	ha	8,632		
						15,106	
	Sub-total of power station and fuel preparation					**331,106**	55.6%
	Miscellaneous of power station (5%, consumables, gas detector, fire distinguisher, water content meter, computer set, etc.)				**12,000**		
	Power station sub-total (before tax)					343,106	57.7%
	Customs & VAT (CIF x 25%)	351	120	kW	42,120		
	Power station sub-total (including tax)					**385,226**	64.7%
	Distribution Facilities						
	MV lines	6,000	**2.5**	km	15,000		
	MV-LV lines	10,700	6.0	km	64,200		
	LV lines	7,100	**2.0**	km	14,200		
	Pole-mounted distribution transformers						
	15 kVA-1P	6,200		set	0		
	25 kVA-3P	7,300	4	set	29,200		
	50 kVA-3P	8,100	1	set	8,100		
	Distribution line - transformer sub-total (including tax)					130,700	22.0%
	Miscellaneous (5%, street lights, etc.)				**6,535**		
	Distribution line - transformer sub-total (including tax)					137,235	23.1%
	Service wire, etc.				44,300		7.4%
	Domestic cutomers	50	886	hh	44,300		
	Daytime customers (to be fixed individually)	0		customers	0		
	Distribution line - transformer - service wires, etc. sub-total (including tax)					**181,535**	30.5%
	Sub-total					**566,761**	
	Contingecy (5%)					**28,338**	
	Construction costs total					**595,099**	100.0%

(2)	**Costs for CEC supports**	Unit Price ($)	Q'ty	Unit	Amount($)
	Costs for CEC supports and training				**33,000**
	2.1 Facilitation for CEC setting up and management	500	12.00	MM	6,000
	2.2 Technical supports	500	18.00	MM	9,000
	2.3 Vehicles and lodging	1,000	18.00	month	18,000

(3) **Operation and maintenance costs**

Personnel costs of CEC staff	Salary ($/mon)	Nos. of person	MM	Amount($)	Total ($)
Operation Chief	$80	1	12.00	960	
Operator	$40	2	12.00	960	
Fuel preparation workers	$30	1	12.00	360	
Director and accountant	$40	2	12.00	960	
Personnel costs sub-total					**$3,240**

Maintenance costs of gasifier and engine-generator	CIF ($)	Ratio of O&M Costs	Amount ($)	Total ($)
Gasifier and engine-generator costs (CIF)	240,400			
5% of engine-generator set	80,133	5.0%	4,010	
Heat resistant cone of gasifier (replacement at ever 3,000 hr operation/every one year, 4-6%)	160,267	5.0%	8,010	
Replacement of lamp of street lights, office stationery and consumables			1,080	
Maintenance costs of powerhouse (% of powerhouse)	15,600	2.0%	310	
Maintenance costs sub-total				**13,410**
Operation and maintenance costs sub-total				**16,650**
Payment for technical supports ($/yr for 15 years from 1st year)				**2,930**

Items	Unit fuel cost ($/kWh)	Energy generation	unit	Fuel costs ($)
Annual fuel costs	0.03	285	MWh/yr	**8,558**
Operation, maintenance and fuel costs sub-total				**25,208**

(4) **Maintenance costs of distribution facilities**

Maintenance costs (0.5% of construction costs) **700**

Community Electrication Project, Kampong Kor, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A5 Economic Costs

Items	Foreign Currency	Local Currency	Financial Costs	Economic Costs	Remarks
	$	$	$	$	
1. Hard costs	285,910	309,189	595,099	490,062	SCF
1.1 Generating equip. excl. tax	168,480	10,920	179,400	178,308	0.90
1.2 Customs & VAT	0	42,120	42,120	0	LCF
1.3 Road and powerhouse		75,600	75,600	**37,800**	0.50 1/
1.4 Growing fuel trees	180	14,926	15,106	**7,643**	
1.5 Swichyard equip.		61,000	61,000	54,900	
1.6 Powerhouse miscellaneous		12,000	12,000	10,800	
1.7 Distribution lines	87,569	43,131	130,700	126,387	
1.8 Service wires, etc.	29,681	14,619	44,300	42,838	
1.9 Distri. Lines miscellaneous		6,535	6,535	5,882	
1.10 Contingency (5%)		28,338	28,338	25,504	
2. CEC facilitation costs	0	33,000	33,000	29,700	
Project Costs Total	285,910	342,189	628,099	519,762	
O&M	12,020	13,888	25,908	17,744	
1. Personnel costs	0	3,240	3,240	**2,754**	
2. Biomass gasifier generator	12,020	1,390	13,410	13,271	
3. Fuel		8,558	8,558	**1,369**	0.16 2/
4. Distribution lines	0	700	700	**350**	

Note: 1/ Economic conversion factor for seasonal jobless labors

Table A6 Economic Benefits

Items	Foreign Currency	Local Currency	Financial Costs	Economic Costs	Remarks
	$	$	$	$	
1. Hard costs	158,999	278,412	437,411	367,820	
1.1 Diesel generator excl. tax	81,480	10,920	92,400	91,308	770 $/kW
1.2 Customs & VAT		23,100	23,100		
1.3 Road & land preparation		52,400	52,400	**26,200**	
1.4 Powerhouse & fuel tank (10%)		9,240	9,240	8,316	
1.5 Swichyard equip.		61,000	61,000	54,900	
1.6 Powerhouse miscellaneous (5%)		11,907	11,907	10,716	
1.7 Distribution lines	77,519	38,181	**115,700**	111,882	
1.8 Service wires, etc.		44,300	44,300	39,870	
1.9 Distri. Lines miscellaneous		6,535	6,535	5,882	
1.10 Contingency (5%)		20,829	20,829	18,746	
2. CEC facilitation costs	0	33,000	33,000	29,700	
Project Costs Total	158,999	311,412	470,411	397,520	
O&M	5,387	69,816	75,203	67,942	
1. Personnel costs	0	2,880	2,880	2,592	
2. Diesel generator	5,387	623	6,010	5,948	5%
3. Fuel	0	65,613	65,613	59,052	0.23 $/kWh
4. Distribution lines	0	700	700	**350**	

Adjsutment for Kampong Kor diesel power station

1. Road powerhouse	24	**0.50**	km	12,000
2. Embankment of station yard	20	2,000	m^2	40,000
3. Land acquisition	0.2	2,000	m^2	400

Community Electrication Project, Kampong Kor, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A7 Unit Costs of Electricity

Items	with tax ($)	with tax exemption and subsidy ($)
1. Capital Costs	689,099	485,234
2. CEC facilitation costs	33,000	33,000
3. Total construction costs excluding design, testing, etc.		**518,234**
Interest rate	3.0%	
Repayment period	10 yr	
CRF (3.0%, 10 yr) =	0.1172	
4. Annual costs excluding design, etc.	80,783	60,753
5. O&M costs in 10th year	28,242	28,242
5.1 O&M	16,650	16,650
5.2 Fuel costs	8,558	8,558
5.3 EAC license fee	104	104
5.4 Yearly monitoring fee by DIME	2,930	2,930
6. Annual total costs	109,025	88,995
7. Annual energy sales from 7th year (MWh)	259.3	259.3
8. Unit cost of electricity from 7th year ($/kWh)	**0.420**	**0.343**
9. NPV of energy sold	MWh	4,661
10. NPV of finacial costs excluding tax	$	1,303,981
11. Average cost of electricity	$/kWh	**0.280**

Table A8 Tariff Setting

Items	$	Riel
Unit cost of electricity from 7th year ($/kWh)	**0.280**	1,119
Rate of reserve for operational risks (12%)	0.034	134
Average tariff ($/kWh)	**$0.313**	1,252
Tariff adopted for nighttime demand	**$0.350**	**1,400**
Tariff adopted for street lights	**$0.350**	**1,400**
Tariff adopted for industrial demand	**$0.300**	**1,200**
Tariff adopted for irrigation demand	**$0.300**	**1,200**
Monthly revenue (US$/mon)	$7,178	
from nighttime users	$4,652	
for street lights	$210	
from industrial users	$1,994	
from irrigation pump users	$323	
Average monthly tariff @ 15 kWh per HH ($)	$5.25	21,000
Tariff for street lights	$0.24	900
Total @ 15 kWh/hh including street lights	**$5.49**	21,900
Average monthly tariff @ 10 kWh per HH ($) including street lights	**$3.74**	**14,900**
Tariff of poor household ($/mon/hh) @ 40 W x 4h x 30 days = 4.8 kWh/month + street lights	$1.92	7,700
Tariff of poorest household (US$/mon/hh) @ 7 W x 4h x 30 days = 0.84 kWh/mon + street	$0.53	2,100
	Monthly Costs	
ATP for monthly tariff	$	Riel
Diesel oil lamp (100%)	$1.46	5,844
Battery lighting (70%, incl. Riel 4,000 per month for battery purchase)	$3.12	12,470
Total	**$4.58**	18,314

Community Electrication Project, Kampong Kor, Phase 1, soft loan @ 3% - 15 yr including 3

Table 1 Adopted Conditions for Economic and Finacial Analyses

1. Energy sold See attached Table A2

2. Tariff See attached Table A7

3. Long-term borrowing from GOC
   - 3% per year
   - 25 years repayment period including 5 years' grace

4. Short-term borrowing from commercial bank
   - 10% per year
   - revolving every year

5. Depreciation
   - Ratio of depreciation 90%
   - Ratio of residual value 10%

   Generating equipment
   - 5 years' grace and 5 years' depreciation for the first 10 years
   - 10 years' depreciation from 11th year onward

   Distribution lines, service wires, etc.
   - 5 years' grace and 20 years' depreciation

6. Interest earning
   - Interest of saving deposit at 10% per year

Community Electrication Project, Kampong Kor, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 2 Financial Analysis

(unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Expenditure)																				
Initital costs																				
Construction costs excluding tax	552,979											179,400				179,400				911,779
Supports to CEC	24,750	8,250																		
Operation and maintenance costs		14,269	20,474	22,694	24,215	25,888	27,728	28,753	28,942	28,942	28,942	28,942	28,942	28,942	28,942	28,942	28,942	28,942	28,942	829,681
Personnel costs		3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	97,200
O&M of biomass gasification power plant		4,495	8,266	9,614	10,538	11,555	12,673	13,295	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	378,866
Maintenance of distribution lines, etc.		700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	21,000
Biomass fuel cost		2,869	5,275	6,135	6,725	7,374	8,088	8,485	8,558	8,558	8,558	8,558	8,558	8,558	8,558	8,558	8,558	8,558	8,558	241,785
EAC license fee @ Riel 1.6/kWh		35	64	74	82	89	98	103	104	104	104	104	104	104	104	104	104	104	104	2,931
Payment for technical supports		2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	87,900
Total expenditure	577,729	22,519	20,474	22,694	24,215	25,888	27,728	28,753	28,942	28,942	28,942	208,342	28,942	28,942	28,942	208,342	28,942	28,942	28,942	1,774,460
(Revenue)																				
Operating revenue through electricity sales		30,429	53,631	61,985	67,932	74,473	81,668	85,471	86,136	86,136	86,136	86,136	86,136	86,136	86,136	86,136	86,136	86,136	86,136	2,436,724
Sales of CER		791	1,455	1,692	1,855	2,033	2,230	2,340	2,360	2,360	2,360	2,360	2,360	2,360	2,360	2,360	2,360	2,360	2,360	66,676
Residual value of equipment											17,940				17,940				59,510	
Total revenue		31,220	55,086	63,677	69,786	76,507	83,899	87,811	88,496	88,496	106,436	88,496	88,496	88,496	106,436	88,496	88,496	88,496	148,006	2,598,789
(Net operating income)	-577,729	8,701	34,611	40,984	45,572	50,619	56,170	59,058	59,555	59,555	77,495	-119,845	59,555	59,555	77,495	-119,845	59,555	59,555	119,064	824,329
FIRR	**6.2%**																			

Community Electrication Project, Kampong Kor, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 2 Financial Analysis

Including taxes, excluding CER sales (unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Expenditure)																				
Initital costs																				
Construction costs	595,099											179,400				179,400				953,899
Supports to CEC	24,750	8,250																		
Operation and maintenance costs		14,269	20,474	22,694	24,215	25,888	27,728	28,753	28,942	28,942	28,942	28,942	28,942	28,942	28,942	28,942	28,942	28,942	28,942	829,681
Personnel costs		3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	97,200
O&M of biomass gasification power plant		4,495	8,266	9,614	10,538	11,555	12,673	13,295	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	378,866
Maintenance of distribution lines, etc.		700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	21,000
Biomass fuel cost		2,869	5,275	6,135	6,725	7,374	8,088	8,485	8,558	8,558	8,558	8,558	8,558	8,558	8,558	8,558	8,558	8,558	8,558	241,785
EAC license fee @ Riel 1.6/kWh		35	64	74	82	89	98	103	104	104	104	104	104	104	104	104	104	104	104	2,931
Payment for technical supports		2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	87,900
Total expenditure	619,849	22,519	20,474	22,694	24,215	25,888	27,728	28,753	28,942	28,942	28,942	208,342	28,942	28,942	28,942	208,342	28,942	28,942	28,942	1,816,580
(Revenue)																				
Operating revenue through electricity sales		30,429	53,631	61,985	67,932	74,473	81,668	85,471	86,136	86,136	86,136	86,136	86,136	86,136	86,136	86,136	86,136	86,136	86,136	2,436,724
Sales of CER																				0
Residual value of equipment											17,940				17,940				59,510	
Total revenue		30,429	53,631	61,985	67,932	74,473	81,668	85,471	86,136	86,136	104,076	86,136	86,136	86,136	104,076	86,136	86,136	86,136	145,646	2,532,113
(Net operating income)	-619,849	7,910	33,157	39,292	43,717	48,585	53,940	56,718	57,195	57,195	75,135	-122,205	57,195	57,195	75,135	-122,205	57,195	57,195	116,704	715,533

FIRR **5.2%**

Community Electrication Project, Kampong Kor, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 2 Financial Analysis

Excluding taxes and subsidy from costs, and including CER sales (unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Expenditure)																				
Initital costs																				
Construction costs	391,234											179,400				179,400				750,034
Supports to CEC	24,750	8,250																		
Operation and maintenance costs		14,269	20,474	22,694	24,215	25,888	27,728	28,753	28,942	28,942	28,942	28,942	28,942	28,942	28,942	28,942	28,942	28,942	28,942	829,681
Personnel costs		3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	97,200
O&M of biomass gasification power plant		4,495	8,266	9,614	10,538	11,555	12,673	13,295	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	378,866
Maintenance of distribution lines, etc.		700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	21,000
Biomass fuel cost		2,869	5,275	6,135	6,725	7,374	8,088	8,485	8,558	8,558	8,558	8,558	8,558	8,558	8,558	8,558	8,558	8,558	8,558	241,785
EAC license fee @ Riel 1.6/kWh		35	64	74	82	89	98	103	104	104	104	104	104	104	104	104	104	104	104	2,931
Payment for technical supports		2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	2,930	87,900
Total expenditure	415,984	22,519	20,474	22,694	24,215	25,888	27,728	28,753	28,942	28,942	28,942	208,342	28,942	28,942	28,942	208,342	28,942	28,942	28,942	1,612,715
(Revenue)																				
Operating revenue through electricity sales		30,429	53,631	61,985	67,932	74,473	81,668	85,471	86,136	86,136	86,136	86,136	86,136	86,136	86,136	86,136	86,136	86,136	86,136	2,436,724
Sales of CER		791	1,455	1,692	1,855	2,033	2,230	2,340	2,360	2,360	2,360	2,360	2,360	2,360	2,360	2,360	2,360	2,360	2,360	66,676
Residual value of equipment											17,940				17,940				59,510	
Total revenue		31,220	55,086	63,677	69,786	76,507	83,899	87,811	88,496	88,496	106,436	88,496	88,496	88,496	106,436	88,496	88,496	88,496	148,006	2,598,789
(Net operating income)	-415,984	8,701	34,611	40,984	45,572	50,619	56,170	59,058	59,555	59,555	77,495	-119,845	59,555	59,555	77,495	-119,845	59,555	59,555	119,064	986,074

FIRR **9.3%**

Community Electrication Project, Kampong Kor, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 3 Economic Evaluation

(unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Economic costs)																				
Initital costs																				
Economic costs	490,062											178,308				178,308				846,678
Supports to CEC	22,275	7,425																		
Operation and maintenance costs	0	8,174	12,290	13,762	14,771	15,881	17,101	17,781	17,906	17,906	17,906	17,906	17,906	17,906	17,906	17,906	17,906	17,906	17,906	
Personenel costs		2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	87,480
O&M of biomass gasification power plant		4,449	8,180	9,514	10,429	11,435	12,541	13,158	13,271	13,271	13,271	13,271	13,271	13,271	13,271	13,271	13,271	13,271	13,271	374,939
Maintenance of distribution lines, etc.		350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	10,500
Biomass fuel cost		459	844	982	1,076	1,180	1,294	1,358	1,369	1,369	1,369	1,369	1,369	1,369	1,369	1,369	1,369	1,369	1,369	38,686
EAC license fee @ Riel 1.6/kWh		31	58	67	73	80	88	93	93	93	93	93	93	93	93	93	93	93	93	2,638
Monitoring of CEC by DIME		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual value											-17,831				-17,831				-49,006	-84,668
Total expenditure	512,337	15,630	12,347	13,829	14,844	15,961	17,190	17,874	18,000	18,000	169	196,308	18,000	18,000	169	196,308	18,000	18,000	-31,007	1,305,952
(Economic benefits as costs of alternative diesel mini-grid)																				
Initital costs																				
Economic costs	367,820											91,308				91,308				550,436
Supports to CEC	22,275	7,425																		
Operation and maintenance costs	0	24,732	43,006	49,541	54,021	58,948	64,368	67,386	67,942	67,942	67,942	67,942	67,942	67,942	67,942	67,942	67,942	67,942	67,942	
Personenel costs		2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	77,760
O&M of diesel power plant		1,994	3,666	4,264	4,674	5,125	5,621	5,897	5,948	5,948	5,948	5,948	5,948	5,948	5,948	5,948	5,948	5,948	5,948	168,037
Maintenance of distribution lines, etc.		350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	10,500
Fuel cost		19,796	36,398	42,335	46,405	50,881	55,806	58,547	59,052	59,052	59,052	59,052	59,052	59,052	59,052	59,052	59,052	59,052	59,052	1,668,362
EAC license fee		31	58	67	73	80	88	93	93	93	93	93	93	93	93	93	93	93	93	2,638
Payment for technical supports		2,637	2,637	2,637	2,637	2,637	2,637	2,637	2,637	2,637	2,637	2,637	2,637	2,637	2,637	2,637	2,637	2,637	2,637	79,110
Residual value											-9,131				-9,131				-36,782	-55,044
Benefits from CER sales		791	1,455	1,692	1,855	2,033	2,230	2,340	2,360	2,360	2,360	2,360	2,360	2,360	2,360	2,360	2,360	2,360	2,360	66,676
Total benefits	390,095	35,617	47,155	53,937	58,586	63,699	69,324	72,455	73,032	73,032	63,901	164,340	73,032	73,032	63,901	164,340	73,032	73,032	36,250	2,598,176
(Net benefits)	-122,242	19,986	34,808	40,108	43,742	47,738	52,134	54,582	55,032	55,032	63,732	-31,968	55,032	55,032	63,732	-31,968	55,032	55,032	67,257	1,292,224

EIRR **30.9%**

Community Electrication Project, Kampong Kor, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 4 Financing Plan

(unit: $)

Financial Resources			Financial Application	
Equity - CEC			**Power Plant before tax**	**404,106**
Cash (@ $50/hh)	44,300	6.8%	Biomass gasification power equipment	240,400
In kind (@ $40/MM)	52,747	8.2%	Road improvement works	60,000
1319 MM			Powerhouse, etc.	15,600
Grant			Switching equip. & transformer	61,000
REF	161,745	25.0%	Growing fuel trees	15,106
(25% of capital costs)			Misecellaneous equipment	12,000
Borrowing for capitals			**Distribution facilities, service wires, etc.**	181,535
Long-term	388,187	60.0%		
(15 yr including 3-year grace, 3%/yr)			Contingecy	28,338
			Capital costs before tax	613,979
Total fund for capital costs and CEC supports	646,979	100.0%	**CEC support**	33,000
Borrowing for operation	5,000		**Operation fund in hand**	5,000
Short-term				
(Revolving, 15%/yr)				
Tax exemption	42,120		**Customs and tax**	42,120
Total Financial Resources	**694,099**		**Total Financial Resources**	**694,099**

Community Electrication Project, Kampong Kor, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 5 Profit and Loss Statement with Cash Flow, 15-yr repayment period

(unit: $)

		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	20	21	22	30	Total
Operating revenue incl. CER & residual value			30,429	53,631	61,985	67,932	74,473	81,668	85,471	86,136	86,136	86,136	86,136	86,136	86,136	86,136	86,136	86,136	86,136	86,136	86,136	2,436,724
Operating costs			14,269	20,474	22,694	24,215	25,888	27,728	28,753	28,942	28,942	28,942	28,942	28,942	28,942	28,942	28,942	28,942	28,942	28,942	28,942	829,681
new land required for tree plantation					3.9	2.7	2.9	3.2	1.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.9
tree plantation costs for increasing demand				2,464	1,689	1,858	2,044	1,138	210	0	0	0	0	0	0	0	0	0	0	0	9,402	18,804
Gross profit			16,160	30,693	37,599	41,857	46,539	52,799	56,507	57,194	57,195	57,195	57,195	57,195	57,195	57,195	57,195	57,195	57,195	57,195	47,793	1,588,224
Interests payment																						
Short-term commercial loan (15%/yr)			750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	22,500
Long-term soft loan	3.0%		11,646	11,646	11,646	10,675	9,705	8,734	7,764	6,793	5,823	4,852	3,882	2,911	1,941	970						98,988
Deprecitation																						
Generating equipment (5 yr - 10 yr - 10 yr)	216,360							43,272	43,272	43,272	43,272	43,272	21,636	21,636	21,636	21,636	21,636	21,636	21,636	21,636	21,636	649,080
Others (20 yr from 6th year)	365,921							18,296	18,296	18,296	18,296	18,296	18,296	18,296	18,296	18,296	18,296	18,296	18,296	18,296		365,921
Operating profit before depreciation			3,764	18,297	25,203	30,432	36,084	43,315	47,993	49,651	50,622	51,592	52,563	53,533	54,504	55,474	56,445	56,445	56,445	56,445	47,043	1,466,736
Interests received (10%)			0	0	2,431	2,128	2,335	3,145	4,779	7,056	9,727	12,764	17,994	22,051	26,610	31,723	37,444	96,204	113,499	130,730	347,479	2,690,565
Residual value upon completion of depreciation	10%											17,940						17,940			59,510	95,390
CER received			791	1,455	1,692	1,855	2,033	2,230	2,340	2,360	2,360	2,360	2,360	2,360	2,360	2,360	2,360	2,360	2,360	2,360	2,360	66,676
Net profit after depreciation			4,555	19,752	29,326	34,414	40,452	-12,878	-6,456	-2,501	1,141	23,088	32,985	38,012	43,542	49,625	56,316	133,017	132,372	149,602	434,755	3,304,366
Cash in hand			4,555	19,752	29,326	34,414	40,452	48,690	55,112	59,067	62,709	84,656	72,917	77,944	83,474	89,557	96,248	172,949	172,304	189,534	456,391	4,319,367
Accumulated cash in hand after principal repayment		0	4,555	24,307	21,284	23,349	31,453	47,794	70,557	97,275	127,635	**179,942**	220,510	266,105	317,230	374,438	470,687	1,134,993	1,307,297	1,496,831	3,931,179	
Principal repayment	388,187	0	0	0	32,349	32,349	32,349	32,349	32,349	32,349	32,349	32,349	32,349	32,349	32,349	32,349						388,187
Long-term debt balance	388,187	388,187	388,187	388,187	355,838	323,490	291,141	258,792	226,443	194,094	161,745	129,396	97,047	64,698	32,349	-0						

Community Electrication Project, Samlout, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A1 Principal Features of Electrification Plan

(1) Generating Equipment Planning

Items	Unit	Q'ty	Remarks
Nos. of households	h.h.	774	11% of the total 7,284 households
Unit nighttime domestic demand	W/hh	100	
Nighttime domestic demand	kW	77.4	
Street light demand	kW	3.1	1 light per 40 m of LV lir 155 street lights
Reserve capacity	kW	23.2	30% of nighttime domestic demand, allocated for station use + reserved power + distribution losses
Required capacity	kW	103.7	
Adopted capacity	kW	120.0	

(2) Energy Generation Planning for 8th Year Onward

Items	Monthly Unit Energy Sold	Monthly Energy Sold	Annual Energy Sold	Station Use, Losses, etc. (10%)	Annual Energy Generated	Annual Plant Factor	Annual Operation Hours	Remarks (refer to Table A2 for demand growth rates)
	kWh/hh	MWh	MWh	MWh	MWh	%	hr	
Nighttime domestic demand 1/, 2/	15.0	11.6	139.3	13.9	153.3	14.6%	1,277	100% from 8th year onward
Street light demand	0.6	0.5	5.6	0.6	6.1	0.6%	51	100% from the 1st year
Industrial demand 3/	7.5	5.8	69.7	7.0	76.6	7.3%	639	100% from 8th year onward
Irrigation pump demand 4/	6.1	14.1	56.4	5.6	62.1	5.9%	517	in 4 dry months, 100% from 8th year onward
Total energy	29.2	32.0	271.0	27.1	298.1	28.4%	2,484	100% from 8th year onward

Note:

1/ Typical consumption level of existing mini-grids in rural villages as of 2005 was 10 kWh (= 100W / 1,000 * 5hrs * 30 days * 67%) and assumed to be realized from 2nd year.

2/ Average consumption of existing REE mini-grids supplying to rural towns as of 2005 was 15 kWh（= 100 W / 1,000 * 7.5hrs * 30days * 67%）and was assumed to be realized in 7th year.

3/ Power demand of BCS, rice-mills, water supply stations, ice factory, workshop of boat engines, etc. Assumed to be 50% of the nighttime demand based on the actual demand of existing Anlong Ta Mey mini-grid (700 kWh at nighttime, 300 kWh for BCS at daytime) and potential daytime users in the villages shown in Table A3.

4/ see Table A3 for irrigation power demand.

Community Electrication Project, Samlout, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A2 Energy and CER Sold

		1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Annual energy sold)																				
Demand growth	Growth rate																			
Domestic	1.10	50%	67%	73%	81%	89%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Street lights	0.00	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Industrial	1.10	0%	50%	67%	73%	81%	89%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Irrigation	1.10	0%	50%	67%	73%	81%	89%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Energy sold (MWh/yr)	Demand																			
Domestic	139.3	69.7	92.9	102.2	112.4	123.6	136.0	139.3	139.3	139.3	139.3	139.3	139.3	139.3	139.3	139.3	139.3	139.3	139.3	3,980
Street lights	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	167
Industrial	69.7	0.0	34.8	46.4	51.1	56.2	61.8	68.0	69.7	69.7	69.7	69.7	69.7	69.7	69.7	69.7	69.7	69.7	69.7	1,921
Irrigation	56.4	0.0	28.2	37.6	41.4	45.5	50.1	55.1	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	1,556
Total	271.0	75.2	161.5	191.8	210.4	230.9	253.5	268.0	271.0	271.0	271.0	271.0	271.0	271.0	271.0	271.0	271.0	271.0	271.0	7,624
Unit energy sold (kWh per household per month)																				
Domestic	15.0	**7.5**	**10.0**	11.0	12.1	13.3	14.6	**15.0**	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
Street lights	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
Industrial	7.5	0.0	3.8	5.0	5.5	6.1	6.7	**7.3**	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	
Irrigation	6.1	0.0	3.0	4.1	4.5	4.9	5.4	**5.9**	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	
Total	29.2	8.1	17.4	20.7	22.7	24.9	27.3	28.9	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	
(Operating revenue from electricity sales, $)																				
	Tariff																			
Domestic	$0.34	23,336	31,115	34,226	37,649	41,414	45,555	46,672	46,672	46,672	46,672	46,672	46,672	46,672	46,672	46,672	46,672	46,672	46,672	1,333,428
Street lights	$0.34	1,869	1,869	1,869	1,869	1,869	1,869	1,869	1,869	1,869	1,869	1,869	1,869	1,869	1,869	1,869	1,869	1,869	1,869	56,079
Industrial	$0.28	0	9,578	12,771	14,048	15,453	16,998	18,698	19,157	19,157	19,157	19,157	19,157	19,157	19,157	19,157	19,157	19,157	19,157	528,146
Irrigation	$0.28	0	7,760	10,347	11,382	12,520	13,772	15,149	15,520	15,520	15,520	15,520	15,520	15,520	15,520	15,520	15,520	15,520	15,520	427,896
Total		25,205	50,323	59,213	64,948	71,256	78,194	82,388	83,218	83,218	83,218	83,218	83,218	83,218	83,218	83,218	83,218	83,218	83,218	2,345,549
(Monthly tariff, $ per household)																				
Domestic		2.51	3.35	3.69	4.05	4.46	4.90	5.03	5.03	5.03	5.03	5.03	5.03	5.03	5.03	5.03	5.03	5.03	5.03	
Street lights		0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	
Industrial		0.00	1.03	1.38	1.51	1.66	1.83	2.01	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06	
Irrigation		0.00	0.84	1.11	1.23	1.35	1.48	1.63	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	
Total		2.71	5.42	6.38	6.99	7.67	8.42	8.87	8.96	8.96	8.96	8.96	8.96	8.96	8.96	8.96	8.96	8.96	8.96	
(Tariff receivable, $/yr)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	kg-CO_2/kWh																			
(CER saleable)	(to-CO_2) 1.3	98	210	249	274	300	329	348	352	352	352	352	352	352	352	352	352	352	352	9,912
	($/yr) 1/ **$7**	685	1,470	1,745	1,915	2,101	2,306	2,439	2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466	69,381
Fuel tree consumed (ton per month)		9.4	20.2	24.0	26.3	28.9	31.7	33.5	33.9	33.9	33.9	33.9	33.9	33.9	33.9	33.9	33.9	33.9	33.9	953
Land required to supply fuel trees (ha)		11.3	24.2	28.8	31.6	34.6	38.0	40.2	40.6	40.6	40.6	40.6	40.6	40.6	40.6	40.6	40.6	40.6	40.6	
Nos. of fuel tree farmers (0.2 ha per farmer)		56	121	144	158	173	190	201	203	203	203	203	203	203	203	203	203	203	203	
Payment to fuel tree farmers ($/farmer/month		3.4	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	
Total payment to fuel tree farmers ($/yr)		2,257	4,845	5,754	6,313	6,928	7,604	8,039	8,130	8,130	8,130	8,130	8,130	8,130	8,130	8,130	8,130	8,130	8,130	228,729

Ratio of tariff collected and billed= 100%

Note: 1/ Assumed at %4/ton-CO_2/yr deducting costs required for prepration of PDD, application and monitoring. CER: Certified Emission Reduction

Community Electrication Project, Samlout, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A3 Potential Daytime Users and Demand

No.	Demand	Diesel Consumption	Electricity Demand	Operation Hour	Unit Power Demand	Nos. of Customers	Total Demand		
		liter/month	kWh/month	hr/month	kW		kW	kWh/month	Load Factor
1	BCS	200	600	50	12.00	5	60.00	3,000	6.9%
2	Water supply	60	180	15	12.00	10	120.00	1,800	2.1%
3	Rice-mill	30	90	30	3.00	30	90.00	2,700	4.2%
4	Ice factory	30	90	30	3.00	1	3.00	90	4.2%
5	Workshop	25	75	60	1.25	1	1.25	75	8.3%
6	Café	115	345	296	1.17	1	1.17	345	41.1%
Monthly total		460	1,380	481	-	48	120.00	8,010	9.3%
Annual total		5520	16,560	5,772	-	-	120.00	**96,120**	9.3%

Source: The potential daytime users above are candidates in Kampong Kor for reference purpose.

Potential irrigation demand in the dry season

Unit land to irrigate	0.5	ha/hh
Ratio of irrigation hh	50.0%	
Total land area to irrigate	193.5	ha
Depth of irrigation	500	mm
Total irrigation water	0.968	mcm/yr
Irrigation period	4	month
Daily operation hour	8	hr/day
Total pump discharge	0.280	m^3/s
Pumping head	15.0	m
Combined efficiency	0.70	
Total power required	59	kW
Total energy required	56	MWh

Community Electrication Project, Samlout, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A4 Cost Estimate

(1)	**Construction Costs**	Unit Price ($)	Q'ty	Unit	Amount($)	Total ($)	%
	Power Station						
	Biomass gasification power generating equipment (FOB)	1,300	120	kW	156,000		
	Ocean freight & insurance (FOBx8%)	104	120	kW	12,480		
	Inland transportation & installation (FOB x (2%+5%))	91	120	kW	10,920		
	Switching equipment, main transformer		150	kVA	**61,000**		
						240,400	45.7%
	Civil and substation works						
	Road improvement works for dry season use to be further improved to all weather road in Phase 2	**24**	**0.20**	km	4,800		
	Land, powerhouse, water tank, etc. (10%FOB)	130	120	kW	15,600		
						20,400	
	Fuel tree preparation for 2nd year demand						
	Scarified seeds of Leucaena of 0.4-0.5 kg/ha and $15/kg	8	24	ha	182		
	Nursery	1	240	m^2	240		
	Watering of nursery for the first 3 months	**100**	3	month	300		
	Bush clearing	40	24	ha	969		
	Land preparation	**80**	24	ha	1,938		
	Transplanting	**80**	24	ha	1,938		
	Maintenance for initital 6 months @ $60/ha/mon	**360**	24	ha	8,721		
						14,288	
	Sub-total of power station and fuel preparation					**275,088**	52.3%
	Miscellaneous of power station (5%, consumables, gas detector, fire distinguisher, water content meter, computer set, etc.)				**12,000**		
	Power station sub-total (before tax)					287,088	54.6%
	Customs & VAT (CIF x 25%)	351	120	kW	42,120		
	Power station sub-total (including tax)					**329,208**	62.6%
	Distribution Facilities						
	MV lines	6,000	**6.3**	km	37,800		
	MV-LV lines	10,700	3.7	km	39,590		
	LV lines	7,100	**2.5**	km	17,750		
	Pole-mounted distribution transformers						
	15 kVA-1P	6,200		set	0		
	25 kVA-3P	7,300	1	set	7,300		
	50 kVA-3P	8,100	3	set	24,300		
	Distribution line - transformer sub-total (including tax)					126,740	24.1%
	Miscellaneous (5%, street lights, etc.)				**6,337**		
	Distribution line - transformer sub-total (including tax)					133,077	25.3%
	Service wire, etc.				38,700		7.4%
	Domestic cutomers	50	774	hh	38,700		
	Daytime customers (to be fixed individually)	0		customers	0		
	Distribution line - transformer - service wires, etc. sub-total (including tax)					**171,777**	32.7%
	Sub-total					**500,985**	
	Contingecy (5%)					**25,049**	
	Construction costs total					**526,034**	100.0%

(2)	**Costs for CEC supports**	Unit Price ($)	Q'ty	Unit	Amount($)
	Costs for CEC supports and training				**33,000**
	2.1 Facilitation for CEC setting up and management	500	12.00	MM	6,000
	2.2 Technical supports	500	18.00	MM	9,000
	2.3 Vehicles and lodging	1,000	18.00	month	18,000

(3) **Operation and maintenance costs**

Personnel costs of CEC staff	Salary ($/mon)	Nos. of person	MM	Amount($)	Total ($)
Operation Chief	$80	1	12.00	960	
Operator	$40	2	12.00	960	
Fuel preparation workers	$30	1	12.00	360	
Director and accountant	$40	2	12.00	960	
Personnel costs sub-total					**$3,240**

Maintenance costs of gasifier and engine-generator	CIF ($)	Ratio of O&M Costs	Amount ($)	Total ($)
Gasifier and engine-generator costs (CIF)	240,400			
5% of engine-generator set	80,133	5.0%	4,010	
Heat resistant cone of gasifier (replacement at ever 3,000 hr operation/every one year, 4-6%)	160,267	5.0%	8,010	
Replacement of lamp of street lights, office stationery and consumables			1,080	
Maintenance costs of powerhouse (% of powerhouse)	15,600	2.0%	310	
Maintenance costs sub-total				**13,410**
Operation and maintenance costs sub-total				**16,650**
Payment for technical supports ($/yr for 15 years from 1st year)				**2,560**

Items	Unit fuel cost ($/kWh)	Energy generation	unit	Fuel costs ($)
Annual fuel costs	0.03	298	MWh/yr	**8,943**
Operation, maintenance and fuel costs sub-total				**25,593**

(4) **Maintenance costs of distribution facilities**

Maintenance costs (0.5% of construction costs) **700**

Community Electrication Project, Samlout, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A5 Economic Costs

Items	Foreign Currency	Local Currency	Financial Costs	Economic Costs	Remarks
	$	$	$	$	
1. Hard costs	279,507	246,527	526,034	449,671	SCF
1.1 Generating equip. excl. tax	168,480	10,920	179,400	178,308	0.90
1.2 Customs & VAT	0	42,120	42,120	0	LCF
1.3 Road and powerhouse		20,400	20,400	**10,200**	0.50 1/
1.4 Growing fuel trees	182	14,106	14,288	**7,235**	
1.5 Swichyard equip.		61,000	61,000	54,900	
1.6 Powerhouse miscellaneous		12,000	12,000	10,800	
1.7 Distribution lines	84,916	41,824	126,740	122,558	
1.8 Service wires, etc.	25,929	12,771	38,700	37,423	
1.9 Distri. Lines miscellaneous		6,337	6,337	5,703	
1.10 Contingency (5%)		25,049	25,049	22,544	
2. CEC facilitation costs	0	33,000	33,000	29,700	
Project Costs Total	279,507	279,527	559,034	479,371	
O&M	12,020	14,273	26,293	17,806	
1. Personnel costs	0	3,240	3,240	**2,754**	
2. Biomass gasifier generator	12,020	1,390	13,410	13,271	
3. Fuel		8,943	8,943	**1,431**	0.16 2/
4. Distribution lines	0	700	700	**350**	

Note: 1/ Economic conversion factor for seasonal jobless labors

Table A6 Economic Benefits

Items	Foreign Currency	Local Currency	Financial Costs	Economic Costs	Remarks
	$	$	$	$	
1. Hard costs	141,070	209,676	350,746	307,069	
1.1 Diesel generator excl. tax	81,480	10,920	92,400	91,308	770 $/kW
1.2 Customs & VAT		23,100	23,100		
1.3 Road & land preparation		4,800	4,800	**2,400**	
1.4 Powerhouse & fuel tank (10%)		9,240	9,240	8,316	
1.5 Swichyard equip.		61,000	61,000	54,900	
1.6 Powerhouse miscellaneous (5%)		9,527	9,527	8,574	
1.7 Distribution lines	59,590	29,350	**88,940**	86,005	
1.8 Service wires, etc.		38,700	38,700	34,830	
1.9 Distri. Lines miscellaneous		6,337	6,337	5,703	
1.10 Contingency (5%)		16,702	16,702	15,032	
2. CEC facilitation costs	0	33,000	33,000	29,700	
Project Costs Total	141,070	242,676	383,746	336,769	
O&M	5,387	72,765	78,152	70,596	
1. Personnel costs	0	2,880	2,880	2,592	
2. Diesel generator	5,387	623	6,010	5,948	5%
3. Fuel	0	68,562	68,562	61,706	0.23 $/kWh
4. Distribution lines	0	700	700	**350**	

Adjsutment for Kampong Kor diesel power station

1. Road powerhouse	24	**0.20**	km	4,800
2. Embankment of station yard	0	2,000	m^2	0
3. Land acquisition	0	2,000	m^2	0

Community Electrication Project, Samlout, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A7 Unit Costs of Electricity

Items	with tax ($)	with tax exemption and subsidy ($)
1. Capital Costs	620,034	433,436
2. CEC facilitation costs	33,000	33,000
3. Total construction costs excluding design, testing, etc.		**466,436**
Interest rate	3.0%	
Repayment period	10 yr	
CRF (3.0%, 10 yr) =	0.1172	
4. Annual costs excluding design, etc.	72,687	54,680
5. O&M costs in 10th year	28,261	28,261
5.1 O&M	16,650	16,650
5.2 Fuel costs	8,943	8,943
5.3 EAC license fee	108	108
5.4 Yearly monitoring fee by DIME	2,560	2,560
6. Annual total costs	100,948	82,942
7. Annual energy sales from 7th year (MWh)	271.0	271.0
8. Unit cost of electricity from 7th year ($/kWh)	**0.373**	**0.306**
9. NPV of energy sold	MWh	4,840
10. NPV of finacial costs excluding tax	$	1,234,281
11. Average cost of electricity	$/kWh	**0.255**

Table A8 Tariff Setting

Items	$	Riel
Unit cost of electricity from 7th year ($/kWh)	**0.255**	1,020
Rate of reserve for operational risks (12%)	0.031	122
Average tariff ($/kWh)	**$0.286**	1,144
Tariff adopted for nighttime demand	**$0.335**	**1,340**
Tariff adopted for street lights	**$0.335**	**1,340**
Tariff adopted for industrial demand	**$0.275**	**1,100**
Tariff adopted for irrigation demand	**$0.275**	**1,100**
Monthly revenue (US$/mon)	$6,935	
from nighttime users	$3,889	
for street lights	$156	
from industrial users	$1,596	
from irrigation pump users	$1,293	
Average monthly tariff @ 15 kWh per HH ($)	$5.03	20,100
Tariff for street lights	$0.20	800
Total @ 15 kWh/hh including street lights	**$5.23**	20,900
Average monthly tariff @ 10 kWh per HH ($) including street lights	**$3.55**	**14,200**
Tariff of poor household ($/mon/hh) @ 40 W x 4h x 30 days = 4.8 kWh/month + street lights	$1.81	7,200
Tariff of poorest household (US$/mon/hh) @ 7 W x 4h x 30 days = 0.84 kWh/mon + street	$0.48	1,900
	Monthly Costs	
ATP for monthly tariff	$	Riel
Diesel oil lamp (100%)	$1.46	5,844
Battery lighting (70%, incl. Riel 4,000 per month for battery purchase)	$3.12	12,470
Total	**$4.58**	18,314

Community Electrication Project, Samlout, Phase 1, soft loan @ 3% - 15 yr incluc

Table 1 Adopted Conditions for Economic and Finacial Analyses

1. Energy sold — See attached Table A2

2. Tariff — See attached Table A7

3. Long-term borrowing from GOC
   - 3% per year
   - 25 years repayment period including 5 years' grace

4. Short-term borrowing from commercial bank
   - 10% per year
   - revolving every year

5. Depreciation

- Ratio of depreciation	90%
- Ratio of residual value	10%

Generating equipment
- 5 years' grace and 5 years' depreciation for the first 10 years
- 10 years' depreciation from 11th year onward

Distribution lines, service wires, etc.
- 5 years' grace and 20 years' depreciation

6. Interest earning
   - Interest of saving deposit at 10% per year

Community Electrication Project, Samlout, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 2 Financial Analysis

(unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Expenditure)																				
Initital costs																				
Construction costs excluding tax	483,914											179,400				179,400				842,714
Supports to CEC	24,750	8,250																		
Operation and maintenance costs		12,736	19,887	22,398	23,942	25,640	27,507	28,711	28,961	28,961	28,961	28,961	28,961	28,961	28,961	28,961	28,961	28,961	28,961	826,934
Personnel costs		3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	97,200
O&M of biomass gasification power plant		3,723	7,992	9,492	10,413	11,427	12,542	13,261	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	377,280
Maintenance of distribution lines, etc.		700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	21,000
Biomass fuel cost		2,483	5,330	6,330	6,944	7,620	8,364	8,843	8,943	8,943	8,943	8,943	8,943	8,943	8,943	8,943	8,943	8,943	8,943	251,604
EAC license fee @ Riel 1.6/kWh		30	65	77	84	92	101	107	108	108	108	108	108	108	108	108	108	108	108	3,050
Payment for technical supports		2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	76,800
Total expenditure	508,664	20,986	19,887	22,398	23,942	25,640	27,507	28,711	28,961	28,961	28,961	208,361	28,961	28,961	28,961	208,361	28,961	28,961	28,961	1,702,648
(Revenue)																				
Operating revenue through electricity sales		25,205	50,323	59,213	64,948	71,256	78,194	82,388	83,218	83,218	83,218	83,218	83,218	83,218	83,218	83,218	83,218	83,218	83,218	2,345,549
Sales of CER		685	1,470	1,745	1,915	2,101	2,306	2,439	2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466	69,381
Residual value of equipment											17,940				17,940				52,603	
Total revenue		25,890	51,792	60,959	66,863	73,357	80,501	84,827	85,684	85,684	103,624	85,684	85,684	85,684	103,624	85,684	85,684	85,684	138,288	2,503,413
(Net operating income)	-508,664	4,904	31,906	38,561	42,921	47,717	52,993	56,116	56,723	56,723	74,663	-122,677	56,723	56,723	74,663	-122,677	56,723	56,723	109,326	800,766
FIRR	**6.7%**																			

Community Electrication Project, Samlout, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 2 Financial Analysis

Including taxes, excluding CER sales (unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Expenditure)																				
Initital costs																				
Construction costs	526,034											179,400				179,400				884,834
Supports to CEC	24,750	8,250																		
Operation and maintenance costs		12,736	19,887	22,398	23,942	25,640	27,507	28,711	28,961	28,961	28,961	28,961	28,961	28,961	28,961	28,961	28,961	28,961	28,961	826,934
Personnel costs		3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	97,200
O&M of biomass gasification power plant		3,723	7,992	9,492	10,413	11,427	12,542	13,261	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	377,280
Maintenance of distribution lines, etc.		700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	21,000
Biomass fuel cost		2,483	5,330	6,330	6,944	7,620	8,364	8,843	8,943	8,943	8,943	8,943	8,943	8,943	8,943	8,943	8,943	8,943	8,943	251,604
EAC license fee @ Riel 1.6/kWh		30	65	77	84	92	101	107	108	108	108	108	108	108	108	108	108	108	108	3,050
Payment for technical supports		2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	76,800
Total expenditure	550,784	20,986	19,887	22,398	23,942	25,640	27,507	28,711	28,961	28,961	28,961	208,361	28,961	28,961	28,961	208,361	28,961	28,961	28,961	1,744,768
(Revenue)																				
Operating revenue through electricity sales		25,205	50,323	59,213	64,948	71,256	78,194	82,388	83,218	83,218	83,218	83,218	83,218	83,218	83,218	83,218	83,218	83,218	83,218	2,345,549
Sales of CER																				0
Residual value of equipment											17,940				17,940				52,603	
Total revenue		25,205	50,323	59,213	64,948	71,256	78,194	82,388	83,218	83,218	101,158	83,218	83,218	83,218	101,158	83,218	83,218	83,218	135,822	2,434,032
(Net operating income)	-550,784	4,219	30,436	36,815	41,006	45,616	50,687	53,677	54,257	54,257	72,197	-125,143	54,257	54,257	72,197	-125,143	54,257	54,257	106,860	689,265
FIRR	**5.5%**																			

Community Electrication Project, Samlout, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 2 Financial Analysis

Excluding taxes and subsidy from costs, and including CER sales (unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Expenditure)																				
Initital costs																				
Construction costs	339,436											179,400				179,400				698,236
Supports to CEC	24,750	8,250																		
Operation and maintenance costs		12,736	19,887	22,398	23,942	25,640	27,507	28,711	28,961	28,961	28,961	28,961	28,961	28,961	28,961	28,961	28,961	28,961	28,961	826,934
Personnel costs		3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	97,200
O&M of biomass gasification power plant		3,723	7,992	9,492	10,413	11,427	12,542	13,261	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	377,280
Maintenance of distribution lines, etc.		700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	21,000
Biomass fuel cost		2,483	5,330	6,330	6,944	7,620	8,364	8,843	8,943	8,943	8,943	8,943	8,943	8,943	8,943	8,943	8,943	8,943	8,943	251,604
EAC license fee @ Riel 1.6/kWh		30	65	77	84	92	101	107	108	108	108	108	108	108	108	108	108	108	108	3,050
Payment for technical supports		2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	2,560	76,800
Total expenditure	364,186	20,986	19,887	22,398	23,942	25,640	27,507	28,711	28,961	28,961	28,961	208,361	28,961	28,961	28,961	208,361	28,961	28,961	28,961	1,558,169
(Revenue)																				
Operating revenue through electricity sales		25,205	50,323	59,213	64,948	71,256	78,194	82,388	83,218	83,218	83,218	83,218	83,218	83,218	83,218	83,218	83,218	83,218	83,218	2,345,549
Sales of CER		685	1,470	1,745	1,915	2,101	2,306	2,439	2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466	69,381
Residual value of equipment											17,940				17,940				52,603	
Total revenue		25,890	51,792	60,959	66,863	73,357	80,501	84,827	85,684	85,684	103,624	85,684	85,684	85,684	103,624	85,684	85,684	85,684	138,288	2,503,413
(Net operating income)	-364,186	4,904	31,906	38,561	42,921	47,717	52,993	56,116	56,723	56,723	74,663	-122,677	56,723	56,723	74,663	-122,677	56,723	56,723	109,326	945,244

FIRR **9.9%**

Community Electrication Project, Samlout, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 3 Economic Evaluation

(unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Economic costs)																				
Initital costs																				
Economic costs	449,671											178,308				178,308				806,287
Supports to CEC	22,275	7,425																		
Operation and maintenance costs	0	7,348	12,028	13,672	14,682	15,794	17,016	17,804	17,968	17,968	17,968	17,968	17,968	17,968	17,968	17,968	17,968	17,968	17,968	
Personenel costs		2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	87,480
O&M of biomass gasification power plant		3,685	7,909	9,393	10,305	11,308	12,412	13,123	13,271	13,271	13,271	13,271	13,271	13,271	13,271	13,271	13,271	13,271	13,271	373,369
Maintenance of distribution lines, etc.		350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	10,500
Biomass fuel cost		397	853	1,013	1,111	1,219	1,338	1,415	1,431	1,431	1,431	1,431	1,431	1,431	1,431	1,431	1,431	1,431	1,431	40,257
EAC license fee @ Riel 1.6/kWh		27	58	69	76	83	91	96	98	98	98	98	98	98	98	98	98	98	98	2,745
Monitoring of CEC by DIME		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual value											-17,831				-17,831				-44,967	-80,629
Total expenditure	471,946	14,800	12,086	13,741	14,758	15,877	17,107	17,901	18,065	18,065	235	196,373	18,065	18,065	235	196,373	18,065	18,065	-26,902	1,269,709
(Economic benefits as costs of alternative diesel mini-grid)																				
Initital costs																				
Economic costs	307,069											91,308				91,308				489,685
Supports to CEC	22,275	7,425																		
Operation and maintenance costs	0	21,725	43,262	50,828	55,477	60,591	66,217	69,842	70,596	70,596	70,596	70,596	70,596	70,596	70,596	70,596	70,596	70,596	70,596	
Personenel costs		2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	77,760
O&M of diesel power plant		1,651	3,545	4,210	4,619	5,068	5,563	5,881	5,948	5,948	5,948	5,948	5,948	5,948	5,948	5,948	5,948	5,948	5,948	167,334
Maintenance of distribution lines, etc.		350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	10,500
Fuel cost		17,132	36,776	43,676	47,916	52,581	57,712	61,019	61,706	61,706	61,706	61,706	61,706	61,706	61,706	61,706	61,706	61,706	61,706	1,736,053
EAC license fee		27	58	69	76	83	91	96	98	98	98	98	98	98	98	98	98	98	98	2,745
Payment for technical supports		2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	69,120
Residual value											-9,131				-9,131				-30,707	-48,968
Benefits from CER sales		685	1,470	1,745	1,915	2,101	2,306	2,439	2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466	69,381
Total benefits	329,344	32,166	47,094	54,946	59,772	65,080	70,918	74,682	75,463	75,463	66,333	166,771	75,463	75,463	66,333	166,771	75,463	75,463	44,757	2,603,309
(Net benefits)	-142,602	17,366	35,008	41,205	45,013	49,203	53,811	56,781	57,398	57,398	66,098	-29,602	57,398	57,398	66,098	-29,602	57,398	57,398	71,658	1,333,600

EIRR **27.4%**

Community Electrication Project, Samlout, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 4 Financing Plan

(unit: $)

Financial Resources			Financial Application	
Equity - CEC			**Power Plant before tax**	**348,088**
Cash (@ $50/hh)	38,700	6.7%	Biomass gasification power equipment	240,400
In kind (@ $40/MM)	47,987	8.3%	Road improvement works	4,800
1200 MM			Powerhouse, etc.	15,600
Grant			Switching equip. & transformer	61,000
REF	144,479	25.0%	Growing fuel trees	14,288
(25% of capital costs)			Misecellaneous equipment	12,000
Borrowing for capitals			**Distribution facilities, service wires, etc.**	171,777
Long-term	346,748	60.0%		
(15 yr including 3-year grace, 3%/yr)			Contingecy	25,049
			Capital costs before tax	544,914
Total fund for capital costs and CEC supports	577,914	100.0%	**CEC support**	33,000
Borrowing for operation	5,000		**Operation fund in hand**	5,000
Short-term				
(Revolving, 15%/yr)				
Tax exemption	42,120		**Customs and tax**	42,120
Total Financial Resources	**625,034**		**Total Financial Resources**	**625,034**

Community Electrication Project, Samlout, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 5 Profit and Loss Statement with Cash Flow, 15-yr repayment period

(unit: $)

		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	20	21	22	30	Total
Operating revenue incl. CER & residual value			25,205	50,323	59,213	64,948	71,256	78,194	82,388	83,218	83,218	83,218	83,218	83,218	83,218	83,218	83,218	83,218	83,218	83,218	83,218	2,345,549
Operating costs			12,736	19,887	22,398	23,942	25,640	27,507	28,711	28,961	28,961	28,961	28,961	28,961	28,961	28,961	28,961	28,961	28,961	28,961	28,961	826,934
new land required for tree plantation					4.5	2.8	3.1	3.4	2.2	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.4
tree plantation costs for increasing demand				2,681	1,648	1,812	1,994	1,285	267	0	0	0	0	0	0	0	0	0	0	0	9,686	19,372
Gross profit			12,469	27,755	35,163	39,191	43,619	49,399	53,408	54,256	54,257	54,257	54,257	54,257	54,257	54,257	54,257	54,257	54,257	54,257	44,571	1,499,227
Interests payment																						
Short-term commercial loan (15%/yr)			750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	22,500
Long-term soft loan	3.0%		10,402	10,402	10,402	9,536	8,669	7,802	6,935	6,068	5,201	4,334	3,467	2,601	1,734	867						88,421
Depreciation																						
Generating equipment (5 yr - 10 yr - 10 yr)	216,360							43,272	43,272	43,272	43,272	43,272	21,636	21,636	21,636	21,636	21,636	21,636	21,636	21,636	21,636	649,080
Others (20 yr from 6th year)	303,763							15,188	15,188	15,188	15,188	15,188	15,188	15,188	15,188	15,188	15,188	15,188	15,188	15,188		303,763
Operating profit before depreciation			1,317	16,603	24,011	28,905	34,201	40,847	45,723	47,438	48,306	49,173	50,039	50,906	51,773	52,640	53,507	53,507	53,507	53,507	43,821	1,388,306
Interests received (10%)			0	0	2,007	1,894	2,276	3,244	4,994	7,421	10,263	13,477	18,893	23,144	27,906	33,231	39,175	97,264	114,381	131,417	345,713	2,702,314
Residual value upon completion of depreciation	10%											17,940						17,940			52,603	88,483
CER received			685	1,470	1,745	1,915	2,101	2,306	2,439	2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466	2,466	69,381
Net profit after depreciation			2,001	18,072	27,764	32,715	38,578	-12,063	-5,304	-1,135	2,575	24,596	34,575	39,692	45,321	51,513	58,324	134,352	133,530	150,565	422,968	3,295,642
Cash in hand			2,001	18,072	27,764	32,715	38,578	46,398	53,156	57,325	61,035	83,056	71,399	76,516	82,145	88,337	95,148	171,177	170,354	187,390	444,604	4,248,484
Accumulated cash in hand after principal repayment		0	2,001	20,074	18,942	22,760	32,443	49,945	74,205	102,634	134,774	**188,934**	231,437	279,058	332,307	391,748	486,896	1,143,812	1,314,166	1,501,556	3,901,736	
Principal repayment	346,748	0	0	0	28,896	28,896	28,896	28,896	28,896	28,896	28,896	28,896	28,896	28,896	28,896	28,896						346,748
Long-term debt balance	346,748	346,748	346,748	346,748	317,853	288,957	260,061	231,166	202,270	173,374	144,479	115,583	86,687	57,791	28,896	-0						

Community Electrication Project, Pramaoy, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A1 Principal Features of Electrification Plan

(1) Generating Equipment Planning

Items	Unit	Q'ty	Remarks
Nos. of households	h.h.	146	80% of the total 182 households
Unit nighttime domestic demand	W/hh	100	
Nighttime domestic demand	kW	14.6	
Street light demand	kW	1.5	1 light per 40 m of LV lir 75 street lights
Reserve capacity	kW	4.4	30% of nighttime domestic demand, allocated for station use + reserved power + distribution losses
Required capacity	kW	20.5	
Adopted capacity	kW	20.0	

(2) Energy Generation Planning for 8th Year Onward

Items	Monthly Unit Energy Sold	Monthly Energy Sold	Annual Energy Sold	Station Use, Losses, etc. (10%)	Annual Energy Generated	Annual Plant Factor	Annual Operation Hours	Remarks (refer to Table A2 for demand growth rates)
	kWh/hh	MWh	MWh	MWh	MWh	%	hr	
Nighttime domestic demand 1/, 2/	15.0	2.2	26.3	2.6	28.9	16.5%	1,445	100% from 8th year onward
Street light demand	1.5	0.2	2.7	0.3	3.0	1.7%	149	100% from the 1st year
Industrial demand 3/	5.0	0.7	8.8	0.9	9.6	5.5%	482	100% from 8th year onward
Irrigation pump demand 4/	0.7	0.3	1.3	0.1	1.4	0.8%	70	in 4 dry months, 100% from 8th year onward
Total energy	22.3	3.5	39.0	3.9	42.9	24.5%	2,146	100% from 8th year onward

Note:

1/ Typical consumption level of existing mini-grids in rural villages as of 2005 was 10 kWh (= 100W / 1,000 * 5hrs * 30 days * 67%) and assumed to be realized from 2nd year.

2/ Average consumption of existing REE mini-grids supplying to rural towns as of 2005 was 15 kWh（= 100 W / 1,000 * 7.5hrs * 30days * 67%）and was assumed to be realized in 7th year.

3/ Power demand of BCS, rice-mills, water supply stations, ice factory, workshop of boat engines, etc. Assumed to be 50% of the nighttime demand based on the actual demand of existing Anlong Ta Mey mini-grid (700 kWh at nighttime, 300 kWh for BCS at daytime) and potential daytime users in the villages shown in Table A3.

4/ see Table A3 for irrigation power demand.

Community Electrication Project, Pramaoy, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A2 Energy and CER Sold

			1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Annual energy sold)																					
Demand growth	Growth rate																				
Domestic		1.10	50%	67%	73%	81%	89%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Street lights		0.00	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Industrial		1.10	0%	50%	67%	73%	81%	89%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Irrigation		1.10	0%	50%	67%	73%	81%	89%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Energy sold (MWh/yr)	Demand																				
Domestic		26.3	13.1	17.5	19.3	21.2	23.3	25.7	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	751
Street lights		2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	81
Industrial		8.8	0.0	4.4	5.8	6.4	7.1	7.8	8.6	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	242
Irrigation		1.3	0.0	0.6	0.9	0.9	1.0	1.1	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	35
Total		39.0	15.8	25.2	28.7	31.3	34.1	37.3	38.8	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	1,109
Unit energy sold (kWh per household per month)																					
Domestic		15.0	**7.5**	**10.0**	11.0	12.1	13.3	14.6	**15.0**	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
Street lights		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	
Industrial		5.0	0.0	2.5	3.3	3.7	4.0	4.4	**4.9**	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Irrigation		0.7	0.0	0.4	0.5	0.5	0.6	0.6	**0.7**	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	
Total		22.3	9.0	14.4	16.4	17.8	19.5	21.3	22.1	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	
(Operating revenue from electricity sales, $)																					
	Tariff																				
Domestic		$0.40	5,256	7,008	7,709	8,480	9,328	10,260	10,512	10,512	10,512	10,512	10,512	10,512	10,512	10,512	10,512	10,512	10,512	10,512	300,329
Street lights		$0.40	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080	32,400
Industrial		$0.34	0	1,489	1,986	2,184	2,403	2,643	2,907	2,978	2,978	2,978	2,978	2,978	2,978	2,978	2,978	2,978	2,978	2,978	82,115
Irrigation		$0.34	0	217	290	319	350	385	424	434	434	434	434	434	434	434	434	434	434	434	11,975
Total			6,336	9,794	11,064	12,062	13,161	14,369	14,923	15,005	15,005	15,005	15,005	15,005	15,005	15,005	15,005	15,005	15,005	15,005	426,818
(Monthly tariff, $ per household)																					
Domestic			3.00	4.00	4.40	4.84	5.32	5.86	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	
Street lights			0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	
Industrial			0.00	0.85	1.13	1.25	1.37	1.51	1.66	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	
Irrigation			0.00	0.12	0.17	0.18	0.20	0.22	0.24	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
Total			3.62	5.59	6.32	6.88	7.51	8.20	8.52	8.56	8.56	8.56	8.56	8.56	8.56	8.56	8.56	8.56	8.56	8.56	
(Tariff receivable, $/yr)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	kg-CO_2/kWh																				
(CER saleable)	(to-CO_2)	1.3	21	33	37	41	44	48	50	51	51	51	51	51	51	51	51	51	51	51	1,441
	($/yr) 1/	**$7**	144	230	261	284	310	339	353	355	355	355	355	355	355	355	355	355	355	355	10,088
Fuel tree consumed (ton per month)			2.0	3.2	3.6	3.9	4.3	4.7	4.8	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	139
Land required to supply fuel trees (ha)			2.4	3.8	4.3	4.7	5.1	5.6	5.8	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	
Nos. of fuel tree farmers (0.2 ha per farmer)			12	19	21	23	26	28	29	29	29	29	29	29	29	29	29	29	29	29	
Payment to fuel tree farmers ($/farmer/month			3.3	3.3	3.4	3.4	3.3	3.3	3.3	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	
Total payment to fuel tree farmers ($/yr)			475	757	860	938	1,023	1,118	1,163	1,171	1,171	1,171	1,171	1,171	1,171	1,171	1,171	1,171	1,171	1,171	33,257

Ratio of tariff collected and billed= 100%

Note: 1/ Assumed at %4/ton-CO_2/yr deducting costs required for prepration of PDD, application and monitoring. CER: Certified Emission Reduction

Community Electrication Project, Pramaoy, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A3 Potential Daytime Users and Demand

No.	Demand	Diesel Consumption	Electricity Demand	Operation Hour	Unit Power Demand	Nos. of Customers	Total Demand		
		liter/month	kWh/month	hr/month	kW		kW	kWh/month	Load Factor
1	BCS	200	600	50	12.00	5	60.00	3,000	6.9%
2	Water supply	60	180	15	12.00	10	120.00	1,800	2.1%
3	Rice-mill	30	90	30	3.00	30	90.00	2,700	4.2%
4	Ice factory	30	90	30	3.00	1	3.00	90	4.2%
5	Workshop	25	75	60	1.25	1	1.25	75	8.3%
6	Café	115	345	296	1.17	1	1.17	345	41.1%
Monthly total		460	1,380	481	-	48	20.00	8,010	55.6%
Annual total		5520	16,560	5,772	-	-	20.00	**96,120**	55.6%

Source: The potential daytime users above are candidates in Kampong Kor for reference purpose.

Potential irrigation demand in the dry season

Unit land to irrigate	0.1	ha/hh
Ratio of irrigation hh	30.0%	
Total land area to irrigate	4.38	ha
Depth of irrigation	500	mm
Total irrigation water	0.022	mcm/yr
Irrigation period	4	month
Daily operation hour	8	hr/day
Total pump discharge	0.006	m^3/s
Pumping head	15.0	m
Combined efficiency	0.70	
Total power required	1	kW
Total energy required	1	MWh

Community Electrication Project, Pramaoy, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A4 Cost Estimate

(1)	**Construction Costs**	Unit Price ($)	Q'ty	Unit	Amount($)	Total ($)	%
	Power Station						
	Biomass gasification power generating equipment (FOB)	1,300	20	kW	26,000		
	Ocean freight & insurance (FOBx8%)	104	20	kW	2,080		
	Inland transportation & installation (FOB x (2%+5%))	91	20	kW	1,820		
	Switching equipment, main transformer		25	kVA	**0**		
						29,900	38.3%
	Civil and substation works						
	Road improvement works for dry season use to be further improved to all weather road in Phase 2	**24**	**0.05**	km	1,200		
	Land, powerhouse, water tank, etc. (10%FOB)	130	20	kW	2,600		
						3,800	
	Fuel tree preparation for 2nd year demand						
	Scarified seeds of Leucaena of 0.4-0.5 kg/ha and $15/kg	8	4	ha	28		
	Nursery	1	40	m^2	40		
	Watering of nursery for the first 3 months	**100**	3	month	300		
	Bush clearing	40	4	ha	151		
	Land preparation	**80**	4	ha	303		
	Transplanting	**80**	4	ha	303		
	Maintenance for initital 6 months @ $60/ha/mon	**360**	4	ha	1,363		
						2,488	
	Sub-total of power station and fuel preparation					**36,188**	46.3%
	Miscellaneous of power station (5%, consumables, gas detector, fire distinguisher, water content meter, computer set, etc.)				**1,500**		
	Power station sub-total (before tax)					37,688	48.3%
	Customs & VAT (CIF x 25%)	351	20	kW	7,020		
	Power station sub-total (including tax)					**44,708**	57.3%
	Distribution Facilities						
	MV lines	6,000		km	0		
	MV-LV lines	10,700		km	0		
	LV lines	7,100	**3.0**	km	21,300		
	Pole-mounted distribution transformers						
	15 kVA-1P	6,200		set	0		
	25 kVA-3P	7,300		set	0		
	50 kVA-3P	8,100		set	0		
	Distribution line - transformer sub-total (including tax)					21,300	27.3%
	Miscellaneous (5%, street lights, etc.)				**1,065**		
	Distribution line - transformer sub-total (including tax)					22,365	28.6%
	Service wire, etc.				7,300		9.3%
	Domestic cutomers	50	146	hh	7,300		
	Daytime customers (to be fixed individually)	0		customers	0		
	Distribution line - transformer - service wires, etc. sub-total (including tax)					**29,665**	38.0%
	Sub-total					**74,373**	
	Contingecy (5%)					**3,719**	
	Construction costs total					**78,092**	100.0%

(2)	**Costs for CEC supports**	Unit Price ($)	Q'ty	Unit	Amount($)
	Costs for CEC supports and training				**8,000**
	2.1 Facilitation for CEC setting up and management	500	4.00	MM	2,000
	2.2 Technical supports	500	4.00	MM	2,000
	2.3 Vehicles and lodging	1,000	4.00	month	4,000

(3) **Operation and maintenance costs**

Personnel costs of CEC staff	Salary ($/mon)	Nos. of person	MM	Amount($)	Total ($)
Operation Chief	$60	1	12.00	720	
Operator	$40	1	12.00	480	
Fuel preparation workers	$30	1	12.00	360	
Director and accountant	$40	2	12.00	960	
Personnel costs sub-total					**$2,520**

Maintenance costs of gasifier and engine-generator	CIF ($)	Ratio of O&M Costs	Amount ($)	Total ($)
Gasifier and engine-generator costs (CIF)	29,900			
5% of engine-generator set	9,967	5.0%	500	
Heat resistant cone of gasifier (replacement at ever 3,000 hr operation/every one year, 4-6%)	19,933	5.0%	1,000	
Replacement of lamp of street lights, office stationery and consumables			840	
Maintenance costs of powerhouse (% of powerhouse)	2,600	2.0%	50	
Maintenance costs sub-total				**2,390**
Operation and maintenance costs sub-total				**4,910**
Payment for technical supports ($/yr for 15 years from 1st year)				**480**

Items	Unit fuel cost ($/kWh)	Energy generation	unit	Fuel costs ($)
Annual fuel costs	0.03	43	MWh/yr	**1,288**
Operation, maintenance and fuel costs sub-total				**6,198**

(4) **Maintenance costs of distribution facilities**

Maintenance costs (0.5% of construction costs)	**100**

Community Electrication Project, Pramaoy, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A5 Economic Costs

Items	Foreign Currency	Local Currency	Financial Costs	Economic Costs	Remarks
	$	$	$	$	
1. Hard costs	47,270	30,822	78,092	66,188	SCF
1.1 Generating equip. excl. tax	28,080	1,820	29,900	29,718	0.90
1.2 Customs & VAT	0	7,020	7,020	0	LCF
1.3 Road and powerhouse		3,800	3,800	**1,900**	0.50 1/
1.4 Growing fuel trees	28	2,460	2,488	**1,258**	
1.5 Swichyard equip.		0	0	0	
1.6 Powerhouse miscellaneous		1,500	1,500	1,350	
1.7 Distribution lines	14,271	7,029	21,300	20,597	
1.8 Service wires, etc.	4,891	2,409	7,300	7,059	
1.9 Distri. Lines miscellaneous		1,065	1,065	959	
1.10 Contingency (5%)		3,719	3,719	3,347	
2. CEC facilitation costs	0	8,000	8,000	7,200	
Project Costs Total	47,270	38,822	86,092	73,388	
O&M	1,500	4,798	6,298	4,663	
1. Personnel costs	0	2,520	2,520	**2,106**	
2. Biomass gasifier generator	1,500	890	2,390	2,301	
3. Fuel		1,288	1,288	**206**	0.16 2/
4. Distribution lines	0	100	100	**50**	

Note: 1/ Economic conversion factor for seasonal jobless labors

Table A6 Economic Benefits

Items	Foreign Currency	Local Currency	Financial Costs	Economic Costs	Remarks
	$	$	$	$	
1. Hard costs	27,851	27,541	55,392	48,693	
1.1 Diesel generator excl. tax	13,580	1,820	15,400	15,218	770 $/kW
1.2 Customs & VAT		3,850	3,850		
1.3 Road & land preparation		1,200	1,200	**600**	
1.4 Powerhouse & fuel tank (10%)		1,540	1,540	1,386	
1.5 Swichyard equip.		0	0	0	
1.6 Powerhouse miscellaneous (5%)		1,100	1,100	990	
1.7 Distribution lines	14,271	7,029	**21,300**	20,597	
1.8 Service wires, etc.		7,300	7,300	6,570	
1.9 Distri. Lines miscellaneous		1,065	1,065	959	
1.10 Contingency (5%)		2,638	2,638	2,374	
2. CEC facilitation costs	0	8,000	8,000	7,200	
Project Costs Total	27,851	35,541	63,392	55,893	
O&M	1,042	12,750	13,791	12,476	
1. Personnel costs	0	2,160	2,160	1,944	
2. Diesel generator	1,042	618	1,660	1,598	5%
3. Fuel	0	9,871	9,871	8,884	0.23 $/kWh
4. Distribution lines	0	100	100	**50**	

Adjsutment for Kampong Kor diesel power station

1. Road powerhouse	24	**0.05**	km	1,200
2. Embankment of station yard	0	2,000	m^2	0
3. Land acquisition	0	2,000	m^2	0

Community Electrication Project, Pramaoy, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A7 Unit Costs of Electricity

Items	with tax ($)	with tax exemption and subsidy ($)
1. Capital Costs	86,092	59,304
2. CEC facilitation costs	8,000	8,000
3. Total construction costs excluding design, testing, etc.		**67,304**
Interest rate	3.0%	
Repayment period	10 yr	
CRF (3.0%, 10 yr) =	0.1172	
4. Annual costs excluding design, etc.	10,093	7,890
5. O&M costs in 10th year	6,694	6,694
5.1 O&M	4,910	4,910
5.2 Fuel costs	1,288	1,288
5.3 EAC license fee	16	16
5.4 Yearly monitoring fee by DIME	480	480
6. Annual total costs	16,786	14,584
7. Annual energy sales from 7th year (MWh)	39.0	39.0
8. Unit cost of electricity from 7th year ($/kWh)	**0.430**	**0.374**
9. NPV of energy sold	MWh	707
10. NPV of finacial costs excluding tax	$	237,259
11. Average cost of electricity	$/kWh	**0.336**

Table A8 Tariff Setting

Items	$	Riel
Unit cost of electricity from 7th year ($/kWh)	**0.336**	1,342
Rate of reserve for operational risks (12%)	0.040	161
Average tariff ($/kWh)	**$0.376**	1,504
Tariff adopted for nighttime demand	**$0.400**	**1,600**
Tariff adopted for street lights	**$0.400**	**1,600**
Tariff adopted for industrial demand	**$0.340**	**1,360**
Tariff adopted for irrigation demand	**$0.340**	**1,360**
Monthly revenue (US$/mon)	$1,250	
from nighttime users	$876	
for street lights	$90	
from industrial users	$248	
from irrigation pump users	$36	
Average monthly tariff @ 15 kWh per HH ($)	$6.00	24,000
Tariff for street lights	$0.62	2,500
Total @ 15 kWh/hh including street lights	**$6.62**	26,500
Average monthly tariff @ 10 kWh per HH ($) including street lights	**$4.62**	**18,500**
Tariff of poor household ($/mon/hh) @ 40 W x 4h x 30 days = 4.8 kWh/month + street lights	$2.54	10,100
Tariff of poorest household (US$/mon/hh) @ 7 W x 4h x 30 days = 0.84 kWh/mon + street	$0.95	3,800
	Monthly Costs	
ATP for monthly tariff	$	Riel
Diesel oil lamp (100%)	$1.46	5,844
Battery lighting (70%, incl. Riel 4,000 per month for battery purchase)	$3.12	12,470
Total	**$4.58**	18,314

Community Electrication Project, Pramaoy, Phase 1, soft loan @ 3% - 15 yr including 3-yr gr

Table 1 Adopted Conditions for Economic and Finacial Analyses

1. Energy sold — See attached Table A2

2. Tariff — See attached Table A7

3. Long-term borrowing from GOC
   - 3% per year
   - 25 years repayment period including 5 years' grace

4. Short-term borrowing from commercial bank
   - 10% per year
   - revolving every year

5. Depreciation
   - Ratio of depreciation 90%
   - Ratio of residual value 10%

   Generating equipment
   - 5 years' grace and 5 years' depreciation for the first 10 years
   - 10 years' depreciation from 11th year onward

   Distribution lines, service wires, etc.
   - 5 years' grace and 20 years' depreciation

6. Interest earning
   - Interest of saving deposit at 10% per year

Community Electrication Project, Pramaoy, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 2 Financial Analysis

(unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Expenditure)																				
Initital costs																				
Construction costs excluding tax	71,072											29,900				29,900				130,872
Supports to CEC	6,000	2,000																		
Operation and maintenance costs		4,599	5,489	5,813	6,059	6,330	6,627	6,771	6,794	6,794	6,794	6,794	6,794	6,794	6,794	6,794	6,794	6,794	6,794	197,942
Personnel costs		2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	75,600
O&M of biomass gasification power plant		970	1,546	1,756	1,915	2,090	2,282	2,375	2,390	2,390	2,390	2,390	2,390	2,390	2,390	2,390	2,390	2,390	2,390	67,904
Maintenance of distribution lines, etc.		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	3,000
Biomass fuel cost		523	833	946	1,032	1,126	1,230	1,280	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	36,594
EAC license fee @ Riel 1.6/kWh		6	10	11	13	14	15	16	16	16	16	16	16	16	16	16	16	16	16	443
Payment for technical supports		480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	14,400
Total expenditure	77,072	6,599	5,489	5,813	6,059	6,330	6,627	6,771	6,794	6,794	6,794	36,694	6,794	6,794	6,794	36,694	6,794	6,794	6,794	336,814
(Revenue)																				
Operating revenue through electricity sales		6,336	9,794	11,064	12,062	13,161	14,369	14,923	15,005	15,005	15,005	15,005	15,005	15,005	15,005	15,005	15,005	15,005	15,005	426,818
Sales of CER		144	230	261	284	310	339	353	355	355	355	355	355	355	355	355	355	355	355	10,088
Residual value of equipment											2,990				2,990				7,809	
Total revenue		6,480	10,024	11,325	12,347	13,471	14,708	15,276	15,360	15,360	18,350	15,360	15,360	15,360	18,350	15,360	15,360	15,360	23,169	450,695
(Net operating income)	-77,072	-119	4,535	5,511	6,288	7,141	8,081	8,505	8,566	8,566	11,556	-21,334	8,566	8,566	11,556	-21,334	8,566	8,566	16,375	113,881
FIRR	**6.3%**																			

Community Electrication Project, Pramaoy, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 2 Financial Analysis

Including taxes, excluding CER sales (unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Expenditure)																				
Initital costs																				
Construction costs	78,092											29,900				29,900				137,892
Supports to CEC	6,000	2,000																		
Operation and maintenance costs		4,599	5,489	5,813	6,059	6,330	6,627	6,771	6,794	6,794	6,794	6,794	6,794	6,794	6,794	6,794	6,794	6,794	6,794	197,942
Personnel costs		2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	75,600
O&M of biomass gasification power plant		970	1,546	1,756	1,915	2,090	2,282	2,375	2,390	2,390	2,390	2,390	2,390	2,390	2,390	2,390	2,390	2,390	2,390	67,904
Maintenance of distribution lines, etc.		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	3,000
Biomass fuel cost		523	833	946	1,032	1,126	1,230	1,280	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	36,594
EAC license fee @ Riel 1.6/kWh		6	10	11	13	14	15	16	16	16	16	16	16	16	16	16	16	16	16	443
Payment for technical supports		480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	14,400
Total expenditure	84,092	6,599	5,489	5,813	6,059	6,330	6,627	6,771	6,794	6,794	6,794	36,694	6,794	6,794	6,794	36,694	6,794	6,794	6,794	343,834
(Revenue)																				
Operating revenue through electricity sales		6,336	9,794	11,064	12,062	13,161	14,369	14,923	15,005	15,005	15,005	15,005	15,005	15,005	15,005	15,005	15,005	15,005	15,005	426,818
Sales of CER																				0
Residual value of equipment											2,990				2,990				7,809	
Total revenue		6,336	9,794	11,064	12,062	13,161	14,369	14,923	15,005	15,005	17,995	15,005	15,005	15,005	17,995	15,005	15,005	15,005	22,814	440,607
(Net operating income)	-84,092	-263	4,305	5,251	6,003	6,831	7,742	8,152	8,211	8,211	11,201	-21,689	8,211	8,211	11,201	-21,689	8,211	8,211	16,020	96,774
FIRR	**5.1%**																			

Community Electrication Project, Pramaoy, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 2 Financial Analysis

Excluding taxes and subsidy from costs, and including CER sales (unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Expenditure)																				
Initital costs																				
Construction costs	51,304											29,900				29,900				111,104
Supports to CEC	6,000	2,000																		
Operation and maintenance costs		4,599	5,489	5,813	6,059	6,330	6,627	6,771	6,794	6,794	6,794	6,794	6,794	6,794	6,794	6,794	6,794	6,794	6,794	197,942
Personnel costs		2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	75,600
O&M of biomass gasification power plant		970	1,546	1,756	1,915	2,090	2,282	2,375	2,390	2,390	2,390	2,390	2,390	2,390	2,390	2,390	2,390	2,390	2,390	67,904
Maintenance of distribution lines, etc.		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	3,000
Biomass fuel cost		523	833	946	1,032	1,126	1,230	1,280	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	36,594
EAC license fee @ Riel 1.6/kWh		6	10	11	13	14	15	16	16	16	16	16	16	16	16	16	16	16	16	443
Payment for technical supports		480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	14,400
Total expenditure	57,304	6,599	5,489	5,813	6,059	6,330	6,627	6,771	6,794	6,794	6,794	36,694	6,794	6,794	6,794	36,694	6,794	6,794	6,794	317,046
(Revenue)																				
Operating revenue through electricity sales		6,336	9,794	11,064	12,062	13,161	14,369	14,923	15,005	15,005	15,005	15,005	15,005	15,005	15,005	15,005	15,005	15,005	15,005	426,818
Sales of CER		144	230	261	284	310	339	353	355	355	355	355	355	355	355	355	355	355	355	10,088
Residual value of equipment											2,990				2,990				7,809	
Total revenue		6,480	10,024	11,325	12,347	13,471	14,708	15,276	15,360	15,360	18,350	15,360	15,360	15,360	18,350	15,360	15,360	15,360	23,169	450,695
(Net operating income)	-57,304	-119	4,535	5,511	6,288	7,141	8,081	8,505	8,566	8,566	11,556	-21,334	8,566	8,566	11,556	-21,334	8,566	8,566	16,375	133,649
FIRR	**9.0%**																			

Community Electrication Project, Pramaoy, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 3 Economic Evaluation

(unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Economic costs)																				
Initital costs																				
Economic costs	66,188											29,718				29,718				125,624
Supports to CEC	5,400	1,800																		
Operation and maintenance costs	0	3,336	3,940	4,160	4,327	4,510	4,712	4,810	4,825	4,825	4,825	4,825	4,825	4,825	4,825	4,825	4,825	4,825	4,825	
Personenel costs		2,268	2,268	2,268	2,268	2,268	2,268	2,268	2,268	2,268	2,268	2,268	2,268	2,268	2,268	2,268	2,268	2,268	2,268	68,040
O&M of biomass gasification power plant		934	1,488	1,690	1,844	2,012	2,197	2,287	2,301	2,301	2,301	2,301	2,301	2,301	2,301	2,301	2,301	2,301	2,301	65,375
Maintenance of distribution lines, etc.		50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	1,500
Biomass fuel cost		84	133	151	165	180	197	205	206	206	206	206	206	206	206	206	206	206	206	5,855
EAC license fee @ Riel 1.6/kWh		6	9	10	11	12	13	14	14	14	14	14	14	14	14	14	14	14	14	399
Monitoring of CEC by DIME		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual value											-2,972				-2,972				-6,619	-12,562
Total expenditure	71,588	5,142	3,949	4,170	4,338	4,522	4,725	4,824	4,839	4,839	1,867	34,557	4,839	4,839	1,867	34,557	4,839	4,839	-1,780	261,431
(Economic benefits as costs of alternative diesel mini-grid)																				
Initital costs																				
Economic costs	48,693											15,218				15,218				79,129
Supports to CEC	5,400	1,800																		
Operation and maintenance costs	0	6,250	8,775	9,695	10,392	11,160	12,004	12,412	12,476	12,476	12,476	12,476	12,476	12,476	12,476	12,476	12,476	12,476	12,476	
Personenel costs		1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944	58,320
O&M of diesel power plant		649	1,034	1,174	1,280	1,397	1,526	1,588	1,598	1,598	1,598	1,598	1,598	1,598	1,598	1,598	1,598	1,598	1,598	45,407
Maintenance of distribution lines, etc.		50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	1,500
Fuel cost		3,607	5,747	6,527	7,118	7,768	8,484	8,830	8,884	8,884	8,884	8,884	8,884	8,884	8,884	8,884	8,884	8,884	8,884	252,418
EAC license fee		6	9	10	11	12	13	14	14	14	14	14	14	14	14	14	14	14	14	399
Payment for technical supports		432	432	432	432	432	432	432	432	432	432	432	432	432	432	432	432	432	432	12,960
Residual value											-1,522				-1,522				-4,869	-7,913
Benefits from CER sales		144	230	261	284	310	339	353	355	355	355	355	355	355	355	355	355	355	355	10,088
Total benefits	54,093	8,631	9,445	10,398	11,120	11,914	12,788	13,211	13,278	13,278	11,756	28,496	13,278	13,278	11,756	28,496	13,278	13,278	8,408	459,509
(Net benefits)	-17,495	3,490	5,497	6,228	6,782	7,392	8,063	8,387	8,438	8,438	9,888	-6,062	8,438	8,438	9,888	-6,062	8,438	8,438	10,188	198,077

EIRR **33.5%**

Community Electrication Project, Pramaoy, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 4 Financing Plan

(unit: $)

Financial Resources			Financial Application	
Equity - CEC			**Power Plant before tax**	**37,688**
Cash (@ $50/hh)	7,300	9.2%	Biomass gasification power equipment	29,900
In kind (@ $40/MM)	4,561	5.8%	Road improvement works	1,200
114 MM			Powerhouse, etc.	2,600
Grant			Switching equip. & transformer	0
REF	19,768	25.0%	Growing fuel trees	2,488
(25% of capital costs)			Misecellaneous equipment	1,500
Borrowing for capitals			**Distribution facilities, service wires, etc.**	29,665
Long-term	47,443	60.0%		
(15 yr including 3-year grace, 3%/yr)			Contingecy	3,719
			Capital costs before tax	71,072
Total fund for capital costs and CEC supports	79,072	100.0%	**CEC support**	8,000
Borrowing for operation	2,000		**Operation fund in hand**	2,000
Short-term				
(Revolving, 15%/yr)				
Tax exemption	7,020		**Customs and tax**	7,020
Total Financial Resources	**88,092**		**Total Financial Resources**	**88,092**

Community Electrication Project, Pramaoy, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 5 Profit and Loss Statement with Cash Flow, 15-yr repayment period

(unit: $)

		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	20	21	22	30	Total
Operating revenue incl. CER & residual value			6,336	9,794	11,064	12,062	13,161	14,369	14,923	15,005	15,005	15,005	15,005	15,005	15,005	15,005	15,005	15,005	15,005	15,005	15,005	426,818
Operating costs			4,599	5,489	5,813	6,059	6,330	6,627	6,771	6,794	6,794	6,794	6,794	6,794	6,794	6,794	6,794	6,794	6,794	6,794	6,794	197,942
new land required for tree plantation					0.5	0.4	0.4	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1
tree plantation costs for increasing demand				338	256	282	310	150	24	0	0	0	0	0	0	0	0	0	0	0	1,358	2,717
Gross profit			1,737	3,968	4,994	5,721	6,521	7,591	8,128	8,211	8,211	8,211	8,211	8,211	8,211	8,211	8,211	8,211	8,211	8,211	6,853	226,158
Interests payment																						
Short-term commercial loan (15%/yr)			300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	9,000
Long-term soft loan	3.0%		1,423	1,423	1,423	1,305	1,186	1,067	949	830	712	593	474	356	237	119						12,098
Depreciation																						
Generating equipment (5 yr - 10 yr - 10 yr)	26,910							5,382	5,382	5,382	5,382	5,382	2,691	2,691	2,691	2,691	2,691	2,691	2,691	2,691	2,691	80,730
Others (20 yr from 6th year)	44,255							2,213	2,213	2,213	2,213	2,213	2,213	2,213	2,213	2,213	2,213	2,213	2,213	2,213		44,255
Operating profit before depreciation			13	2,244	3,271	4,117	5,035	6,224	6,879	7,081	7,199	7,318	7,437	7,555	7,674	7,793	7,911	7,911	7,911	7,911	6,553	205,060
Interests received (10%)			0	0	263	247	317	488	797	1,205	1,674	2,201	3,092	3,785	4,559	5,423	6,384	15,329	17,987	20,612	53,638	423,240
Residual value upon completion of depreciation	10%											2,990						2,990			7,809	13,789
CER received			144	230	261	284	310	339	353	355	355	355	355	355	355	355	355	355	355	355	355	10,088
Net profit after depreciation			157	2,474	3,795	4,648	5,662	-544	435	1,046	1,633	5,269	5,980	6,792	7,684	8,667	9,747	21,681	21,350	23,975	65,664	527,192
Cash in hand			157	2,474	3,795	4,648	5,662	7,050	8,030	8,641	9,228	12,864	10,884	11,695	12,588	13,570	14,651	26,585	26,253	28,879	68,355	652,176
Accumulated cash in hand after principal repayment		0	157	2,631	2,472	3,167	4,875	7,972	12,048	16,735	22,010	**30,920**	37,850	45,592	54,227	63,844	78,494	179,872	206,125	235,004	604,733	
Principal repayment	47,443	0	0	0	3,954	3,954	3,954	3,954	3,954	3,954	3,954	3,954	3,954	3,954	3,954	3,954						47,443
Long-term debt balance	47,443	47,443	47,443	47,443	43,490	39,536	35,582	31,629	27,675	23,722	19,768	15,814	11,861	7,907	3,954	0						

Community Electrication Project, Samraong, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A1 Principal Features of Electrification Plan

(1) Generating Equipment Planning

Items	Unit	Q'ty	Remarks
Nos. of households	h.h.	470	31% of the total 1,536 households
Unit nighttime domestic demand	W/hh	100	
Nighttime domestic demand	kW	47.0	
Street light demand	kW	1.3	1 light per 40 m of LV lir 63 street lights
Reserve capacity	kW	14.1	30% of nighttime domestic demand, allocated for station use + reserved power + distribution losses
Required capacity	kW	62.4	
Adopted capacity	kW	64.0	

(2) Energy Generation Planning for 8th Year Onward

Items	Monthly Unit Energy Sold	Monthly Energy Sold	Annual Energy Sold	Station Use, Losses, etc. (10%)	Annual Energy Generated	Annual Plant Factor	Annual Operation Hours	Remarks (refer to Table A2 for demand growth rates)
	kWh/hh	MWh	MWh	MWh	MWh	%	hr	
Nighttime domestic demand 1/, 2/	15.0	7.1	84.6	8.5	93.1	16.6%	1,454	100% from 8th year onward
Street light demand	0.4	0.2	2.3	0.2	2.5	0.4%	39	100% from the 1st year
Industrial demand 3/	7.5	3.5	42.3	4.2	46.5	8.3%	727	100% from 8th year onward
Irrigation pump demand 4/	2.4	3.4	13.7	1.4	15.1	2.7%	236	in 4 dry months, 100% from 8th year onward
Total energy	25.3	14.2	142.9	14.3	157.2	28.0%	2,456	100% from 8th year onward

Note:

1/ Typical consumption level of existing mini-grids in rural villages as of 2005 was 10 kWh (= 100W / 1,000 * 5hrs * 30 days * 67%) and assumed to be realized from 2nd year.

2/ Average consumption of existing REE mini-grids supplying to rural towns as of 2005 was 15 kWh（= 100 W / 1,000 * 7.5hrs * 30days * 67%）and was assumed to be realized in 7th year.

3/ Power demand of BCS, rice-mills, water supply stations, ice factory, workshop of boat engines, etc. Assumed to be 50% of the nighttime demand based on the actual demand of existing Anlong Ta Mey mini-grid (700 kWh at nighttime, 300 kWh for BCS at daytime) and potential daytime users in the villages shown in Table A3.

4/ see Table A3 for irrigation power demand.

Community Electrication Project, Samraong, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A2 Energy and CER Sold

			1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Annual energy sold)																					
Demand growth	Growth rate																				
Domestic		1.10	50%	67%	73%	81%	89%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Street lights		0.00	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Industrial		1.10	0%	50%	67%	73%	81%	89%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Irrigation		1.10	0%	50%	67%	73%	81%	89%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Energy sold (MWh/yr)	Demand																				
Domestic		84.6	42.3	56.4	62.0	68.2	75.1	82.6	84.6	84.6	84.6	84.6	84.6	84.6	84.6	84.6	84.6	84.6	84.6	84.6	2,417
Street lights		2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	68
Industrial		42.3	0.0	21.2	28.2	31.0	34.1	37.5	41.3	42.3	42.3	42.3	42.3	42.3	42.3	42.3	42.3	42.3	42.3	42.3	1,166
Irrigation		13.7	0.0	6.9	9.1	10.1	11.1	12.2	13.4	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	378
Total		142.9	44.6	86.7	101.6	111.6	122.5	134.5	141.5	142.9	142.9	142.9	142.9	142.9	142.9	142.9	142.9	142.9	142.9	142.9	4,029
Unit energy sold (kWh per household per month)																					
Domestic		15.0	**7.5**	**10.0**	11.0	12.1	13.3	14.6	**15.0**	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
Street lights		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	
Industrial		7.5	0.0	3.8	5.0	5.5	6.1	6.7	**7.3**	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	
Irrigation		2.4	0.0	1.2	1.6	1.8	2.0	2.2	**2.4**	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	
Total		25.3	7.9	15.4	18.0	19.8	21.7	23.9	25.1	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	
(Operating revenue from electricity sales, $)																					
	Tariff																				
Domestic		$0.27	11,421	15,228	16,751	18,426	20,268	22,295	22,842	22,842	22,842	22,842	22,842	22,842	22,842	22,842	22,842	22,842	22,842	22,842	652,597
Street lights		$0.27	612	612	612	612	612	612	612	612	612	612	612	612	612	612	612	612	612	612	18,371
Industrial		$0.25	0	5,288	7,050	7,755	8,531	9,384	10,322	10,575	10,575	10,575	10,575	10,575	10,575	10,575	10,575	10,575	10,575	10,575	291,553
Irrigation		$0.25	0	1,714	2,285	2,513	2,765	3,041	3,345	3,427	3,427	3,427	3,427	3,427	3,427	3,427	3,427	3,427	3,427	3,427	94,485
Total			12,033	22,841	26,698	29,306	32,176	35,332	37,121	37,456	37,456	37,456	37,456	37,456	37,456	37,456	37,456	37,456	37,456	37,456	1,057,007
(Monthly tariff, $ per household)																					
Domestic			2.03	2.70	2.97	3.27	3.59	3.95	4.05	4.05	4.05	4.05	4.05	4.05	4.05	4.05	4.05	4.05	4.05	4.05	
Street lights			0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	
Industrial			0.00	0.94	1.25	1.38	1.51	1.66	1.83	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	
Irrigation			0.00	0.30	0.41	0.45	0.49	0.54	0.59	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	
Total			2.13	4.05	4.73	5.20	5.70	6.26	6.58	6.64	6.64	6.64	6.64	6.64	6.64	6.64	6.64	6.64	6.64	6.64	
(Tariff receivable, $/yr)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	kg-CO_2/kWh																				
(CER saleable)	(to-CO_2)	1.3	58	113	132	145	159	175	184	186	186	186	186	186	186	186	186	186	186	186	5,238
	($/yr) 1/	**$7**	406	789	925	1,015	1,115	1,224	1,288	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	36,666
Fuel tree consumed (ton per month)			5.6	10.8	12.7	13.9	15.3	16.8	17.7	17.9	17.9	17.9	17.9	17.9	17.9	17.9	17.9	17.9	17.9	17.9	504
Land required to supply fuel trees (ha)			6.7	13.0	15.2	16.7	18.4	20.2	21.2	21.4	21.4	21.4	21.4	21.4	21.4	21.4	21.4	21.4	21.4	21.4	
Nos. of fuel tree farmers (0.2 ha per farmer)			33	65	76	84	92	101	106	107	107	107	107	107	107	107	107	107	107	107	
Payment to fuel tree farmers ($/farmer/month			3.4	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	
Total payment to fuel tree farmers ($/yr)			1,337	2,600	3,049	3,348	3,675	4,036	4,246	4,286	4,286	4,286	4,286	4,286	4,286	4,286	4,286	4,286	4,286	4,286	120,877

Ratio of tariff collected and billed= 100%

Note: 1/ Assumed at %4/ton-CO_2/yr deducting costs required for prepration of PDD, application and monitoring.

Community Electrication Project, Samraong, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A3 Potential Daytime Users and Demand

No.	Demand	Diesel Consumption	Electricity Demand	Operation Hour	Unit Power Demand	Nos. of Customers	Total Demand		
		liter/month	kWh/month	hr/month	kW		kW	kWh/month	Load Factor
1	BCS	200	600	50	12.00	5	60.00	3,000	6.9%
2	Water supply	60	180	15	12.00	10	120.00	1,800	2.1%
3	Rice-mill	30	90	30	3.00	30	90.00	2,700	4.2%
4	Ice factory	30	90	30	3.00	1	3.00	90	4.2%
5	Workshop	25	75	60	1.25	1	1.25	75	8.3%
6	Café	115	345	296	1.17	1	1.17	345	41.1%
Monthly total		460	1,380	481	-	48	64.00	8,010	17.4%
Annual total		5520	16,560	5,772	-	-	64.00	**96,120**	17.4%

Source: The potential daytime users above are candidates in Kampong Kor for reference purpose.

Potential irrigation demand in the dry season

Unit land to irrigate	0.2	ha/hh
Ratio of irrigation hh	50.0%	
Total land area to irrigate	47	ha
Depth of irrigation	500	mm
Total irrigation water	0.235	mcm/yr
Irrigation period	4	month
Daily operation hour	8	hr/day
Total pump discharge	0.068	m^3/s
Pumping head	15.0	m
Combined efficiency	0.70	
Total power required	14	kW
Total energy required	14	MWh

Community Electrication Project, Samraong, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A4 Cost Estimate

(1)	**Construction Costs**	Unit Price ($)	Q'ty	Unit	Amount($)	Total ($)	%シェア
	Power Station						
	Biomass gasification power generating equipment (FOB)	1,300	64	kW	83,200		
	Ocean freight & insurance (FOBx8%)	104	64	kW	6,656		
	Inland transportation & installation (FOB x (2%+5%))	91	64	kW	5,824		
	Switching equipment, main transformer		80	kVA			
						95,680	49.0%
	Civil and substation works						
	Road improvement works for dry season use to be further improved to all weather road in Phase 2	**24**	**0.20**	km	4,800		
	Land, powerhouse, water tank, etc. (10%FOB)	130	64	kW	8,320		
						13,120	
	Fuel tree preparation for 2nd year demand						
	Scarified seeds of Leucaena of 0.4-0.5 kg/ha and $15/kg	8	13	ha	98		
	Nursery	1	130	m^2	130		
	Watering of nursery for the first 3 months	**100**	3	month	300		
	Bush clearing	40	13	ha	520		
	Land preparation	**80**	13	ha	1,040		
	Transplanting	**80**	13	ha	1,040		
	Maintenance for initital 6 months @ $60/ha/mon	**360**	13	ha	4,680		
						7,808	
	Sub-total of power station and fuel preparation					**116,608**	59.7%
	Miscellaneous of power station (5%, consumables, gas detector, fire distinguisher, water content meter, computer set, etc.)				**4,800**		
	Power station sub-total (before tax)					121,408	62.2%
	Customs & VAT (CIF x 25%)	351	64	kW	22,464		
	Power station sub-total (including tax)					**143,872**	73.7%
	Distribution Facilities						
	MV lines	6,000		km	0		
	MV-LV lines	10,700		km	0		
	LV lines	7,100	**2.5**	km	17,750		
	Pole-mounted distribution transformers						
	15 kVA-1P	6,200		set	0		
	25 kVA-3P	7,300		set	0		
	50 kVA-3P	8,100		set	0		
	Distribution line - transformer sub-total (including tax)					17,750	9.1%
	Miscellaneous (5%, street lights, etc.)				**888**		
	Distribution line - transformer sub-total (including tax)					18,638	9.5%
	Service wire, etc.				23,500		12.0%
	Domestic cutomers	50	470	hh	23,500		
	Daytime customers (to be fixed individually)	0		customers	0		
	Distribution line - transformer - service wires, etc. sub-total (including tax)					**42,138**	21.6%
	Sub-total					**186,010**	
	Contingecy (5%)					**9,301**	
	Construction costs total					**195,311**	100.0%

(2)	**Costs for CEC supports**	Unit Price ($)	Q'ty	Unit	Amount($)
	Costs for CEC supports and training				**24,000**
	2.1 Facilitation for CEC setting up and management	500	12.00	MM	6,000
	2.2 Technical supports	500	12.00	MM	6,000
	2.3 Vehicles and lodging	1,000	12.00	month	12,000

(3) **Operation and maintenance costs**

Personnel costs of CEC staff	Salary ($/mon)	Nos. of person	MM	Amount($)	Total ($)
Operation Chief	$80	1	12.00	960	
Operator	$40	2	12.00	960	
Fuel preparation workers	$30	1	12.00	360	
Director and accountant	$40	2	12.00	960	
Personnel costs sub-total					**$3,240**

Maintenance costs of gasifier and engine-generator	CIF ($)	Ratio of O&M Costs	Amount ($)	Total ($)
Gasifier and engine-generator costs (CIF)	95,680			
5% of engine-generator set	31,893	5.0%	1,590	
Heat resistant cone of gasifier (replacement at ever 3,000 hr operation/every one year, 4-6%)	63,787	5.0%	3,190	
Replacement of lamp of street lights, office stationery and consumables			1,080	
Maintenance costs of powerhouse (% of powerhouse)	8,320	2.0%	170	
Maintenance costs sub-total				**6,030**
Operation and maintenance costs sub-total				**9,270**
Payment for technical supports ($/yr for 15 years from 1st year)				**1,550**

Items	Unit fuel cost ($/kWh)	Energy generation	unit	Fuel costs ($)
Annual fuel costs	0.03	157	MWh/yr	**4,715**
Operation, maintenance and fuel costs sub-total				**13,985**

(4) **Maintenance costs of distribution facilities**

Maintenance costs (0.5% of construction costs)	**100**

Community Electrication Project, Samraong, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A5 Economic Costs

Items	Foreign Currency	Local Currency	Financial Costs	Economic Costs	Remarks
	$	$	$	$	
1. Hard costs	117,592	77,720	195,311	158,989	SCF
1.1 Generating equip. excl. tax	89,856	5,824	95,680	95,098	0.90
1.2 Customs & VAT	0	22,464	22,464	0	LCF
1.3 Road and powerhouse		13,120	13,120	**6,560**	0.50 1/
1.4 Growing fuel trees	98	7,710	7,808	**3,953**	
1.5 Swichyard equip.		0	0	0	
1.6 Powerhouse miscellaneous		4,800	4,800	4,320	
1.7 Distribution lines	11,893	5,858	17,750	17,164	
1.8 Service wires, etc.	15,745	7,755	23,500	22,725	
1.9 Distri. Lines miscellaneous		888	888	799	
1.10 Contingency (5%)		9,301	9,301	8,371	
2. CEC facilitation costs	0	24,000	24,000	21,600	
Project Costs Total	117,592	101,720	219,311	180,589	
O&M	4,780	9,305	14,085	9,463	
1. Personnel costs	0	3,240	3,240	**2,754**	
2. Biomass gasifier generator	4,780	1,250	6,030	5,905	
3. Fuel		4,715	4,715	**754**	0.16 2/
4. Distribution lines	0	100	100	**50**	

Note: 1/ Economic conversion factor for seasonal jobless labors

Table A6 Economic Benefits

Items	Foreign Currency	Local Currency	Financial Costs	Economic Costs	Remarks
	$	$	$	$	
1. Hard costs	55,349	67,536	122,884	103,122	
1.1 Diesel generator excl. tax	43,456	5,824	49,280	48,698	770 $/kW
1.2 Customs & VAT		12,320	12,320		
1.3 Road & land preparation		4,800	4,800	**2,400**	
1.4 Powerhouse & fuel tank (10%)		4,928	4,928	4,435	
1.5 Swichyard equip.		0	0	0	
1.6 Powerhouse miscellaneous (5%)		3,566	3,566	3,210	
1.7 Distribution lines	11,893	5,858	**17,750**	17,164	
1.8 Service wires, etc.		23,500	23,500	21,150	
1.9 Distri. Lines miscellaneous		888	888	799	
1.10 Contingency (5%)		5,852	5,852	5,266	
2. CEC facilitation costs	0	24,000	24,000	21,600	
Project Costs Total	55,349	91,536	146,884	124,722	
O&M	2,944	39,898	42,842	38,812	
1. Personnel costs	0	2,880	2,880	2,592	
2. Diesel generator	2,944	770	3,714	3,637	5%
3. Fuel	0	36,148	36,148	32,533	0.23 $/kWh
4. Distribution lines	0	100	100	**50**	

Adjsutment for Kampong Kor diesel power station

1. Road powerhouse	24	**0.20**	km	4,800
2. Embankment of station yard	0	2,000	m^2	0
3. Land acquisition	0	2,000	m^2	0

Community Electrication Project, Samraong, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table A7 Unit Costs of Electricity

Items	with tax ($)	with tax exemption and subsidy ($)
1. Capital Costs	219,311	147,635
2. CEC facilitation costs	24,000	24,000
3. Total construction costs excluding design, testing, etc.		**171,635**
Interest rate	3.0%	
Repayment period	10 yr	
CRF (3.0%, 10 yr) =	0.1172	
4. Annual costs excluding design, etc.	25,710	20,121
5. O&M costs in 10th year	15,592	15,592
5.1 O&M	9,270	9,270
5.2 Fuel costs	4,715	4,715
5.3 EAC license fee	57	57
5.4 Yearly monitoring fee by DIME	1,550	1,550
6. Annual total costs	41,302	35,713
7. Annual energy sales from 7th year (MWh)	142.9	142.9
8. Unit cost of electricity from 7th year ($/kWh)	**0.289**	**0.250**
9. NPV of energy sold	MWh	2,561
10. NPV of finacial costs excluding tax	$	589,015
11. Average cost of electricity	$/kWh	**0.230**

Table A8 Tariff Setting

Items	$	Riel
Unit cost of electricity from 7th year ($/kWh)	**0.230**	920
Rate of reserve for operational risks (12%)	0.028	110
Average tariff ($/kWh)	**$0.258**	1,032
Tariff adopted for nighttime demand	**$0.270**	**1,080**
Tariff adopted for street lights	**$0.270**	**1,080**
Tariff adopted for industrial demand	**$0.250**	**1,000**
Tariff adopted for irrigation demand	**$0.250**	**1,000**
Monthly revenue (US$/mon)	$3,121	
from nighttime users	$1,904	
for street lights	$51	
from industrial users	$881	
from irrigation pump users	$286	
Average monthly tariff @ 15 kWh per HH ($)	$4.05	16,200
Tariff for street lights	$0.11	400
Total @ 15 kWh/hh including street lights	**$4.16**	16,600
Average monthly tariff @ 10 kWh per HH ($) including street lights	**$2.81**	**11,200**
Tariff of poor household ($/mon/hh) @ 40 W x 4h x 30 days = 4.8 kWh/month + street lights	$1.40	5,600
Tariff of poorest household (US$/mon/hh) @ 7 W x 4h x 30 days = 0.84 kWh/mon + street	$0.34	1,300
	Monthly Costs	
ATP for monthly tariff	$	Riel
Diesel oil lamp (100%)	$1.46	5,844
Battery lighting (70%, incl. Riel 4,000 per month for battery purchase)	$3.12	12,470
Total	**$4.58**	18,314

Community Electrication Project, Samraong, Phase 1, soft loan @ 3% - 15 yr including 3-yr g

Table 1 Adopted Conditions for Economic and Finacial Analyses

1. Energy sold — See attached Table A2

2. Tariff — See attached Table A7

3. Long-term borrowing from GOC
   - 3% per year
   - 25 years repayment period including 5 years' grace

4. Short-term borrowing from commercial bank
   - 10% per year
   - revolving every year

5. Depreciation
   - Ratio of depreciation 90%
   - Ratio of residual value 10%

   Generating equipment
   - 5 years' grace and 5 years' depreciation for the first 10 years
   - 10 years' depreciation from 11th year onward

   Distribution lines, service wires, etc.
   - 5 years' grace and 20 years' depreciation

6. Interest earning
   - Interest of saving deposit at 10% per year

Community Electrication Project, Samraong, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 2 Financial Analysis

(unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Expenditure)																				
Initital costs																				
Construction costs excluding tax	172,847											95,680				95,680				364,207
Supports to CEC	18,000	6,000																		
Operation and maintenance costs		8,260	11,443	12,575	13,326	14,153	15,062	15,591	15,692	15,692	15,692	15,692	15,692	15,692	15,692	15,692	15,692	15,692	15,692	451,329
Personnel costs		3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	97,200
O&M of biomass gasification power plant		1,881	3,658	4,290	4,709	5,171	5,678	5,973	6,030	6,030	6,030	6,030	6,030	6,030	6,030	6,030	6,030	6,030	6,030	170,051
Maintenance of distribution lines, etc.		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	3,000
Biomass fuel cost		1,471	2,860	3,354	3,682	4,043	4,440	4,671	4,715	4,715	4,715	4,715	4,715	4,715	4,715	4,715	4,715	4,715	4,715	132,967
EAC license fee @ Riel 1.6/kWh		18	35	41	45	49	54	57	57	57	57	57	57	57	57	57	57	57	57	1,612
Payment for technical supports		1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	46,500
Total expenditure	190,847	14,260	11,443	12,575	13,326	14,153	15,062	15,591	15,692	15,692	15,692	111,372	15,692	15,692	15,692	111,372	15,692	15,692	15,692	839,536
(Revenue)																				
Operating revenue through electricity sales		12,033	22,841	26,698	29,306	32,176	35,332	37,121	37,456	37,456	37,456	37,456	37,456	37,456	37,456	37,456	37,456	37,456	37,456	1,057,007
Sales of CER		406	789	925	1,015	1,115	1,224	1,288	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	36,666
Residual value of equipment											9,568				9,568				19,531	
Total revenue		12,439	23,630	27,623	30,322	33,291	36,557	38,409	38,757	38,757	48,325	38,757	38,757	38,757	48,325	38,757	38,757	38,757	58,288	1,132,340
(Net operating income)	-190,847	-1,821	12,187	15,048	16,996	19,138	21,495	22,818	23,064	23,064	32,632	-72,616	23,064	23,064	32,632	-72,616	23,064	23,064	42,596	292,804
FIRR	**6.5%**																			

Community Electrication Project, Samraong, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 2 Financial Analysis

Including taxes, excluding CER sales (unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Expenditure)																				
Initital costs																				
Construction costs	195,311											95,680				95,680				386,671
Supports to CEC	18,000	6,000																		
Operation and maintenance costs		8,260	11,443	12,575	13,326	14,153	15,062	15,591	15,692	15,692	15,692	15,692	15,692	15,692	15,692	15,692	15,692	15,692	15,692	451,329
Personnel costs		3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	97,200
O&M of biomass gasification power plant		1,881	3,658	4,290	4,709	5,171	5,678	5,973	6,030	6,030	6,030	6,030	6,030	6,030	6,030	6,030	6,030	6,030	6,030	170,051
Maintenance of distribution lines, etc.		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	3,000
Biomass fuel cost		1,471	2,860	3,354	3,682	4,043	4,440	4,671	4,715	4,715	4,715	4,715	4,715	4,715	4,715	4,715	4,715	4,715	4,715	132,967
EAC license fee @ Riel 1.6/kWh		18	35	41	45	49	54	57	57	57	57	57	57	57	57	57	57	57	57	1,612
Payment for technical supports		1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	46,500
Total expenditure	213,311	14,260	11,443	12,575	13,326	14,153	15,062	15,591	15,692	15,692	15,692	111,372	15,692	15,692	15,692	111,372	15,692	15,692	15,692	862,000
(Revenue)																				
Operating revenue through electricity sales		12,033	22,841	26,698	29,306	32,176	35,332	37,121	37,456	37,456	37,456	37,456	37,456	37,456	37,456	37,456	37,456	37,456	37,456	1,057,007
Sales of CER																				0
Residual value of equipment											9,568				9,568				19,531	
Total revenue		12,033	22,841	26,698	29,306	32,176	35,332	37,121	37,456	37,456	47,024	37,456	37,456	37,456	47,024	37,456	37,456	37,456	56,988	1,095,674
(Net operating income)	-213,311	-2,226	11,399	14,123	15,980	18,023	20,270	21,531	21,764	21,764	31,332	-73,916	21,764	21,764	31,332	-73,916	21,764	21,764	41,295	233,674

FIRR **4.9%**

Community Electrication Project, Samraong, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 2 Financial Analysis

Excluding taxes and subsidy from costs, and including CER sales (unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Expenditure)																				
Initital costs																				
Construction costs	123,635											95,680				95,680				314,995
Supports to CEC	18,000	6,000																		
Operation and maintenance costs		8,260	11,443	12,575	13,326	14,153	15,062	15,591	15,692	15,692	15,692	15,692	15,692	15,692	15,692	15,692	15,692	15,692	15,692	451,329
Personnel costs		3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	97,200
O&M of biomass gasification power plant		1,881	3,658	4,290	4,709	5,171	5,678	5,973	6,030	6,030	6,030	6,030	6,030	6,030	6,030	6,030	6,030	6,030	6,030	170,051
Maintenance of distribution lines, etc.		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	3,000
Biomass fuel cost		1,471	2,860	3,354	3,682	4,043	4,440	4,671	4,715	4,715	4,715	4,715	4,715	4,715	4,715	4,715	4,715	4,715	4,715	132,967
EAC license fee @ Riel 1.6/kWh		18	35	41	45	49	54	57	57	57	57	57	57	57	57	57	57	57	57	1,612
Payment for technical supports		1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	46,500
Total expenditure	141,635	14,260	11,443	12,575	13,326	14,153	15,062	15,591	15,692	15,692	15,692	111,372	15,692	15,692	15,692	111,372	15,692	15,692	15,692	790,324
(Revenue)																				
Operating revenue through electricity sales		12,033	22,841	26,698	29,306	32,176	35,332	37,121	37,456	37,456	37,456	37,456	37,456	37,456	37,456	37,456	37,456	37,456	37,456	1,057,007
Sales of CER		406	789	925	1,015	1,115	1,224	1,288	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	36,666
Residual value of equipment											9,568				9,568				19,531	
Total revenue		12,439	23,630	27,623	30,322	33,291	36,557	38,409	38,757	38,757	48,325	38,757	38,757	38,757	48,325	38,757	38,757	38,757	58,288	1,132,340
(Net operating income)	-141,635	-1,821	12,187	15,048	16,996	19,138	21,495	22,818	23,064	23,064	32,632	-72,616	23,064	23,064	32,632	-72,616	23,064	23,064	42,596	342,016

FIRR **9.3%**

Community Electrication Project, Samraong, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 3 Economic Evaluation

(unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Economic costs)																				
Initital costs																				
Economic costs	158,989											95,098				95,098				349,185
Supports to CEC	16,200	5,400																		
Operation and maintenance costs	0	5,043	7,006	7,704	8,167	8,676	9,237	9,563	9,625	9,625	9,625	9,625	9,625	9,625	9,625	9,625	9,625	9,625	9,625	
Personenel costs		2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	87,480
O&M of biomass gasification power plant		1,842	3,582	4,201	4,612	5,064	5,561	5,850	5,905	5,905	5,905	5,905	5,905	5,905	5,905	5,905	5,905	5,905	5,905	166,525
Maintenance of distribution lines, etc.		50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	1,500
Biomass fuel cost		235	458	537	589	647	710	747	754	754	754	754	754	754	754	754	754	754	754	21,275
EAC license fee @ Riel 1.6/kWh		16	31	37	40	44	48	51	51	51	51	51	51	51	51	51	51	51	51	1,451
Monitoring of CEC by DIME		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual value											-9,510				-9,510				-15,899	-34,918
Total expenditure	175,189	10,459	7,037	7,740	8,207	8,721	9,285	9,614	9,677	9,677	167	104,774	9,677	9,677	167	104,774	9,677	9,677	-6,222	614,097
(Economic benefits as costs of alternative diesel mini-grid)																				
Initital costs																				
Economic costs	103,122											48,698				48,698				200,518
Supports to CEC	16,200	5,400																		
Operation and maintenance costs	0	13,925	24,584	28,374	30,890	33,658	36,702	38,473	38,812	38,812	38,812	38,812	38,812	38,812	38,812	38,812	38,812	38,812	38,812	
Personenel costs		2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	2,592	77,760
O&M of diesel power plant		1,135	2,206	2,587	2,840	3,119	3,425	3,603	3,637	3,637	3,637	3,637	3,637	3,637	3,637	3,637	3,637	3,637	3,637	102,566
Maintenance of distribution lines, etc.		50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	1,500
Fuel cost		10,148	19,735	23,145	25,408	27,897	30,635	32,228	32,533	32,533	32,533	32,533	32,533	32,533	32,533	32,533	32,533	32,533	32,533	917,454
EAC license fee		16	31	37	40	44	48	51	51	51	51	51	51	51	51	51	51	51	51	1,451
Payment for technical supports		1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	41,850
Residual value											-4,870				-4,870				-10,312	-20,052
Benefits from CER sales		406	789	925	1,015	1,115	1,224	1,288	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	36,666
Total benefits	119,322	21,141	26,798	30,731	33,341	36,212	39,370	41,207	41,559	41,559	36,689	90,256	41,559	41,559	36,689	90,256	41,559	41,559	31,246	1,381,312
(Net benefits)	-55,867	10,682	19,762	22,991	25,134	27,491	30,084	31,593	31,882	31,882	36,522	-14,518	31,882	31,882	36,522	-14,518	31,882	31,882	37,468	767,216

EIRR **37.3%**

Community Electrication Project, Samraong, Phase 1, soft loan @ 3% - 15 yr including 3-yr grace

Table 4 Financing Plan

(unit: $)

Financial Resources			Financial Application	
Equity - CEC			**Power Plant before tax**	**121,408**
Cash (@ $50/hh)	23,500	11.9%	Biomass gasification power equipment	95,680
In kind (@ $40/MM)	6,027	3.1%	Road improvement works	4,800
151 MM			Powerhouse, etc.	8,320
Grant			Switching equip. & transformer	0
REF	49,212	25.0%	Growing fuel trees	7,808
(25% of capital costs)			Misecellaneous equipment	4,800
Borrowing for capitals			**Distribution facilities, service wires, etc.**	42,138
Long-term	118,108	60.0%		
(15 yr including 3-year grace, 3%/yr)			Contingecy	9,301
			Capital costs before tax	172,847
Total fund for capital costs and CEC supports	196,847	100.0%	**CEC support**	24,000
Borrowing for operation	3,000		**Operation fund in hand**	3,000
Short-term				
(Revolving, 15%/yr)				
Tax exemption	22,464		**Customs and tax**	22,464
Total Financial Resources	**222,311**		**Total Financial Resources**	**222,311**

Community Electrication Project, Cambodia, soft loan @ 3% - 15 yr including 3-yr grace

Table A1 Principal Features of Electrification Plan

(1) Generating Equipment Planning

Items	Unit	Q'ty	Remarks
Nos. of households	h.h.	600	
Unit nighttime domestic demand	W/hh	100	
Nighttime domestic demand	kW	60.0	
Street light demand	kW	4.5	1 light per 40 m of LV lin 225 street lights
Reserve capacity	kW	18.0	30% of nighttime domestic demand, allocated for station use + reserved power + distribution losses
Required capacity	kW	82.5	
Adopted capacity	kW	82.5	

(2) Energy Generation Planning for 8th Year Onward

Items	Monthly Unit Energy Sold	Monthly Energy Sold	Annual Energy Sold	Station Use, Losses, etc. (10%)	Annual Energy Generated	Annual Plant Factor	Annual Operation Hours	Remarks (refer to Table A2 for demand growth rates)
	kWh/hh	MWh	MWh	MWh	MWh	%	hr	
Nighttime domestic demand 1/, 2/	15.0	9.0	108.0	10.8	118.8	16.4%	1,440	100% from 8th year onward
Street light demand	1.1	0.7	8.1	0.8	8.9	1.2%	108	100% from the 1st year
Industrial demand 3/	7.5	4.5	54.0	5.4	59.4	8.2%	720	100% from 8th year onward
Irrigation pump demand 4/	1.2	2.2	8.8	0.9	9.6	1.3%	117	in 4 dry months, 100% from 8th year onward
Total energy	24.8	16.4	178.9	17.9	196.7	27.2%	2,385	100% from 8th year onward

Note:

1/ Typical consumption level of existing mini-grids in rural villages as of 2005 was 10 kWh (= 100W / 1,000 * 5hrs * 30 days * 67%) and assumed to be realized from 2nd year.

2/ Average consumption of existing REE mini-grids supplying to rural towns as of 2005 was 15 kWh（= 100 W / 1,000 * 7.5hrs * 30days * 67%）and was assumed to be realized in 7th year.

3/ Power demand of BCS, rice-mills, water supply stations, ice factory, workshop of boat engines, etc. Assumed to be 50% of the nighttime demand based on the actual demand of existing Anlong Ta Mey mini-grid (700 kWh at nighttime, 300 kWh for BCS at daytime) and potential daytime users in the villages shown in Table A3.

4/ see Table A3 for irrigation power demand.

Community Electrication Project, Cambodia, soft loan @ 3% - 15 yr including 3-yr grace

Table A2 Energy and CER Sold

			1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Annual energy sold)																					
Demand growth	Growth rate																				
Domestic		1.10	50%	67%	73%	81%	89%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Street lights		0.00	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Industrial		1.10	0%	50%	67%	73%	81%	89%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Irrigation		1.10	0%	50%	67%	73%	81%	89%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Energy sold (MWh/yr)	Demand																				
Domestic		108.0	54.0	72.0	79.2	87.1	95.8	105.4	108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0	3,086
Street lights		8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	243
Industrial		54.0	0.0	27.0	36.0	39.6	43.6	47.9	52.7	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	1,489
Irrigation		8.8	0.0	4.4	5.8	6.4	7.1	7.8	8.5	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	241
Total		178.9	62.1	111.5	129.1	141.2	154.6	169.2	177.3	178.9	178.9	178.9	178.9	178.9	178.9	178.9	178.9	178.9	178.9	178.9	5,059
Unit energy sold (kWh per household per month)																					
Domestic		15.0	**7.5**	**10.0**	11.0	12.1	13.3	14.6	**15.0**	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
Street lights		1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	
Industrial		7.5	0.0	3.8	5.0	5.5	6.1	6.7	**7.3**	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	
Irrigation		1.2	0.0	0.6	0.8	0.9	1.0	1.1	**1.2**	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
Total		24.8	8.6	15.5	17.9	19.6	21.5	23.5	24.6	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	
(Operating revenue from electricity sales, $)																					
	Tariff																				
Domestic		$0.35	18,900	25,200	27,720	30,492	33,541	36,895	37,800	37,800	37,800	37,800	37,800	37,800	37,800	37,800	37,800	37,800	37,800	37,800	1,079,949
Street lights		$0.35	2,835	2,835	2,835	2,835	2,835	2,835	2,835	2,835	2,835	2,835	2,835	2,835	2,835	2,835	2,835	2,835	2,835	2,835	85,050
Industrial		$0.30	0	8,100	10,800	11,880	13,068	14,375	15,812	16,200	16,200	16,200	16,200	16,200	16,200	16,200	16,200	16,200	16,200	16,200	446,635
Irrigation		$0.30	0	1,313	1,750	1,925	2,118	2,329	2,562	2,625	2,625	2,625	2,625	2,625	2,625	2,625	2,625	2,625	2,625	2,625	72,371
Total			21,735	37,448	43,105	47,132	51,562	56,434	59,009	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	1,684,005
(Monthly tariff, $ per household)																					
Domestic			2.63	3.50	3.85	4.24	4.66	5.12	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	
Street lights			0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	
Industrial			0.00	1.13	1.50	1.65	1.82	2.00	2.20	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	
Irrigation			0.00	0.18	0.24	0.27	0.29	0.32	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	
Total			3.02	5.20	5.99	6.55	7.16	7.84	8.20	8.26	8.26	8.26	8.26	8.26	8.26	8.26	8.26	8.26	8.26	8.26	
(Tariff receivable, $/yr)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	kg-CO_2/kWh																				
(CER saleable)	(to-CO_2)	1.3	81	145	168	184	201	220	231	233	233	233	233	233	233	233	233	233	233	233	6,576
	($/yr) 1/	**$7**	565	1,014	1,175	1,285	1,406	1,540	1,614	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	46,033
Fuel tree consumed (ton per month)			7.8	13.9	16.1	17.7	19.3	21.1	22.2	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	632
Land required to supply fuel trees (ha)			9.3	16.7	19.4	21.2	23.2	25.4	26.6	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	
Nos. of fuel tree farmers (0.2 ha per farmer)			47	84	97	106	116	127	133	134	134	134	134	134	134	134	134	134	134	134	
Payment to fuel tree farmers ($/farmer/month			3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	
Total payment to fuel tree farmers ($/yr)			1,863	3,344	3,874	4,237	4,637	5,076	5,320	5,366	5,366	5,366	5,366	5,366	5,366	5,366	5,366	5,366	5,366	5,366	151,758

Ratio of tariff collected and billed= 100%

Note: 1/ Assumed at %4/ton-CO_2/yr deducting costs required for prepration of PDD, application and monitoring.

Community Electrication Project, Cambodia, soft loan @ 3% - 15 yr including 3-yr grace

Table A3 Potential Daytime Users and Demand

No.	Demand	Diesel Consumption	Electricity Demand	Operation Hour	Unit Power Demand	Nos. of Customers	Total Demand		
		liter/month	kWh/month	hr/month	kW		kW	kWh/month	Load Factor
1	BCS	200	600	50	12.00	5	60.00	3,000	6.9%
2	Water supply	60	180	15	12.00	10	120.00	1,800	2.1%
3	Rice-mill	30	90	30	3.00	30	90.00	2,700	4.2%
4	Ice factory	30	90	30	3.00	1	3.00	90	4.2%
5	Workshop	25	75	60	1.25	1	1.25	75	8.3%
6	Café	115	345	296	1.17	1	1.17	345	41.1%
Monthly total		460	1,380	481	-	48	82.50	8,010	13.5%
Annual total		5520	16,560	5,772	-	-	82.50	**96,120**	13.5%

Source: The potential daytime users above are candidates in Kampong Kor for reference purpose.

Potential irrigation demand in the dry season

Unit land to irrigate	0.1	ha/hh
Ratio of irrigation hh	50.0%	
Total land area to irrigate	30	ha
Depth of irrigation	500	mm
Total irrigation water	0.150	mcm/yr
Irrigation period	4	month
Daily operation hour	8	hr/day
Total pump discharge	0.043	m^3/s
Pumping head	15.0	m
Combined efficiency	0.70	
Total power required	9	kW
Total energy required	9	MWh

Community Electrication Project, Cambodia, soft loan @ 3% - 15 yr including 3-yr grace

Table A4 Cost Estimate

(1)	**Construction Costs**	Unit Price ($)	Q'ty	Unit	Amount($)	Total ($)	%シェア
	Power Station						
	Biomass gasification power generating equipment (FOB)	1,300	83	kW	107,250		
	Ocean freight & insurance (FOBx8%)	104	83	kW	8,580		
	Inland transportation & installation (FOB x (2%+5%))	91	83	kW	7,508		
	Switching equipment, main transformer		103	kVA	**46,970**		
						170,308	43.9%
	Civil and substation works						
	Road improvement works for dry season use to be further improved to all weather road in Phase 2	**24**	**0.10**	km	2,400		
	Land, powerhouse, water tank, etc. (10%FOB)	130	83	kW	10,725		
						13,125	
	Fuel tree preparation for 2nd year demand						
	Scarified seeds of Leucaena of 0.4-0.5 kg/ha and $15/kg	8	17	ha	125		
	Nursery	1	170	m^2	170		
	Watering of nursery for the first 3 months	**100**	3	month	300		
	Bush clearing	40	17	ha	669		
	Land preparation	**40**	17	ha	669		
	Transplanting	**80**	17	ha	1,338		
	Maintenance for initital 6 months @ $60/ha/mon	**360**	17	ha	6,020		
						9,291	
	Sub-total of power station and fuel preparation					**192,724**	49.7%
	Miscellaneous of power station (5%, consumables, gas detector, fire distinguisher, water content meter, computer set, etc.)				**8,500**		
	Power station sub-total (before tax)					201,224	51.9%
	Customs & VAT (CIF x 25%)	351	83	kW	28,958		
	Power station sub-total (including tax)					**230,182**	59.4%
	Distribution Facilities						
	MV lines	6,000	**3.0**	km	18,000		
	MV-LV lines	10,700		km	0		
	LV lines	7,100	**9.0**	km	63,900		
	Pole-mounted distribution transformers						
	15 kVA-1P	6,200		set	0		
	25 kVA-3P	7,300	3	set	21,900		
	50 kVA-3P	8,100		set	0		
	Distribution line - transformer sub-total (including tax)					103,800	26.8%
	Miscellaneous (5%, street lights, etc.)				**5,190**		
	Distribution line - transformer sub-total (including tax)					108,990	28.1%
	Service wire, etc.				30,000		7.7%
	Domestic cutomers	50	600	hh	30,000		
	Daytime customers (to be fixed individually)	0		customers	0		
	Distribution line - transformer - service wires, etc. sub-total (including tax)					**138,990**	35.9%
	Sub-total					**369,172**	
	Contingecy (5%)					**18,459**	
	Construction costs total					**387,631**	100.0%

(2)	**Costs for CEC supports**	Unit Price ($)	Q'ty	Unit	Amount($)
	Costs for CEC supports and training				**19,000**
	2.1 Facilitation for CEC setting up and management	500	8.00	MM	4,000
	2.2 Technical supports	500	10.00	MM	5,000
	2.3 Vehicles and lodging	1,000	10.00	month	10,000

(3) **Operation and maintenance costs**

Personnel costs of CEC staff	Salary ($/mon)	Nos. of person	MM	Amount($)	Total ($)
Operation Chief	$80	1	12.00	960	
Operator	$40	1	12.00	480	
Fuel preparation workers	$30	2	12.00	720	
Director and accountant	$40	2	12.00	960	
Personnel costs sub-total					**$3,120**

Maintenance costs of gasifier and engine-generator	CIF ($)	Ratio of O&M Costs	Amount ($)	Total ($)
Gasifier and engine-generator costs (CIF)	170,308			
5% of engine-generator set	56,769	5.0%	2,840	
Heat resistant cone of gasifier (replacement at ever 3,000 hr operation/every one year, 4-6%)	113,539	5.0%	5,680	
Replacement of lamp of street lights, office stationery and consumables			1,040	
Maintenance costs of powerhouse (% of powerhouse)	10,725	2.0%	210	
Maintenance costs sub-total				**9,770**
Operation and maintenance costs sub-total				**12,890**
Payment for technical supports ($/yr for 15 years from 1st year)				**1,980**

Items	Unit fuel cost ($/kWh)	Energy generation	unit	Fuel costs ($)
Annual fuel costs	0.03	197	MWh/yr	**5,902**
Operation, maintenance and fuel costs sub-total				**18,792**

(4) **Maintenance costs of distribution facilities**

Maintenance costs (0.5% of construction costs)	**500**

Community Electrication Project, Cambodia, soft loan @ 3% - 15 yr including 3-yr grace

Table A5 Economic Costs

Items	Foreign Currency	Local Currency	Financial Costs	Economic Costs	Remarks
	$	$	$	$	
1. Hard costs	205,601	182,030	387,631	334,449	SCF
1.1 Generating equip. excl. tax	115,830	7,508	123,338	122,587	0.90
1.2 Customs & VAT	0	28,958	28,958	0	LCF
1.3 Road and powerhouse		13,125	13,125	**6,563**	0.50 1/
1.4 Growing fuel trees	125	9,166	9,291	**4,708**	
1.5 Swichyard equip.		46,970	46,970	42,273	
1.6 Powerhouse miscellaneous		8,500	8,500	7,650	
1.7 Distribution lines	69,546	34,254	103,800	100,375	
1.8 Service wires, etc.	20,100	9,900	30,000	29,010	
1.9 Distri. Lines miscellaneous		5,190	5,190	4,671	
1.10 Contingency (5%)		18,459	18,459	16,613	
2. CEC facilitation costs	0	19,000	19,000	17,100	
Project Costs Total	205,601	201,030	406,631	351,549	
O&M	8,520	10,772	19,292	13,323	
1. Personnel costs	0	3,120	3,120	**2,484**	
2. Biomass gasifier generator	8,520	1,250	9,770	9,645	
3. Fuel		5,902	5,902	**944**	0.16 2/
4. Distribution lines	0	500	500	**250**	

Note: 1/ Economic conversion factor for seasonal jobless labors

Table A6 Economic Benefits

Items	Foreign Currency	Local Currency	Financial Costs	Economic Costs	Remarks
	$	$	$	$	
1. Hard costs	113,503	162,516	276,019	244,514	
1.1 Diesel generator excl. tax	56,017	7,508	63,525	62,774	770 $/kW
1.2 Customs & VAT		15,881	15,881		
1.3 Road & land preparation		2,400	2,400	**1,200**	
1.4 Powerhouse & fuel tank (10%)		6,353	6,353	5,717	
1.5 Swichyard equip.		46,970	46,970	42,273	
1.6 Powerhouse miscellaneous (5%)		6,756	6,756	6,081	
1.7 Distribution lines	57,486	28,314	**85,800**	82,969	
1.8 Service wires, etc.		30,000	30,000	27,000	
1.9 Distri. Lines miscellaneous		5,190	5,190	4,671	
1.10 Contingency (5%)		13,144	13,144	11,829	
2. CEC facilitation costs	0	19,000	19,000	17,100	
Project Costs Total	113,503	181,516	295,019	261,614	
O&M	3,860	48,715	52,575	47,504	
1. Personnel costs	0	2,400	2,400	2,160	
2. Diesel generator	3,860	566	4,426	4,370	5%
3. Fuel	0	45,249	45,249	40,724	0.23 $/kWh
4. Distribution lines	0	500	500	**250**	

Adjsutment for Kampong Kor diesel power station

1. Road powerhouse	24	**0.10**	km	2,400
2. Embankment of station yard	0	1,400	m^2	0
3. Land acquisition	0	1,400	m^2	0

Community Electrication Project, Cambodia, soft loan @ 3% - 15 yr including 3-yr grace

Table A7 Unit Costs of Electricity

Items	with tax ($)	with tax exemption and subsidy ($)
1. Capital Costs	453,601	318,482
2. CEC facilitation costs	19,000	19,000
3. Total construction costs excluding design, testing, etc.		**337,482**
Interest rate	3.0%	
Repayment period	10 yr	
CRF (3.0%, 10 yr) =	0.1172	
4. Annual costs excluding design, etc.	53,176	39,563
5. O&M costs in 10th year	20,844	20,844
5.1 O&M	12,890	12,890
5.2 Fuel costs	5,902	5,902
5.3 EAC license fee	72	72
5.4 Yearly monitoring fee by DIME	1,980	1,980
6. Annual total costs	74,019	60,407
7. Annual energy sales from 7th year (MWh)	178.9	178.9
8. Unit cost of electricity from 7th year ($/kWh)	**0.414**	**0.338**
9. NPV of energy sold	MWh	3,219
10. NPV of finacial costs excluding tax	$	899,127
11. Average cost of electricity	$/kWh	**0.279**

Table A8 Tariff Setting

Items	$	Riel
Unit cost of electricity from 7th year ($/kWh)	**0.279**	1,117
Rate of reserve for operational risks (12%)	0.034	134
Average tariff ($/kWh)	**$0.313**	1,252
Tariff adopted for nighttime demand	**$0.350**	**1,400**
Tariff adopted for street lights	**$0.350**	**1,400**
Tariff adopted for industrial demand	**$0.300**	**1,200**
Tariff adopted for irrigation demand	**$0.300**	**1,200**
Monthly revenue (US$/mon)	$4,955	
from nighttime users	$3,150	
for street lights	$236	
from industrial users	$1,350	
from irrigation pump users	$219	
Average monthly tariff @ 15 kWh per HH ($)	$5.25	21,000
Tariff for street lights	$0.39	1,600
Total @ 15 kWh/hh including street lights	**$5.64**	22,600
Average monthly tariff @ 10 kWh per HH ($) including street lights	**$3.89**	**15,600**
Tariff of poor household ($/mon/hh) @ 40 W x 4h x 30 days = 4.8 kWh/month + street lights	$2.07	8,300
Tariff of poorest household (US$/mon/hh) @ 7 W x 4h x 30 days = 0.84 kWh/mon + street	$0.69	2,800
	Monthly Costs	
ATP for monthly tariff	$	Riel
Diesel oil lamp (100%)	$1.46	5,844
Battery lighting (70%, incl. Riel 4,000 per month for battery purchase)	$3.12	12,470
Total	**$4.58**	18,314

Community Electrication Project, Cambodia, soft loan @ 3% - 15 yr including 3-y

Table 1 Adopted Conditions for Economic and Finacial Analyses

1. Energy sold See attached Table A2

2. Tariff See attached Table A7

3. Long-term borrowing from GOC
   - 3% per year
   - 25 years repayment period including 5 years' grace

4. Short-term borrowing from commercial bank
   - 10% per year
   - revolving every year

5. Depreciation

- Ratio of depreciation	90%
- Ratio of residual value	10%

   Generating equipment
   - 5 years' grace and 5 years' depreciation for the first 10 years
   - 10 years' depreciation from 11th year onward

   Distribution lines, service wires, etc.
   - 5 years' grace and 20 years' depreciation

6. Interest earning
   - Interest of saving deposit at 10% per year

Community Electrication Project, Cambodia, soft loan @ 3% - 15 yr including 3-yr grace

Table 2 Financial Analysis

(unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Expenditure)																				
Initital costs																				
Construction costs excluding tax	358,673											123,338				123,338				605,349
Supports to CEC	14,250	4,750																		
Operation and maintenance costs		11,066	15,413	16,967	18,033	19,205	20,494	21,211	21,344	21,344	21,344	21,344	21,344	21,344	21,344	21,344	21,344	21,344	21,344	613,290
Personnel costs		3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	93,600
O&M of biomass gasification power plant		3,392	6,090	7,054	7,715	8,443	9,243	9,688	9,770	9,770	9,770	9,770	9,770	9,770	9,770	9,770	9,770	9,770	9,770	276,334
Maintenance of distribution lines, etc.		500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	15,000
Biomass fuel cost		2,049	3,679	4,261	4,661	5,100	5,583	5,852	5,902	5,902	5,902	5,902	5,902	5,902	5,902	5,902	5,902	5,902	5,902	166,932
EAC license fee @ Riel 1.6/kWh		25	45	52	56	62	68	71	72	72	72	72	72	72	72	72	72	72	72	2,023
Payment for technical supports		1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	59,400
Total expenditure	372,923	15,816	15,413	16,967	18,033	19,205	20,494	21,211	21,344	21,344	21,344	144,682	21,344	21,344	21,344	144,682	21,344	21,344	21,344	1,237,639
(Revenue)																				
Operating revenue through electricity sales		21,735	37,448	43,105	47,132	51,562	56,434	59,009	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	1,684,005
Sales of CER		565	1,014	1,175	1,285	1,406	1,540	1,614	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	46,033
Residual value of equipment											12,334				12,334				38,763	
Total revenue		22,300	38,462	44,280	48,417	52,968	57,974	60,623	61,088	61,088	73,421	61,088	61,088	61,088	73,421	61,088	61,088	61,088	99,851	1,793,469
(Net operating income)	-372,923	6,484	23,049	27,313	30,385	33,764	37,480	39,412	39,744	39,744	52,078	-83,594	39,744	39,744	52,078	-83,594	39,744	39,744	78,507	555,830
FIRR	**6.4%**																			

Community Electrication Project, Cambodia, soft loan @ 3% - 15 yr including 3-yr grace

Table 2 Financial Analysis

Including taxes, excluding CER sales (unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Expenditure)																				
Initital costs																				
Construction costs	387,631											123,338				123,338				634,307
Supports to CEC	14,250	4,750																		
Operation and maintenance costs		11,066	15,413	16,967	18,033	19,205	20,494	21,211	21,344	21,344	21,344	21,344	21,344	21,344	21,344	21,344	21,344	21,344	21,344	613,290
Personnel costs		3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	93,600
O&M of biomass gasification power plant		3,392	6,090	7,054	7,715	8,443	9,243	9,688	9,770	9,770	9,770	9,770	9,770	9,770	9,770	9,770	9,770	9,770	9,770	276,334
Maintenance of distribution lines, etc.		500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	15,000
Biomass fuel cost		2,049	3,679	4,261	4,661	5,100	5,583	5,852	5,902	5,902	5,902	5,902	5,902	5,902	5,902	5,902	5,902	5,902	5,902	166,932
EAC license fee @ Riel 1.6/kWh		25	45	52	56	62	68	71	72	72	72	72	72	72	72	72	72	72	72	2,023
Payment for technical supports		1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	59,400
Total expenditure	401,881	15,816	15,413	16,967	18,033	19,205	20,494	21,211	21,344	21,344	21,344	144,682	21,344	21,344	21,344	144,682	21,344	21,344	21,344	1,266,597
(Revenue)																				
Operating revenue through electricity sales		21,735	37,448	43,105	47,132	51,562	56,434	59,009	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	1,684,005
Sales of CER																				0
Residual value of equipment											12,334				12,334				38,763	
Total revenue		21,735	37,448	43,105	47,132	51,562	56,434	59,009	59,460	59,460	71,794	59,460	59,460	59,460	71,794	59,460	59,460	59,460	98,223	1,747,436
(Net operating income)	-401,881	5,919	22,035	26,138	29,099	32,357	35,941	37,798	38,116	38,116	50,450	-85,222	38,116	38,116	50,450	-85,222	38,116	38,116	76,880	480,839

FIRR **5.4%**

Community Electrication Project, Cambodia, soft loan @ 3% - 15 yr including 3-yr grace

Table 2 Financial Analysis

Excluding taxes and subsidy from costs, and including CER sales (unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Expenditure)																				
Initital costs																				
Construction costs	252,512											123,338				123,338				499,188
Supports to CEC	14,250	4,750																		
Operation and maintenance costs		11,066	15,413	16,967	18,033	19,205	20,494	21,211	21,344	21,344	21,344	21,344	21,344	21,344	21,344	21,344	21,344	21,344	21,344	613,290
Personnel costs		3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	93,600
O&M of biomass gasification power plant		3,392	6,090	7,054	7,715	8,443	9,243	9,688	9,770	9,770	9,770	9,770	9,770	9,770	9,770	9,770	9,770	9,770	9,770	276,334
Maintenance of distribution lines, etc.		500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	15,000
Biomass fuel cost		2,049	3,679	4,261	4,661	5,100	5,583	5,852	5,902	5,902	5,902	5,902	5,902	5,902	5,902	5,902	5,902	5,902	5,902	166,932
EAC license fee @ Riel 1.6/kWh		25	45	52	56	62	68	71	72	72	72	72	72	72	72	72	72	72	72	2,023
Payment for technical supports		1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	59,400
Total expenditure	266,762	15,816	15,413	16,967	18,033	19,205	20,494	21,211	21,344	21,344	21,344	144,682	21,344	21,344	21,344	144,682	21,344	21,344	21,344	1,131,478
(Revenue)																				
Operating revenue through electricity sales		21,735	37,448	43,105	47,132	51,562	56,434	59,009	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	1,684,005
Sales of CER		565	1,014	1,175	1,285	1,406	1,540	1,614	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	46,033
Residual value of equipment											12,334				12,334				38,763	
Total revenue		22,300	38,462	44,280	48,417	52,968	57,974	60,623	61,088	61,088	73,421	61,088	61,088	61,088	73,421	61,088	61,088	61,088	99,851	1,793,469
(Net operating income)	-266,762	6,484	23,049	27,313	30,385	33,764	37,480	39,412	39,744	39,744	52,078	-83,594	39,744	39,744	52,078	-83,594	39,744	39,744	78,507	661,991

FIRR **9.7%**

Community Electrication Project, Cambodia, soft loan @ 3% - 15 yr including 3-yr grace

Table 3 Economic Evaluation

(unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Economic costs)																				
Initital costs																				
Economic costs	334,449											122,587				122,587				579,624
Supports to CEC	12,825	4,275																		
Operation and maintenance costs	0	6,735	9,658	10,704	11,420	12,209	13,076	13,558	13,647	13,647	13,647	13,647	13,647	13,647	13,647	13,647	13,647	13,647	13,647	
Personenel costs		2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	84,240
O&M of biomass gasification power plant		3,349	6,012	6,964	7,617	8,335	9,124	9,564	9,645	9,645	9,645	9,645	9,645	9,645	9,645	9,645	9,645	9,645	9,645	272,799
Maintenance of distribution lines, etc.		250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	7,500
Biomass fuel cost		328	589	682	746	816	893	936	944	944	944	944	944	944	944	944	944	944	944	26,709
EAC license fee @ Riel 1.6/kWh		22	40	46	51	56	61	64	64	64	64	64	64	64	64	64	64	64	64	1,821
Monitoring of CEC by DIME		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual value											-12,259				-12,259				-33,445	-57,962
Total expenditure	347,274	11,032	9,698	10,750	11,471	12,264	13,137	13,622	13,712	13,712	1,453	136,299	13,712	13,712	1,453	136,299	13,712	13,712	-19,733	931,831
(Economic benefits as costs of alternative diesel mini-grid)																				
Initital costs																				
Economic costs	244,514											62,774				62,774				370,063
Supports to CEC	12,825	4,275																		
Operation and maintenance costs	0	18,067	30,516	34,969	38,020	41,377	45,070	47,125	47,504	47,504	47,504	47,504	47,504	47,504	47,504	47,504	47,504	47,504	47,504	
Personenel costs		2,160	2,160	2,160	2,160	2,160	2,160	2,160	2,160	2,160	2,160	2,160	2,160	2,160	2,160	2,160	2,160	2,160	2,160	64,800
O&M of diesel power plant		1,517	2,724	3,155	3,451	3,776	4,134	4,333	4,370	4,370	4,370	4,370	4,370	4,370	4,370	4,370	4,370	4,370	4,370	123,590
Maintenance of distribution lines, etc.		250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	7,500
Fuel cost		14,140	25,383	29,404	32,160	35,191	38,526	40,382	40,724	40,724	40,724	40,724	40,724	40,724	40,724	40,724	40,724	40,724	40,724	1,151,841
EAC license fee		22	40	46	51	56	61	64	64	64	64	64	64	64	64	64	64	64	64	1,821
Payment for technical supports		1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	53,460
Residual value											-6,277				-6,277				-24,451	-37,006
Benefits from CER sales		565	1,014	1,175	1,285	1,406	1,540	1,614	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	46,033
Total benefits	257,339	24,712	33,353	37,972	41,138	44,621	48,452	50,585	50,978	50,978	44,700	113,752	50,978	50,978	44,700	113,752	50,978	50,978	26,526	1,799,202
(Net benefits)	-89,935	13,680	23,655	27,222	29,667	32,357	35,316	36,963	37,266	37,266	43,247	-22,547	37,266	37,266	43,247	-22,547	37,266	37,266	46,259	867,371

EIRR **28.8%**

Community Electrication Project, Cambodia, soft loan @ 3% - 15 yr including 3-yr grace

Table 4 Financing Plan

(unit: $)

Financial Resources			Financial Application	
Equity - CEC			**Power Plant before tax**	**248,194**
Cash (@ $50/hh)	30,000	7.1%	Biomass gasification power equipment	170,308
In kind (@ $40/MM)	33,696	7.9%	Road improvement works	2,400
842 MM			Powerhouse, etc.	10,725
Grant			Switching equip. & transformer	46,970
REF	106,161	25.0%	Growing fuel trees	9,291
(25% of capital costs)			Misecellaneous equipment	8,500
Borrowing for capitals			**Distribution facilities, service wires, etc.**	138,990
Long-term	254,786	60.0%		
(15 yr including 3-year grace, 3%/yr)			Contingecy	18,459
			Capital costs before tax	405,643
Total fund for capital costs and CEC supports	424,643	100.0%	**CEC support**	19,000
Borrowing for operation	4,000		**Operation fund in hand**	4,000
Short-term				
(Revolving, 15%/yr)				
Tax exemption	28,958		**Customs and tax**	28,958
Total Financial Resources	**457,601**		**Total Financial Resources**	**457,601**

Community Electrication Project, Cambodia, soft loan @ 3% - 15 yr including 3-yr grace

Table 5 Profit and Loss Statement with Cash Flow, 25-yr repayment period with 5-yr grace

(unit: $)

		0	1	2	3	4	5	6	7	8	9	10	11	12	20	21	22	24	25	26	30	Total
Operating revenue incl. CER & residual value			21,735	37,448	43,105	47,132	51,562	56,434	59,009	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	1,684,005
Operating costs			11,066	15,413	16,967	18,033	19,205	20,494	21,211	21,344	21,344	21,344	21,344	21,344	21,344	21,344	21,344	21,344	21,344	21,344	21,344	613,290
Gross profit			10,669	22,035	26,138	29,099	32,357	35,941	37,798	38,116	38,116	38,116	38,116	38,116	38,116	38,116	38,116	38,116	38,116	38,116	38,116	1,070,715
Interests payment																						
Short-term commercial loan (15%/yr)			600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	18,000
Long-term soft loan	3.0%		7,644	7,644	7,644	7,644	7,644	7,261	6,879	6,497	6,115	5,733	5,351	4,968	1,911	1,529	1,147	382	-0			110,832
Deprecitation																						
Generating equipment (5 yr - 10 yr - 10 yr)	153,277							30,655	30,655	30,655	30,655	30,655	15,328	15,328	15,328	15,328	15,328	15,328	15,328	15,328	15,328	459,832
Others (20 yr from 6th year)	228,902							11,445	11,445	11,445	11,445	11,445	11,445	11,445	11,445	11,445	11,445	11,445	11,445			228,902
Operating profit before depreciation			2,425	13,791	17,894	20,856	24,114	28,079	30,319	31,019	31,402	31,784	32,166	32,548	35,606	35,988	36,370	37,134	37,516	37,516	37,516	941,883
Interests received (10%)			0	0	1,780	3,864	6,465	8,390	10,917	13,928	17,311	21,071	26,479	31,232	92,776	105,737	118,798	149,088	166,599	187,173	292,207	2,495,627
Residual value upon completion of depreciation	10%											12,334			12,334						38,763	63,431
CER received			565	1,014	1,175	1,285	1,406	1,540	1,614	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	46,033
Net profit after depreciation			2,990	14,806	20,849	26,006	31,985	-4,092	749	4,474	8,240	24,716	33,500	38,635	115,570	116,579	130,023	161,077	178,970	210,990	354,787	2,858,241
Cash in hand			2,990	14,806	20,849	26,006	31,985	38,009	42,849	46,574	50,340	66,816	60,272	65,408	142,343	143,352	156,796	187,850	205,743	226,317	370,114	3,546,974
Accumulated cash in hand after principal repayment		0	2,990	17,796	38,645	64,650	83,896	109,165	139,275	173,110	210,711	**264,788**	312,321	364,990	1,057,368	1,187,980	1,332,037	1,665,991	1,871,734	2,098,052	3,292,188	
Principal repayment	254,786	0	0	0	0	0	0	12,739	12,739	12,739	12,739	12,739	12,739	12,739	12,739	12,739	12,739	12,739				254,786
Long-term debt balance	254,786	254,786	254,786	254,786	254,786	254,786	254,786	242,047	229,307	216,568	203,829	191,089	178,350	165,611	152,871	50,957	38,218	25,479	-0			

Community Electrication Project, Cambodia, soft loan @ 3% - 15 yr including 3-yr grace

Table 5 Profit and Loss Statement with Cash Flow, 15-yr repayment period with 3-yr grace

(unit: $)

		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	20	21	22	30	Total
Operating revenue incl. CER & residual value			21,735	37,448	43,105	47,132	51,562	56,434	59,009	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	59,460	1,684,005
Operating costs			11,066	15,413	16,967	18,033	19,205	20,494	21,211	21,344	21,344	21,344	21,344	21,344	21,344	21,344	21,344	21,344	21,344	21,344	21,344	613,290
new land required for tree plantation					2.6	1.8	2.0	2.2	1.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.1
tree plantation costs for increasing demand				1,472	1,009	1,110	1,221	680	125	0	0	0	0	0	0	0	0	0	0	0	5,615	11,231
Gross profit			10,669	20,563	25,126	27,988	31,135	35,259	37,672	38,116	38,116	38,116	38,116	38,116	38,116	38,116	38,116	38,116	38,116	38,116	32,501	1,059,474
Interests payment																						
Short-term commercial loan (15%/yr)			600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	18,000
Long-term soft loan	3.0%		7,644	7,644	7,644	7,007	6,370	5,733	5,096	4,459	3,822	3,185	2,548	1,911	1,274	637						64,970
Deprecitation																						
Generating equipment (5 yr - 10 yr - 10 yr)	153,277							30,655	30,655	30,655	30,655	30,655	15,328	15,328	15,328	15,328	15,328	15,328	15,328	15,328	15,328	459,832
Others (20 yr from 6th year)	228,902							11,445	11,445	11,445	11,445	11,445	11,445	11,445	11,445	11,445	11,445	11,445	11,445	11,445		228,902
Operating profit before depreciation			2,425	12,319	16,883	20,381	24,165	28,926	31,976	33,057	33,695	34,332	34,969	35,606	36,243	36,879	37,516	37,516	37,516	37,516	31,901	976,504
Interests received (10%)			0	0	1,632	1,478	1,669	2,270	3,421	4,999	6,844	8,937	12,537	15,327	18,460	21,970	25,894	65,600	77,308	88,953	235,444	1,830,998
Residual value upon completion of depreciation	10%											12,334						12,334			38,763	63,431
CER received			565	1,014	1,175	1,285	1,406	1,540	1,614	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	46,033
Net profit after depreciation			2,990	13,334	19,690	23,145	27,241	-9,364	-5,090	-2,417	65	15,130	22,360	25,787	29,557	33,704	38,265	90,305	89,679	101,325	292,408	2,228,232
Cash in hand			2,990	13,334	19,690	23,145	27,241	32,736	37,011	39,684	42,166	57,230	49,133	52,560	56,330	60,477	65,038	117,078	116,452	128,097	307,736	2,916,965
Accumulated cash in hand after principal repayment		0	2,990	16,324	14,782	16,695	22,703	34,208	49,986	68,438	89,371	**125,369**	153,270	184,598	219,696	258,941	323,979	773,083	889,535	1,017,632	2,662,180	
Principal repayment	254,786	0	0	0	21,232	21,232	21,232	21,232	21,232	21,232	21,232	21,232	21,232	21,232	21,232	21,232						254,786
Long-term debt balance	254,786	254,786	254,786	254,786	233,554	212,322	191,089	169,857	148,625	127,393	106,161	84,929	63,696	42,464	21,232	0						

Community Electrication Project, Kampong Kor, Phase 1+2, soft loan @ 3% - 15 yr including 3-yr grace

Table A1 Principal Features of Electrification Plan

(1) Generating Equipment Planning

Items	Unit	Q'ty	Remarks
Nos. of households	h.h.	4,882	80% of the total 6,1027 households
Unit nighttime domestic demand	W/hh	100	
Nighttime domestic demand	kW	488.2	
Street light demand	kW	22.0	1 light per 40 m of LV lir 1100 street lights
Reserve capacity	kW	146.5	30% of nighttime domestic demand, allocated for station use + reserved power + distribution losses
Required capacity	kW	656.7	
Adopted capacity	kW	640.0	

(2) Energy Generation Planning for 8th Year Onward

Items	Monthly Unit Energy Sold	Monthly Energy Sold	Annual Energy Sold	Station Use, Losses, etc. (10%)	Annual Energy Generated	Annual Plant Factor	Annual Operation Hours	Remarks (refer to Table A2 for demand growth rates)
	kWh/hh	MWh	MWh	MWh	MWh	%	hr	
Nighttime domestic demand 1/, 2/	15.0	73.2	878.8	87.9	966.6	17.2%	1,510	100% from 8th year onward
Street light demand	0.7	3.3	39.6	4.0	43.6	0.8%	68	100% from the 1st year
Industrial demand 3/	7.5	36.6	439.4	43.9	483.3	8.6%	755	100% from 8th year onward
Irrigation pump demand 4/	1.2	17.8	71.2	7.1	78.3	1.4%	122	in 4 dry months, 100% from 8th year onward
Total energy	24.4	130.9	1,428.9	142.9	1,571.8	28.0%	2,456	100% from 8th year onward

Note:

1/ Typical consumption level of existing mini-grids in rural villages as of 2005 was 10 kWh (= 100W / 1,000 * 5hrs * 30 days * 67%) and assumed to be realized from 2nd year.

2/ Average consumption of existing REE mini-grids supplying to rural towns as of 2005 was 15 kWh（= 100 W / 1,000 * 7.5hrs * 30days * 67%）and was assumed to be realized in 7th year.

3/ Power demand of BCS, rice-mills, water supply stations, ice factory, workshop of boat engines, etc. Assumed to be 50% of the nighttime demand based on the actual demand of existing Anlong Ta Mey mini-grid (700 kWh at nighttime, 300 kWh for BCS at daytime) and potential daytime users in the villages shown in Table A3.

4/ see Table A3 for irrigation power demand.

Community Electrication Project, Kampong Kor, Phase 1+2, soft loan @ 3% - 15 yr including 3-yr grace

Table A2 Energy and CER Sold

			1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Annual energy sold)																					
Demand growth	Growth rate																				
Domestic		1.10	50%	67%	73%	81%	89%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Street lights		0.00	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Industrial		1.10	0%	50%	67%	73%	81%	89%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Irrigation		1.10	0%	50%	67%	73%	81%	89%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Energy sold (MWh/yr)	Demand																				
Domestic		878.8	439.4	585.8	644.4	708.9	779.8	857.7	878.8	878.8	878.8	878.8	878.8	878.8	878.8	878.8	878.8	878.8	878.8	878.8	25,106
Street lights		39.6	39.6	39.6	39.6	39.6	39.6	39.6	39.6	39.6	39.6	39.6	39.6	39.6	39.6	39.6	39.6	39.6	39.6	39.6	1,188
Industrial		439.4	0.0	219.7	292.9	322.2	354.4	389.9	428.9	439.4	439.4	439.4	439.4	439.4	439.4	439.4	439.4	439.4	439.4	439.4	12,114
Irrigation		71.2	0.0	35.6	47.5	52.2	57.4	63.2	69.5	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	1,963
Total		1,428.9	479.0	880.7	1,024.4	1,122.9	1,231.2	1,350.4	1,416.7	1,428.9	1,428.9	1,428.9	1,428.9	1,428.9	1,428.9	1,428.9	1,428.9	1,428.9	1,428.9	1,428.9	40,371
Unit energy sold (kWh per household per month)																					
Domestic		15.0	**7.5**	**10.0**	11.0	12.1	13.3	14.6	**15.0**	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
Street lights		0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	
Industrial		7.5	0.0	3.8	5.0	5.5	6.1	6.7	**7.3**	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	
Irrigation		1.2	0.0	0.6	0.8	0.9	1.0	1.1	**1.2**	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
Total		24.4	8.2	15.0	17.5	19.2	21.0	23.1	24.2	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	
(Operating revenue from electricity sales, $)																					
	Tariff																				
Domestic		$0.31	136,208	181,610	199,771	219,749	241,723	265,896	272,416	272,416	272,416	272,416	272,416	272,416	272,416	272,416	272,416	272,416	272,416	272,416	7,782,932
Street lights		$0.31	12,276	12,276	12,276	12,276	12,276	12,276	12,276	12,276	12,276	12,276	12,276	12,276	12,276	12,276	12,276	12,276	12,276	12,276	368,280
Industrial		$0.27	0	59,316	79,088	86,997	95,697	105,267	115,793	118,633	118,633	118,633	118,633	118,633	118,633	118,633	118,633	118,633	118,633	118,633	3,270,709
Irrigation		$0.27	0	9,611	12,815	14,097	15,506	17,057	18,763	19,223	19,223	19,223	19,223	19,223	19,223	19,223	19,223	19,223	19,223	19,223	529,976
Total			148,484	262,814	303,951	333,119	365,203	400,496	419,248	422,547	422,547	422,547	422,547	422,547	422,547	422,547	422,547	422,547	422,547	422,547	11,951,896
(Monthly tariff, $ per household)																					
Domestic			2.33	3.10	3.41	3.75	4.13	4.54	4.65	4.65	4.65	4.65	4.65	4.65	4.65	4.65	4.65	4.65	4.65	4.65	
Street lights			0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	
Industrial			0.00	1.01	1.35	1.49	1.63	1.80	1.98	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03	
Irrigation			0.00	0.16	0.22	0.24	0.26	0.29	0.32	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	
Total			2.53	4.49	5.19	5.69	6.23	6.84	7.16	7.21	7.21	7.21	7.21	7.21	7.21	7.21	7.21	7.21	7.21	7.21	
(Tariff receivable, $/yr)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	kg-CO_2/kWh																				
(CER saleable)	(to-CO_2)	1.3	623	1,145	1,332	1,460	1,601	1,755	1,842	1,858	1,858	1,858	1,858	1,858	1,858	1,858	1,858	1,858	1,858	1,858	52,482
	($/yr) 1/	**$7**	4,359	8,015	9,322	10,218	11,204	12,288	12,892	13,003	13,003	13,003	13,003	13,003	13,003	13,003	13,003	13,003	13,003	13,003	367,375
Fuel tree consumed (ton per month)			59.9	110.1	128.1	140.4	153.9	168.8	177.1	178.6	178.6	178.6	178.6	178.6	178.6	178.6	178.6	178.6	178.6	178.6	5,046
Land required to supply fuel trees (ha)			71.8	132.1	153.7	168.4	184.7	202.6	212.5	214.3	214.3	214.3	214.3	214.3	214.3	214.3	214.3	214.3	214.3	214.3	
Nos. of fuel tree farmers (0.2 ha per farmer)			359	661	768	842	923	1,013	1,063	1,072	1,072	1,072	1,072	1,072	1,072	1,072	1,072	1,072	1,072	1,072	
Payment to fuel tree farmers ($/farmer/month			3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	
Total payment to fuel tree farmers ($/yr)			14,369	26,422	30,732	33,687	36,937	40,511	42,501	42,868	42,868	42,868	42,868	42,868	42,868	42,868	42,868	42,868	42,868	42,868	1,211,125

Ratio of tariff collected and billed= 100%

Note: 1/ Assumed at %4/ton-CO_2/yr deducting costs required for prepration of PDD, application and monitoring.

Community Electrication Project, Kampong Kor, Phase 1+2, soft loan @ 3% - 15 yr including 3-yr grace

Table A3 Potential Daytime Users and Demand

No.	Demand	Diesel Consumption	Electricity Demand	Operation Hour	Unit Power Demand	Nos. of Customers	Total Demand		
		liter/month	kWh/month	hr/month	kW		kW	kWh/month	Load Factor
1	BCS	200	600	50	12.00	5	60.00	3,000	6.9%
2	Water supply	60	180	15	12.00	10	120.00	1,800	2.1%
3	Rice-mill	30	90	30	3.00	30	90.00	2,700	4.2%
4	Ice factory	30	90	30	3.00	1	3.00	90	4.2%
5	Workshop	25	75	60	1.25	1	1.25	75	8.3%
6	Café	115	345	296	1.17	1	1.17	345	41.1%
Monthly total		460	1,380	481	-	48	640.00	8,010	1.7%
Annual total		5520	16,560	5,772	-	-	640.00	**96,120**	1.7%

Source: The potential daytime users above are candidates in Kampong Kor for reference purpose.

Potential irrigation demand in the dry season

Unit land to irrigate	0.1	ha/hh
Ratio of irrigation hh	50.0%	
Total land area to irrigate	244.1	ha
Depth of irrigation	500	mm
Total irrigation water	1.221	mcm/yr
Irrigation period	4	month
Daily operation hour	8	hr/day
Total pump discharge	0.353	m^3/s
Pumping head	15.0	m
Combined efficiency	0.70	
Total power required	74	kW
Total energy required	71	MWh

Community Electrication Project, Kampong Kor, Phase 1+2, soft loan @ 3% - 15 yr including 3-yr grace

Table A4 Cost Estimate

(1)	**Construction Costs**	Unit Price ($)	Q'ty	Unit	Amount($)	Total ($)	%シェア
	Power Station						
	Biomass gasification power generating equipment (FOB)	1,300	640	kW	832,000		
	Ocean freight & insurance (FOBx8%)	104	640	kW	66,560		
	Inland transportation & installation (FOB x (2%+5%))	91	640	kW	58,240		
	Switching equipment, main transformer		800	kVA	**265,700**		
						1,222,500	41.6%
	Civil and substation works						
	Road improvement works for dry season use to be further improved to all weather road in Phase 2	**48**	**2.50**	km	120,000		
	Land, powerhouse, water tank, etc. (10%FOB)	130	640	kW	83,200		
						203,200	
	Fuel tree preparation for 2nd year demand						
	Scarified seeds of Leucaena of 0.4-0.5 kg/ha and $15/kg	8	132	ha	991		
	Nursery	1	1,320	m^2	1,320		
	Watering of nursery for the first 3 months	**500**	3	month	1,500		
	Bush clearing	80	132	ha	10,569		
	Land preparation	**80**	132	ha	10,569		
	Transplanting	**80**	132	ha	10,569		
	Maintenance for initital 6 months @ $60/ha/mon	**360**	132	ha	47,559		
						83,077	
	Sub-total of power station and fuel preparation					**1,508,777**	51.4%
	Miscellaneous of power station (5%, consumables, gas detector, fire distinguisher, water content meter, computer set, etc.)				**61,100**		
	Power station sub-total (before tax)					1,569,877	53.4%
	Customs & VAT (CIF x 25%)	351	640	kW	224,640		
	Power station sub-total (including tax)					**1,794,517**	61.1%
	Distribution Facilities						
	MV lines	6,000	**13.8**	km	82,800		
	MV-LV lines	10,700	33.0	km	353,100		
	LV lines	7,100	**11.0**	km	78,100		
	Pole-mounted distribution transformers						
	15 kVA-1P	6,200		set	0		
	25 kVA-3P	7,300	22	set	160,600		
	50 kVA-3P	8,100	6	set	48,600		
	Distribution line - transformer sub-total (including tax)					723,200	24.6%
	Miscellaneous (5%, street lights, etc.)				**36,160**		
	Distribution line - transformer sub-total (including tax)					759,360	25.8%
	Service wire, etc.				244,100		8.3%
	Domestic cutomers	50	4,882	hh	244,100		
	Daytime customers (to be fixed individually)	0		customers	0		
	Distribution line - transformer - service wires, etc. sub-total (including tax)					**1,003,460**	34.2%
	Sub-total					**2,797,977**	
	Contingecy (5%)					**139,899**	
	Construction costs total					**2,937,876**	100.0%

(2)	**Costs for CEC supports**	Unit Price ($)	Q'ty	Unit	Amount($)
	Costs for CEC supports and training				**72,000**
	2.1 Facilitation for CEC setting up and management	500	36.00	MM	18,000
	2.2 Technical supports	500	36.00	MM	18,000
	2.3 Vehicles and lodging	1,000	36.00	month	36,000

(3) **Operation and maintenance costs**

Personnel costs of CEC staff	Salary ($/mon)	Nos. of person	MM	Amount($)	Total ($)
Operation Chief	$80	2	12.00	1,920	
Operator	$40	8	12.00	3,840	
Fuel preparation workers	$30	5	12.00	1,800	
Director and accountant	$40	6	12.00	2,880	
Personnel costs sub-total					**$10,440**

Maintenance costs of gasifier and engine-generator	CIF ($)	Ratio of O&M Costs	Amount ($)	Total ($)
Gasifier and engine-generator costs (CIF)	1,222,500			
5% of engine-generator set	407,500	5.0%	20,380	
Heat resistant cone of gasifier (replacement at ever 3,000 hr operation/every one year, 4-6%)	815,000	5.0%	40,750	
Replacement of lamp of street lights, office stationery and consumables			3,480	
Maintenance costs of powerhouse (% of powerhouse)	83,200	2.0%	1,660	
Maintenance costs sub-total				**66,270**
Operation and maintenance costs sub-total				**76,710**
Payment for technical supports ($/yr for 15 years from 1st year)				**16,140**

Items	Unit fuel cost ($/kWh)	Energy generation	unit	Fuel costs ($)
Annual fuel costs	0.03	1,572	MWh/yr	**47,155**
Operation, maintenance and fuel costs sub-total				**123,865**

(4) **Maintenance costs of distribution facilities**

Maintenance costs (0.5% of construction costs)	**3,800**

Community Electrication Project, Kampong Kor, Phase 1+2, soft loan @ 3% - 15 yr including 3-yr grace

Table A5 Economic Costs

Items	Foreign Currency	Local Currency	Financial Costs	Economic Costs	Remarks
	$	$	$	$	
1. Hard costs	1,547,642	1,390,234	2,937,876	2,482,562	SCF
1.1 Generating equip. excl. tax	898,560	58,240	956,800	950,976	0.90
1.2 Customs & VAT	0	224,640	224,640	0	LCF
1.3 Road and powerhouse		203,200	203,200	**101,600**	0.50 1/
1.4 Growing fuel trees	991	82,086	83,077	**42,034**	
1.5 Swichyard equip.		265,700	265,700	239,130	
1.6 Powerhouse miscellaneous		61,100	61,100	54,990	
1.7 Distribution lines	484,544	238,656	723,200	699,334	
1.8 Service wires, etc.	163,547	80,553	244,100	236,045	
1.9 Distri. Lines miscellaneous		36,160	36,160	32,544	
1.10 Contingency (5%)		139,899	139,899	125,909	
2. CEC facilitation costs	0	72,000	72,000	64,800	
Project Costs Total	1,547,642	1,462,234	3,009,876	2,547,362	
O&M	61,130	66,535	127,665	83,787	
1. Personnel costs	0	10,440	10,440	**8,586**	
2. Biomass gasifier generator	61,130	5,140	66,270	65,756	
3. Fuel		47,155	47,155	**7,545**	0.16 2/
4. Distribution lines	0	3,800	3,800	**1,900**	

Note: 1/ Economic conversion factor for seasonal jobless labors

Table A6 Economic Benefits

Items	Foreign Currency	Local Currency	Financial Costs	Economic Costs	Remarks
	$	$	$	$	
1. Hard costs	863,628	1,378,635	2,242,263	1,903,120	
1.1 Diesel generator excl. tax	434,560	58,240	492,800	486,976	770 $/kW
1.2 Customs & VAT		123,200	123,200		
1.3 Road & land preparation		226,000	226,000	**113,000**	
1.4 Powerhouse & fuel tank (10%)		49,280	49,280	44,352	
1.5 Swichyard equip.		265,700	265,700	239,130	
1.6 Powerhouse miscellaneous (5%)		57,849	57,849	52,064	
1.7 Distribution lines	429,068	211,332	**640,400**	619,267	
1.8 Service wires, etc.		244,100	244,100	219,690	
1.9 Distri. Lines miscellaneous		36,160	36,160	32,544	
1.10 Contingency (5%)		106,774	106,774	96,097	
2. CEC facilitation costs	0	72,000	72,000	64,800	
Project Costs Total	863,628	1,450,635	2,314,263	1,967,920	
O&M	27,470	376,271	403,741	364,594	
1. Personnel costs	0	8,640	8,640	7,776	
2. Diesel generator	27,470	2,310	29,780	29,549	5%
3. Fuel	0	361,521	361,521	325,369	0.23 $/kWh
4. Distribution lines	0	3,800	3,800	**1,900**	

Adjsutment for Kampong Kor diesel power station

1. Road powerhouse	48	**0.50**	km	24,000
2. Embankment of station yard	20	10,000	m^2	200,000
3. Land acquisition	0.2	10,000	m^2	2,000

Community Electrication Project, Kampong Kor, Phase 1+2, soft loan @ 3% - 15 yr including 3-yr grace

Table A7 Unit Costs of Electricity

Items	with tax ($)	with tax exemption and subsidy ($)
1. Capital Costs	3,275,576	2,288,202
2. CEC facilitation costs	72,000	72,000
3. Total construction costs excluding design, testing, etc.		**2,360,202**
Interest rate	3.0%	
Repayment period	10 yr	
CRF (3.0%, 10 yr) =	0.1172	
4. Annual costs excluding design, etc.	383,997	276,688
5. O&M costs in 10th year	140,577	140,577
5.1 O&M	76,710	76,710
5.2 Fuel costs	47,155	47,155
5.3 EAC license fee	572	572
5.4 Yearly monitoring fee by DIME	16,140	16,140
6. Annual total costs	524,574	417,264
7. Annual energy sales from 7th year (MWh)	1,428.9	1,428.9
8. Unit cost of electricity from 7th year ($/kWh)	**0.367**	**0.292**
9. NPV of energy sold	MWh	25,680
10. NPV of finacial costs excluding tax	$	6,441,185
11. Average cost of electricity	$/kWh	**0.251**

Table A8 Tariff Setting

Items	$	Riel
Unit cost of electricity from 7th year ($/kWh)	**0.251**	1,003
Rate of reserve for operational risks (12%)	0.030	120
Average tariff ($/kWh)	**$0.281**	1,124
Tariff adopted for nighttime demand	**$0.310**	**1,240**
Tariff adopted for street lights	**$0.310**	**1,240**
Tariff adopted for industrial demand	**$0.270**	**1,080**
Tariff adopted for irrigation demand	**$0.270**	**1,080**
Monthly revenue (US$/mon)	$35,212	
from nighttime users	$22,701	
for street lights	$1,023	
from industrial users	$9,886	
from irrigation pump users	$1,602	
Average monthly tariff @ 15 kWh per HH ($)	$4.65	18,600
Tariff for street lights	$0.21	800
Total @ 15 kWh/hh including street lights	**$4.86**	19,400
Average monthly tariff @ 10 kWh per HH ($) including street lights	**$3.31**	**13,200**
Tariff of poor household ($/mon/hh) @ 40 W x 4h x 30 days = 4.8 kWh/month + street lights	$1.70	6,800
Tariff of poorest household (US$/mon/hh) @ 7 W x 4h x 30 days = 0.84 kWh/mon + street	$0.47	1,900
	Monthly Costs	
ATP for monthly tariff	$	Riel
Diesel oil lamp (100%)	$1.46	5,844
Battery lighting (70%, incl. Riel 4,000 per month for battery purchase)	$3.12	12,470
Total	**$4.58**	18,314

Community Electrication Project, Kampong Kor, Phase 1+2, soft loan @ 3% - 15 yr including

Table 1 Adopted Conditions for Economic and Finacial Analyses

1. Energy sold — See attached Table A2

2. Tariff — See attached Table A7

3. Long-term borrowing from GOC
   - 3% per year
   - 25 years repayment period including 5 years' grace

4. Short-term borrowing from commercial bank
   - 10% per year
   - revolving every year

5. Depreciation
   - Ratio of depreciation 90%
   - Ratio of residual value 10%

   Generating equipment
   - 5 years' grace and 5 years' depreciation for the first 10 years
   - 10 years' depreciation from 11th year onward

   Distribution lines, service wires, etc.
   - 5 years' grace and 20 years' depreciation

6. Interest earning
   - Interest of saving deposit at 10% per year

Community Electrication Project, Kampong Kor, Phase 1+2, soft loan @ 3% - 15 yr including 3-yr grace

Table 2 Financial Analysis

(unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Expenditure)																				
Initital costs																				
Construction costs excluding tax	2,713,236											956,800				956,800				4,626,836
Supports to CEC	54,000	18,000																		
Operation and maintenance costs		68,592	100,642	112,104	119,961	128,603	138,110	143,402	144,377	144,377	144,377	144,377	144,377	144,377	144,377	144,377	144,377	144,377	144,377	4,132,075
Personnel costs		10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	313,200
O&M of biomass gasification power plant		22,214	40,846	47,509	52,076	57,100	62,627	65,703	66,270	66,270	66,270	66,270	66,270	66,270	66,270	66,270	66,270	66,270	66,270	1,872,285
Maintenance of distribution lines, etc.		3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	114,000
Biomass fuel cost		15,806	29,064	33,806	37,055	40,630	44,563	46,752	47,155	47,155	47,155	47,155	47,155	47,155	47,155	47,155	47,155	47,155	47,155	1,332,241
EAC license fee @ Riel 1.6/kWh		192	352	410	449	492	540	567	572	572	572	572	572	572	572	572	572	572	572	16,148
Payment for technical supports		16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	484,200
Total expenditure	2,767,236	86,592	100,642	112,104	119,961	128,603	138,110	143,402	144,377	144,377	144,377	1,101,177	144,377	144,377	144,377	1,101,177	144,377	144,377	144,377	8,830,911
(Revenue)																				
Operating revenue through electricity sales		148,484	262,814	303,951	333,119	365,203	400,496	419,248	422,547	422,547	422,547	422,547	422,547	422,547	422,547	422,547	422,547	422,547	422,547	11,951,896
Sales of CER		4,359	8,015	9,322	10,218	11,204	12,288	12,892	13,003	13,003	13,003	13,003	13,003	13,003	13,003	13,003	13,003	13,003	13,003	367,375
Residual value of equipment											95,680				95,680				293,788	
Total revenue		152,843	270,829	313,273	343,337	376,407	412,784	432,140	435,550	435,550	531,230	435,550	435,550	435,550	531,230	435,550	435,550	435,550	729,338	12,804,419
(Net operating income)	-2,767,236	66,251	170,187	201,169	223,376	247,804	274,674	288,738	291,174	291,174	386,854	-665,626	291,174	291,174	386,854	-665,626	291,174	291,174	584,961	3,973,508

FIRR **6.3%**

Community Electrication Project, Kampong Kor, Phase 1+2, soft loan @ 3% - 15 yr including 3-yr grace

Table 2 Financial Analysis

Including taxes, excluding CER sales (unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Expenditure)																				
Initital costs																				
Construction costs	2,937,876											956,800				956,800				4,851,476
Supports to CEC	54,000	18,000																		
Operation and maintenance costs		68,592	100,642	112,104	119,961	128,603	138,110	143,402	144,377	144,377	144,377	144,377	144,377	144,377	144,377	144,377	144,377	144,377	144,377	4,132,075
Personnel costs		10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	313,200
O&M of biomass gasification power plant		22,214	40,846	47,509	52,076	57,100	62,627	65,703	66,270	66,270	66,270	66,270	66,270	66,270	66,270	66,270	66,270	66,270	66,270	1,872,285
Maintenance of distribution lines, etc.		3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	114,000
Biomass fuel cost		15,806	29,064	33,806	37,055	40,630	44,563	46,752	47,155	47,155	47,155	47,155	47,155	47,155	47,155	47,155	47,155	47,155	47,155	1,332,241
EAC license fee @ Riel 1.6/kWh		192	352	410	449	492	540	567	572	572	572	572	572	572	572	572	572	572	572	16,148
Payment for technical supports		16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	484,200
Total expenditure	2,991,876	86,592	100,642	112,104	119,961	128,603	138,110	143,402	144,377	144,377	144,377	1,101,177	144,377	144,377	144,377	1,101,177	144,377	144,377	144,377	9,055,551
(Revenue)																				
Operating revenue through electricity sales		148,484	262,814	303,951	333,119	365,203	400,496	419,248	422,547	422,547	422,547	422,547	422,547	422,547	422,547	422,547	422,547	422,547	422,547	11,951,896
Sales of CER																				0
Residual value of equipment											95,680				95,680				293,788	
Total revenue		148,484	262,814	303,951	333,119	365,203	400,496	419,248	422,547	422,547	518,227	422,547	422,547	422,547	518,227	422,547	422,547	422,547	716,335	12,437,044
(Net operating income)	-2,991,876	61,892	162,172	191,847	213,158	236,600	262,386	275,846	278,171	278,171	373,851	-678,629	278,171	278,171	373,851	-678,629	278,171	278,171	571,958	3,381,493
FIRR	**5.2%**																			

Community Electrication Project, Kampong Kor, Phase 1+2, soft loan @ 3% - 15 yr including 3-yr grace

Table 2 Financial Analysis

Excluding taxes and subsidy from costs, and including CER sales

(unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Expenditure)																				
Initital costs																				
Construction costs	1,950,502											956,800				956,800				3,864,102
Supports to CEC	54,000	18,000																		
Operation and maintenance costs		68,592	100,642	112,104	119,961	128,603	138,110	143,402	144,377	144,377	144,377	144,377	144,377	144,377	144,377	144,377	144,377	144,377	144,377	4,132,075
Personnel costs		10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	10,440	313,200
O&M of biomass gasification power plant		22,214	40,846	47,509	52,076	57,100	62,627	65,703	66,270	66,270	66,270	66,270	66,270	66,270	66,270	66,270	66,270	66,270	66,270	1,872,285
Maintenance of distribution lines, etc.		3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	114,000
Biomass fuel cost		15,806	29,064	33,806	37,055	40,630	44,563	46,752	47,155	47,155	47,155	47,155	47,155	47,155	47,155	47,155	47,155	47,155	47,155	1,332,241
EAC license fee @ Riel 1.6/kWh		192	352	410	449	492	540	567	572	572	572	572	572	572	572	572	572	572	572	16,148
Payment for technical supports		16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	16,140	484,200
Total expenditure	2,004,502	86,592	100,642	112,104	119,961	128,603	138,110	143,402	144,377	144,377	144,377	1,101,177	144,377	144,377	144,377	1,101,177	144,377	144,377	144,377	8,068,177
(Revenue)																				
Operating revenue through electricity sales		148,484	262,814	303,951	333,119	365,203	400,496	419,248	422,547	422,547	422,547	422,547	422,547	422,547	422,547	422,547	422,547	422,547	422,547	11,951,896
Sales of CER		4,359	8,015	9,322	10,218	11,204	12,288	12,892	13,003	13,003	13,003	13,003	13,003	13,003	13,003	13,003	13,003	13,003	13,003	367,375
Residual value of equipment											95,680				95,680				293,788	
Total revenue		152,843	270,829	313,273	343,337	376,407	412,784	432,140	435,550	435,550	531,230	435,550	435,550	435,550	531,230	435,550	435,550	435,550	729,338	12,804,419
(Net operating income)	-2,004,502	66,251	170,187	201,169	223,376	247,804	274,674	288,738	291,174	291,174	386,854	-665,626	291,174	291,174	386,854	-665,626	291,174	291,174	584,961	4,736,242
FIRR	**9.4%**																			

Community Electrication Project, Kampong Kor, Phase 1+2, soft loan @ 3% - 15 yr including 3-yr grace

Table 3 Economic Evaluation

(unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Economic costs)																				
Initital costs																				
Economic costs	2,482,562											950,976				950,976				4,384,514
Supports to CEC	48,600	16,200																		
Operation and maintenance costs	0	35,866	56,475	63,846	68,897	74,454	80,567	83,970	84,597	84,597	84,597	84,597	84,597	84,597	84,597	84,597	84,597	84,597	84,597	
Personenel costs		9,396	9,396	9,396	9,396	9,396	9,396	9,396	9,396	9,396	9,396	9,396	9,396	9,396	9,396	9,396	9,396	9,396	9,396	281,880
O&M of biomass gasification power plant		22,041	40,529	47,141	51,672	56,658	62,141	65,194	65,756	65,756	65,756	65,756	65,756	65,756	65,756	65,756	65,756	65,756	65,756	1,857,764
Maintenance of distribution lines, etc.		1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	57,000
Biomass fuel cost		2,529	4,650	5,409	5,929	6,501	7,130	7,480	7,545	7,545	7,545	7,545	7,545	7,545	7,545	7,545	7,545	7,545	7,545	213,159
EAC license fee @ Riel 1.6/kWh		172	317	369	404	443	486	510	514	514	514	514	514	514	514	514	514	514	514	14,534
Monitoring of CEC by DIME		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual value											-95,098				-95,098				-248,256	-438,451
Total expenditure	2,531,162	52,239	56,792	64,214	69,302	74,898	81,053	84,480	85,111	85,111	-9,986	1,036,087	85,111	85,111	-9,986	1,036,087	85,111	85,111	-163,145	6,435,199
(Economic benefits as costs of alternative diesel mini-grid)																				
Initital costs																				
Economic costs	1,903,120											486,976				486,976				2,877,072
Supports to CEC	48,600	16,200																		
Operation and maintenance costs	0	128,645	228,430	264,117	288,578	315,485	345,082	361,559	364,594	364,594	364,594	364,594	364,594	364,594	364,594	364,594	364,594	364,594	364,594	
Personenel costs		7,776	7,776	7,776	7,776	7,776	7,776	7,776	7,776	7,776	7,776	7,776	7,776	7,776	7,776	7,776	7,776	7,776	7,776	233,280
O&M of diesel power plant		9,905	18,213	21,184	23,220	25,460	27,925	29,296	29,549	29,549	29,549	29,549	29,549	29,549	29,549	29,549	29,549	29,549	29,549	834,830
Maintenance of distribution lines, etc.		1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	57,000
Fuel cost		109,064	200,542	233,258	255,682	280,348	307,481	322,586	325,369	325,369	325,369	325,369	325,369	325,369	325,369	325,369	325,369	325,369	325,369	9,192,441
EAC license fee		172	317	369	404	443	486	510	514	514	514	514	514	514	514	514	514	514	514	14,534
Payment for technical supports		14,526	14,526	14,526	14,526	14,526	14,526	14,526	14,526	14,526	14,526	14,526	14,526	14,526	14,526	14,526	14,526	14,526	14,526	435,780
Residual value											-48,698				-48,698				-190,312	-287,707
Benefits from CER sales		4,359	8,015	9,322	10,218	11,204	12,288	12,892	13,003	13,003	13,003	13,003	13,003	13,003	13,003	13,003	13,003	13,003	13,003	367,375
Total benefits	1,951,720	163,902	251,288	288,334	313,727	341,658	372,383	389,487	392,637	392,637	343,940	879,613	392,637	392,637	343,940	879,613	392,637	392,637	202,325	13,789,404
(Net benefits)	-579,442	111,663	194,496	224,120	244,425	266,760	291,329	305,007	307,526	307,526	353,926	-156,474	307,526	307,526	353,926	-156,474	307,526	307,526	365,470	7,354,205
EIRR	**35.6%**																			

Community Electrication Project, Kampong Kor, Phase 1+2, soft loan @ 3% - 15 yr including 3-yr grace

Table 4 Financing Plan

(unit: $)

Financial Resources			Financial Application	
Equity - CEC			**Power Plant before tax**	**1,835,577**
Cash (@ $50/hh)	244,100	8.0%	Biomass gasification power equipment	1,222,500
In kind (@ $40/MM)	213,540	7.0%	Road improvement works	120,000
5339 MM			Powerhouse, etc.	83,200
Grant			Switching equip. & transformer	265,700
REF	762,734	25.0%	Growing fuel trees	83,077
(25% of capital costs)			Misecellaneous equipment	61,100
Borrowing for capitals			**Distribution facilities, service wires, etc.**	1,003,460
Long-term	1,830,562	60.0%		
(15 yr including 3-year grace, 3%/yr)			Contingecy	139,899
			Capital costs before tax	2,978,936
Total fund for capital costs and CEC supports	3,050,936	100.0%	**CEC support**	72,000
Borrowing for operation	30,000		**Operation fund in hand**	30,000
Short-term				
(Revolving, 15%/yr)				
Tax exemption	224,640		**Customs and tax**	224,640
Total Financial Resources	**3,305,576**		**Total Financial Resources**	**3,305,576**

Community Electrication Project, Samlout, Phase 1+2 bio only, soft loan @ 3% - 15 yr including 3-yr grace

Table A1 Principal Features of Electrification Plan

(1) Generating Equipment Planning

Items	Unit	Q'ty	Remarks
Nos. of households	h.h.	4,216	
Unit nighttime domestic demand	W/hh	100	
Nighttime domestic demand	kW	421.6	
Street light demand	kW	17.9	1 light per 40 m of LV lir 895 street lights
Reserve capacity	kW	126.5	30% of nighttime domestic demand, allocated for station use + reserved power + distribution losses
Required capacity	kW	566.0	
Adopted capacity	kW	550.0	

(2) Energy Generation Planning for 8th Year Onward

Items	Monthly Unit Energy Sold	Monthly Energy Sold	Annual Energy Sold	Station Use, Losses, etc. (10%)	Annual Energy Generated	Annual Plant Factor	Annual Operation Hours	Remarks (refer to Table A2 for demand growth rates)
	kWh/hh	MWh	MWh	MWh	MWh	%	hr	
Nighttime domestic demand 1/, 2/	15.0	63.2	758.9	75.9	834.8	17.3%	1,518	100% from 8th year onward
Street light demand	0.6	2.7	32.2	3.2	35.4	0.7%	64	100% from the 1st year
Industrial demand 3/	7.5	31.6	379.4	37.9	417.4	8.7%	759	100% from 8th year onward
Irrigation pump demand 4/	6.1	76.9	307.4	30.7	338.2	7.0%	615	in 4 dry months, 100% from 8th year onward
Total energy	29.2	174.4	1,478.0	147.8	1,625.8	33.7%	2,956	100% from 8th year onward

Note:

1/ Typical consumption level of existing mini-grids in rural villages as of 2005 was 10 kWh (= 100W / 1,000 * 5hrs * 30 days * 67%) and assumed to be realized from 2nd year.

2/ Average consumption of existing REE mini-grids supplying to rural towns as of 2005 was 15 kWh（= 100 W / 1,000 * 7.5hrs * 30days * 67%）and was assumed to be realized in 7th year.

3/ Power demand of BCS, rice-mills, water supply stations, ice factory, workshop of boat engines, etc. Assumed to be 50% of the nighttime demand based on the actual demand of existing Anlong Ta Mey mini-grid (700 kWh at nighttime, 300 kWh for BCS at daytime) and potential daytime users in the villages shown in Table A3.

4/ see Table A3 for irrigation power demand.

Community Electrication Project, Samlout, Phase 1+2 bio only, soft loan @ 3% - 15 yr including 3-yr grace

Table A2 Energy and CER Sold

		1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Annual energy sold)																				
Demand growth	Growth rate																			
Domestic	1.10	50%	67%	73%	81%	89%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Street lights	0.00	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Industrial	1.10	0%	50%	67%	73%	81%	89%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Irrigation	1.10	0%	50%	67%	73%	81%	89%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Energy sold (MWh/yr)	Demand																			
Domestic	758.9	379.4	505.9	556.5	612.2	673.4	740.7	758.9	758.9	758.9	758.9	758.9	758.9	758.9	758.9	758.9	758.9	758.9	758.9	21,681
Street lights	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	967
Industrial	379.4	0.0	189.7	253.0	278.3	306.1	336.7	370.4	379.4	379.4	379.4	379.4	379.4	379.4	379.4	379.4	379.4	379.4	379.4	10,461
Irrigation	307.4	0.0	153.7	204.9	225.4	248.0	272.8	300.1	307.4	307.4	307.4	307.4	307.4	307.4	307.4	307.4	307.4	307.4	307.4	8,475
Total	1,478.0	411.7	881.6	1,046.6	1,148.1	1,259.7	1,382.4	1,461.5	1,478.0	1,478.0	1,478.0	1,478.0	1,478.0	1,478.0	1,478.0	1,478.0	1,478.0	1,478.0	1,478.0	41,585
Unit energy sold (kWh per household per month)																				
Domestic	15.0	**7.5**	**10.0**	11.0	12.1	13.3	14.6	**15.0**	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
Street lights	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
Industrial	7.5	0.0	3.8	5.0	5.5	6.1	6.7	**7.3**	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	
Irrigation	6.1	0.0	3.0	4.1	4.5	4.9	5.4	**5.9**	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	
Total	29.2	8.1	17.4	20.7	22.7	24.9	27.3	28.9	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	
(Operating revenue from electricity sales, $)																				
	Tariff																			
Domestic	$0.31	115,729	154,306	169,736	186,710	205,381	225,919	231,458	231,458	231,458	231,458	231,458	231,458	231,458	231,458	231,458	231,458	231,458	231,458	6,612,782
Street lights	$0.31	9,827	9,827	9,827	9,827	9,827	9,827	9,827	9,827	9,827	9,827	9,827	9,827	9,827	9,827	9,827	9,827	9,827	9,827	294,813
Industrial	$0.28	0	52,173	69,564	76,520	84,172	92,590	101,849	104,346	104,346	104,346	104,346	104,346	104,346	104,346	104,346	104,346	104,346	104,346	2,876,826
Irrigation	$0.28	0	42,270	56,360	61,996	68,195	75,015	82,516	84,540	84,540	84,540	84,540	84,540	84,540	84,540	84,540	84,540	84,540	84,540	2,330,762
Total		125,556	258,575	305,487	335,053	367,576	403,350	425,650	430,171	430,171	430,171	430,171	430,171	430,171	430,171	430,171	430,171	430,171	430,171	12,115,183
(Monthly tariff, $ per household)																				
Domestic		2.29	3.05	3.36	3.69	4.06	4.47	4.58	4.58	4.58	4.58	4.58	4.58	4.58	4.58	4.58	4.58	4.58	4.58	
Street lights		0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	
Industrial		0.00	1.03	1.38	1.51	1.66	1.83	2.01	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06	
Irrigation		0.00	0.84	1.11	1.23	1.35	1.48	1.63	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	
Total		2.48	5.11	6.04	6.62	7.27	7.97	8.41	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	
(Tariff receivable, $/yr)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	kg-CO_2/kWh																			
(CER saleable)	(to-CO_2) 1.3	535	1,146	1,361	1,493	1,638	1,797	1,900	1,921	1,921	1,921	1,921	1,921	1,921	1,921	1,921	1,921	1,921	1,921	54,060
	($/yr) 1/ **$7**	3,746	8,022	9,524	10,448	11,463	12,580	13,300	13,449	13,449	13,449	13,449	13,449	13,449	13,449	13,449	13,449	13,449	13,449	378,419
Fuel tree consumed (ton per month)		51.5	110.2	130.8	143.5	157.5	172.8	182.7	184.7	184.7	184.7	184.7	184.7	184.7	184.7	184.7	184.7	184.7	184.7	5,198
Land required to supply fuel trees (ha)		61.7	132.2	157.0	172.2	188.9	207.4	219.2	221.7	221.7	221.7	221.7	221.7	221.7	221.7	221.7	221.7	221.7	221.7	
Nos. of fuel tree farmers (0.2 ha per farmer)		309	661	785	861	945	1,037	1,096	1,108	1,108	1,108	1,108	1,108	1,108	1,108	1,108	1,108	1,108	1,108	
Payment to fuel tree farmers ($/farmer/month		3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	
Total payment to fuel tree farmers ($/yr)		12,350	26,447	31,399	34,442	37,790	41,472	43,846	44,339	44,339	44,339	44,339	44,339	44,339	44,339	44,339	44,339	44,339	44,339	1,247,536

Ratio of tariff collected and billed= 100%

Note: 1/ Assumed at %4/ton-CO_2/yr deducting costs required for prepration of PDD, application and monitoring.

Community Electrication Project, Samlout, Phase 1+2 bio only, soft loan @ 3% - 15 yr including 3-yr grace

Table A3 Potential Daytime Users and Demand

No.	Demand	Diesel Consumption	Electricity Demand	Operation Hour	Unit Power Demand	Nos. of Customers	Total Demand		
		liter/month	kWh/month	hr/month	kW		kW	kWh/month	Load Factor
1	BCS	200	600	50	12.00	5	60.00	3,000	6.9%
2	Water supply	60	180	15	12.00	10	120.00	1,800	2.1%
3	Rice-mill	30	90	30	3.00	30	90.00	2,700	4.2%
4	Ice factory	30	90	30	3.00	1	3.00	90	4.2%
5	Workshop	25	75	60	1.25	1	1.25	75	8.3%
6	Café	115	345	296	1.17	1	1.17	345	41.1%
Monthly total		460	1,380	481	-	48	550.00	8,010	2.0%
Annual total		5520	16,560	5,772	-	-	550.00	**96,120**	2.0%

Source: The potential daytime users above are candidates in Kampong Kor for reference purpose.

Potential irrigation demand in the dry season

Unit land to irrigate	0.5	ha/hh
Ratio of irrigation hh	50.0%	
Total land area to irrigate	1054	ha
Depth of irrigation	500	mm
Total irrigation water	5.270	mcm/yr
Irrigation period	4	month
Daily operation hour	8	hr/day
Total pump discharge	1.525	m^3/s
Pumping head	15.0	m
Combined efficiency	0.70	
Total power required	320	kW
Total energy required	307	MWh

Community Electrication Project, Samlout, Phase 1+2 bio only, soft loan @ 3% - 15 yr including 3-yr grace

Table A4 Cost Estimate

(1)	**Construction Costs**	Unit Price ($)	Q'ty	Unit	Amount($)	Total ($)	%
	Power Station						
	Biomass gasification power generating equipment (FOB)	1,300	550	kW	715,000		
	Ocean freight & insurance (FOBx8%)	104	550	kW	57,200		
	Inland transportation & installation (FOB x (2%+5%))	91	550	kW	50,050		
	Switching equipment, main transformer		688	kVA	**354,100**		
						1,176,350	41.2%
	Civil and substation works						
	Road improvement works for dry season use to be further improved to all weather road in Phase 2	**24**	**0.20**	km	4,800		
	Land, powerhouse, water tank, etc. (10%FOB)	130	550	kW	71,500		
						76,300	
	Fuel tree preparation for 2nd year demand						
	Scarified seeds of Leucaena of 0.4-0.5 kg/ha and $15/kg	8	132	ha	992		
	Nursery	1	1,320	m^2	1,320		
	Watering of nursery for the first 3 months	**500**	3	month	1,500		
	Bush clearing	40	132	ha	5,289		
	Land preparation	**80**	132	ha	10,579		
	Transplanting	**80**	132	ha	10,579		
	Maintenance for initital 6 months @ $60/ha/mon	**360**	132	ha	47,605		
						77,864	
	Sub-total of power station and fuel preparation					**1,330,514**	46.6%
	Miscellaneous of power station (5%, consumables, gas detector, fire distinguisher, water content meter, computer set, etc.)				**58,800**		
	Power station sub-total (before tax)					1,389,314	48.7%
	Customs & VAT (CIF x 25%)	351	550	kW	193,050		
	Power station sub-total (including tax)					**1,582,364**	55.5%
	Distribution Facilities						
	MV lines	6,000	**60.2**	km	361,200		
	MV-LV lines	10,700	26.3	km	281,410		
	LV lines	7,100	**9.5**	km	67,450		
	Pole-mounted distribution transformers						
	15 kVA-1P	6,200	0	set	0		
	25 kVA-3P	7,300	11	set	80,300		
	50 kVA-3P	8,100	11	set	89,100		
	Distribution line - transformer sub-total (including tax)					879,460	30.8%
	Miscellaneous (5%, street lights, etc.)				**43,973**		
	Distribution line - transformer sub-total (including tax)					923,433	32.4%
	Service wire, etc.				210,800		7.4%
	Domestic cutomers	50	4,216	hh	210,800		
	Daytime customers (to be fixed individually)	0		customers	0		
	Distribution line - transformer - service wires, etc. sub-total (including tax)					**1,134,233**	39.8%
	Sub-total					**2,716,597**	
	Contingecy (5%)					**135,830**	
	Construction costs total					**2,852,427**	100.0%

(2)	**Costs for CEC supports**	Unit Price ($)	Q'ty	Unit	Amount($)
	Costs for CEC supports and training				**72,000**
	2.1 Facilitation for CEC setting up and management	500	36.00	MM	18,000
	2.2 Technical supports	500	36.00	MM	18,000
	2.3 Vehicles and lodging	1,000	36.00	month	36,000

(3) **Operation and maintenance costs**

Personnel costs of CEC staff	Salary ($/mon)	Nos. of person	MM	Amount($)	Total ($)
Operation Chief	$80	2	12.00	1,920	
Operator	$40	8	12.00	3,840	
Fuel preparation workers	$30	5	12.00	1,800	
Director and accountant	$40	14	12.00	6,720	
Personnel costs sub-total					**$14,280**

Maintenance costs of gasifier and engine-generator	CIF ($)	Ratio of O&M Costs	Amount ($)	Total ($)
Gasifier and engine-generator costs (CIF)	1,176,350			
5% of engine-generator set	392,117	5.0%	19,610	
Heat resistant cone of gasifier (replacement at ever 3,000 hr operation/every one year, 4-6%)	784,233	5.0%	39,210	
Replacement of lamp of street lights, office stationery and consumables			4,760	
Maintenance costs of powerhouse (% of powerhouse)	71,500	2.0%	1,430	
Maintenance costs sub-total				**65,010**
Operation and maintenance costs sub-total				**79,290**
Payment for technical supports ($/yr for 15 years from 1st year)				**13,940**

Items	Unit fuel cost ($/kWh)	Energy generation	unit	Fuel costs ($)
Annual fuel costs	0.03	1,626	MWh/yr	**48,773**
Operation, maintenance and fuel costs sub-total				**128,063**

(4) **Maintenance costs of distribution facilities**

Maintenance costs (0.5% of construction costs) **4,600**

Community Electrication Project, Samlout, Phase 1+2 bio only, soft loan @ 3% - 15 yr including 3-yr grace

Table A5 Economic Costs

Items	Foreign Currency	Local Currency	Financial Costs	Economic Costs	Remarks
	$	$	$	$	
1. Hard costs	1,503,666	1,348,761	2,852,427	2,482,537	SCF
1.1 Generating equip. excl. tax	772,200	50,050	822,250	817,245	0.90
1.2 Customs & VAT	0	193,050	193,050	0	LCF
1.3 Road and powerhouse		76,300	76,300	**38,150**	0.50 1/
1.4 Growing fuel trees	992	76,872	77,864	**39,428**	
1.5 Swichyard equip.		354,100	354,100	318,690	
1.6 Powerhouse miscellaneous		58,800	58,800	52,920	
1.7 Distribution lines	589,238	290,222	879,460	850,438	
1.8 Service wires, etc.	141,236	69,564	210,800	203,844	
1.9 Distri. Lines miscellaneous		43,973	43,973	39,576	
1.10 Contingency (5%)		135,830	135,830	122,247	
2. CEC facilitation costs	0	72,000	72,000	64,800	
Project Costs Total	1,503,666	1,420,761	2,924,427	2,547,337	
O&M	58,820	73,843	132,663	86,537	
1. Personnel costs	0	14,280	14,280	**12,042**	
2. Biomass gasifier generator	58,820	6,190	65,010	64,391	
3. Fuel		48,773	48,773	**7,804**	0.16 2/
4. Distribution lines	0	4,600	4,600	**2,300**	

Note: 1/ Economic conversion factor for seasonal jobless labors

Table A6 Economic Benefits

Items	Foreign Currency	Local Currency	Financial Costs	Economic Costs	Remarks
	$	$	$	$	
1. Hard costs	720,684	1,117,015	1,837,699	1,628,790	
1.1 Diesel generator excl. tax	373,450	50,050	423,500	418,495	770 $/kW
1.2 Customs & VAT		105,875	105,875		
1.3 Road & land preparation		4,800	4,800	**2,400**	
1.4 Powerhouse & fuel tank (10%)		42,350	42,350	38,115	
1.5 Swichyard equip.		354,100	354,100	318,690	
1.6 Powerhouse miscellaneous (5%)		46,531	46,531	41,878	
1.7 Distribution lines	347,234	171,026	**518,260**	501,157	
1.8 Service wires, etc.		210,800	210,800	189,720	
1.9 Distri. Lines miscellaneous		43,973	43,973	39,576	
1.10 Contingency (5%)		87,509	87,509	78,759	
2. CEC facilitation costs	0	72,000	72,000	64,800	
Project Costs Total	720,684	1,189,015	1,909,699	1,693,590	
O&M	24,759	393,609	418,368	377,167	
1. Personnel costs	0	12,480	12,480	11,232	
2. Diesel generator	24,759	2,606	27,365	27,104	5%
3. Fuel	0	373,923	373,923	336,531	0.23 $/kWh
4. Distribution lines	0	4,600	4,600	**2,300**	
Adjsutment for Kampong Kor diesel power station					
1. Road powerhouse	24	**0.20**	km	4,800	
2. Embankment of station yard	0	2,000	m^2	0	
3. Land acquisition	0	2,000	m^2	0	

Community Electrication Project, Samlout, Phase 1+2 bio only, soft loan @ 3% - 15 yr including 3-yr grace

Table A7 Unit Costs of Electricity

Items	with tax ($)	with tax exemption and subsidy ($)
1. Capital Costs	3,278,527	2,314,108
2. CEC facilitation costs	72,000	72,000
3. Total construction costs excluding design, testing, etc.		**2,386,108**
Interest rate	3.0%	
Repayment period	10 yr	
CRF (3.0%, 10 yr) =	0.1172	
4. Annual costs excluding design, etc.	384,343	279,725
5. O&M costs in 10th year	142,594	142,594
5.1 O&M	79,290	79,290
5.2 Fuel costs	48,773	48,773
5.3 EAC license fee	591	591
5.4 Yearly monitoring fee by DIME	13,940	13,940
6. Annual total costs	526,938	422,319
7. Annual energy sales from 7th year (MWh)	1,478.0	1,478.0
8. Unit cost of electricity from 7th year ($/kWh)	**0.357**	**0.286**
9. NPV of energy sold	MWh	26,402
10. NPV of finacial costs excluding tax	$	6,265,331
11. Average cost of electricity	$/kWh	**0.237**

Table A8 Tariff Setting

Items	$	Riel
Unit cost of electricity from 7th year ($/kWh)	**0.237**	949
Rate of reserve for operational risks (12%)	0.028	114
Average tariff ($/kWh)	**$0.266**	1,064
Tariff adopted for nighttime demand	**$0.305**	**1,220**
Tariff adopted for street lights	**$0.305**	**1,220**
Tariff adopted for industrial demand	**$0.275**	**1,100**
Tariff adopted for irrigation demand	**$0.275**	**1,100**
Monthly revenue (US$/mon)	$35,848	
from nighttime users	$19,288	
for street lights	$819	
from industrial users	$8,696	
from irrigation pump users	$7,045	
Average monthly tariff @ 15 kWh per HH ($)	$4.58	18,300
Tariff for street lights	$0.19	800
Total @ 15 kWh/hh including street lights	**$4.77**	19,100
Average monthly tariff @ 10 kWh per HH ($) including street lights	**$3.24**	**13,000**
Tariff of poor household ($/mon/hh) @ 40 W x 4h x 30 days = 4.8 kWh/month + street lights	$1.66	6,600
Tariff of poorest household (US$/mon/hh) @ 7 W x 4h x 30 days = 0.84 kWh/mon + street	$0.45	1,800
	Monthly Costs	
ATP for monthly tariff	$	Riel
Diesel oil lamp (100%)	$1.46	5,844
Battery lighting (70%, incl. Riel 4,000 per month for battery purchase)	$3.12	12,470
Total	**$4.58**	18,314

Community Electrication Project, Samlout, Phase 1+2 bio only, soft loan @ 3% - 15 yr includ

Table 1 Adopted Conditions for Economic and Finacial Analyses

1. Energy sold See attached Table A2

2. Tariff See attached Table A7

3. Long-term borrowing from GOC
   - 3% per year
   - 25 years repayment period including 5 years' grace

4. Short-term borrowing from commercial bank
   - 10% per year
   - revolving every year

5. Depreciation

- Ratio of depreciation	90%
- Ratio of residual value	10%

   Generating equipment
   - 5 years' grace and 5 years' depreciation for the first 10 years
   - 10 years' depreciation from 11th year onward

   Distribution lines, service wires, etc.
   - 5 years' grace and 20 years' depreciation

6. Interest earning
   - Interest of saving deposit at 10% per year

Community Electrication Project, Samlout, Phase 1+2 bio only, soft loan @ 3% - 15 yr including 3-yr grace

Table 2 Financial Analysis

(unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Expenditure)																				
Initital costs																				
Construction costs excluding tax	2,659,377											822,250				822,250				4,303,877
Supports to CEC	54,000	18,000																		
Operation and maintenance costs		64,677	101,042	113,816	121,666	130,301	139,800	145,922	147,194	147,194	147,194	147,194	147,194	147,194	147,194	147,194	147,194	147,194	147,194	4,202,690
Personnel costs		14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	428,400
O&M of biomass gasification power plant		18,107	38,777	46,038	50,500	55,408	60,807	64,287	65,010	65,010	65,010	65,010	65,010	65,010	65,010	65,010	65,010	65,010	65,010	1,829,154
Maintenance of distribution lines, etc.		4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	138,000
Biomass fuel cost		13,585	29,092	34,539	37,887	41,569	45,620	48,231	48,773	48,773	48,773	48,773	48,773	48,773	48,773	48,773	48,773	48,773	48,773	1,372,302
EAC license fee @ Riel 1.6/kWh		165	353	419	459	504	553	585	591	591	591	591	591	591	591	591	591	591	591	16,634
Payment for technical supports		13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	418,200
Total expenditure	2,713,377	82,677	101,042	113,816	121,666	130,301	139,800	145,922	147,194	147,194	147,194	969,444	147,194	147,194	147,194	969,444	147,194	147,194	147,194	8,578,567
(Revenue)																				
Operating revenue through electricity sales		125,556	258,575	305,487	335,053	367,576	403,350	425,650	430,171	430,171	430,171	430,171	430,171	430,171	430,171	430,171	430,171	430,171	430,171	12,115,183
Sales of CER		3,746	8,022	9,524	10,448	11,463	12,580	13,300	13,449	13,449	13,449	13,449	13,449	13,449	13,449	13,449	13,449	13,449	13,449	378,419
Residual value of equipment											82,225				82,225				285,243	
Total revenue		129,302	266,598	315,011	345,500	379,038	415,930	438,950	443,620	443,620	525,845	443,620	443,620	443,620	525,845	443,620	443,620	443,620	728,863	12,943,295
(Net operating income)	-2,713,377	46,625	165,556	201,196	223,835	248,737	276,130	293,028	296,426	296,426	378,651	-525,824	296,426	296,426	378,651	-525,824	296,426	296,426	581,669	4,364,728

FIRR **6.8%**

Community Electrication Project, Samlout, Phase 1+2 bio only, soft loan @ 3% - 15 yr including 3-yr grace

Table 2 Financial Analysis

Including taxes, excluding CER sales (unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Expenditure)																				
Initital costs																				
Construction costs	2,852,427											822,250				822,250				4,496,927
Supports to CEC	54,000	18,000																		
Operation and maintenance costs		64,677	101,042	113,816	121,666	130,301	139,800	145,922	147,194	147,194	147,194	147,194	147,194	147,194	147,194	147,194	147,194	147,194	147,194	4,202,690
Personnel costs		14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	428,400
O&M of biomass gasification power plant		18,107	38,777	46,038	50,500	55,408	60,807	64,287	65,010	65,010	65,010	65,010	65,010	65,010	65,010	65,010	65,010	65,010	65,010	1,829,154
Maintenance of distribution lines, etc.		4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	138,000
Biomass fuel cost		13,585	29,092	34,539	37,887	41,569	45,620	48,231	48,773	48,773	48,773	48,773	48,773	48,773	48,773	48,773	48,773	48,773	48,773	1,372,302
EAC license fee @ Riel 1.6/kWh		165	353	419	459	504	553	585	591	591	591	591	591	591	591	591	591	591	591	16,634
Payment for technical supports		13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	418,200
Total expenditure	2,906,427	82,677	101,042	113,816	121,666	130,301	139,800	145,922	147,194	147,194	147,194	969,444	147,194	147,194	147,194	969,444	147,194	147,194	147,194	8,771,617
(Revenue)																				
Operating revenue through electricity sales		125,556	258,575	305,487	335,053	367,576	403,350	425,650	430,171	430,171	430,171	430,171	430,171	430,171	430,171	430,171	430,171	430,171	430,171	12,115,183
Sales of CER																				0
Residual value of equipment											82,225				82,225				285,243	
Total revenue		125,556	258,575	305,487	335,053	367,576	403,350	425,650	430,171	430,171	512,396	430,171	430,171	430,171	512,396	430,171	430,171	430,171	715,414	12,564,876
(Net operating income)	-2,906,427	42,879	157,534	191,671	213,387	237,274	263,550	279,728	282,977	282,977	365,202	-539,273	282,977	282,977	365,202	-539,273	282,977	282,977	568,220	3,793,259

FIRR **5.8%**

Community Electrication Project, Samlout, Phase 1+2 bio only, soft loan @ 3% - 15 yr including 3-yr grace

Table 2 Financial Analysis

Excluding taxes and subsidy from costs, and including CER sales (unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Expenditure)																				
Initital costs																				
Construction costs	1,888,008											822,250				822,250				3,532,508
Supports to CEC	54,000	18,000																		
Operation and maintenance costs		64,677	101,042	113,816	121,666	130,301	139,800	145,922	147,194	147,194	147,194	147,194	147,194	147,194	147,194	147,194	147,194	147,194	147,194	4,202,690
Personnel costs		14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	14,280	428,400
O&M of biomass gasification power plant		18,107	38,777	46,038	50,500	55,408	60,807	64,287	65,010	65,010	65,010	65,010	65,010	65,010	65,010	65,010	65,010	65,010	65,010	1,829,154
Maintenance of distribution lines, etc.		4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	138,000
Biomass fuel cost		13,585	29,092	34,539	37,887	41,569	45,620	48,231	48,773	48,773	48,773	48,773	48,773	48,773	48,773	48,773	48,773	48,773	48,773	1,372,302
EAC license fee @ Riel 1.6/kWh		165	353	419	459	504	553	585	591	591	591	591	591	591	591	591	591	591	591	16,634
Payment for technical supports		13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	13,940	418,200
Total expenditure	1,942,008	82,677	101,042	113,816	121,666	130,301	139,800	145,922	147,194	147,194	147,194	969,444	147,194	147,194	147,194	969,444	147,194	147,194	147,194	7,807,198
(Revenue)																				
Operating revenue through electricity sales		125,556	258,575	305,487	335,053	367,576	403,350	425,650	430,171	430,171	430,171	430,171	430,171	430,171	430,171	430,171	430,171	430,171	430,171	12,115,183
Sales of CER		3,746	8,022	9,524	10,448	11,463	12,580	13,300	13,449	13,449	13,449	13,449	13,449	13,449	13,449	13,449	13,449	13,449	13,449	378,419
Residual value of equipment											82,225				82,225				285,243	
Total revenue		129,302	266,598	315,011	345,500	379,038	415,930	438,950	443,620	443,620	525,845	443,620	443,620	443,620	525,845	443,620	443,620	443,620	728,863	12,943,295
(Net operating income)	-1,942,008	46,625	165,556	201,196	223,835	248,737	276,130	293,028	296,426	296,426	378,651	-525,824	296,426	296,426	378,651	-525,824	296,426	296,426	581,669	5,136,097

FIRR **10.1%**

Community Electrication Project, Samlout, Phase 1+2 bio only, soft loan @ 3% - 15 yr including 3-yr grace

Table 3 Economic Evaluation

(unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Economic costs)																				
Initital costs																				
Economic costs	2,482,537											817,245				817,245				4,117,027
Supports to CEC	48,600	16,200																		
Operation and maintenance costs	0	35,261	58,215	66,278	71,233	76,684	82,679	86,544	87,347	87,347	87,347	87,347	87,347	87,347	87,347	87,347	87,347	87,347	87,347	
Personenel costs		12,852	12,852	12,852	12,852	12,852	12,852	12,852	12,852	12,852	12,852	12,852	12,852	12,852	12,852	12,852	12,852	12,852	12,852	385,560
O&M of biomass gasification power plant		17,935	38,408	45,599	50,019	54,881	60,228	63,675	64,391	64,391	64,391	64,391	64,391	64,391	64,391	64,391	64,391	64,391	64,391	1,811,738
Maintenance of distribution lines, etc.		2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	69,000
Biomass fuel cost		2,174	4,655	5,526	6,062	6,651	7,299	7,717	7,804	7,804	7,804	7,804	7,804	7,804	7,804	7,804	7,804	7,804	7,804	219,568
EAC license fee @ Riel 1.6/kWh		148	317	377	413	453	498	526	532	532	532	532	532	532	532	532	532	532	532	14,970
Monitoring of CEC by DIME		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual value											-81,725				-81,725				-248,254	-411,703
Total expenditure	2,531,137	51,609	58,532	66,654	71,646	77,137	83,177	87,070	87,879	87,879	6,154	905,124	87,879	87,879	6,154	905,124	87,879	87,879	-160,375	6,270,961
(Economic benefits as costs of alternative diesel mini-grid)																				
Initital costs																				
Economic costs	1,628,790											418,495				418,495				2,465,780
Supports to CEC	48,600	16,200																		
Operation and maintenance costs	0	114,816	230,432	271,046	296,004	323,459	353,659	373,123	377,167	377,167	377,167	377,167	377,167	377,167	377,167	377,167	377,167	377,167	377,167	
Personenel costs		11,232	11,232	11,232	11,232	11,232	11,232	11,232	11,232	11,232	11,232	11,232	11,232	11,232	11,232	11,232	11,232	11,232	11,232	336,960
O&M of diesel power plant		7,549	16,167	19,194	21,055	23,101	25,352	26,803	27,104	27,104	27,104	27,104	27,104	27,104	27,104	27,104	27,104	27,104	27,104	762,624
Maintenance of distribution lines, etc.		2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	69,000
Fuel cost		93,735	200,733	238,319	261,417	286,825	314,774	332,788	336,531	336,531	336,531	336,531	336,531	336,531	336,531	336,531	336,531	336,531	336,531	9,468,799
EAC license fee		148	317	377	413	453	498	526	532	532	532	532	532	532	532	532	532	532	532	14,970
Payment for technical supports		12,546	12,546	12,546	12,546	12,546	12,546	12,546	12,546	12,546	12,546	12,546	12,546	12,546	12,546	12,546	12,546	12,546	12,546	376,380
Residual value											-41,850				-41,850				-162,879	-246,578
Benefits from CER sales		3,746	8,022	9,524	10,448	11,463	12,580	13,300	13,449	13,449	13,449	13,449	13,449	13,449	13,449	13,449	13,449	13,449	13,449	378,419
Total benefits	1,677,390	147,457	251,318	293,493	319,411	347,921	379,282	399,495	403,695	403,695	361,845	822,190	403,695	403,695	361,845	822,190	403,695	403,695	240,816	13,691,155
(Net benefits)	-853,747	95,848	192,786	226,838	247,765	270,784	296,105	312,425	315,816	315,816	355,691	-82,934	315,816	315,816	355,691	-82,934	315,816	315,816	401,191	7,420,194

EIRR **25.6%**

Community Electrication Project, Samlout, Phase 1+2 bio only, soft loan @ 3% - 15 yr including 3-yr grace

Table 4 Financing Plan

(unit: $)

Financial Resources			Financial Application	
Equity - CEC			**Power Plant before tax**	**1,743,414**
Cash (@ $50/hh)	210,800	6.8%	Biomass gasification power equipment	1,176,350
In kind (@ $40/MM)	252,022	8.2%	Road improvement works	4,800
6301 MM			Powerhouse, etc.	71,500
Grant			Switching equip. & transformer	354,100
REF	771,369	25.0%	Growing fuel trees	77,864
(25% of capital costs)			Misecellaneous equipment	58,800
Borrowing for capitals			**Distribution facilities, service wires, etc.**	1,134,233
Long-term	1,851,286	60.0%		
(15 yr including 3-year grace, 3%/yr)			Contingecy	135,830
			Capital costs before tax	3,013,477
Total fund for capital costs and CEC supports	3,085,477	100.0%	**CEC support**	72,000
Borrowing for operation	30,000		**Operation fund in hand**	30,000
Short-term				
(Revolving, 15%/yr)				
Tax exemption	193,050		**Customs and tax**	193,050
Total Financial Resources	**3,308,527**		**Total Financial Resources**	**3,308,527**

Community Electrication Project, Samlout, Phase 1+2 bio only, soft loan @ 3% - 15 yr including 3-yr grace

Table 5 Profit and Loss Statement with Cash Flow, 15-yr repayment period

(unit: $)

		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	20	21	22	30	Total
Operating revenue incl. CER & residual value			125,556	258,575	305,487	335,053	367,576	403,350	425,650	430,171	430,171	430,171	430,171	430,171	430,171	430,171	430,171	430,171	430,171	430,171	430,171	12,115,183
Operating costs			64,677	101,042	113,816	121,666	130,301	139,800	145,922	147,194	147,194	147,194	147,194	147,194	147,194	147,194	147,194	147,194	147,194	147,194	147,194	4,202,690
new land required for tree plantation					24.8	15.2	16.7	18.4	11.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	89.5
tree plantation costs for increasing demand				14,580	8,960	9,856	10,841	6,987	1,452	0	0	0	0	0	0	0	0	0	0	0	52,676	105,351
Gross profit			60,879	142,954	182,687	203,516	226,416	256,545	278,265	282,974	282,977	282,977	282,977	282,977	282,977	282,977	282,977	282,977	282,977	282,977	230,301	7,807,052
Interests payment																						
Short-term commercial loan (15%/yr)			4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	135,000
Long-term soft loan	3.0%		55,539	55,539	55,539	50,910	46,282	41,654	37,026	32,398	27,769	23,141	18,513	13,885	9,256	4,628						472,078
Deprecitation																						
Generating equipment (5 yr - 10 yr - 10 yr)	1,058,715							211,743	211,743	211,743	211,743	211,743	105,872	105,872	105,872	105,872	105,872	105,872	105,872	105,872	105,872	3,176,145
Others (20 yr from 6th year)	1,718,214							85,911	85,911	85,911	85,911	85,911	85,911	85,911	85,911	85,911	85,911	85,911	85,911	85,911		1,718,214
Operating profit before depreciation			841	82,916	122,648	148,106	175,634	210,391	236,739	246,077	250,708	255,336	259,964	264,592	269,220	273,849	278,477	278,477	278,477	278,477	225,801	7,199,974
Interests received (10%)			0	0	9,552	8,298	9,555	13,793	22,042	33,823	47,730	63,492	89,515	110,380	133,795	160,014	189,318	483,122	568,849	654,927	1,737,737	13,462,800
Residual value upon completion of depreciation	10%											82,225						82,225			285,243	449,693
CER received			3,746	8,022	9,524	10,448	11,463	12,580	13,300	13,449	13,449	13,449	13,449	13,449	13,449	13,449	13,449	13,449	13,449	13,449	13,449	378,419
Net profit after depreciation			4,587	90,938	141,725	166,851	196,652	-60,890	-25,573	-4,305	14,234	116,848	171,146	196,639	224,682	255,530	289,462	665,491	668,993	755,071	2,156,359	16,596,527
Cash in hand			4,587	90,938	141,725	166,851	196,652	236,764	272,081	293,349	311,887	414,502	362,928	388,422	416,465	447,312	481,244	857,273	860,775	946,853	2,262,230	21,490,887
Accumulated cash in hand after principal repayment		0	4,587	95,525	82,976	95,553	137,931	220,421	338,228	477,304	634,917	**895,145**	1,103,799	1,337,947	1,600,138	1,893,176	2,374,420	5,688,491	6,549,266	7,496,119	19,639,600	
Principal repayment	1,851,286	0	0	0	154,274	154,274	154,274	154,274	154,274	154,274	154,274	154,274	154,274	154,274	154,274	154,274						1,851,286
Long-term debt balance	1,851,286	1,851,286	1,851,286	1,851,286	1,697,012	1,542,739	1,388,465	1,234,191	1,079,917	925,643	771,369	617,095	462,822	308,548	154,274	-0						

付属資料-I

単価・積算資料

カンボジア国
再生可能エネルギー利用地方電化マスタープラン調査

ファイナルレポート
第 5 巻　付属資料

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Appendix-I　単価・積算資料

1．プレ FS の積算に用いた単価

フィージビリティ調査（プレ FS）の費用算定に用いる単価は、収集したデータや見積り、業者への聞き取り調査や過去のプロジェクトの例を参考に、下記の項目と単価を適用した。

(1)　土木工事、水車発電機等の単価

No.	項目	単位	単価
1	掘削	$/m^3	5
2	盛土、埋め戻し	$/m^3	6
3	マスコンクリート	$/m^3	80
4	構造コンクリート	$/m^3	130
5	鉄筋	$/ton	700
6	鋼材	$/ton	1,200
7	水車・発電機	$/kW	660
8	バイオマスガス化炉、エンジン発電機	$/kW	1,950

（注：関税、付加価値税、間接費を含む）

(2)　配電線、変圧器の単価

No	項目	単位	単価	
			500 世帯未満	500 世帯以上
1	22 kV 中圧配電線	$/km	5,100（35mm^2）	6,000（50mm^2）
2	22 kV 中圧配電線と低圧配電線併架	$/km	9,800	10,700
3	低圧配電線*	$/km	6,500（50mm^2）	7,100（70mm^2）
4	変圧器 15kVA 単相（集落の端部に設置）	$/set	6,200	
5	変圧器 25kVA 単相（集落の端部に設置）	$/set	6,600	
6	変圧器 25kVA ３相（集落の中心部に設置）	$/set	7,300	
7	変圧器 50kVA ３相（集落の中心部に設置）	$/set	8,100	

*3 相 4 線(50%)と単相 2 線(50%)の被服電線の加重平均